Nesiotites rafelinensis sp. nov., the earliest shrew (Mammalia, Soricidae) from the Balearic Islands, Spain

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ABSTRACT

This paper describes a new species of shrew from a fossiliferous bone breccia near to Caló den Rafelino (Mallorca, Spain). The site is stratigraphically and palaeontologically dated to the earliest Early Pliocene (MN13-14). *Nesiotites rafelinensis* sp. nov. (Mammalia, Soricidae) is arguably the earliest representative of the *Nesiotites* known to date, a clade restricted to the Balearic Islands. The new species combines primitive dental traits with a relatively large size. The primitive features relate *N. rafelinensis* more with *Asoriculus gibberodon*, the possible ancestor of *Nesiotites*, than any other representative of the genus. The large size interrupts a, otherwise, regular trend of increase of size from the comparatively small *A. gibberodon* to the recent very large *N. hidalgo*. The faunal assemblage of Caló den Rafelino represents the earliest evidence of the fauna that arrived to the Mallorca Island during the Messinian Salinity Crisis.

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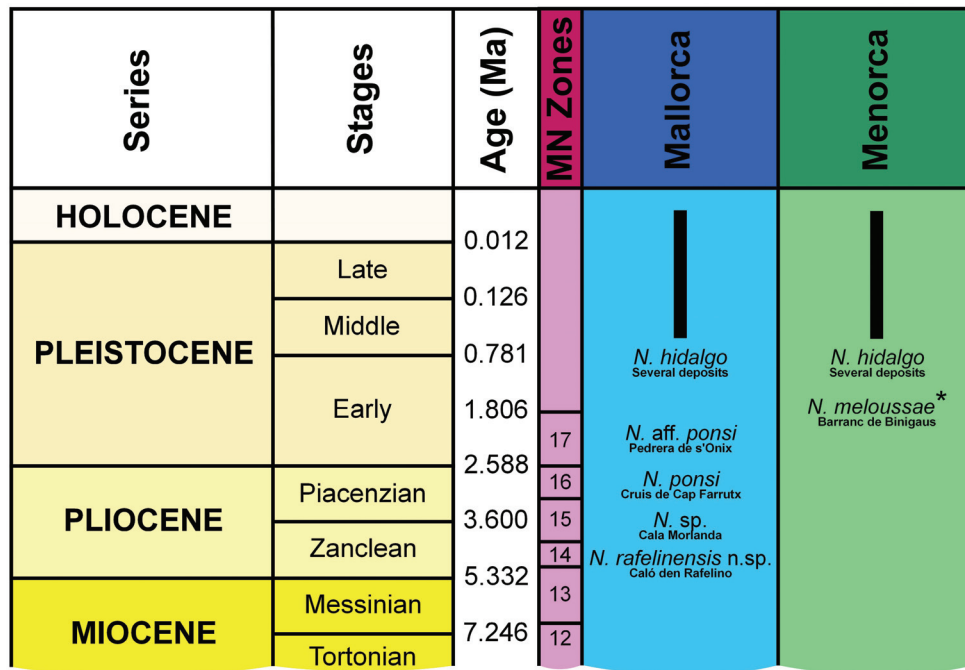| Series	Stages	Age (Ma)	MN Zones	Mallorca	Menorca
HOLOCENE		0.012			
PLEISTOCENE	Late	0.126			
	Middle	0.781		*N. hidalgo* Several deposits	*N. hidalgo* Several deposits
	Early	1.806	17	*N.* aff. *ponsi* Pedrera de s'Ònix	*N. meloussae* [*] Barranc de Binigaus
PLIOCENE	Piacenzian	2.588	16	*N. ponsi* Cruis de Cap Farrutx	
		3.600	15	*N.* sp. Cala Morlanda	
	Zanclean	5.332	14	*N. rafelinensis* n.sp. Caló den Rafelino	
MIOCENE	Messinian	7.246	13		
	Tortonian		12		

FIGURE 1. Chronological frame of the *Nesiotites* species described in the Balearic Islands. The Quaternary chronology follows Gibbard et al. (2010). MN zones according to Agustí et al. (2001). (*): The taxonomical identity of *N. meloussae* and the presence of a separate phylogenetic lineage of the genus in Menorca are controversial and are currently under discussion.

INTRODUCTION

The genus *Nesiotites* was erected in 1945 by Dorothea M.A. Bate to include three Late Pleistocene species of shrews (Mammalia, Soricidae): *Nesiotites hidalgo* Bate, 1945, from Mallorca and Menorca, *N. corsicanus* Bate, 1945, from Corsica, and *N. similis* (Hensel, 1855) from Sardinia. This latter species was initially assigned to *Sorex*.

The oldest remains of *Nesiotites*, described as *Nesiotites* sp., came from Cala Morlanda (Mallorca, Pons-Moyà, 1990), a site of nearly middle Pliocene age. The location of this material is unknown. Pons-Moyà (1990) indicates that the specimens were slightly smaller than those of *N. ponsi* from the Late Pliocene of Mallorca (Reumer, 1979) (see Figure 1). This latter species differs from *N. hidalgo* mainly by its small size and by the presence of a fourth antemolar in all individuals. Pons-Moyà and Moyà-Solà (1980) described *Nesiotites meloussae* from Menorca. This species, found at the Early Pleistocene site of Binigaus, has a general size intermediate between *N. hidalgo* and *N. ponsi*. The authors erected the new species on the basis of morphological characters that made them to postulate the existence of a hypothetic

independent phyletic lineage of the genus on Menorca.

