

NON-VOLANT TERRESTRIAL MAMMALS (MAMMALIA)
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ABSTRACT

Eleven species of non-volant terrestrial mammals are known to occur on the island of Korčula: *Crocivura suaveolens*, *Lepus europaeus*, *Apodemus epimelas*, *A. sylvaticus*, *Rattus rattus*, *Mus domesticus*, *Glis glis*, *Eliomys quercinus*, *Canis aureus*, *Martes foina*, and *Herpestes auropunctatus*. *Rattus norvegicus* has been deleted from the faunal list of the island. House mouse *Mus domesticus* seems to be the dominant species. Although the island of Korčula, which covers 276 km², is not the largest island in the central and southern Adriatic archipelago, it is inhabited by the largest number of non-volant mammal species. This is presumably the consequence of the following two facts: the mainland proximity that enables immigrations from the land, and the large habitat diversity within the island.

Keywords: terrestrial mammals, barn owl pellets, the island of Korčula

I MAMMIFERI TERRESTRI (MAMMALIA) DELL'ISOLA ADRIATICA DI CURZOLA

SINTESI

Nell'isola adriatica di Curzola sono state evidenziate undici specie di mammiferi terrestri (esclusi i pipistrelli): *Crocivura suaveolens*, *Lepus europaeus*, *Apodemus epimelas*, *A. sylvaticus*, *Rattus rattus*, *Mus domesticus*, *Glis glis*, *Eliomys quercinus*, *Canis aureus*, *Martes foina*, e *Herpestes auropunctatus*. Il ratto grigio *Rattus norvegicus* è stato escluso dall'elenco. La specie dominante sull'isola è rappresentata dal topolino delle case *Mus domesticus*. Curzola ha una superficie di 276 km² e, pur non essendo l'isola più grande fra quelle dell'Adriatico centrale e meridionale, ospita la maggior parte di specie di mammiferi. Ciò è dovuto, probabilmente, a due fattori: la vicinanza del continente, che permette la migrazione dalla terra ferma e la ricca varietà di habitat presenti sull'isola.

Parole chiave: mammiferi terrestri, borra del barbagianni, isola di Curzola

INTRODUCTION

The Eastern Adriatic coast abounds with islands, which are actually peaks or ridges of the submerged Dinaric Alps. The great majority of these islands are small, with only 67 covering ≥ 1 km²; surface area of 29 of them exceeds 10 km², while merely eight islands are larger than 100 km². It is clear therefore that most of the Adriatic islands are too small to host viable populations of the non-volant mammals, especially as their natural vegetation – consisting mainly of evergreen forests and shrubs – was severely degraded in the past centuries. The deforestation was followed by overgrazing and overbrowsing, as well as occasional intentional burnings. All these facts increased soil erosion and caused habitat degradation. On the other hand, the Adriatic islands as former parts of the continent became finally isolated after the end of the Pleistocene due to the considerable rise of the sea surface, thus the endemism is lacking (Rodić, 1970; Griffiths *et al.*, 2004).

The bulk of faunal research on the Adriatic coast was carried out in the 1960s and 1970s by B. Đulić (also spelled as Dulić or Djulić) and N. Tvrković from the University of Zagreb. Their focus was on small terrestrial mammals (insectivores, rodents) and bats (Dulić, 1970, 1972; Đulić, 1989; Dulić & Tvrković, 1970, 1979; Tvrković *et al.*, 1985). Faunal composition of small mammals is thus reasonably well known (see Petrov, 1992, for a summary of insectivores and rodents). However, information on other mammalian groups has never been compiled. In this paper we report on new material and data collected recently on the island of Korčula, which allows some insight into the relative abundance of mammals and the assembly composition. Besides, we revised a faunal checklist of the island mammals, other than bats.

