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A CONTRIBUTE TO THE KNOWLEDGE OF THE FOOD NICHE OF THE BARN OWL *TYTO ALBA* (Scop., 1976) IN TUSCANY: LOCAL CHANGES OF THE DIET

Abstract — We have analysed the food niche of the Barn Owl, *Tyto alba* (Scop., 1769), in seven localities of the Monti Pisani and the Subappennino Lucchese. The data of the annual diet are significantly different in the various localities. The regression analysis indicates that the diet is related with prevalent conditions of biotopes (vegetation cover, buildings, type of human activities) in the hunting territories of the Barn Owl.

Riassunto — *Contributo alla conoscenza della nicchia trofica del Barbagianni in Toscana: variazioni locali della dieta*. Viene analizzata la dieta del Barbagianni, *Tyto alba* (Scop.,1769) in sette località dei Monti Pisani e del Subappennino lucchese. I dati relativi alla dieta su base annuale risultano significativamente differenti nelle diverse località. L'analisi di regressione indica che la dieta è dipendente dalle caratteristiche dei biotopi compresi nei territori di caccia del barbagianni (copertura vegetale, edifici, tipo di attività umane).

Key words — Barn Owl, food niche , Monti Pisani, Subappenino Lucchese, vegetation cover, buildings, human activities, regression.

INTRODUCTION

In 1989 a study of the presence and distribution of micromammals in plains and hills within the region of Monti Pisani and the Subappennino in Lucca was performed (TURINI, 1991). As a part of the study a periodical collection of pellets of Barn Owls (*Tyto alba*, Scop.

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1769) was made. Thanks to the osteological contents obtained during the research of 1989 a quantitative analysis of local dietary changes of the Barn Owl has been possible (BIGINI & TURINI, 1993). Other authors (CONTOLI, 1980; 1982; 1984; 1988; SARA' & MASSA, 1985) have pointed out the relationship between the food niche of the Barn Owl and the population -dynamic of the Barn Owl's preys. These relationship can be understood only when taken into consideration under the global aspect of environmental changes. This study should be considered together with other studies of different biotopes of Tuscany to increase the knowledge of the *Tyto alba's* diet.

THE STUDIED AREA

The region of Monti Pisani (TOMEI, 1988) is situated between Pisa and Lucca. Its southern side is located within the xerotermic mediterranean climate region; its northern side lays on the mesomediterranean region. This region exhibits temperate climate conditions (VITTORINI, 1972; TOMASELLI, 1973; WALTERS & POLUNIN, 1987; TOMEI, 1989; DEL PRETE et al., 1990). Its geological composition is diverse where the rocks in the N/W are carbonaceous and in S/E they are predominantly siliceous. The variety of vegetational communities, altered by human presence, is directly associated with the difference of climate conditions. The areas considered extend over the bordering plain and hills of the region, into the inner territory of the nearby towns, where the owl's roosts can be found situated within old buildings or natural caves. The sites where the research was done are: Noce, Gabella, Vicopisano, Buti, S. Andrea di Compito (Lucca), S. Lorenzo a Vaccoli (Lucca). Here, the vegetational associations are represented by: agricultural fields, maritime pine woods (*Pinus pinaster*, Aiton) planted by men, holm oak woods (with trees of average dimensions or shrubs), garigues (in areas with calcareous substrate), chestnut groves and coenosis with dominance of mesophyl deciduous trees with little communities of beech trees, *Fagus sylvatica* L. which are actively cultivated. The localities of Noce and Benabbio represent the two geographical extremes of this research. The area of Noce is particularly interesting because of concentrated human activities and for their effects on the territory. The Noce begins immediately south of the Barn Owl's roost up until the bank of Arno River. The original vegetation, composed of herb (with shrubs and agricultural zones)

was displaced by buildings and prefabricated structures, industry and industrial activities. In the Media Valle del Serchio one finds Benabbio (Lucca) which is an area situated 35.6 Km N/W of Noce (the south-east extrem of the studied region) within the Subappennino in Lucca. Benabbio is in the very centre of mesomediterranean climate zone, and is characterized by an alternance of woods and little areas treated with contour plowing where agriculture is practiced as well as pasturing. This area is at an altitude of 400m from sea level. Only two seasonal collections were carried out, because the Barn Owl is temporarily absent from the bell tower of this town, where it rests and lays pellets.