Reumer (1981) described also an intermediate form from Pedrera de s'Ònix at the Early Pleistocene of Mallorca, which was referred as *Nesiotites* ex. interc. *ponsi-hidalgo*. This form has been referred also as *Nesiotites* aff. *ponsi* by Alcover et al. (1981) and other authors. Reumer (1982) rejected the existence of an endemic lineage on Menorca and considers *N. meloussae* as a valid name for his previously named *N.* ex interc. *ponsi-hidalgo*. *Nesiotites* aff. *ponsi* will be used in this paper to name the material from Pedrera de s'Ònix, as its specific identity remains unclear (see Pons-Monjo et al., 2010).

It has been generally accepted that the most likely ancestor of *Nesiotites* was the genus *Episoriculus* Ellerman and Morrison-Scott, 1951 (Reumer, 1980). Hutterer (1994) transferred all European fossil *Episoriculus* to the genus *Asoriculus* Kretzoi, 1959, an opinion widely accepted by scholars. Reumer (1998) considered *Episoriculus* a subgenus of *Soriculus* Blyth, 1854, differentiating it from *Asoriculus*.

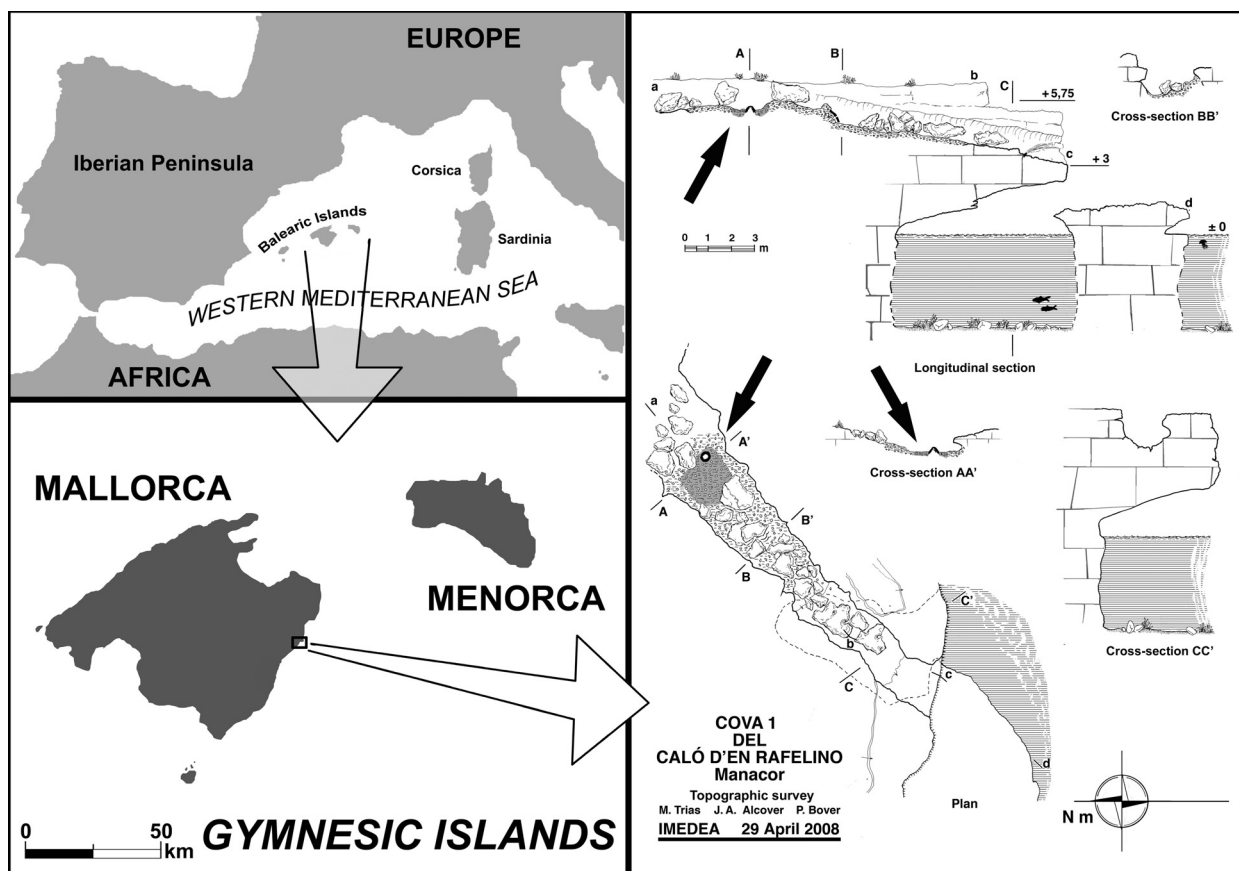The phylogenetic analysis performed by Rofes and Cuenca-Bescós (2009) showed that the

FIGURE 2. Location map (left) and topographic survey (right) of the palaeontological deposit from Caló den Rafelino. Arrows and grey colored zone indicate the exact location of the fossiliferous breccia.

autapomorphies of *Asoriculus* and *Nesiotites* with respect to their most recent common relative were minimal. Their results support the opinion of Reumer (1984), who considered *Nesiotites* as a very close relative or a direct descendant of *Episoriculus*. Masini and Sarà (1998), on the basis of a morphometric study, proposed that *Nesiotites* should be included in the genus *Asoriculus*, a view that has been followed by Furió (2007) and Bover and Alcover (2008). Van der Made (1999) suggests restricting the genus name for the Balearic taxa and to include the Corso-Sardinian species in *Asoriculus*, a point of view that has been followed by Van der Geer et al. (2010). All the authors agree with the strong relationship between the species placed in *Nesiotites* and *Asoriculus*.

