

The Forest dormouse (*Dryomys nitedula* Pallas, 1779) in the Eastern Alps (Rodentia Gliridae)

PAOLO PAOLUCCI(*) - ANDREA BATTISTI(*) - RENZO DE BATTISTI(**)

(*) *Istituto di Entomologia agraria, Università di Padova, via Gradenigo 6, 35131
Padova*

(**) *Corpo Forestale dello Stato, Coordinamento Regionale di Padova.*

SUMMARY

In this study we present the findings achieved during faunistic researches in the Forest of Tarvisio and elsewhere, that concern the presence of *Dryomys nitedula* in the Eastern Alps.

The main morphological and biometrical data regarding the specimens observed, are exposed in comparison with those already known from other European populations. As far as the reproductive cycle is concerned, it seems that there is only one litter annually with an average size of 3-4.

In the examined biotopes, the species is found in different kinds of environments (at the edges of forests of beech and Norway spruce with rich undergrowth; in old coppices of beech with the presence of man-made stands of conifers). These habitats are characterized by abundant moisture and often by the presence of fresh flowing water.

Observations on animals in captivity, confirmed what was known until now in other European regions about the feeding preferences shown by the Forest dormouse.

Finally, the biogeographical problems relative to the colonization of the Italian territory are discussed. The fossil findings of *Dryomys nitedula*, attributed to the central period of the Würmian glaciation, permit to affirm that *Dryomys nitedula* existed in the Alpine regions before the period pointed out by other authors.

INTRODUCTION

In the context of the faunistic researches carried out in the years 1981-84 in the Forest of Tarvisio (UD), 21 species of small mammals were recorded, of which 7 insectivores and 14 rodents (Tab. I). Among others, special interest is aroused by some specimens of *Neomys anomalus* Cabrera, a completely albinotic adult female of *Microtus nivalis* (Martins) and a series of individuals belonging to the species *Dryomys nitedula* (Pallas) (Fig. 1).

Herewithin we expose the results of the observations carried out on this interesting species of Gliridae in the Forest of Tarvisio and in other localities of the Eastern Alps.

OBSERVATIONS

Distribution

Among the European Gliridae, the Forest dormouse is the species with the most eastern distribution (Corbet, 1980) (Fig. 2). In fact, it is present

from Chinese Turkestan through Caucasus, Asia Minor and the Balkans as far west as to the Centraleastern Alps and the Apennines. The northern and southern boundaries of its range are respectively Poland and Israel, whereas the western boundary is represented by Engadine. According to some authors who have recently revised the taxonomy of the genus *Dryomys* Thomas in the palaearctic region (Corbet, 1980) and in Europe (Storch, 1978), the species *D. nitedula* is divided into several subspecies, two of which are recorded in Italy: *D. n. intermedius* (Nehring) present in the Alps and *D. n. aspromontis* Lehmann in the Southern Apennines⁽¹⁾.

The distribution of Forest dormouse in Italy appears to be rather peculiar (Toschi, 1965), including as far as it is known, three distinctly separate zones: the Centraleastern Alps, from the Friuli mountains to Engadine, the Mount Pollino (Filippucci, 1986) and the Massif of Aspromonte (Lehmann, 1964). As for the Austrian side of the Carnic Alps, Spitzenberger (1983) notices several records of *D. nitedula*, whereas Kryštufek (1985) noticed it in various localities of Northeastern Slovenia.

Therefore, the Alpine range of the Forest dormouse is likely to be continuous as far east as the Balkanic and Dinaric regions, whereas the Apennine areas are disjuncted and perhaps relictual. These last are difficult to interpret and should be probably correlated to the history of the colonization of this mountain chain during the last glacial period.

Data about the Eastern Alps gathered in the literature and the recent findings discussed in this work are exposed in Tab. II and Fig. 3.

Morphological and biometrical characteristics

The external morphology readily allows recognition of the Forest dormouse from the other Gliridae, even though sometimes there may be some doubts in the distinction of this species from the Garden dormouse (*Eliomys quercinus* [Linnaeus]) or from young specimens of the Fat dormouse (*Glis glis* [Linnaeus])⁽²⁾.

