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GEOGRAPHICAL PENINSULAR EFFECTS ON THE TROPHIC SYSTEM "*TYTO ALBA* - MTCROMAMMALS" IN SALENTO (ITALY).

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ABSTRACT - The following study contains data from 2420 preys found in Barn Owl pellets from 16 sites of the Salento peninsula (Apulia. Italy). Nine preyed spccics were detected. *Microtus savii* was the most frequent prey. No specimen of *Chletrionomys glareolus*, *Muscardinus avellanarius* and *Sorex* spp. were ever found, probably for ecological and bioclimatological reasons. The relatively low values of some ecological parameters (Richness, Trophic level. Diversity) suggest that the micromammalian populations in Salcnto arc influenced. locally. by both anthropic and biogeographical factors. These results may bc inserted into the general debate on the "peninsula effects".

Key words: Trophic system. Diversity. Micrornarnrnals. Peninsularity, Italy.

INTRODUCTION

The study of the trophic relationships between Strigiformes, in particular *Tyto alba* (Scopoli, 1769), and their preys has become of increasing importance in Italy (e.g. starting from Pasa, 1951, Barbieri et al., 1975, Lovari et al., 1976).

This kind of research brings new information to light on the fauna and the biogeography of the theriocoenosise examined (Contoli et al., 1985).

The theriocoenotic and theriological characteristics in the Salento area have been little studied, although new records have been obtained from neighbouring territories (Sublimi-Saponetti, 1985, Sublimi-Saponetti and Quaranta. 1988, Sublimi-Saponetti and Scalera Liaci, 1989).

In the last decade, Cignini and Berrilli (1986) obtained new data from which a tentative analysis, by means of ecological parameters of the influence of isolation on such theriococnosis in a subpeninsular position. can be carried out.

The authors arc collectively responsible for this work although each had the following specific roles: C.Battisti, collection. classification and numerical analysis of the material; B.Cignini, identification of sites and general planning of the research; L.Contoli, statistical-quantitative approach to the eco-biogcographic problem.

STUDY AREA

The sampling area is geographically located within the territory of Salento, in the Salcnto peninsula, South of the isthmus Taranto - Brindisi, between the Adriatic arid Ionian seas (Lat 40° 30' N - 39" 45' N; Long. 17° 40' E - 18" 30' E). It covers an area of 2800 square km and has an altitude between 0 and 200 m a.s.l..

Salento is therefore an even territory which is quitc flat. It can be subdivided into a northern area. which is tlat and intensely cultivated (Tavoliere of Lecce) and a southern area. which is a low plateau that slopes down towards the sea (Murge Salentine). This region has karstic characteristics which have prevented the develop-

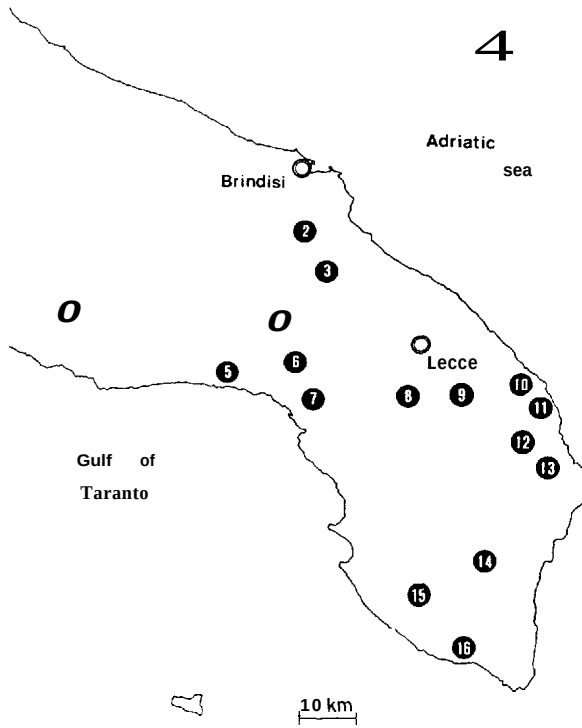

Figure 1 - Localization of the studied sites. The numbers are the same as in Table I.

ment of a superficial hydrography (AA.VV., 1957). *Oleo-Ceratonium* is the original climax vegetation (Br. RI., 1936), which is typical of the littoral areas of South Italy. According to Tomaselli (1973) *Quercion ilicis*, Br. BI.. 1936 is the more prevailing climax vegetation towards north.