Maul and Rzebik-Kowalska (1998) suggested that *Asoriculus* should be considered as the direct ancestor of *Neomys* Kaup, 1829. Nevertheless, the phylogenetic approach by Rofes and Cuenca-Bescós (2009) does not sustain this hypothesis.

In this paper, following Van der Made (1999) we maintain *Nesiotites* as a genus name restricted to the Balearic taxa, in order to avoid the previous polyphyletic interpretation. In this sense, *Nesiotites similis* and *N. corsicanus* will be referred to as *Asoriculus similis* and *A. corsicanus* from here on.

Asoriculus was present in the Mediterranean zone since the Late Miocene (Rofes and Cuenca-Bescós, 2006). These authors give a detailed account of the great dispersion of *Asoriculus* in the European mainland and the Mediterranean Islands during the Late Miocene and the Plio-Pleistocene. *Nesiotites* should be considered as an insular derivative from, probably, *Asoriculus gibberodon* Petényi, 1864 (e.g., Kotsakis, 1980; Esu and Kotsakis, 1980; Reumer, 1984; Pons-Monjo et al., 2010).

In this context, the mandible of a soricid from Caló den Rafelino that we present in this paper is particularly interesting, not only for its early age, preceding all the previous records at the Balearic Islands, but also for its peculiar morphology and morphometrics.

3

The Site

The fossiliferous bone breccia yielding the fossils here studied is located on the East coast of Mallorca, close to Caló den Rafelino, in the municipality of Manacor (Figure 2). The outcrop is very close to the seashore and consists of hardened red limestones of a collapsed cave gallery excavated in the Upper Miocene Reef Complex (Pomar et al., 1990; Fornós, 1998; Robledo and Pomar, 2000). This complex has a Late Tortonian-Messinian age (Bizon et al., 1973). Although red limestones are filling the whole collapsed gallery, the fossils are concentrated in a small area, about 1 m^2 (Figure 2).

The stratigraphic and palaeontological evidence suggests an Early Pliocene age (Bover et al., 2007, 2010; Bailon et al., 2010; Quintana et al., 2010). Likely, the infilling was restricted to a very short period, posterior to the Tortonian-Messinian boundary and previous to Piacenzian (i.e., at the uppermost part of MN13 or at MN14). Some taxa recorded in Caló den Rafelino are not present in the later Mallorcan Pliocene deposits, while three of the mammals present at this site display intermediate characters between the fauna recorded at Cala Morlanda (MN15) and their putative mainland Miocene ancestors. The mammalian fauna of the deposit (Bover et al., 2007, 2010; Quintana, 2010) suggests that the colonization event occurred during the Messinian Salinity Crisis (5.6-5.32 Ma, according to Krijgsman et al., 1999). Consequently, an earliest Early Pliocene age (MN13-14) is suggested for the site. A detailed chronostratigraphical and biochronological framework is presented in Figure 1.

The faunal assemblage of Caló den Rafelino has not been previously recorded in Mallorca. In addition to the soricid studied herein, it contains remains of four other mammals (the caprine *Myotragus palomboi* Bover et al., 2010; the lagomorph *Hypolagus balearicus*, Quintana et al., 2010; a large-sized still not described new genus of cricetid, and a glirid of the genus *Hypnomys* Bate, 1918), several reptiles (*Vipera* sp. of the Oriental Vipers complex, *Vipera* aff. *natiensis*, a colubroid snake, a tortoise, a lacertid, and an anguid), a bird, and some fish teeth (Bover et al., 2007, 2010; Bailon et al., 2010; Quintana et al., 2010).

Abbreviations

Institutional: IMEDEA, Institut Mediterrani d'Estudis Avançats (CSIC-UIB); UZ, Universidad de Zaragoza.

Dental terminology and measurements: p, lower premolar; m, lower molar; L, length; TRW, trigonid width; TAW, talonid width; Hm1, height of mandible below m1 (medial side); Hm2, height of mandible below m2 (medial side).

MATERIAL AND METHODS

The specimen was extracted from the fossiliferous bone breccia through treatment with acetic acid, and it was posteriorly consolidated. More than 50 kg of breccia have been processed, and no additional shrew bones have been obtained. Although some breccia is still in the deposit, it seems that the fossiliferous part has been already collected and, thus, no additional material can be obtained.

We follow Reumer's (1984) anatomical nomenclature, with a few additions from Jin and Kawamura (1996), given its almost universal use among scholars dealing with fossil soricids from the Plio-Quaternary.