In the specimens from the Centraleastern Alps that we examined, the fur is grey with olive-coloured shadings on the back and yellowish-white on the abdomen. Besides, the tail shows an apical white tuft, which seems not to be constant in colour, varying from a light grey to a reddishgrey tonality.

The biometrical analysis (Tab. IIIa, b) points out the inferior dimensions of the specimens from the Eastern Alps in comparison with those from Eastern Europe. In particular we can notice a constant decline in the biometric

⁽¹⁾ Recent comparisons carried out by Filippucci (1986) between specimens found in M. Pollino (Lucania) and those found in Northeastern Italy do not seem to evidentiate significant genetic differentiations between these two populations.

⁽²⁾ In the course of our research we were able to verify the wrong determination of some specimens conserved in the Museo Civico di Storia Naturale di Venezia. Thus, it is possible that the lack of records for the Southeastern Alps, is partially due to such mistakes.

TABLE I - Small mammals recorded in the Forest of Tarvisio (1981-84).

INSECTIVORA

Erinaceidae

Erinaceus europaeus Linnaeus

Soricidae

Sorex alpinus Schinz

Sorex araneus Linnaeus

Sorex minutus Linnaeus

Neomys anomalus Cabrera

Neomys fodiens (Pennant)

Talpidae

Talpa europaea Linnaeus

RODENTIA

Sciuridae

Sciurus vulgaris Linnaeus

Gliridae

Dryomys nitedula (Pallas)

Glis glis (Linnaeus)

Muscardinus avellanarius (Linnaeus)

Microtidae

Clethrionomys glareolus (Schreber)

Arvicola terrestris (Linnaeus)

Pitymys subterraneus (De Selys Longchamps)

Microtus agrestis (Linnaeus)

Microtus nivalis (Martins)

Muridae

Apodemus flavicollis (Melchior)

Apodemus sylvaticus (Linnaeus)

Rattus norvegicus (Berkenhout)

Rattus rattus (Linnaeus)

Mus musculus Linnaeus

values starting from the central regions of the range moving towards the peripheral western and southern ones.

Bionomics

Information about the breeding season and behaviour in the field was deduced from observations carried out on individuals collected in different periods of the year (Tab. IV).

The young specimens were individuated according to the size of the pre-molar and molar teeth as described by Angermann (1963).

From our data it could be argued that *D. nitedula* rears only one litter a year. Pairing takes place between May and June and the female gives birth



FIG. 1 - Adult of *Dryomys nitedula* (Pallas).

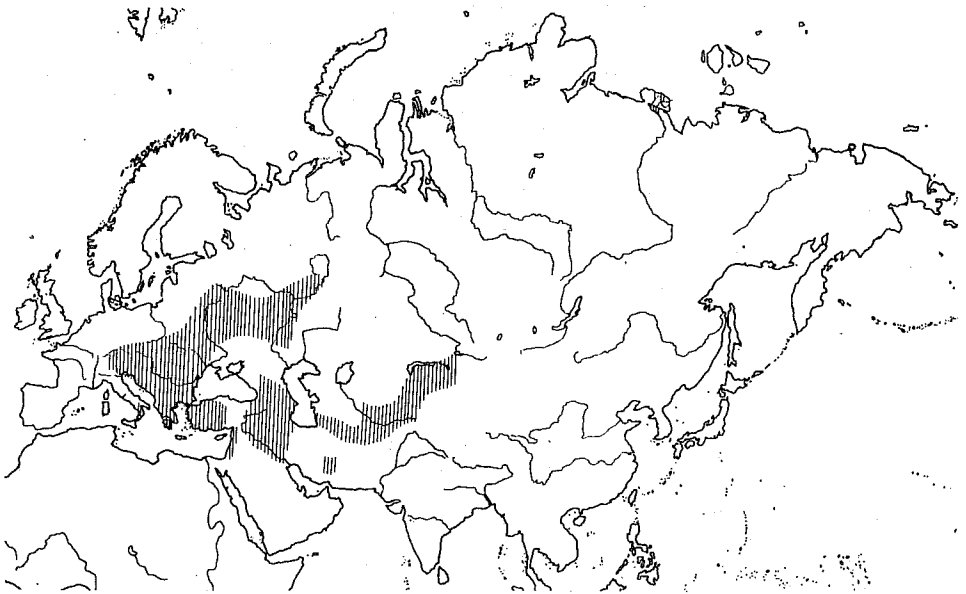


FIG. 2 - Distribution map of *Dryomys nitedula* (Pallas).