The present vepetation has been greatly reduced and transformed due to human presence. The extensive and intensive cultivations of olive groves, vineyards. orchards, oat. barley, wheat, industrial cultivations (sugar beet and tobacco) and localized pasture lands. cover most of the territory (AA. VV.. 1959).

Residual portions of xerophilous vegetation and shrubs typical of either the mediterranean bush (*Arbutus unedo, Phyllirea media, Pistacia lentiscus, Rhamnus alaternus*) and the low maquis ("gariga") are present.

The local climate is typically mediterranean with a marked drought and prevailing sea winds. The annual mean temperature is 18 - 19 °C. Rainfall totals about 600 mm/year (Mennella, 1973). Bioclimatically Salento is classified in the thermomediterranean xerotcric area (Tomaselli et al.. 1973).

MATERIAL AND METHODS

The remains of the prey-s' skull found in the pellets of *Tyto alba* were analysed. This form of research to study trophic relationship between Strigiformes and micromammals is well known (Uttendoerfer, 1952. Contoli et al.. 1983). A search was carried out to find buildings (silos and farms: "masserie") that probably could have hosted diurnal resting sites of this predator.

The following 16 sites were examined. They arc located in the provinces of Lecce (13). Brindisi (2). Taranto (1) (Fig. I):

- site 1 - Palombara farm - Monteparano (TA) - m 71 a.s.l.;

- site 2 - Angelini farm - Tuturano (BR) - m 60;
- site 3 - I Veli farm - Cellino S. Marco (RR) - m 56;
- site 4 - Casante farm - Salice Salentino (LE) - m 55;
- site 5 - Serra degli Angeli farm - Porto Cesareo (LE) - m 10;
- site 6 - Corda di Lana farm - Veglie (LE) - m 45;
- site 7 - loc. Minieri d'Arneo - Leverano (LE) - in *3%:*
- site 8 - loc. Ristoppia - S. Donato (LE) - m 50;
- site 9 - ex oil mill - Calimera (LE) - m 57;
- site 10 - Iucioli farm - Meledugno (LE) - in 14;
- site 11 - S. Andrea (LE) - m 28;
- site 12 - Cànnole (LE) - m 60;
- site 13 - Lama farm - Cànnole (LE) - m 58;
- site 14 - loc. Macchiola - Surano (LE) - m 100;
- site 15 - Coloni farm - Melissano (LE) - m 55;
- site 16 - I Pali farm - Salve (LE) - m 60.

The taxonomy of the animals were determined by using a binocular microscope at low magnification and by following the keys of Toschi and Lanza (1959), Toschi (1965), Chaline et al. (1974), Yalden (1977), Catalan and Poitevin (1981), Erome and Aulagnier (1982). Poitevin et al. (1986). A complex morphological - morphometric index (Filippucci et al., 1984) was applied to the genus *Apodemus*.

Preys counts were based on the number of skulls and mandibles found present in pellets in accordance with established methodology (Contoli et al., 1983).

The collected data was elaborated according to the following criteria:

- Richness of species, expressed as the number of species normalized to 100 specimens (Contoli and Marenzi, 1982), calculated for those sites with a number of preys greater than 100;
- Trophic Level Index (I.L.T. = Insectivores/Rodents: Contoli, 1980);
- Diversity, according to Gini-Simpson (Gini, 1912);
- Evenness (Alatalo, 1981);
- Reliability of absence (Contoli, 1986b).