MATERIAL AND METHODS

Study area

The island of Korčula is situated on the southern border of the Adriatic archipelago, offshore central Dalmatia. With an area of 276 km² it is one of the largest islands in the Adriatic archipelago. Topography is diverse with the highest peak at 568 m above sea level. The bedrock is mainly of Cretaceous limestones with well-developed karst phenomena and, consequently, shortage of surface water. Climate is Mediterranean, with hot, dry summers and mild, wet winters. Mean annual temperature is c. 16 °C; average for July is c. 25.5 °C and for January c. 9 °C; mean winter temperatures are nowhere on the island below 6 °C. Annual precipitation is fairly high (c. 1100 mm), although recorded primarily between October and January.

Korčula is reported to have the best-preserved forests

on all Adriatic islands. This is somewhat surprising, considering the long history of human settling there (since the Neolithic) and the importance that shipbuilding industry had in the island's economy since the 14th century. The majority of plants are evergreen, with a moderate addition of deciduous species. Forests are composed of *Quercus ilex*, *Cupressus sempervirens*, *Pinus halepensis*, *P. pinea*, *P. nigra*, *Olea europaea*, *Myrthus communis*, *Laurus nobilis*, *Pistacia lentiscus* etc. Shrub communities include, in addition to some of the above taxa, *Erica arborea*, *Smilax aspera*, *Arbutus inede*, *Pistacia terebinthus*, *Viburnum pinus*, *Juniperus phoenicea*, *Paliurus spinachristi*, and so on. Following the changes in the island's economy of the last decades, with less grazing and browsing, shrubs expanded into impenetrable maquis.

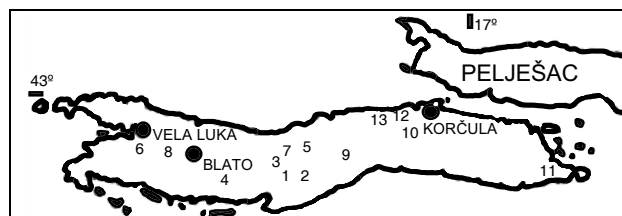


Fig. 1: Map of the island of Korčula with localities cited in text. 1 – Banja, 2 – Kruševo, 3 – Smokvica, 4 – Donji lov, 5 – Doli, 6 – Kokotovac, 7 – Sitnica, 8 – Blatsko polje, 9 – Čara, 10 – Žrnovo, 11 – Lumbarda, 12 – Žrnovska Banja, 13 – Pupnat.

Sl. 1: Zemljevid otoka Korčula z označenimi lokalitetami. 1 – Banja, 2 – Kruševo, 3 – Smokvica, 4 – Donji lov, 5 – Doli, 6 – Kokotovac, 7 – Sitnica, 8 – Blatsko polje, 9 – Čara, 10 – Žrnovo, 11 – Lumbarda, 12 – Žrnovska Banja, 13 – Pupnat.

The above information is summarised from Ivančević & Filippi (1984), Kalogjera (1985), Jovanović *et al.* (1986) and Rodić (1970).

Material and methods

Material and data were collected by the first author during the three excursions to the island in 2002, 2003, and 2004 (all in August) (Fig. 1). Local people were interviewed on the presence of mammals and roads were searched for road casualties. Main source of small mammals were remnants in the pellets of barn owl (*Tyto alba*), collected at Kruševo. The pellets were decomposed by hand, and cranial remnants identified subsequently under the stereomicroscope. Skeletal remnants of medium sized mammals were found in abandoned wells that acted as deadly pitfalls. The material is stored at the Department of Biology, University of Maribor. We also included data housed in the Slovenian Museum of

Natural History (Ljubljana).

Reference material (Slovenian Museum of Natural History) was used in identifying osteological material. Taxonomy and nomenclature follows Mitchell-Jones *et al.* (1999). Toponyms are from Babić (2003). Estimates of relative abundance are based on information that was not collected systematically and are thus entirely subjective.

In preparing the faunal list, we checked all published sources available to us. Data are widely scattered and many records on game species in particular appeared in obscure sources, e.g. in hunters' and in a popular natural history periodicals, in unpublished theses and expert reports as well as in daily press. It is beyond doubt that much of such data, no matter how valuable they are, escaped our attention. The only compilation on small terrestrial mammals (insectivores and rodents) is by Petrov (1992). A detailed crosschecking of this published source, however, detected numerous inaccuracies and errors that induced us to verify all the original literary sources.

