HABITAT PREFERENCE AND FOOD USE BY *Metachirus nudicaudatus* AND *Didelphis aurita* (DIDELPHIMORPHIA, DIDELPHIDAE) IN A RESTINGA FOREST AT RIO DE JANEIRO

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(With 1 figure)

ABSTRACT

The microhabitat characteristics and the feeding habits of *Didelphis aurita* and *Metachirus nudicaudatus* were studied in a restinga forest area at Maricá, Rio de Janeiro, Brazil. Thirty-seven microhabitat variables were measured on the 100 grid points set for the study, and analyzed by multivariate analyses. Diet of opossums was determined through the identification of food remains in faeces, which were compared for composition and diversity between the two species. For *D. aurita* the most important microhabitat variable was litter density, and for *M. nudicaudatus* herbaceous stem density at 20cm and horizontal estimated obstruction from 1m to 1.5m. Both feed mainly on invertebrates, mostly insects. Nevertheless, *D. aurita* used a wider spectrum of litter invertebrates than *M. nudicaudatus*, which has a more insectivorous and restricted diet consuming more ants, termites, cockroaches and beetles. Our data show that both species use the same available resources. The distribution of *D. aurita* is linked with the abundance of food resources, while the distribution of *M. nudicaudatus* is more associated with the structure of its microhabitat.

Key words: microhabitat choice, diet, small mammals, marsupials, tropics.

RESUMO

Preferência de Habitat e Uso do Alimento por *Metachirus nudicaudatus* e *Didelphis aurita* (Marsupialia, Didelphidae) em uma Mata de Restinga do Rio de Janeiro

As características de microhabitat e os hábitos alimentares de *Didelphis aurita* e *Metachirus nudicaudatus* foram estudados em uma área da mata de restinga de Maricá, Rio de Janeiro. Trinta e sete medidas de microhabitat foram tomadas nos 100 pontos da grade sendo analisadas através de análises multivariadas. A dieta foi determinada pela identificação dos restos

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alimentares contidos nas fezes, sendo comparados quanto a composição e a diversidade. Para *D. aurita*, a variável de microhabitat mais importante foi a densidade de folhiço, e para *M. nudicaudatus* as mais importantes foram densidade de caules herbáceos a 20cm e estimativa de obstrução horizontal de 1m a 1,5m. Ambos alimentam-se principalmente de invertebrados, sendo a maioria insetos. *D. aurita* apresentou uma dieta mais diversa, usando um espectro mais amplo de invertebrados do folhiço, do que *M. nudicaudatus*, que possui uma dieta mais insetívora, consumindo mais formigas, cupins, baratas e besouros. Nossos dados mostram que ambas as espécies usam os mesmos recursos disponíveis, no entanto, a distribuição de *D. aurita* está ligada principalmente a abundância de recursos alimentares enquanto que a distribuição de *M. nudicaudatus* está mais associada a estrutura do seu microhabitat.

Palavras-chave: escolha de microhabitat, dieta, pequenos mamíferos, marsupiais, trópicos.

INTRODUCTION

Feeding habits and microhabitat choice are important traits of a species. These traits determine the places where the species could live (Harris, 1986; Lacher & Mares, 1986; Meserve, 1981; Thompson, 1987; Whittaker, Levin & Root, 1973). Previous studies on the diet of *Metachirus nudicaudatus* and *Didelphis aurita* reported the consumption of invertebrates (mainly insects), small vertebrates and fruits (Stallings, 1989; Cerqueira *et al.*, 1994; Leite *et al.*, 1994; Santori *et al.*, 1995). However, Santori *et al.* (1995) suggested that *M. nudicaudatus* has more restrict feeding habits than *D. aurita*, feeding most is upon insects. August (1984) observed a significative relation between *D. marsupialis* and several microhabitat measurements as canopy height, canopy density, percentage ground cover, diameter at breast height, number of species in DBH sample and percentage canopy cover. Cerqueira *et al.* (1994) found differences in microhabitat and food use between *M. nudicaudatus* and *D. aurita*.

Here we report the use of the invertebrate fauna as main food resource by two sympatric marsupial species, *Didelphis aurita* and *Metachirus nudicaudatus* (Didelphidae), living in the same mesohabitat and discuss the occupation of space in relation with their feeding habits and habitat choice.

STUDY AREA AND METHODS

Study area

The restinga forest at Barra de Maricá (22°57′30″ to 22°50′S, 42°50′ to 42°53′30″W), at Rio de Janeiro state, makes a patchwork of shrubs and low trees distributed upon sand barrier beaches and coastal sand plains, being floristically a subset of the vegetation of the Atlantic Forest (Cerqueira *et al.*, 1990). It is formed by dense tickets of shrub vegetation, mainly Myrtaceae, Bromeliaceae, Cactaceae, Erythroxylaceae, Apocinaceae, Anacardiaceae and Mimosaceae, with a canopy height of 1-5m, interspersed by barren sand patches (Cerqueira *et al.*, 1990). The area is formed by a mixture of herbaceous species and woody stems interlaced at several strata that produces a dense litter layer except in the small and sparse sand patches.