The distance of each site from the beginning of the italian peninsula, measured from an ipothetical line which connects the Gulf of Genova and the Po River delta (Contoli, 1986a), was adopted to evaluate the influence of peninsular factors on the variation of the aforementioned parameters.

RESULTS AND DISCUSSION

The data refer to 2420 preys consisting of 9 different species of terrestrial micromammals: *Talpa romana*, *Crocidura suaveolens*, *C. leucodon*, *Suncus etruscus*, *Microtus (Terricola) savii*, *Apodemus sylvaticus*, *Mus domesticus*, *Rattus rattus*, *R. norvegicus*.

In Table 1 quantitative data relative to species by site and year of collection are shown.

Faunal aspects will be more deeply dealt with in later papers (Cignini et. al., in preparation). However, certain more important aspects are already mentioned below. For example, the presence of *Crocidura russula* was not recorded which is contrary to the findings of Pasa (1951) and Corbet and Ovenden (1985). The same applies for the genus *Sorex*, *Chletrionomys glareolus* and *Muscardinus avellanarius*.

It is possible (Index of Reliability of absence) to calculate a minimum sample of preys, above which the absence of a specific *taxon* from the diet can be considered significant. By using this index we were able to rule out (see Contoli et al., 1991) almost certainly the predation of *Chletrionomys* (minimum sample: N=94). The same applies for the genus *Sows* and *Muscardinus* (although the minimum sample was higher: N = 6 15 and N = 1151 respectively), considering all the sites as a very homogeneous group.

The absence of *Sorex* spp., though recorded at the borders of Salento in pellets of Murge (Ferrara and Contoli, 1992). does not exclude its presence in relict environments which have a microclimate and vegetation

Table 1 - Terrestrial micromammal communities preyed upon by *Tyto alba* in Salento (Apulia, Italy).

Site	1		2/86		2/87		3		4		5		6		7		8	
Species	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Crocidura leucodon			9	6,34	7	8,97			2	2,25	5	2,65			4	2,55	1	0,42
Crocidura suaveolens			4	2,82	3	3,85					1	0,53						
Suncus etruscus	3	1,19	6	4,23	7	8,97	1	0,99	8	8,99	1	0,53	3	3,9	2	1,27	4	1,69
Talpa romana																		
INSECTIVORA	3	1,19	19	13,38	17	21,79	1	0,99	10	11,24	7	3,7	3	3,9	6	3,82	5	2,11
Microtus savii	149	58,89	26	18,31	12	15,38	4	3,96	39	43,82	101	53,44	39	50,65	124	78,98	151	63,71
Apodemus sylvaticus	81	32,02	63	44,37	33	42,31	14	13,86	38	42,7	65	34,39	28	36,36	24	15,29	59	24,89
Rattus rattus	6	2,37	12	8,45	4	5,13	6	5,94			5	2,65					8	3,38
Rattus norvegicus	1	0,4	18	12,68	4	5,13	72	71,29										
Mus domesticus	13	5,14	4	2,82	8	10,26	4	3,96	2	2,25	11	5,82	7	9,09	3	1,91	14	5,91
RODENTIA	250	98,81	123	86,62	61	78,21	100	99,01	79	88,76	182	96,3	74	96,1	151	96,18	232	97,89
Terrestrial micromammals	253	100	142	100	78	100	101	100	89	100	189	100	77	100	157	100	237	100
CHIROPTERA	19				8		1											
MAMMALIA	272		142		86		102		89		189		77		157		237	