between June and July. The observations relative to the sizes of the litter consists in the finding of a female with three young about 15-days-old on 12.07.1948 (Civic Museum of Natural History of Venice) and in the finding of 4 uterine maculae in a female collected on 05.08.1985. According to Angermann (1963) the average size of a litter is 4.

Young specimens of age ranging from 20 to 45 days were found in July and August.

The biological cycle of the Forest dormouse observed by us in Southeastern Alps agrees with that described by Angermann (1963) for Southwestern Russia (Voronez Park); nevertheless, a slight delay in the order of 10-15 days in the different phases is observed. In areas close to the Eastern Alps, such as Slovenia, Moravia and Austria, recent data reported by Kryštufek (1985) Gaisler et al. (1977) and Spitzenberger (1983), confirm the observations here reported. It is interesting to point out that Gaisler et al. (1977), observed a difference of about one month in the breeding season of two populations living at remarkably different altitudes.

Other authors reported by Angermann (1963) state that, in the Central and Southern regions of its range, *D. nitedula* may rear two or three litters a year.

The data relative to moulting concern 5 specimens. Thus it is not possible to draw significant conclusions about the summer moulting that, according to some authors (Angermann, 1963; Homolka, 1978), should occur, in Eastern Europe, from June to August. In two specimens, reared in laboratory for several months, evidence of moulting was noticed in spring and fall, as it had been foreseen, but not verified by the mentioned authors.

Ecology

D. nitedula lives in very different habitats; in Eastern Europe it inhabits both forests of various types (oakgroves mixed with other broadleaf trees, Scotch Pine woods), and shrub- and grassland (Angermann, 1963; Gaisler et al., 1977). In the Eastern Mediterranean region the Forest dormouse lives in oak patches (Nevo & Amir in Spitzenberger, 1983), in the Balkans the typical environments are mainly represented by deciduous forests, and secondarily also by shrub and grassland. In the Alps the Forest dormouse lives mainly in mixed stands of broadleaf trees and conifers.

It should be noted that such biotopes are all generally damp and contain a rich and varied undergrowth.

The altitudinal distribution extends from 60 to 2300 m (Schedl, 1968; Kryštufek, 1985) with the largest number of records around 1000 m. The observations, which this study refers to, regard these altitudinal area (Tab. II).

Below we describe the main characteristics of two biotopes studied:

- Forest of Tarvisio UD (m 800 -1100). The collecting stations are located

TABLE II - Italian records of *Dryomys nitedula* (Pallas).

CENTRAL EASTERN ALPS

Known data

1. Alto Adige, Bolzano, 1880-1882, 2 spec., lg. A. Mulser (Schedl, 1968);
2. Veneto, Padola BL, m 1200, 1908, some spec., lg. E. Festa (Festa, 1908);
3. Alto Adige, Appiano BZ, m 400, some spec. (Schedl, 1968);
4. Trentino, Bresimo TN, m 1000, 30.06.1922, 1 ♀ with 5 embr., lg. G.B. Dal Piaz (Dal Piaz, 1924);
5. Trentino, Campiglio TN, m 1600, 08.1922, 1 ♂ and 1 ♀, lg. G.B. Dal Piaz (Dal Piaz, 1924);
6. Trentino, Tret di Fondo TN, m 1600, 1928, 1 ♀, lg. G. Castelli (De Beaux, 1929).