MATERIALS AND METHODS

The pellets were collected during the solar year 01/01/89 - 01/01/90, weekly or biweekly collections were made when the Barn Owl did not occupy the roost permanently. Single lots of pellets had been found, which certainly came from temporary nocturnal stops. These temporary stops were made during hunting periods as demonstrated in the eco-ethology of this species (GEROUDET, 1984; CRAMP, 1985)(*). After

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(*) In total, 802 pellets have been collected. Every pellet was crushed in dry conditions. Single bones were divided as follows:
1) crania, mandibles and singles teeth
2) girdle flat bones and limbs long bones (except for radius)
3) radius
4) fragments of the cranium flat bone.
5) vertebras, ribs, tarsus, metatarsus, carpus, metacarpus, phalanges, fragments.

The anatomical study was made on the bones of groups 1 and 2, according to some parameters which are very well-known in literature (TOSCHI, 1965; CHAPLIN, 1971; SAINT-GIRONS, 1973; CHALINE, 1974; BARONE, 1980) and according to analysis on contents within the present collection of the Faunal laboratory. This collection had already been arranged by Ezio Tongiorgi and it is an area of continuing research. The morphological analysis of bones, however, was not always sufficient to identify single species. As concerns the Mammalia Insectivora Soricidae only two subfamilies have been identified: the subfamily of Soricinae and the subfamily Crocidurinae. In particular, biogeographic considerations impose a morphometric study for the distinction of the genus Crocidura genus, which is being analysed osteometrically in Sardinia and in Tuscany (BIGINI & TURINI, in prep.). Except for the Rattus genus and for the area of Benabbio (where *Apodemus Sylvaticus* and *Apodemus flavicollis* are sympatric), the Rodentia where identified at the specific level. Future works will include a complete determination of *Rattus sp.* and osteometric studies about *Apodemus sp.*of Benabbio have been carried out. A global number of 100 specimens have been introduced in the collection of the Faunal laboratory of our Department.

having counted the preyed individuals during the year, the data concerning the diet in each locality >100 preys (the data which are available only concern the areas of Noce, Gabella, S. Andrea di Compito, Benabbio) was compared with the chi-squared test (often used in literature in order to determine the diversity between diets in different periods and areas). In addition, ecological indexes for a comparison concerning the fauna of this area, were calculated (Shannon's index of diversity; Sorensen's index of affinity; Cricetidae/Muridae ratio; Insectivora/Rodentia ratio; Thermoxerophyly index) (TURINI, 1991). The results of the calculation concerning are approximate but can be used to draw quantitative comparisons on the difference of zoocoenosis conditions in time and space.

RESULTS AND DISCUSSION

26,719 bones (corresponding to 17.59% of the total 151,908 bones collected) from pellets and counted) have been taken into consideration in order to determined preyed taxa. Table 1 summarizes annual data about the *Tyto alba's* diet within the seven studied areas. As regards sites with the number of preys ≥ 100, the highest percentage (99.78%) of micromammals on total preyes has been detected at Benabbio, while at Noce it stands at 61.41% and at Gabella 60.92%. At Gabella, the highest percentage of Insectivora (which were in this case all Crocidurinae) has been captured and are 27.22% of the total, while the smallest percentage has been recorded at Noce (12.86% of the total). Bird predation was: 24.35% (Noce), 10.35% (Gabella), 0.22% (Benabbio). The chi-squared test, applied to the data of table 1, resulted in a significant outcomes ($p < 0.025$). The chi-squared test points out an actual diversity of diets. Diets have shown their great diversity during the different seasons (BIGINI & TURINI, 1993). With regards to the four sites with the number of preys ≥ 100. Some ecological indexes, already used in the description of Barn Owls' food niche, have been calculated (CONTOLI, 1988; FASOLA, 1988): Thermoxerophyly index, Insectivora/Rodentia ratio, Cricetidae/Muridae ratio, Shannon's index, Sorensen 's index (ODUM, 1973; CONTOLI, 1980). The calculation of the last two indexes should, in some cases, be considered approximate, as determination of preys was limited to genera and subfamilies (see table 1; CONTOLI & SAMMURI, 1981).