Results and Discussion

The new data on non-volant mammals of the island of Korčula are summarised in Tables 1 and 2. It is evident that small mammal assembly is poor in species composition with a high predominance of house mice (*Mus domesticus*). Since the barn owl is a feeding generalist (Mikkola, 1983), one would expect a broader spectrum of the island rodents to be represented in pellets, but the remains of 168 prey specimens belonged to only four species. Although the pooled sample from wells contained only 41 individuals, no less than seven species were represented. Again, house mice dominated, but share of the two carnivores, the mongoose (*Herpestes auropunctatus*) and stone marten (*Martes foina*), was surprisingly high (= 21% of specimens). High abundance of carnivores in a taphonomic sample unlikely reflects their actual share in mammal assembly. In any case, in wells it was much easier to overlook remnants of small shrews and rodents than those of carnivores.

Tab. 1: Mammal species in 75 barn owl pellets from Kruševo (the island of Korčula).

Tab. 1: Sesalci, izolirani iz 75 izbljuvkov pegaste sove, lokaliteta Kruševo, otok Korčula.

Species	No. of individuals	%
<i>Crocidura suaveolens</i>	7	4.1
<i>Apodemus sylvaticus</i>	8	4.7
<i>Mus domesticus</i>	135	79.9
<i>Rattus rattus</i>	18	10.7
Total	168	100.0

Tab. 2: Mammal species in tanatocenoses of abandoned wells according to locality. A minimal number of specimens is given. For localities, see figure 1.

Tab. 2: Tanatocenoza sesalcev, najdenih v zapuščenih vodnjakih. Podano je minimalno število osebkov. Za lokalitete glej sliko 1.

Locality	1	2	3	4	5	6	7	Total	%
Species									
<i>Crocidura suaveolens</i>		1			4	1		6	14
<i>Apodemus sylvaticus</i>			1		2			3	7
<i>Rattus rattus</i>	1			4	1	1	1	8	20
<i>Mus domesticus</i>					3	5	4	12	30
<i>Glis glis</i>		1		2				3	7
<i>Martes foina</i>	1			3				4	10
<i>Herpestes auropunctatus</i>	2	1		1	1			5	12
No. of specimens	4	3	1	10	11	7	5	41	100

Faunal list

In the list below, the literature and our own data are presented. In the subsequent text we paid attention to avoid confusion between the island of Korčula and the town of Korčula.

Crocidura suaveolens (Pallas, 1811)

Published data: Blato; Čara (Đulić, 1976).

New data: Doli (2002); Kruševo (2002, 2003); Kokotovac (2004).

The lesser white-toothed shrew is the only insectivore on the island. Đulić (1976) reports only on three specimens from two different localities. As one can deduce from owl pellet sample, it is fairly rare in the small mammal assembly.

Lepus europaeus Pallas, 1778

New data: Blatsko polje (2003).

Record is based on road casualty. The origin of the European hare on the island of Korčula is not known, but we assume it is due to introduction. In the past, this popular game species was frequently imported to various Adriatic islands for hunting purposes. Animals mainly originated from Central European lowlands, and the success was usually low. Current status of the hare on the Adriatic islands is not known.

Apodemus epimelas (Nehring, 1902)

Published data (as *A. mystacinus*): the island of Korčula (Dulić, 1972). Žrnovo (Petrov, 1992).

Besides the island of Mljet, Korčula is the only Adri-

atic island populated by karst mouse (Petrov, 1992). Dulić (1972) reported it for the island without any further details. So far, Petrov (1992) provides the only exact locality and credits Đulić for it. This species was not present in our samples.

The rarity of *A. epimelas* on the Adriatic islands is somehow surprising, since the closely related *A. mystacinus* is widespread on the Aegean islands (Mitchell-Jones *et al.*, 1999).

***Apodemus sylvaticus* (Linnaeus, 1758)**

Published data: the island of Korčula (Dulić, 1972; Dulić & Tvrtković, 1971, 1972; Tvrtković, 1976a, b, 1979). Čara; Lumbarda (Petrov, 1992).

