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HABITAT SELECTION OF FAT DORMOUSE (GLIS GLIS ITALICUS) IN DECIDUOUS WOODLANDS OF SICILY

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The population ecology of the Fat dormouse (*Glis glis*) is poorly known in Mediterranean biotopes. During 1999–2001, we set artificial nest boxes of suitable size in three deciduous woodlands (1200–1600 m a.s.l.): a pure *Fagus sylvatica* wood, a mixed *Q. petraea* and *Ilex aquifolium* and a mixed *F. sylvatica* and *Quercus petraea* in the Madonie Regional Park (Sicily) to obtain basic data on the species' ecology. Nest box density was 25 per ha.
The Fat dormouse living in Sicily has the typical *italicus* fur pattern and the smallest body size among the Italian populations. It is, however, slightly larger than *G.g. melonii* from Sardinia. The Fat dormouse was absent from the sampled pure beech forest, but present in the other two mixed deciduous woodlands. The nest box occupation rate fluctuated according to the production of oak acorns, which is biennial. It was higher during the years of peak production. Occupation of the nest boxes began in early May. From late August to the end of September lactating females with new-born young occupy the nests. Eight litters gave an average of 5.5±1.9 young. Juveniles were present until early December, whereas the adults disappeared in the first days of November. Using a selection index we showed that the Fat dormouse preferred nest-boxes placed in a vegetation structure with dense understorey and high trees. Secondarily it uses nest-boxes placed in the single stratum of high trees. Mixed deciduous woodland with a high (> 12 m) and dense tree canopy seems, from these preliminary data, to be one determinant habitat feature.

Key words: Habitat selection, *Glis glis*, Mediterranean woodlands, Sicily

INTRODUCTION

The ecology of the Fat dormouse (*Glis glis*) in Mediterranean environments is still poorly known. The only available information for Southern Italy is from KAHMANN (1965). CASAMENTO and SARÀ (1994) obtained fresh information on the species' distribution in Sicily. Another study, dealing with pest topics, was conducted by SANTINI (1983) in Central Italy (Abruzzi). Outside the Mediterranean areas of Italy, PILASTRO (1990) and PILASTRO *et al*. (1994) provided some information about the species' kin selection, FRANCO (1988, 1990) did a general survey in North-East Italy (Pre-Alps).

During a survey of the Common dormouse (*Muscardinus avellanarius*) carried out between 1995 and 1998 in the Madonie Regional Park, we began to record juveniles of Fat dormice in some (4 out of 9) of the sample areas (SARÀ 2000). These irregular occurrences of individuals in post-reproductive dispersal attracted

our attention and prompted the planning of specific research. We report here the first data on the species' life history in some woodland habitats of Sicily.

MATERIALS

We chose three sample areas in different woodlands of the Madonie Regional Park where we established study grids of 1–2 ha (Table 1). We used wooden nest boxes of a size which favours colonisation by the Fat dormouse (20 cm × 20 cm × 30 cm). The entrance hole is 5 cm in diameter and faces the tree trunk. Density of nest-boxes was 25 per ha. Every month, during a period of three years (1999–2001) we visited the sample areas, recording the species' presence and nests with or without individuals. The frequency of visit was increased to every week during the reproductive season (summer to autumn). Captured dormice were aged, sexed, marked by ear tattooing and then released in the same nest box. Reproductive condition (enlarged testis for males, lactating females, etc) and body biometrics were also recorded.

We sampled the oak acorns that are a food known to be consumed by the Fat dormouse in the study areas. We collected acorns for 5 minutes from 1 m^2 on the ground below different nest box trees, then counted and weighed them. To have information about the species' micro-habitat preference (the spatial resource around each nest box) we recorded, in one sample area (G), the presence/absence of vegetation (tree-branches, understorey, etc.) every 5 m, according to the following vertical layers: stratum A: 0–6 m; stratum B: 6–12 m; stratum C: >12 m. The 5 m recording interval resulted in 5 vegetation records between two nest-boxes and 25 in a square of 4 in this 2 ha grid. This allowed comparison of the vegetation structure around the colonized (used) nest-boxes with those unused (availability), according to the design with known proportions of available resource units (MANLY *et al.* 1993). Resource selection was calculated by the formula $w_i = o_i / p_i$ and then standardized to obtain the B_i index of selection (MANLY *et al.* 1993).