TABLE 1 - *Tyto alba's* diet in the seven studied areas (chi-squared test : p<0.025)

Località	Benabbio		Noce		Gabella		S. Andrea C.		Buti		Vicopisano		S. Lorenzo a Vaccoli	
n° pellets	149		308 (254 entire)		244		47		16		23		149	
n° preys	454		583		676		111		53		57		454	
n° preys / n° pellets	3,05		2,09		2,77		2,77		3,31		2,47		3,05	
Taxa:	NI	PNI	NI	PNI	NI	PNI	NI	PNI	NI	PNI	NI	PNI	NI	PNI
Soricinae	53	11,68	–	–	–	–	4	3,6	4	7,55	1	1,76	1	2,27
Crocidurinae	62	13,66	75	12,86	184	27,22	20	18,02	6	11,31	9	15,79	3	6,82
Tot. Insectivora	115	25,34	75	12,86	184	27,22	24	21,62	10	18,87	10	17,55	4	9,09
Chiroptera (Tot.)	–	–	1	0,17	1	0,15	–	–	–	–	–	–	–	–
Clethrionomys glareolus	29	6,38	–	–	–	–	–	–	–	–	–	–	–	–
Arvicola terrestris	124	–	–	–	4	0,59	1	0,9	–	–	–	–	–	–
Pitymys savii	–	27,32	24	4,12	98	14,5	19	–	9	16,98	7	12,28	6	13,64
Pitymys multiplex	1	0,22	–	–	–	–	–	17,12	–	–	–	–	–	–
Apodemus sp.	170	37,44	94	16,12	33	19,67	44	–	26	49,05	15	26,31	19	43,2
Rattus sp.	–	–	69	11,83	47	6,95	10	39,65	1	1,89	5	8,77	1	2,27
Mus musculus	5	1,1	152	26,07	113	16,72	6	9,01	1	1,89	12	21,05	1	2,27
Glis glis	1	0,22	–	–	–	–	–	5,4	–	–	–	–	–	–
Muscardinus avellanarius	–	–	2	0,35	–	–	–	–	2	3,77	–	–	2	4,54
Eliomys quercinus	–	–	2	0,35	3	0,44	–	–	–	–	–	–	3	6,82
Rodentia indet	8	1,76	15	2,57	14	2,07	1	0,9	–	–	1	1,76	1	2,27
Tot. Rodentia	338	74,44	358	61,41	412	60,92	81	72,98	39	73,58	40	70,17	33	75,01
Tot. Mammalia	453	99,78	434	74,44	597	88,29	105	94,6	49	92,45	50	87,72	37	84,1
Passer sp.	1	0,22	142	24,35	70	10,35	5	4,5	4	7,55	7	12,28	5	11,36
Alii Passeriformes	–	–	22	3,77	23	3,4	2	1,8	1	1,89	2	3,51	3	6,82
Aves indet	–	–	19	3,26	18	2,66	2	1,8	3	5,66	–	–	–	–
Tot. Aves	1	0,22	142	24,35	70	10,35	5	4,5	4	7,55	7	12,28	5	11,36
Reptilia (Tot.)	–	–	–	–	1	0,15	–	–	–	–	–	–	–	–
Amphibia (Tot.)	–	–	2	0,35	6	0,89	–	–	–	–	–	–	–	–
invertebrata (Tot.)	–	–	5	0,86	2	0,3	1	0,9	–	–	–	–	3	4,54
TOTAL	454	100	583	100	676	100	111	100	53	100	57	100	44	100

See the following results:

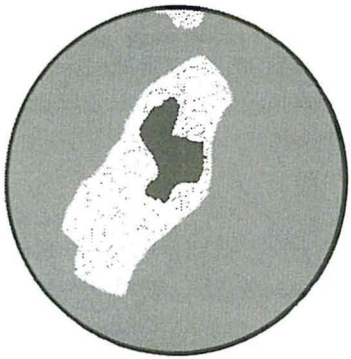
	Noce	Gabella	S. Andrea C.	Benabbio
Thermoxerophyly	1	1	0.83	0.54
Insectivora/Rodentia	0.21	0.45	0.30	0.34
Cricetidae/Muridae	0.08	0.35	0.33	0.88
Shannon value	0.84	0.83	0.73	0.64