New data: Smokvica (2002); Kruševo (2002); Doli (2002).

Đulić and Tvrtković (see citations above) did not refer to any exact locality from the island. Petrov (1992), on the other hand, claims that two localities (Čara and Lumbarda) are cited on the basis of their papers. As one can deduce from our samples, this wood mouse is fairly rare on the island.

The population from the island of Korčula is characterised by large size (Tvrtković, 1976a) and low frequency in the presence of the postero-labial tubercle (T_{12}) on the first upper molar (Tvrtković, 1976b).

***Rattus rattus* (Linnaeus, 1758)**

Published data: Žrnovska Banja (Kataranovski *et al.*, 1989).

New data: Doli (2002); Kruševo (2003); Sitnica (2002); Banja (2002); Kokotovac (2004); Donji lov (2003); Žrnovo (2003).

On the Adriatic islands, the black rat is a common species (own observations), both in synanthropic and feral populations. The island of Korčula seemingly does not deviate in this respect. Since the barn owl does not prey on adult rats, the data in Table 1 do not rely on the actual species frequencies within the small mammal communities. In August 2003, a specimen was trapped in dense maquis c. 2 m high.

***Rattus norvegicus* (Berkenhout, 1769)**

Published data: Žrnovska Banja (Petrov 1992).

Petrov (1992) refers to a communication by Kataranovski *et al.* (1989), which was published as an abstract. This is certainly an error since the above citation deals entirely with *R. rattus*, not mentioning at all *R. norvegicus*. The brown rat is thus to be deleted from the faunal list of the island.

***Mus domesticus* (Schwartz et Schwartz, 1943)**

Published data (all in Dulić & Tvrtković, 1979): Vela

Luka; Smokvica (as *Mus musculus pretextus* x *M. m. brevirostris*). Blato; Smokvica; Čara; Lumbarda (as *Mus musculus brevirostris*).

New data: Doli (2002); Kruševo (2002, 2003); Sitnica (2002); Kokotovac (2004).

On the islands of southern Adriatic, Dulić & Tvrtković (1972) collected house mice in urban settlements, in bushes bordering the arable land, and in a small wood, but was the most common in riverine habitats and in marshes. Our data suggest this species to be the dominant small mammal on the island.

***Glis glis* (Linnaeus 1766)**

Published data: the island of Korčula (as *Glis glis postus*; Dulić, 1972). Žrnovo (as *Myoxus glis*; Petrov, 1992).

New data: Kruševo (2002); Donji lov (2003); Žrnovo (2003, leg.: D. Pavlin).

The edible dormouse is widespread on the Southern Adriatic islands, but was rare in taphonomic material from Korčula. Eight specimens were trapped in dense maquis at Žrnovo between August 5 and 6, 2003.

***Eliomys quercinus* (Linnaeus, 1766)**

Published data: the island of Korčula (Đulić, 1971); Pupnat (Tvrtković *et al.*, 1995).

Although the garden dormouse is fairly widespread on the Adriatic islands, it is seemingly rare on Korčula. We do not have it in our material.

***Canis aureus* Linnaeus, 1758**

Published data: numerous but scattered in hunting and popular natural history journals, as well as in daily press. The only museum specimen (skull) from Korčula (from 1907 no exact locality) is reported by Kryštufek & Tvrtković (1990b).

The jackal was documented on the island of Korčula for the first time as early as in 1491 (Jeričević, 1952) and its presence on the island was seemingly continuous until recently (Kryštufek & Tvrtković, 1990a). Since this animal is a keen swimmer (Kapitan, 1919), it is likely that the island was repeatedly colonised from the nearby Pelješac Peninsula, where the jackal is common as well (Jeričević, 1952). Kühn (1935) refers to the Archives of the city of Dubrovnik (Ragusa), according to which the Venetian Republic had brought jackals from Africa and released them on the island of Korčula, then the property of the Republic of Dubrovnik, with intention to cause harm. The presumption on the African origin of Dalmatian jackals was known already to Fitzinger (1830), but is not supported by cranial data. Morphometric evidence placed Dalmatian jackals close to their

counterparts from the rest of the Balkans and from Asia Minor, rather than to those from Africa. Jackals living on the Balkan Peninsula thus most likely arrived via a Bosphorus land bridge during some of the low sea level phases of the Upper Pleistocene (Kryštufek & Tvrković, 1990b), although one cannot exclude more recent colonisations by swimming across the narrow straits of Bosphorus and Dardanelle.