RESULTS AND DISCUSSION

Fat dormice living in the Madonie Regional Park have the typical colour pattern (A/B *sensu* KAHMANN 1965) of the *italicus* subspecies, but body biometrics showed them to be smaller than reported for some continental populations of the

Table 1. The sample areas in the Madonie Regional Park (Sicily), where the study of *Glis glis* was conducted

Sample area	Vegetation type	Grid code	Surface (ha)	Time of survey
Piano Cervi	Pure beech (*Fagus sylvatica*)	1 C	1	1 year
Gimmeti	Mixed deciduous *Quercus petraea* and *Ilex aquifolium*	1 G, 2 G	2	3 years
Pomieri	Mixed deciduous *Q. petraea*, *I. aquifolium* and *F. sylvatica*	1 P, 2 P	2	1 year

same form. The Sicilian Fat dormouse is, however, larger than *G. g. melonii* from Sardinia (Table 2). Genetic studies are needed to further investigate such differences.

The Fat dormouse did not colonize the sample area in the beech forest (1C), even though there was evidence of the species' presence elsewhere in this area (calling during the night in summer and one individual found dead) and in the same habitat (SARÀ 2000).

In both the other two areas we recorded an increase in activity and colonization of the grids. Nest box colonization was gradual and at the beginning was recorded only by food remains (oak acorns), droppings and by the strong-smelling scent markings from the urogenital glands. Later, the first individuals and some empty nests were found inside the nest boxes. This early phase of colonization, i.e. from June to early August, seems to be by males (5 out 6 records).

During May to early June the Fat dormouse were present in both areas and were recorded during nocturnal inspections while they were moving and calling among the vegetation. The filling of nest boxes with leaves, which constitute the rudimentary nests found in the sample areas, began by the last week of June. The Fat dormouse made extensive use of the nest boxes from July to November. Mating occurred between the end of July and the end of August. Lactating females with their pups occurred from September, but mainly in October. Adults began to leave the nest-boxes just after the weaning of juveniles. The last individuals (juveniles) departed from the boxes at the beginning of December (Fig. 1). There was no evidence of hibernation inside the nest boxes; and only two active nests were recorded in January. The biological cycle of the Fat dormouse in Mediterranean

Table 2. Body biometrics of Fat dormice (*Glis glis*) in Sicily and Italy. a: LOCATELLI & PAOLUCCI (1998); b: SANTINI (1983); c: KAHMANN (1965); TOSCHI (1965). HBL = head–body length (mm), TL = tail length (mm), S% = (TL/HBL)×100, HF = hindfoot length (mm), EL = ear length (mm), NR = not recorded

	HBL	TL	S%	HF	EL
G. g. glis (Trentino)[a]	130–190	94–150	72.3–78.9	22–34	NR
G. g. italicus (Lazio)[b]	184 (175–192)	182 (176–190)	98	31.4 (30.5–32)	25.2 (24–27)
G. g. italicus (Gargano)[c]	199.4 4 (180–215)	179.75 (170–190)	89.02	34.11 (33–35)	24.33 (24–25)
G. g. melonii (Sardinia)[d]	154–165	134–142	86.0–87.0	30–32	20
G. g. italicus (Sicily)	171.1±12.99 (155–190) N = 9	161.43±12.16 (140–190) N =13	94.35	NR	19.25±1.40 (18–22) N = 12

Table 3. Average number of *G. glis* nests per hectare from June to December in the three sample areas of the Madonie Regional Park (Sicily). NR = not recorded

	Piano Cervi	Gimmeti	Pomieri
1999	0	8.4	NR
2000	NR	3.1	NR
2001	NR	5.0	2.4

woodland is similar to that from continental areas (PILASTRO 1990), but is slightly extended into late autumn (Fig. 2).

Table 3 shows the average number of nests found in the sample areas. During 1999, by capture-mark-recapture, we identified 6 territories in the mixed deciduous woodland (grids 1G and 2G) with three cases of breeding. The estimated population density was 20 ind/ha. During 2000 we had only two territories with one case of breeding and the estimated density was only 3 ind/ha. Figures for the year 2001 were much lower: 0 territories, 0 reproduction and 2 ind/ha (Table 4). This result was related to the arrival of a Pine marten (*Martes martes*) which began raiding the grids from early summer. In the third sample area (grids 1P and 2P) data only cover 2001 and showed 6 territories, 1 reproduction and 4 ind/ha. The 8 known litters (4 in our sample areas plus another 4 from the Nebrodi mountains) yielded an average of 5.5±1.9 (range: 2–8) youngsters per family.