Metric values were recorded using a stereomicroscope (Olympus MSZH, objective 64x) connected to a video camera. We follow Reumer (1984) for measurements, with some additions from Rabeder (1972). For the morphometric analysis we used the PAST v2.01 statistical programme (Hammer et al., 2001).

SYSTEMATIC PALAEONTOLOGY

Class MAMMALIA Linnaeus, 1758
Order EULIPOTYPHLA Waddell, Okada and Hasegawa, 1999
Family SORICIDAE Fischer von Waldheim, 1817
Subfamily SORICINAE Fischer von Waldheim, 1817
Genus *NESIOTITES* Bate, 1945
NESIOTITES RAFELINENSIS sp. nov.
Figure 3.1-3

Type locality and age. Caló den Rafelino, Manacor (Mallorca, Balearic Islands, Spain); earliest Early Pliocene (5.3-4.5 Ma, MN13-14).

Holotype. IMEDEA 91950, incomplete left mandible with p4, m1, m2, and m3.

Location of types. Holotype in the collection of the IMEDEA, Palma de Mallorca (Spain).

Etymology. Derived from the type locality, Caló den Rafelino.

Measurements (mm). Lp4 = 1.46, Wp4 = 1.01, Lm1 = 1.93, TRWm1 = 1.1, TAWm1 = 1.22, Lm2 = 1.72, TRWm2 = 1.16, TAWm2 = 1.1, Lm3 = 1.29,
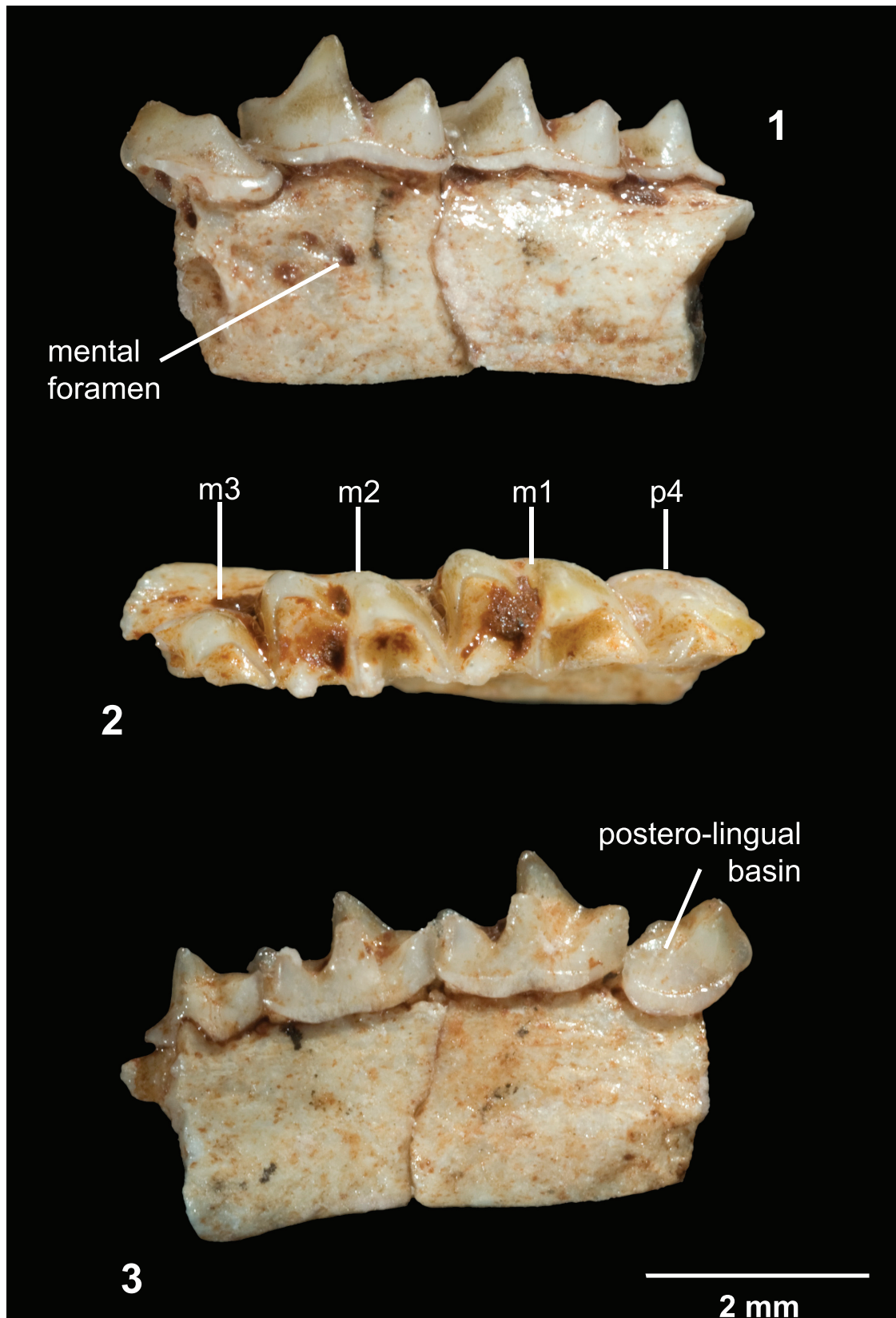
FIGURE 3. *Nesiotites rafelinensis* sp. nov. Holotype IMEDEA 91950, incomplete left mandible from the earliest Early Pliocene site of Caló den Rafelino, in (1) buccal, (2) occlusal, and (3) lingual views.