Throughout the history, the jackal was invariably considered to be a characteristic inhabitant of the island (Morgan, 1906), and the municipality of Blato has it in its coat of arms (Jeričević, 1952). Besides, jackals were constantly reported to cause damage. On Korčula, eradication campaigns were undertaken as early as in 15th century. For the 16th century, Jeričević (1952) lists three such campaigns, two in 1576 and one in 1579. Although the two pursuits in 1576 lasted 30 and 18 days, respectively, none of them were successful. Eradication campaigns are known also from the 20th century, e.g. in the 1930s (Ivković, 1932, 1933; Jeričević, 1952). The annual bag in the period 1964-1974, reported as 50 jackals (Borčić *et al.*, 1990), is possibly an overestimate (= 1.8 jackal killed per 10 km²). Nevertheless, Borčić *et al.* (1990) suggest that relatively high incidence of kala-azar (visceral leishmaniosis) on the island of Korčula is possibly connected to the high density of jackals, presumably the main reservoir of the disease. According to the personal communications by local hunters, the jackal is still present on the island.

***Martes foina* (Erxleben, 1777)**

Published data: the island of Korčula (Tvrković, 1996; cited from Baltić, 2000).

New data: Banja (2002); Donji lov (2003).

Stone marten is widespread on the larger Adriatic islands, including those in the southern part of Dalmatia: Brač, Hvar, Mljet, and Lastovo (Baltić, 2000). History of the species, however, seems to be unknown. We identified in or taphonomic material four martens and five mongooses, which suggests the two carnivores to be approximately equally common.

***Herpestes auropunctatus* (Hodgson, 1836)**

Literature data: Blato (Tvrković & Kryštufek, 1990); Vela Luka (Niethammer & Krapp, 1993); near Lumbarda (Cavallini & Serafini, 1995).

New data: Blato (1 May 1997, leg.: A. Vrezec); Doli (2002); Kruševo (2003); Banja (2002); Donji lov (2003).

The lesser Indian mongoose was introduced onto the island of Korčula on July 13th, 1920, from India and subsequently translocated onto some other nearby islands. For history and taxonomic identity, see Tvrković &

Kryštufek (1990). The species is widespread and abundant enough to be considered a pest. Its successful acclimatisation is somehow surprising, since the January 10 °C isotherm was suggested to predict its most northerly distribution (Ebisu & Whittow, 1976); the corresponding values on the island of Korčula are c. 6-9 °C. Winter diet on Korčula is dominated by vertebrates (mostly murine rodents) and plant matter (Cavallini & Serafini, 1995).

Zoogeography

The summary data on the distribution of non-volant terrestrial mammals on the larger Central and Southern Dalmatian islands are presented in Table 3. According to its surface area, the island of Korčula ranks in the third place among these islands, but it is the richest in the archipelago with respect to non-volant mammal species.

Although in some islands the presence of the brown hare could escape the notice, the total numbers of species presumably reflect the general real state. There are two probable reasons causing the highest species richness on the island of Korčula: (1) the "rescue effect" and (2) the insular habitat diversity.

The jackal, being absent in the two larger islands and reported only once from Mljet, possibly survived on the island of Korčula due to the "rescue effect" (Brown, 1995). The shortest distance to the mainland (1.2 km) is much lesser than for any other nearby island, presumably allowing frequent arrival onto the island. This is believed to be the reason, why the species has lived on the island of Korčula at least since the 15th century, in spite of its relative small area and permanent attempts to exterminate it. We assume that the jackal rarely reached the other islands, and that permanent populations have never been established.

As already stated, vegetation is less degraded on Korčula than on the other islands. We ascribe a sympatric occurrence of two *Apodemus* species, as well as of two dormice, to niche availability in a more complex and structured habitat. If our assumption is valid, then the habitat diversity of Korčula compensates for its smaller surface area.