Excluding the data for 2001 in area G, due to disturbance by the predator, the densities recorded in these Mediterranean insular woodlands changed from 4 to 20 ind/ha and are higher than those reported from Northern latitudes: 1–4.9 ind/ha (PILASTRO 1990 and references therein, MORRIS 1997).

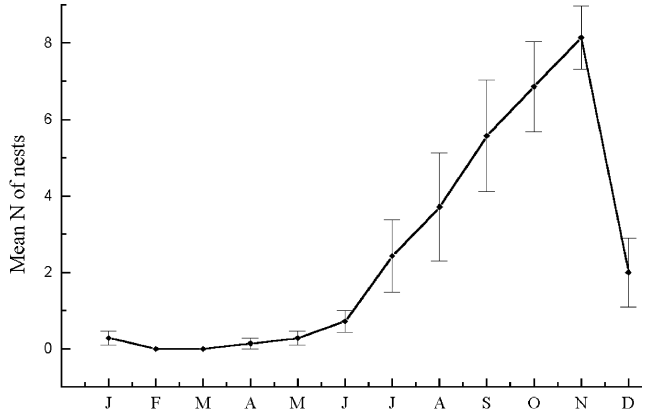

Fig. 1. The average ± SE (3 years, 2 sample areas) year-round occupation of nest-boxes, that corresponds to the activity pattern of *Glis glis* in Mediterranean woodlands (Sicily)

Table 4. The number of *Glis glis* territories per year and per sample area in the Madonie Regional Park (Sicily), revealed by capture-mark-recapture. Each territory is assumed by recaptures of marked individuals in a given group of nest-boxes. T = territory; * = sample area of 2 ha; Ind/Ha = density per hectare; ? = probable litter outside the grid border recorded by independent juveniles within the grid

		T1	T2	T3	T4	T5	T6	Total	Ind./ha
Gimmeti 1999	adult males	1	2	2	1	1	2	9	20
	adult females	2	2	1	1	1	1	8	
	litters	2	1	1?		1?		3+2	
	subadults	2				1		3	
Gimmeti 2000	adult males	2	2					4	6
	adult females	1						1	
	litters	1	1?					1+1	
	subadults							1	
Gimmeti 2001*	adult males							3	2
	adult females							0	
	litters							0	
	subadults							1	
Pomieri 2001*	adult males						2	2	4
	adult females	1	1	1	1			4	
	litters	1	1?	1?				1+2	
	subadults					2		2	

Area G, studied for three years, had a biennial masting crop, with peak years in 1999 and 2001. Oak acorn production proved to be significantly correlated to the rate of occupation of nest boxes, i.e. nest material found inside (Fig. 3), although this relationship was partially obscured by the predator effect evidenced during 2001. The Pine marten raids caused desertion of the grids and nest box avoidance

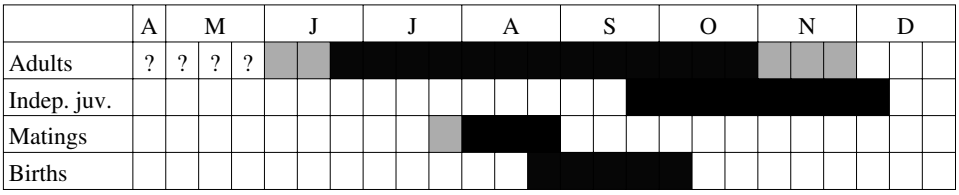

Fig. 2. The biological cycle of *Glis glis* in Mediterranean woodlands (Sicily) divided into ten day periods. Grey indicates the beginning of activity, black the peak of activity and presence in the grids

by the dormice that had begun to colonize them to build their nests, so we were able to detect only the nests. Food availability seems to be one of the main factors inducing density change in this area. Predation by Mustelids (*M. martes* and *M. foina*) has already been recorded in nest boxes (PANCHETTI *et al*. 2002, PILASTRO unpubl.), and is another factor to be taken into account.