Results of the Sorensen's index calculations:

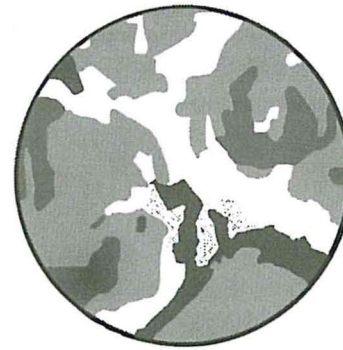
	Benabbio	Noce	Gabella	S. Andrea C
Benabbio	–	0.45	0.43	0.60
Noce	–	–	0.89	0.75
Gabella	–	–	–	0.80
S. Andrea di Compito	–	–	–	–

Other authors have already pointed out that the Barn Owl's feeding strongly reflects man-influenced ecological conditions within hunting territories and also recflects natural ecological conditions (fig.1). (CHALINE, 1974; CONTOLI, 1980; SARA' & MASSA, 1985; CONTOLI, 1988, 1989; BEGON et al.1989). For this reason, a straight line regression has been calculated which concerns the relationship between the frequency of predation of species which is largely favoured by direct human presence (houses, industry and industrial activities), *Passer sp., Mus musculus, Rattus sp.* (fig.2, 3). The regression between the frequency of predation of Apodemus sp. and the extention of woods around roosts has been calculated (fig.4) (LOVARI *et al.*, 1976). The text of linear regression demonstrates significant results in all three comparisons. This results show the polyphagia of the predator (CRAMP, 1985). The diversity of a species's food niche between different periods and areas confirms the hypothesys of an optimized opportunistic utilization of resources (WIENS & ROTENBERRY, 1979).

The analysis of the regression confirms the relationship between diets and environmental variables within hunting territories and between diets and variations of preyed populations evidenced by the various seasonal pattern in an area which has different climate and



Benabbio



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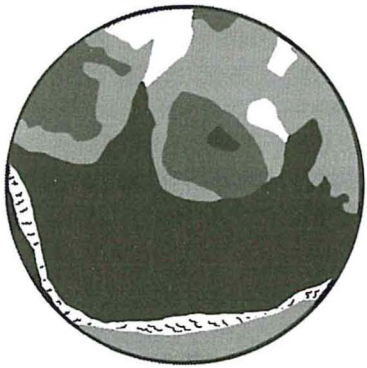

Noce

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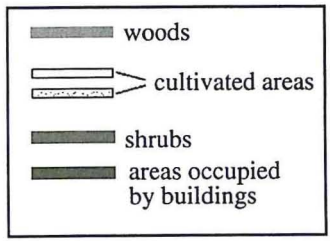

Gabella	
areas occupied by buildings	10.02%
woods	8.15%
shrubs	14.84%
cultivated areas	66.98%
Noce	
areas occupied by buildings	48.71%
woods	6.06%
shrubs	14.51%
cultivated areas	30.69%
Benabbio	
areas occupied by buildings	4.21%
woods	76.82%
shrubs	-
cultivated areas	18.95%
S. Andrea Compito	
areas occupied by buildings	8.98%
woods	47.41%
shrubs	14.23%
cultivated areas	29.36%

Fig. 1 – Environmental features of the surroundings of diurnal roosts of the Barn Owl (centres of circles) for a range of 1 Km. in Benabbio, S. Andrea di Compito, Gabella, Noce (from the «wood map of Monti Pisani», 1984; edited by Regione Toscana, modified).