New data

1. Veneto, Cortina d'Ampezzo BL, 12.07.1948, 1 ♀ and 3 juv., lg. Levrini (Mus. Civ. St. Nat. Venezia);
2. Veneto, Lorenzago BL, m 1000, 08.07.1979, 1 juv., lg. N. Zaramella;
3. Friuli, Malborghetto UD, m 1050, 07.08.1982, 2 ♂♂ and 1 ♀
 08.08.1982, 2 juv.
 26.08.1982, 1 juv. and 3 ♀♀
 31.08.1983, 1 ♂
 11.08.1984, 1 ♂, lg. P. Paolucci;
 15.08.1985, 2 ♂♂ and 2 juv., lg. M. Filippucci;
4. Friuli, Coccau UD, m 700, 02.06.1984, 1 ♂, lg. R. De Battisti;
 31.05.1985, 1 ♀, lg. A. Battisti;
5. Veneto, Roana VI, m 1050, 24.06.1985, 1 ♂
 05.08.1985, 1 ♀
 26.08.1985, 1 ♀, lg. B. Slaviero.

SOUTHERN APENNINE

1. Calabria, Gambarie d'Aspromonte RC, m 1300, 12-13.08.1963, 2 ♂♂, 1 ♀ and 3 juv., lg. E. von Lehmann & R. Huller (Lehmann, 1964);
2. Lucania, M. Pollino PZ, 1983-1985, some spec., lg. M. Filippucci (Filippucci, 1986).

Lapini (in litteris) reports to have found two young specimens of Forest dormouse on 10.08.1971, at Cercivento di Sopra (UD), which were probably killed by *Martes* sp. He also records *Dryomys nitedula* for a second locality in Friuli: Venzone, (UD) m 230. This station is, up to now, the one with the lowest altitude as far as the Eastern Alps are concerned.

on the edge of the forests, which are made up of beech and Norway spruce with some Planetree maples, Scotch-elm, European ash, Mazzard cherry, Common pear tree, European Mountainash. The rich undergrowth is composed of the shrubs and grasses typical of the beech-wood. Such environments are characterized by a high moisture with presence of fresh flowing water. Some specimens have been caught in a forest cottage, where has been found a nest which may be ascribed to Forest dormouse.

- Asiago Plateau VI (m 1000). The vegetation cover is represented by an old beech coppice mixed with man-made stands of Norway spruces. The density is very high and therefore the undergrowth is absent. The moisture of the soil is high and there is no fresh flowing water. All the animals were collected inside the wood.

Other authors' observations in the Italian Alps concern similar environments (Dal Piaz, 1929).

Therefore we can conclude that *D. nitedula* shows a great adaptability to different types of vegetation, characterized by high moisture, often in the presence of fresh flowing water.