Wm3 = 0.73, Lm1-m3 = 4.68, Hm1 = 1.93, Hm2 = 1.79.

Diagnosis: Species of *Nesiotites* with teeth dimensions close to *N. ponsi*, but mandibular body as large as in *N.* aff. *ponsi* (from Pedrera de s'Ònix). It differs from *N. ponsi*, *N.* aff. *ponsi*, *N. hidalgo*, and *Asoriculus similis* in not having accessory cusps on the oblique crest of the first and second lower molars (as in *A. gibberodon*). The cuspule and lingual crest on the posterolingual basin of the p4 (absent in *A. gibberodon*) are not as conspicuous as in *N. ponsi*, *N. aff. ponsi*, or *N. hidalgo*. The buccal and lingual cingula of the lower teeth are comparatively broader and more pronounced than in all other *Nesiotites* species. The buccal cingulum of the lower molars is (as in *A. gibberodon*) not as undulated as in *N. ponsi*, *N. aff. ponsi*, and *N. hidalgo*. Teeth stained a light orange at the top of the crowns (as in *A. gibberodon*). Mental foramen placed slightly forward than in all other *Nesiotites* species.

DESCRIPTION

All the dental elements are supposed to be stained a light orange in the apical part of the crown. However, only a trace of the pigment remains at the very top of the crowns of the specimen, probably due to taphonomical reasons.

p4 (Figure 3.1-3). The occlusal outline is roughly triangular, although the posterior face is remarkably incurvated due to the elongation of the posterobuccal corner of the crown. Two main cusps are present on the crown. The anterior one is higher and lingually oriented in occlusal view. These two cusps are connected by a sharp, high ridge which encloses a posterolingual basin on its lingual side. This basin drains steeply posterolingually and exhibits a very low cuspule, connected to the anterior cusp by an also low lingual crest. A very thick cingulum is observed on the buccal base of the crown, where the crown hangs over the root. The lingual cingulum is also well developed but weaker than the buccal one.

m1-m2 (Figure 3.1-3). They have a trapezoidal shape in occlusal view and present five main cusps: the paraconid, protoconid, metaconid, entoconid, and hypoconid. They also have an accessory cusp, the entostylid. The three anterior cusps (para-, proto-, and metaconid) are connected by crests or ridges, forming the trigonid which is V-shaped. The paralophid is longer than the protolophid. Each crest has a notch at its middle part. The protoconid is the highest cusp of the crown and is situated anterobuccally to the metaconid. From the hypoconid, the oblique crest descends anterolingually towards the protoconid, and attaches to its posterior face forming the hypoflexid, which steeply descends buccally almost reaching the buccal cingulum. Another ridge, the hypolophid, extends lingually from the hypoconid to the entostylid, which is tiny and almost indistinct. The entostylid is separated from the entoconid by a valley more widely opened on m1. The entoconid is an isolated conical cusp which connects to the posterior base of the metaconid by the entoconid crest. The latter is low on m1 and nearly absent on m2. The talonid is wider than the trigonid on m1. On m2 the talonid is slightly narrower. The lingual cingulum is broad but hardly pronounced. The buccal cingulum is broad, well developed and slightly undulated on m2.

m3 (Figure 3.1-3). The occlusal outline is semicircular. The trigonid is smaller but basically similar to those of the first two molars. The talonid is markedly reduced, so that the talonid basin is much smaller and shallower than the trigonid basin. Unfortunately, the posterior half of the talonid is not preserved. The buccal cingulum is well developed, while the lingual one is weaker.

Mandible (Figure 3.1, 3.3). The mandibular body is stoutly built. The mental foramen is placed below the hypoflexid of the first lower molar.

MORPHOMETRIC ANALYSIS

The elements included in the analysis are both dental and mandibular, namely: m1, m2, m3, and the mandibular body. The measurements used as variables were: length (L) and talonid width (TAW) for the lower molars; and height (H) for the mandible.

We compared the specimen from Caló den Rafelino (CDR from here on) with all the species of *Nesiotites* and *Asoriculus* that have these measurements available from reference collections (IMEDEA, UZ), and from the literature (Table 1). In the case of *Asoriculus gibberodon* we took the average values of the measurements published for three sites (see legend of Figure 4).

Figure 4 shows the results of the bivariate analysis carried out with the L and TAW measurements of m1 (see above). The specimen from CDR falls very close to the polygon (nearly a segment) that includes the *Nesiotites ponsi* available specimens. It also falls inside the 95% confidence ellipse of *Nesiotites* aff. *ponsi*, but relatively far from the convex hull of this taxon. CDR m1's dimensions are closer to *Asoriculus thenii* Malez

TABLE 1. Measurements of the mandible and lower teeth of the *Nesiotites* and *Asoriculus* specimens used in the morphometric analysis. Lm1, length of m1; TAWm1, talonid width of m1; Hm2, height below m2; Lm1-m3, length of m1 to m3.