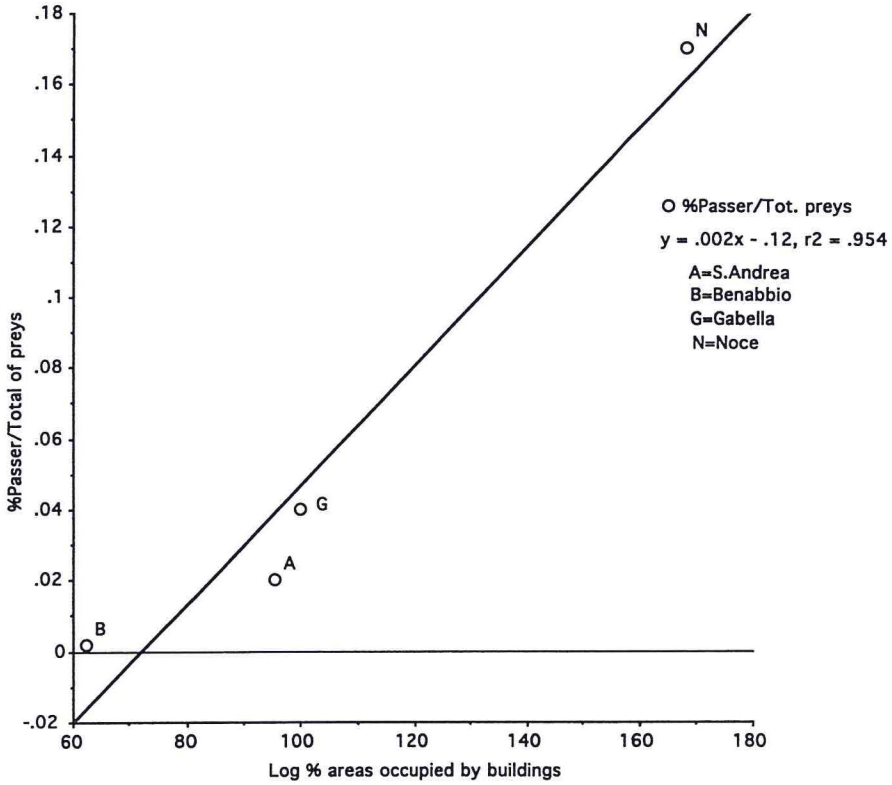

Fig. 2 – Straight line regression between relative frequency of predation of *Passer sp.* and logarithm of percentage of areas under human influence within the four sites (radius 1 Km) with number of preys ≥100 ($p<0.02$).

large number of variables which are required to describe environmental complexity, make an univocal interpretation of the data difficult (BEGON *et al.*, 1989). Preying on micromammals is the predominant behaviour of the *Tyto alba* be it in Noce (the southest area) or in Benabbio (the northest area). Analysis of Barn Owls' food niche are confirmed by effects of human exploitation of the territory (CELLI, 1991): historically, human activities have either transformed vegetational communities (at climax state) into «young» ecosystems (e.g. monocultural agricultural activities) or substituted it with other wood biotopes (e.g. secondary successions with introduction of arboreous species and their utilization). In both cases, these effects make possible either a colonization of the territory by clearing species (e.g. *Pitymys savii* at Benabbio) or the extintion of species accustomed to favourable ecosy-