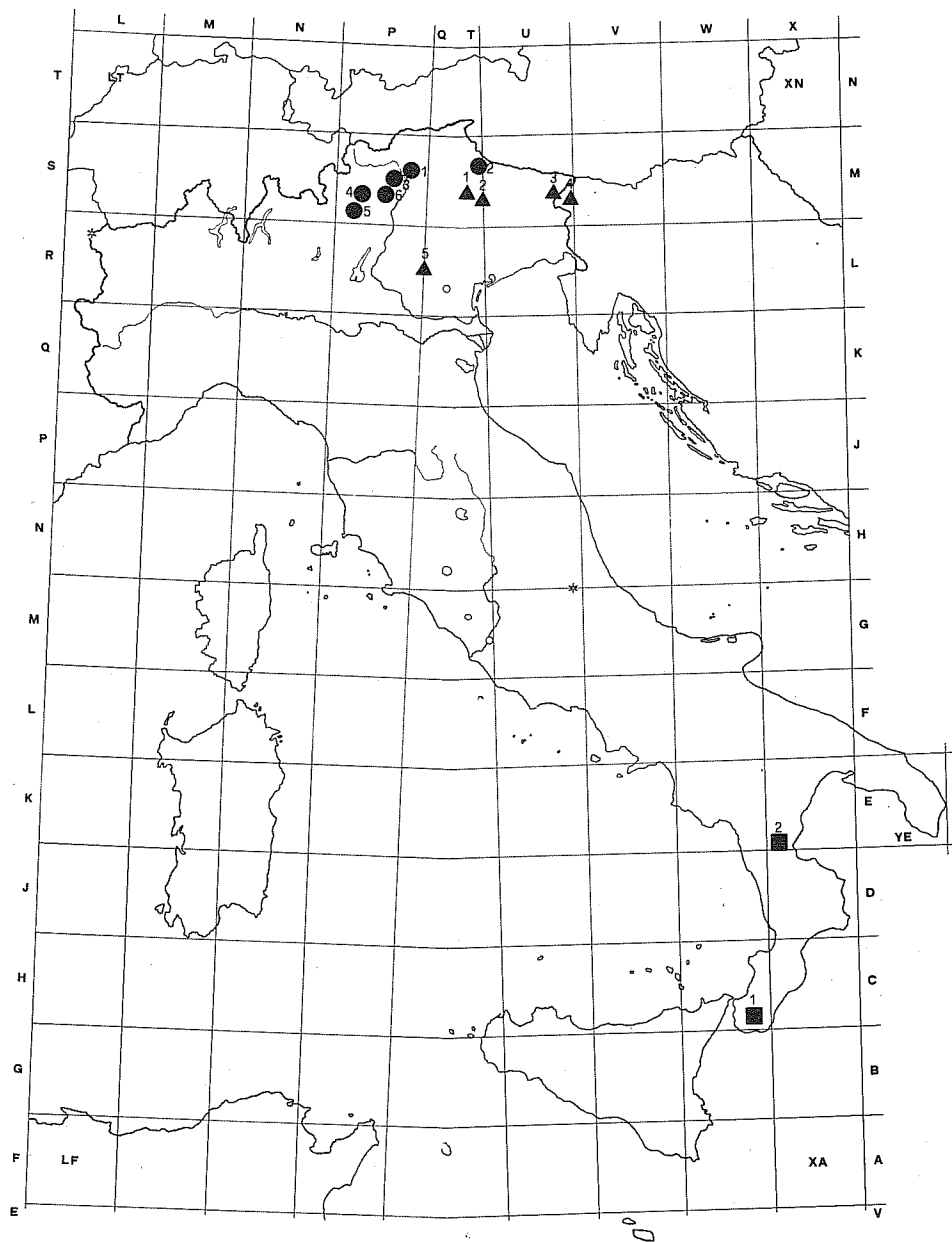


FIG. 3 - Italian records of *Dryomys nitedula* (Pallas).

- Known data (Alps);
- ▲ New data (Eastern Alps);
- Known data (Southern Apennine).

TABLE IIIb - Biometrical data of various populations of *D. nitidula*.

1) Eastern Alps (new data); 2) Austria (Spitzenberger, 1983); 3) Poland (Sidorowicz, 1959); 4) URSS ♂♂ (Angermann, 1963); 5) URSS ♀♀ (Angermann, 1963); 6) Italy, Aspromonte (Lehmann, 1964); 7) Italy, Eastern Alps (Müller, Dal Piaz, Niethammer, in Storch, 1978); 8) Greece (Ondrias, in Storch, 1978); 9) Bulgaria (Niethammer et Bohmann and Sidorowicz, in Storch, 1978); 10) Yugoslavia ♂♂ (Kryštufek, 1985); 11) Yugoslavia ♀♀ (Kryštufek, 1985).

	(1)		(2)		(3)		(4)		(5)			
	INT	Mean	n	INT	Mean	n	INT	Mean	n	INT	Mean	n
HB	78.2	86.5	14	81.0	94.1	10	77.0	88.9	12	89.0	98.8	25
	94.0			102			100			115		
TI	59.5	79.9	12	66.0	84.8	9	78.0	80.6	12	69.0	80.9	22
	93.2			96.0			91.0			99.0		
HF	17.0	19.0	14	18.0	20.7	10	20.0	21.3	12	18.0	20.2	65
	19.8			23.5			22.0			23.0		
E	9.2	12.5	14	12.0	13.5	12	12.0	13.5	12	11.0	13.6	70
	15.1			15.0			15.0			15.0		
CbL	21.8	23.3	14	23.8	24.3	10	22.1	24.2	12	23.2	24.5	34
	24.5			25.5			26.7			25.7		

	(6)		(7)		(8)		(9)		(10)		(11)	
	INT	Mean	n	INT	Mean	n	INT	Mean	n	INT	Mean	n
HB	90.0		3	84.0		14	77.0		17	93.0		23
	100			108			100			106		
TI	75.0		3	76.0		11	62.0		10	84.0		17
	86.0			90.0			95.0			94.0		
HF	19.0		3	18.0		14	17.0		17	19.0		23
	20.0			21.0			22.0			20.5		
E	24.0		3	23.2		12	23.2		12	22.8		22
	24.5			25.2			24.8			26.1		

TABLE IV - Activity of *Dryomys nitedula* (Pallas) in the Southeastern Alps.