Site	9		10		11		12		13/86		13/87		14		15/86		15/87		16	
Species	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Crocidura leucodon							4	4,71	11	5,09	4	2,38	1	1,54			1	0,85		
Crocidura suaveolens	1	1,47																		
Suncus etruscus				2,94			1	1,18	6	2,78			2	3,08	7	5,98			2	1,83
Talpa romana													1	1,54						
INSECTIVORA				4,41			5	5,88	17	7,87	4	2,38	4	6,15	7	5,98	1	0,85	2	1,83
Microtus savii	48	64,86		44,12	22	33,85	50	58,82	125	57,87	83	49,4	49	75,38	60	51,28	66	55,93	75	68,81
Apodemus sylvaticus	25	33,78		35,29	18	27,69	29	34,12	52	24,07	73	43,45	8	12,31	37	31,62	36	30,51	24	22,02
Rattus rattus				11,76	9	13,85	1	1,18	5	2,31	4	2,38	2	3,08	9	7,69	5	4,24	3	2,75
Rattus norvegicus																				
Mus domesticus	1	1,35		4,41	16	24,62			17	7,87	4	2,38	2	3,08	4	3,42	10	8,47	5	4,59
RODENTIA	74	100		95,59	65	100	80	94,12	199	92,13	164	97,62	61	93,85	110	94,02	117	99,15	107	98,17
Terrestrial micromammals	74	100	68	100	65	100	85	100	216	100	168	100	65	100	117	100	118	100	109	100
CHIROPTERA																				
MAMMALIA	74		68		65		85		216		168		65		117		121		109	

which is very different with respect to the normal surroundings like, for instance, the "gravine".

Similarly, *Chletrionomys glareolus* is absent from the trophic system that we studied, probably because of its ecological characteristcs which are linked to wooden coenosis of temperate bioclimates which have an elevated tree cover (Lovari et al., 1976). This could also be true for *Muscardinus avellanarius*, which was recorded in bordering areas (Cignini, 1989).

Microtus savii is ubiquitous and dominant almost everywhere. We will deal with its diffused presence (68,1 %; N= 182) in M3 of the "persimplcx" form (Contoli, 1980) in future papers (Contoli et al.. in preparation).

The absence of *Apodemus flavicollis* from the cxtragarganic Apulia (Van den Brink. 1969, Corbet and Ovenden, 1985, Amori et al.. 1984) due to the ecological and biogeographical characteristics of this species. was confirmed in the Salento area. The presence of *Mus domesticus* was recorded everywhere. It is a commensal and anthropophile xerophilous species and is found in temperate areas. Wilder populations which are less bound to the human presence also exist in rnediterrancan bioclimates (Anderson. 1970 quoted by Amori et al.. l.c.).

The high frequence of *Crocidurinae* seems related to bioclimatic factors, whereas the dominance of *Microtinae* over *Murinae* is due to the anthropic influence in the area (Contoli et al., 1978).

Apodemus was found to be much more widespread than other *Murinae*, which confirms previous literature in peninsular Italy (Contoli et al.. 1978).

Some ecological conclusions can bc drawn from the indexes (Table 2).

From 3 to 8 species were recorded in each site. These values arc mostly in accordance to the general trend shown in Fig. 7, where

Table 2 - Synthethic ecological parameters. N. sp. = number of species; Microt./Murin. = *Microtinae/Murinae*; ILT = Trophic Level Index; % Insectiv. = % Insectivores: G = Diversity (Gini); E = Evenness.

Site	N. sp.	Microt./ Murin.	I.L.T.	% Insectiv.	G	E
1	6	1,37	0.01	1.19	0.55	0,727
2/86	8	0,25	0,13	13,38	0.75	0.687
2/87	8	0.2 1	0,2	21.79	0.8	0.916
3	6	0,04	0,01	0,99	0.17	0.534
4	5	0.97	0.11	11.21	0.62	0.838
5	7	1,24	0,04	3.7	0,59	0.697
6	1	1.11	0,04	3.9	0.6	0.796
7	6	4.33	0.04	3,82	0,32	0.523
8	6	1.86	0,02	2,11	0.53	0.637
9	3	1.85	0	0	0,46	0.824
10	6	0.86	0,04	4.1	0.66	0,49
11	1	0,51	0	0	0.72	0.959
12	5	1,67	0.06	5,88	0.54	0.804
13	5	1,02	0 02	2,38	0.56	0.765
14	7	3.83	0 06	6,15	0.43	0,29
15/86	5	1,2	0 06	5,98	0.63	0.711
15/87	5	1.3	0 01	0,85	0,58	0.721
16	5	2.31	0.02	1.83	0.47	0.778

Richness is correlated to the length of the Italian peninsula (the line was calculated without data from Salento).