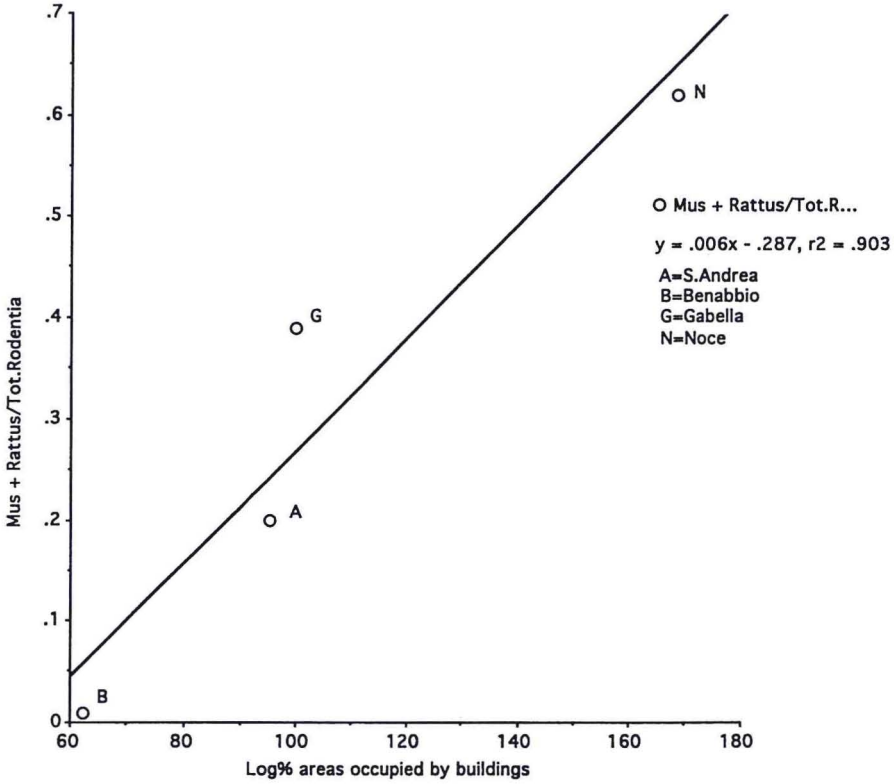

Fig. 3 – Straight line regression between Mus + Rattus/total of Rodentia value and logarithm of percentage of areas under human influence within the four sites (radius 1 Km) with number of preys ≥100 ($p < 0.05$).

biological features (CONTOLI, 1980; 1982; BIGINI & TURINI, 1993). The stems (e.g. *Clethrionomys glareolus,* no longer present within the Monti Pisani region; AMORI *et al.*,1986). Eventually overdevelopment (constructions, industrialization) of the territory provokes total substitution of the original vegetational characteristics. This in turn stops recolonization of the primary producers, with the singular exception existing only in the small remaining undeveloped areas. As a consequence , there is a predominant presence of micromammals and birds which are in cohabitation with man (Muridae micromammals; *Passer sp.* among Passeriformes). Barn Owls' diet reflects these various ecological conditions (e.g. changes in avalability and spatial location of micromammals and other preys).

Barn Owl, a predator which has been accustomed to clearings and

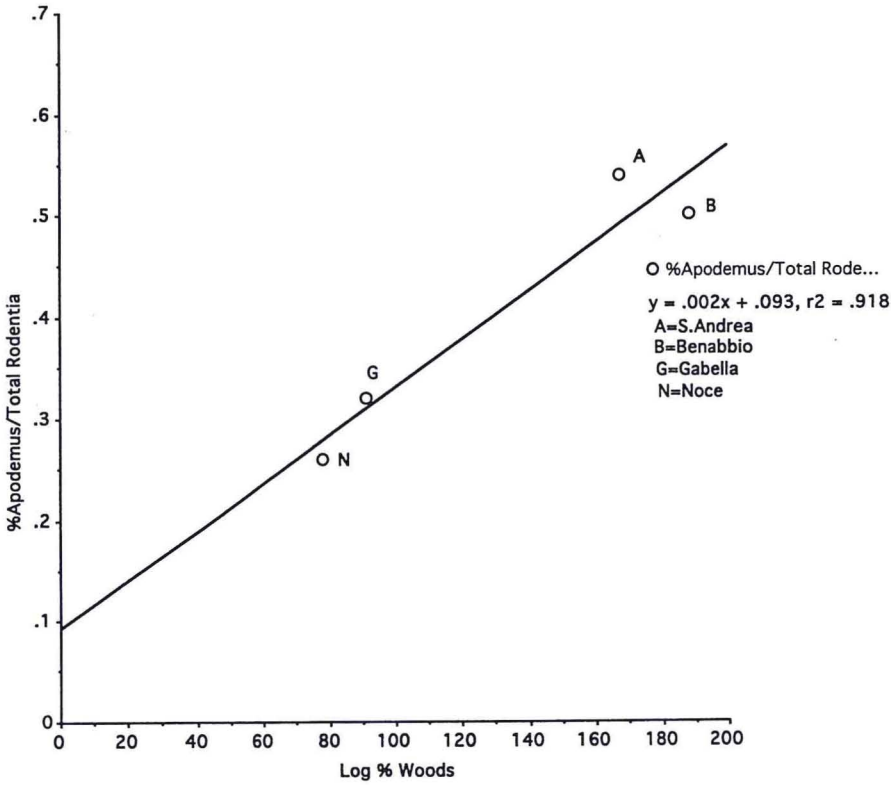

Fig. 4 – Straight line regression between relative frequency of predation of *Apodemus sp.* (on the total of Rodentia) and logarithm of percentage of wood areas within the four sites (radius 1 Km) with the number of preys ≥100 ($p<0.04$).

areas at the extremity of woods began to settle in areas where it has been in direct contact with man (for feeding and for areas of reproduction as well) because it has always had in these areas its "realized" ecological niche (HUTCHINSO, 1958; ROLANDO, 1986).

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