Species	Site	Age	Lm1	TAWm1	Hm2	Lm1-m3
Nesiotites rafelinensis sp. nov.	Caló den Rafelino	Early Pliocene	1.93	1.22	1.79	4.68
Nesiotites ponsi	Cruis de Cap Farrutx	Late Pliocene	1.88	1.22	1.69	4.63
			1.8	1.19	1.61	4.3
			1.95	1.24	1.65	4.47
			1.88	1.22	1.65	4.47
Nesiotites aff. ponsi	Pedrera de s'Onix	Early Pleistocene	2.1	1.32	2.02	4.93
			1.9	1.3	1.79	4.76
			2.1	1.34	1.9	5.05
			2.14	1.28	2.03	5
			2.11	1.33	1.93	4.95
			2.14	1.26	2.02	5.12
Nesiotites meloussae	Barranc de Binigaus	Early Pleistocene	2.11	1.54	1.99	5.31
Nesiotites hidalgo	Cova de Llenaire	Late Pleistocene	2.27	1.39	2.07	5.43
			2.14	1.36	1.93	5.2
			2.4	1.4	1.92	5.47
	Cova Estreta	Late Pleis/Holocene	2.37	1.51	1.96	5.63
			2.39	1.5	2.17	5.58
			2.37	1.43	1.94	5.56
	Cova de Canet	Late Pleis/Holocene	2.23	1.48	1.94	5.47
			2.32	1.47	2.02	5.5
			2.35	1.44	2.16	5.63
Asoriculus similis	Sardinia	Late Pleistocene	2.23	1.23	1.67	5.11
			2.32	1.32	1.66	5.29
			2.31	1.33	1.76	5.34
Asoriculus gibberodon	Vceláre 3	Late Pliocene	1.42	0.9	1.35	3.7
	Monte La Mesa	Early Pleistocene	1.58	1.02	1.54	3.64
	Sima del Elefante	Early Pleistocene	1.6	0.97	1.41	3.92
Asoriculus thenii	Podumci 1	Early Pleistocene	1.71	1.08	1.87	4.19
	Tatinja Draga	Early Pleistocene	1.86	1.12	1.99	4.46

and Rabeder, 1984, than they are to *Asoriculus gibberodon*, *A. similis*, *Nesiotites hidalgo*, and the single available *N. meloussae*.

According to the plot, the m1 of CDR has almost the same size and shape than that of *N. ponsi*. Altogether, *Nesiotites* species have a wider talonid (TAW) than continental *Asoriculus*. *Nesiotites meloussae* has the widest talonid of the whole sample.

The principal components analysis (PCA) (Figure 5) carried out with the measurements of the lower teeth and the mandible (see Table 1) shows a closer morphometric affinity of the CDR specimen with *N.* aff. *ponsi* than with *N. ponsi*, even though it also falls inside the 95% confidence
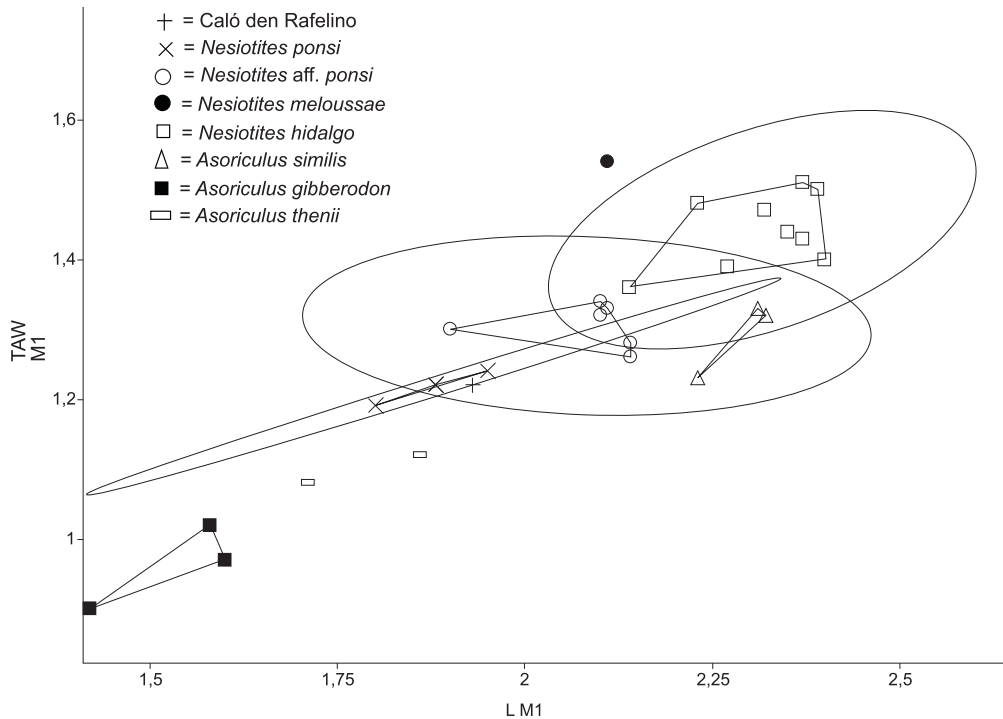
FIGURE 4. Bivariate diagram of the m1's L and TAW measurements. Measurements of *Asoriculus gibberodon* taken from Fejfar and Horácek (1983), Marchetti et al. (2000), and Rofes and Cuenca-Bescós (2006). Measurements of *Asoriculus thenii* taken from Malez and Rabeder (1984). *Nesiotites ponsi* specimens are from the site of Cruis de Cap Farrutx, Mallorca (Late Pliocene); *Nesiotites* aff. *ponsi* specimens from Pedrera de s'Onix, Mallorca (Early Pleistocene); *Nesiotites hidalgo* specimens from Cova de Llenaire, Cova de Canet, and Cova Estreta, Mallorca (Late Pleistocene/Holocene); *N. meloussae* specimen from Barranc de Binigaus, Menorca (Early Pleistocene); *Asoriculus similis* specimens from Sardinia (Late Pleistocene); *Asoriculus gibberodon* specimens from Vceláre 3, Slovakia (Late Pliocene), Monte La Mesa, Italy (Early Pleistocene), and Sima del Elefante, Spain (Early Pleistocene); *Asoriculus thenii* specimens from Podumci 1 and Tatinja Draga, Croatia (Early Pleistocene). Convex hulls, distribution; Ellipses, 95% confidence.