The slightly lower than expected values can be easily explained when you consider that the Salento area is a peninsula within the Italian peninsula. This causes the overlapping of two distinct expressions of peninsularity.

The index of trophic level (I.L.T.) compared to the rest of Italy (Fig. 3) is similar to previous data. although it is explanable in a different way i.e. not only in terms of absence (perhaps biogeographical) of some taxa of *Soricidae*. This pal-ameter, infact, is clearly affected also by local conditions which are related to the degree of anthropization which can negatively affect the importance of Insectivores (Contoli. 1981. Contoli and Di Russo, 198.5). Indirect geographical causes connected to climatic variation, and maybe sinecological factors also arc important. In fact, I.L.T. decreases from North to South and from temperate to the mediterranean bioclimate (Contoli. 1988).

The influence of anthropization and peninsularity for each site is shown in Fig. 3, where the recorded values are in average lower than the line.

Values of Diversity ranged between 0.3 and 0.8. with average values falling between 0.4 and 0.7. These values are lower than those found in other areas of the Italian peninsula (0.6-0.8; Contoli, 1981). However, Diversity can be affected by anthropic causes such as agriculture which lower Evenness values. Geographical location on the other hand affects Kichness (see Fig. 2). This can be seen in the "R./E." diagram (Fig. 4), which shows how the theriocoenosis of this area are intermediate between insular and Apennine values. which are more continental, as can be expected in a subpeninsula such as the Salentina.

In Fig. 5 Richness and the natural logarithm of the number of prey are compared. The lines show differing inclinations which relate to their degree of continentality (Contoli, 1988). The Salento falls in a range of values between those of the geographic islands and the northern - central part of Italy. It however shows a different trend and has values which are lower than

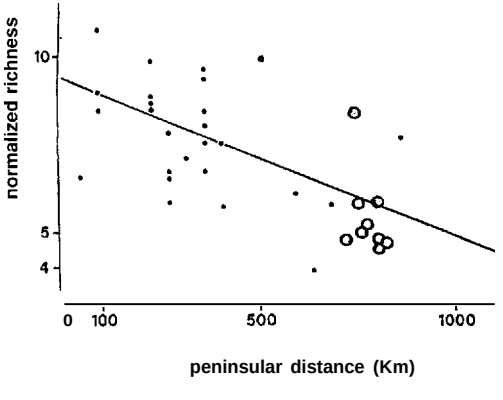

Figure 2 - The relationship between Normalized Richness and peninsular distances from the beginning of the Italian peninsula. Black points: data from Contoli, 1986a. Circles: studied sites.

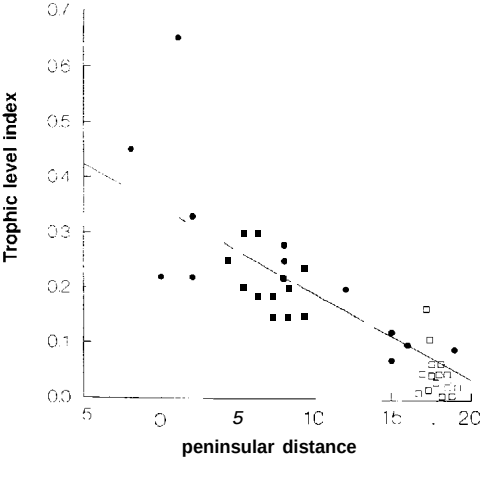

Figure 3 Trophic Level Index (I.L.T.) and peninsular distances (1 = 45 km). Squares = studied sites. Black points: data from Contoli (1988).

those of other related areas such as Calabria (another subpeninsula, but less anthropized).