	MAY	JUN	JUL	AUG	SEP	OCT	NOV
ACTIVITY OF ADULTS	-XXX-----						
ACTIVITY OF YOUNGS				-----XXXXXXXXXXXXXXXXXXXX			
PAIRING	-----XXXXXXXXX----						
BIRTH				-----XXXXXXXXX----			

The nourishment of the Forest dormouse is very diverse, as described by authors (Angermann, 1963; Holisova, 1968) by means of analysis of the stomach content.

Its diet presents remarkable seasonal variations depending on the periodic abundance of nourishments available in the environment. While after awakening from winter hibernation *D. nitedula* feeds especially on vegetable substances (buds, sprouts and seed of the previous year), in the following periods it seems to prefer a carnivorous diet, based on invertebrates, in particular arthropods, and small vertebrates (nestlings). In autumn the fruits of undergrowth are intensively utilized.

During our research observations on the nourishment of specimens in captivity have been carried out: the results seem to confirm the preference for foods with an high protein content. In particular we observed a remarkable tendency to catch of living preys (flies and moths). On the other hand the Forest dormouse is not able to open ripe hazelnut shells.

It is possible therefore that food don't bind the Forest dormouse to particular environments, as in the case of some other Gliridae. However it requires always an abundance of trophic resources with high nutritional value.

CONCLUSION

The origin and the territorial expansion of *D. nitedula* was studied by Chalin & Mein (1979) and Spitzenberger (1983). Asia Minor is considered by these authors as the center of origin of the species; the colonization of the area occupied at present seems in fact to have originated from there, in an age ascribable to the final phases of the last glacial age and to the following periods.

As far as the Alpine region is concerned, the above mentioned authors and others (Kratochvil, 1967; Schedl, 1968; Storch, 1978), agree in affirming that *D. nitedula* reached these zones from the South-East during the last post-glacial, as paleontological findings of former periods do not exist. In particular, according to Spitzenberger (1983), the Forest dormouse probably followed the Norway spruce in its expansion towards the Alps in the Boreal period.

Yet, in this respect the fossil findings of *D. nitedula* found by Bartolomei

(1980, 1984) in Riparo Tagliente near Verona are of particular interest. These fossils are attributed by the author, on the basis of the presence of tools of the upper Palaeolithic culture, to the central period of the Würmian glaciation (35000-33000 B.P.), in relation to the temperate and damp phases which characterized the middle Würmian period. According to Paganelli (1984) the vegetation cover in that period is basically formed by conifers (*Pinus sylvestris*, *Picea abies*) and on a minor scale by several broadleaved trees.

In the light to these data, it must be admitted that the Forest dormouse existed in the Alpine regions before the period pointed out by the above mentioned authors.

As far as its diffusion in the Apennine regions is concerned, the hypothesis expressed by Zoller in von Lehmann (1964) seems still valid. According to this hypothesis the Forest dormouse colonized the peninsula during the expansion of the temperate broadleaved forest, which followed the maximal expansion of the glaciers in the Würmian period.

On the other hand it is also probable that the wide variations of climate and vegetation in the late glacial period and in the Holocene allowed further *D. nitedula* colonizations of the Alps and the Apennines.

ACKNOWLEDGEMENT

We thank Prof. L. Masutti for critical reading of the manuscript. Thanks are also due to the State Forest Service of Tarvisio and Asiago.

This work was supported by a grant of Ministry of Education (60%).