ellipses of both. A closer look at the loads of the PCA variables reveals that they are very similar on PC1 (Table 2), a sure sign that the first axis represents size. PC1 explains 88.38% of the global variance. On PC2, by contrast, the contribution of Hm2 is clearly greater (Table 2). PC2 should have a higher morphological load, explaining the 8.49% of the variance.

It is noteworthy to say that the morphometric distance between the CDR item and *N. ponsi* is also rather short. In fact, it is less than the intraspecific variability recorded for all the samples except for *N. ponsi*, which is indeed peculiar in having a very limited variation.

It must be said that the results of the PCA are guiding more than conclusive, due to the restricted number of items of some taxa (i.e., CDR, *N. meloussae*, *A. thenii*).

Even though, the combined results of both bivariate and multivariate (PCA) analyses are consistent with the assignation of the CDR specimen to a new species with primitive dental features and closer in dental dimensions to *N. ponsi*, although with a mandibular body size close to *N.* aff. *ponsi*.

SIZE AND CHRONOLOGY

Differentiating among fossil species of the genus *Nesiotites* has involved classic size differences. There is a clear evolutionary trend of increase of size from *Nesiotites ponsi*, the earliest species known to date (Late Pliocene) to *Nesiotites hidalgo*, from the Pleistocene-Holocene (e.g., Reumer, 1980). As previously mentioned, *Nesiotites* aff. *ponsi* (*Nesiotites* ex. interc. *ponsi-hidalgo*, sensu Reumer, 1981) from the Early Pleistocene is a form intermediate in size.

In this evolutionary trend towards larger size, where the purported ancestor of the genus *Nesiotites*, namely *Asoriculus gibberodon* (Reumer, 1984; Masini and Sarà, 1998; Van der Made, 1999; Rofes and Cuenca-Bescós, 2009; Pons-Monjo et
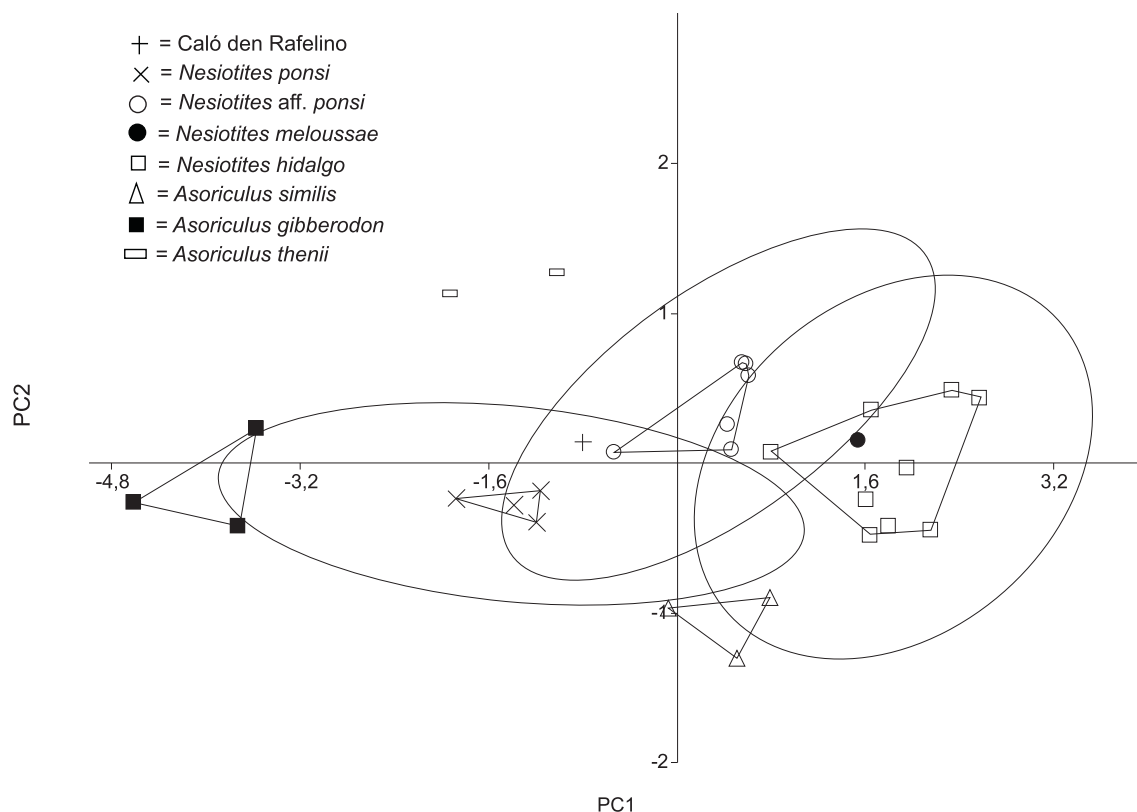
FIGURE 5. Principal component analysis (PCA) showing plot of components 1 against 2. Measurements of the lower teeth and the mandible used: Lm1, TAWm1, Hm2, and Lm1-m3. Measurements of *Asoriculus gibberodon* and *A. thenii* taken from the same sources as in Figure 4. Specimens other than that of Caló den Rafelino are from the same locations as in Figure 4. Details can be found in Table 2. Convex hulls, distribution; Ellipses, 95% confidence.