The nest boxes in the G grids were placed in woodland stands with a different vegetation structure, whose main layers were as follows:

- a first batch were in stands of *Quercus petreae* and *Q. pubescens* 13–18 m high and without understorey, namely the stratum A (0–6 m) and B (6–12 m) were absent whereas the stratum C (> 12 m) present (see Materials). This was coded as a single 001 stratum;
- a second batch were in stands of *Ilex aquifolium* and other understorey species, without trees, 12 m high on average, namely strata A and B present, C absent, hence this was a double 110 stratum;
- a third batch were in stands with both holly understorey and oak trees, i.e. in a triple 111 stratum (A, B and C present).

Using the selection index we showed that the Fat dormouse preferred the nest boxes placed in the triple 111 stratum ($B_i = 0.55$), i.e. a complex vegetation structure with dense understorey and high trees (Table 5). The relatively highest selection for nest boxes placed in the single 001 stratum ($B_i = 0.38$) woodland with re-

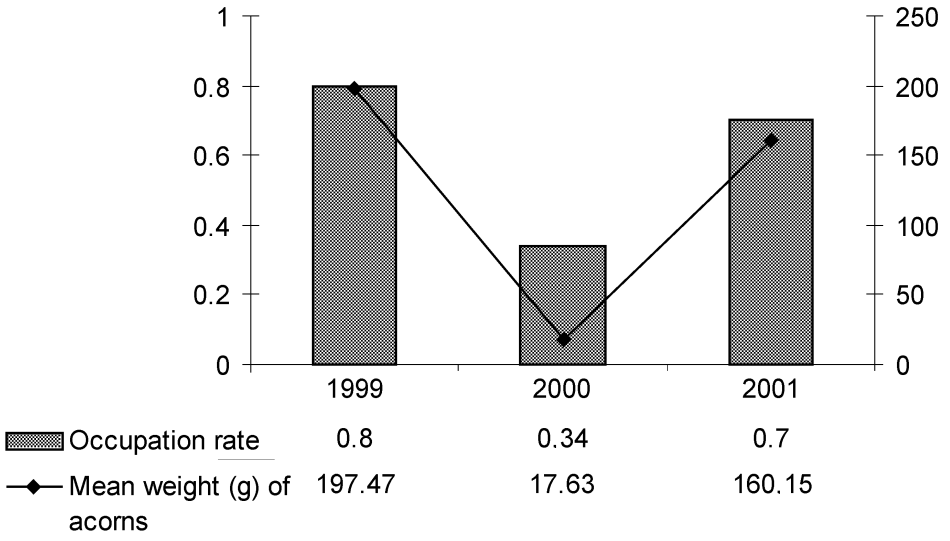

Fig. 3. The *Glis glis* occupation rate of nest-boxes is statistically correlated (r = 1; P< 0.05) to the year crop of oak acorns

Table 5. The standardized selection indexes (B_i) of nest boxes placed in different vegetation layers in the Gimmeti sample area. 111 = triple stratum, 0–18 m high; 110 = double stratum, 0–12 m; 001 = single stratum, 12–18 m; π_i = percentage of nest-boxes per each vegetation stratum; u_i = of used nest-boxes; $o_i = u_i / \sum u_i$; $wi = o_i / p_i$

Structure code	π_i	u_i	o_i	w_i	B_i
111	0.38	20	0.61	1.59	0.55
110	0.32	2	0.06	0.19	0.07
001	0.30	11	0.33	1.11	0.38
Total	1	33	1	2.90	1

spect to those in that with two (110) strata ($B_i = 0.07$), suggests that dense and high (> 12 m) tree canopy may be one determinant habitat feature.

In conclusion, both the vegetation structure and woodland composition seem to be important in determining the species' presence in the Mediterranean woodlands of the Madonie Regional Park. The high altitude (1500–1600 m a.s.l.) pure beech woods seem to be avoided, probably for a variety of reasons, including low temperatures, the scarcity of food (only beech mast) and its vegetation structure (maximum height 13 m). In contrast, the lower altitude (1200–1300 m a.s.l.) mixed deciduous woodlands are preferred. Here thermal stress is lower and the tree stands are high (maximum height 20–22 m). The food resource is highly palatable and abundant (oak acorns, but also beech mast and holly fruits), and account for the high population densities reached during the peak acorn year.

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