These data concord with previous studies (Massa. 1982, Contoli, 1986a), which suggest that in Italy there is a gradual decrease in fauna from North to South, due to a "peninsula effect (see Brown and Opler. 1990 for a review). The particular narrow and elongated conformation of the peninsula, the orography, the climate and the isolation which cause this decrease might be important factors. There are no significant differences among sites of the Salento area which is probably due to the short distances between them (Test of Spearman).

CONCLUSIONS

The low values of Diversity and its Richness component may suggest the ecological isolation of the area. The low I.L.T. values are to be expected considering the long distance from the start of the Italian peninsula. This phenomenon could be due to poor vagility in the *Soricidae* which limits biogeographical dispersion. Ecological and anthropic factors. such as a probable high use of chemicals in an area which is very agricultural, could also be significant.

The fact that the Salento is affected by its accentuated and complex peninsularity is clearly highlighted by the micromammals - *Tyto alba* trophic system. The level of antliropization could also be considered as one of the causes of the low values of Richness, Diversity, Evenness and Trophic levels. However, it must be said that much higher values have been registered in the northern part of the Italian peninsula where anthropization levels are much the same.

The results, therefore. might give further support to the theory concerning the Richness of species suggested by Mac Arthur and Wilson (1967) and by Simpson (1964; "peninsula effect"; for rodents see also Taylor and Regal, 1978). Having said this, it should be underlined that climatic factors,

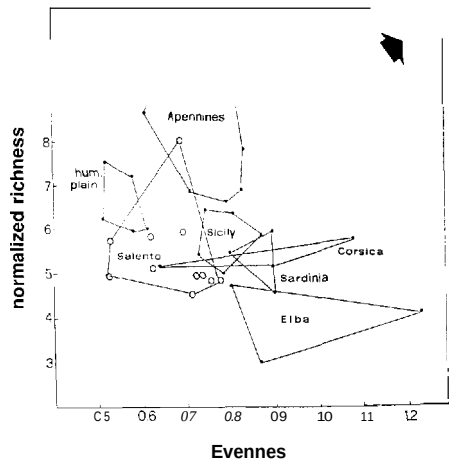

Fig. *3* - The relationship between Normalized Richness arid Evenness. Empty circles = studied sites. Hum. pl. = humid plain biotopes.

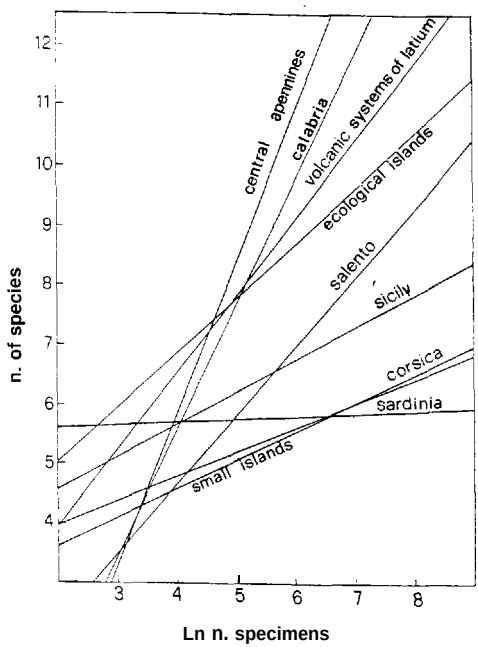

Figure 5 - The relationship between the number of species anti the n. of specimens.

due to the latitude **of** the italian peninsula, environmental and anthropization effects could explain general trends for the parame-

ters in the Salento. Competition with other more thermoxerophilous *taxa* may also be important (see Contoli, 1988).

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