al., 2010; Van der Geer, 2010), is considerably smaller than *Nesiotites ponsi* (see Figures 4, 5), the mandibular body height and robustness of the specimen from Caló den Rafelino, similar to that of *Nesiotites* aff. *ponsi*, is unexpected. If we take into account that the taxon from Caló den Rafelino is considerably older than the earliest remains of *Nesiotites* found to date (i.e., earliest Early Pliocene versus Late Pliocene, respectively; see Table 1), we can say that it possibly breaks a otherwise regular trend.

DISCUSSION

The morphological features displayed by the single *Nesiotites* specimen obtained from Caló den Rafelino are, in our opinion, strong enough to differentiate it from the species of *Nesiotites* described until now. *Nesiotites rafelinensis* sp. nov. represents the most primitive species of the genus, close to its putative mainland ancestor *Asoriculus gibberodon*.

Pons-Monjo et al. (2010) highlight the uncertainty of the "presence/absence of accessory cusps" on the first and second lower molars as a valid feature to discriminate among the different forms of the genus. The presence of those accessory cuspules in *Asoriculus similis* argues in favour of its ambiguous nature (JR, personal observation). In this regard, we want to emphasize that, although we include this trait in the diagnosis, we do not rely exclusively on it to define a new species, but on the combination of a set of characters instead (see

TABLE 2. Results of the PCA performed with the measurements of the mandible and the lower dentition. Jolliffe cut-off: 0.7.

	PC1	PC2	PC3	PC4
Eigenvalue	3.535	0.339	0.109	0.017
% variance	88.376	8.487	2.717	0.420
Loadings				
L m1	0.510	-0.364	0.527	0.574
TAW m1	0.510	-0.154	-0.822	0.204
H m2	0.456	0.88	0.127	0.037
L m1-m3	0.522	-0.263	0.176	-0.792

above). The general appearance of the lower teeth of the specimen from Caló den Rafelino does not substantially differ from that of *Nesiotites*, but it has certain features that relate it more with *A. gibberodon* than any other representative of the genus.

N. rafelinensis combines primitive dental traits with a relatively large size. Its size is greater than that of *Asoriculus gibberodon* and *Nesiotites ponsi*. The new species is also morphometrically closer to the *A. gibberodon* items from Spain (Sima del Elefante) and Italy (Monte La Mesa) than to those from central Europe (Vceláre 3).

The evolution of body size in the Mallorcan shrews involved an initial size increase (from the presumed ancestor *A. gibberodon* to *N. rafelinensis*), followed by a size decrease (from *N. rafelinensis* to *N. ponsi*), to increase again size later (from *N. ponsi* to *N. hidalgo*). The size of *N. rafelinensis* breaks a regular trend from *Asoriculus gibberodon* to *N. hidalgo*. Size decreasing coeval the disappearance of most of the taxa present in Caló den Rafelino, and possibly both phenomena (i.e., size decreasing of shrews and disappearance of most of the taxa) could be related to the same unknown causes.

It should be noticed that although *Nesiotites rafelinensis* have a size closer to *Asoriculus thenni* (see Figures 4, 5), an endemism of Croatia (Malez and Rabeder, 1984), than to *A. gibberodon*, a direct phylogenetic relationship between the Mallorcan and Croatian species seems unlikely due to chronological and biogeographical constrains (see Rofes and Cuenca-Bescós, 2006).

Besides *N. rafelinensis*, the faunal assemblage from Caló den Rafelino includes the first representatives of the genera *Myotragus* (i.e., *M. palomboi*) and *Hypolagus* (i.e., *H. balearicus*) of the Balearic Islands, together with a new genus of cricetid, and a species of *Hypnomys* (Gliridae) that remain to be described (Bover et al., 2008, 2010; Quintana et al., 2010). Also it has the earliest fossil record of *Vipera* from the western Mediterranean Islands (Bailon et al., 2010). All these endemic taxa show the anatomical effects of insularity to a greater or a lesser extent. The relatively large size and morphological peculiarities of *N. rafelinensis* could be no exception in this sense. Altogether, the faunal assemblage of this deposit represents the earliest evidence of the fauna that arrived to the Mallorca Island during the Messinian Salinity Crisis.

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