To summarise, the sympatric occurrence of relatively high number of non-volant mammals on the island of Korčula in comparison with the other Adriatic islands reflects well preserved vegetation on the island causing large niche availability within different habitats. This is why it has not been elucidated why the generalist hedgehog species *Erinaceus concolor*, otherwise widely spread on the Adriatic islands (Petrov, 1992), is missing of the island.

Tab. 3: Occurrence of non-volant terrestrial mammals on the larger islands of the Central and Southern Adriatic. Compiled from Kryštufek & Tvrtković (1990a), Tvrtković & Kryštufek (1990), Petrov (1992), and Baltić (2000). The distribution of *Lepus europaeus* is most likely underestimated. Parentheses indicate historical occurrence, not considered in sums. Notes: ¹present in the 1920s and 1930s (Tvrtković & Kryštufek, 1990a); ²recorded once before 1920 (Kapitan, 1919).

Tab. 3: Seznam terestričnih sesalcev (brez netopirjev) na večjih otokih srednjega in južnega Jadrana. Povzeto po Kryštufek & Tvrtković (1990a), Tvrtković & Kryštufek (1990), Petrov (1992), in Baltić (2000). Domnevamo, da je razširjenost *Lepus europaeus* podcenjena. Starejša opazovanja so v oklepajih in niso všteta v seštevek vrst. Opomba: ¹zabeležen leta 1920 in 1930 (Tvrtković & Kryštufek, 1990a); ²eno opazovanje pred letom 1920 (Kapitan, 1919).

Island	Brač	Hvar	Korčula	Mljet	Vis	Lastovo	No. of islands
Area (km ²)	395	300	276	100	90	47	
Species							
<i>Erinaceus concolor</i>	+	+		+	+	+	5
<i>Crocidura suaveolens</i>	+	+	+			+	4
<i>Lepus europaeus</i>			+		+		2
<i>Apodemus sylvaticus</i>	+	+	+	+	+	+	5
<i>Apodemus epimelas</i>			+	+			2
<i>Mus domesticus</i>	+	+	+	+	+	+	6
<i>Rattus rattus</i>	+	+	+		+		4
<i>Glis glis</i>	+	+	+	+			4
<i>Eliomys quercinus</i>	+	+	+				3
<i>Martes foina</i>	+	+	+	+		+	5
<i>Herpestes auropunctatus</i>	(+) ¹	+	+	+			3
<i>Canis aureus</i>			+	(+) ²			1
No. of species	8	9	11	6	5	5	

ACKNOWLEDGEMENTS

For the access to the Indian mongoose specimen we thank Al Vrezec (Ljubljana), and for dormice we are

grateful to Dušan Pavlin. We are indebted to Alen Andrijić (Brna, Korčula) for the information on the mammals of Korčula Island, and to Tone Novak (University of Maribor) for his comments on the earlier draft.

KOPENSKI SESALCI (MAMMALIA) OTOKA KORČULA V JADRANSKEM MORJU

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POVZETEK

Na otoku Korčula v Jadranskem morju smo ugotovili enajst vrst kopenskih sesalcev (brez netopirjev): *Crocidura suaveolens*, *Lepus europaeus*, *Apodemus epimelas*, *A. sylvaticus*, *Rattus rattus*, *Mus domesticus*, *Glis glis*, *Eliomys quercinus*, *Canis aureus*, *Martes foina* in *Herpestes auropunctatus*. Sivo podgano *Rattus norvegicus* smo črtali s seznama sesalcev Korčule. Dominantna vrsta na otoku je bila hišna miš *Mus domesticus*. Otok Korčula meri 276 km² in čeprav ni največji otok srednjega in južnega jadranskega arhipelaga, na njem živi največ sesalčjih vrst. Domnevamo, da je to posledica dveh dejstev: bližine celine, ki omogoča imigracijo s kopnega, in visoke pestrosti habitatov na otoku.

Ključne besede: kopenski sesalci, izbljuvki pegaste sove, otok Korčula

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