REFERENCES

- ANGERMANN R., 1963 - *Zur Ökologie und Biologie des Baumschläfers*, *Dryomys nitedula* (Pallas, 1779) in der Waldsteppenzone. - *Acta Theriol.*, 7: 333-365.
- BARTOLOMEI G., 1980 - *Micromammiferi del Plio-Pleistocene. I vertebrati fossili italiani*. - Catalogo della Mostra, Verona.
- BARTOLOMEI G., 1984 - *Evoluzione fisica e biologica dal Pliocene ai giorni nostri*. In A. Aspes (ed.) - *Il Veneto nell'antichità. Vol. I: Preistoria e Protostoria*. Banca Popolare di Verona.
- CHALIN J. & MEIN P., 1979 - *Les Rongeurs et l'évolution*. - Doin, Paris.
- CORBET G.B., 1980 - *The Mammals of the Palaearctic Region: a taxonomic review*. - Cornell Univ. Press, London and Ithaca.
- DAL PIAZ G.B., 1924 - *Il Dryomys nitedula intermedius Nebring nel Trentino*. - *Studi Trent. Sc. Nat.*, 5: 65-67.
- DAL PIAZ G.B., 1929 - *I mammiferi fossili e viventi delle Tre Venezie*. - *Studi Trent. Sc. Nat.*, 10: 103-202.
- DE BEAUX O., 1929 - *Mammiferi raccolti dal Museo Regionale di Storia Naturale in Trento durante l'anno 1928*. - *Studi Trent. Sc. Nat.*, 10: 187-202.
- FESTA E., 1908 - *Il Myoxus intermedius Nebring, nelle Alpi Italiane*. - *Boll. Mus. Zool. Anat. Comp. R. Univ. Torino*, 23: 1-3.
- FILIPPUCCI M., 1986 - *Nuova stazione appenninica di Dryomys nitedula* (Pallas, 1779) (Rodentia Gliridae). - *Hystrix*, 1: 83-86.
- GAISLER J., HOLAS V. & HOMOLKA M., 1977 - *Ecology and reproduction of Gliridae (Mammalia) in Northern Moravia*. - *Folia Zool.*, 26: 213-228.
- HOLISOVA V., 1968 - *Notes on the Food of Dormice (Gliridae)*. - *Zool. Listy*, 17: 109-114.
- HOMOLKA M., 1978 - *Zum Haarwechsel bei Adulten dreier Schläferarten (Gliridae)*. - *Folia Zool.*, 27: 203-210.
- KRATOCHVIL J., 1967 - *Der Baumschläfer, Dryomys nitedula und andere Gliridae-Arten in der Tschechoslowakei*. - *Zool. Listy*, 16: 99-110.

- KRYŠTUFEK B., 1985 - *Forest Dormouse Dryomys nitedula (Pallas, 1779) - Rodentia, Mammalia - in Yugoslavia*. - Scopolia, 9: 1-36.
- LEHMANN VON E., 1964 - *Eine Kleinsäugerausbeute vom Aspromonte (Kalabrien)*. - Sber. Ges. naturf. Freunde (N.F.), 4: 31-47.
- PAGANELLI A., 1984 - *Storia climatico-forestale del Pliocene e del Quaternario*. In: A. Aspes (ed.) - *Il Veneto nell'antichità. Vol. I: Preistoria e Protostoria*. Banca Popolare di Verona.
- SCHEDL W., 1968 - *Der Tiroler Baumschläfer (Dryomys nitedula intermedius Nebring, 1902) (Rodentia, Muscardinidae)*. - Ber. nat.-med. Ver. Innsbruck, 56: 389-406.
- SIDOROWICZ J., 1959 - *The Forest Dormouse (Dryomys nitedula Pallas) in the Bialowieza National Park*. - Acta Theriol., 3: 17-26.
- SPITZENBERGER F., 1983 - *Die Schläfer (Gliridae) Österreichs. Mammalia Austriaca 6 (Mammalia, Rodentia)*. - Mitt. Abt. Zool., 30: 19-64.
- STORCH G., 1978 - *Dryomys nitedula (Pallas, 1779) - Baumschläfer*. In: J. Niethammer & F. Krapp (eds.) - *Handbuch der Säugetiere Europas. Bd. 1: Nagetiere 1*. Akademische Vg., Wiesbaden.
- TOSCHI A., 1965 - *Mammalia (Lagomorpha, Rodentia, Carnivora, Ungulata, Cetacea)*. - Fauna d'Italia, vol. 7. Calderini, Bologna.