The climate is warm superhumid tropical (Nimer, 1979). The mean maximal temperature varies between 26°C and 28°C, and the mean minimal between 19°C and 21°C. The soil surface temperatures in open areas reach 50°C in the hottest hours in summer days (Araújo, 1984; Franco, 1987). The annual rainfall varies between 1250mm and 1600mm, with a moderately dry season between May and August (Cerqueira *et al.*, 1994). Mean humidity is around 80%. For a complete description of the area see Cerqueira *et al.* (1990).

Habitat analysis

In October 1987 a 1-ha area grid with 100 evenly spaced trap stations, from 10m to 10m, was established in the restinga forest. Microhabitat data were collected at the different vegetation levels (Tab. 1). Four independent sample units were centred in each trap station (Fig. 1): a circle 1.04m diameter; two perpendicular transects 5-m long cardinally oriented, with points placed every 0.5m, a circular area with a 10m diameter divided in quadrants and another 2.5m diameter. In each

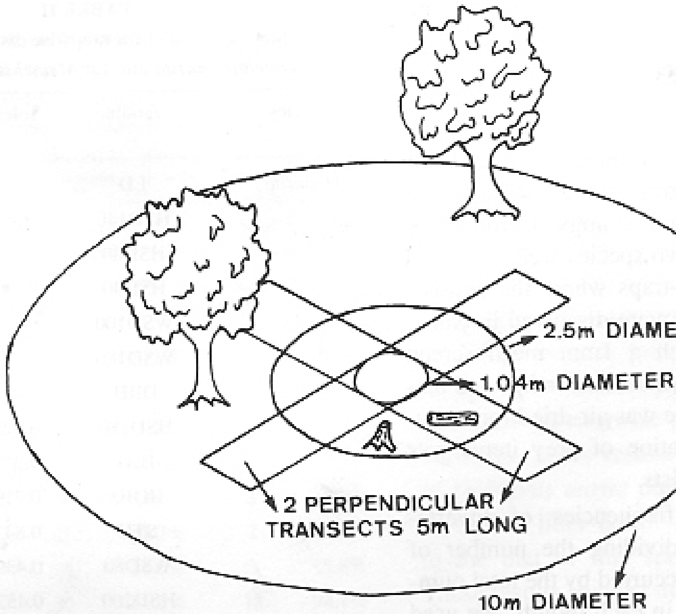

Fig. 1 — Habitat sampling units.

point, 37 microhabitat variables were taken (Table I).

The variables HSD, HD, WSD, WD and HOE were measured from the 1.04m circle. From the transects we measured SSE. In the 10m circle DIAM and DIST were measured, and finally, from the 2.5m circle, we measured HOL, DBH, HID, DC and STU. The variables LD and CH were measured over the trap station (Carvalho-Huber, 1989). Microhabitat comparisons were made between the trap stations' characteristics where species (called *Didelphis* and *Metachirus* groups) were present and the trap stations' characteristics where species were absent (called *Other* group).

TABLE I
Variables used in the microhabitat measurements.

Variable	Description
CH	Canopy height
WD	Woody species density
HD	Herbaceous species density
WSD	Woody stem density (0, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40, 1.60, 1.80, 2.00m)
HSD	Herbaceous stem density (0, 0.20, 0.40, 0.60, 0.80, 1.00, 1.20, 1.40, 1.60, 1.80, 2.00m)
HOE	Horizontal obstruction estimation (0-0.50, 0.50-1.00, 1.00-1.50m)
SSE	Soil surface exposure
LD	Litter-soil density (dry weight)
DIAM	Mean diameter of the closest tree
DIST	Distance to the closest trees
HOL	Number of holes
HID	Number of hiding places
DC	Number of trees with dead canopy
STU	Number of stumps
DBH	Trees of DBH ≥ 0.75m

Statistical tests used for habitat analysis were direct discriminant analysis and stepwise analysis using the Mahalanobis method.

Diet analysis

Diet was determined through faecal analysis. Faeces were obtained during a long term study on small mammals population ecology (Cerqueira *et al.*, 1993). Scats of the two species were collected from the bottom of live-traps where the animals spent the night. Samples were dissolved in water, and then filtered through a 1mm mesh screen sieve under running tap water. The undigested material retained on the sieve was air-dried for analysis. Taxonomic classification of prey items was done with help of specialists.

Monthly relative frequencies of invertebrates were calculated dividing the number of samples where the item occurred by the total number of samples collected in each month. We used the Mann-Whitney (U) test to compare these frequencies between the two species (Zar, 1984).

RESULTS

Habitat analysis

Discriminant analysis calculated for each species, using the direct method, were significant only for the *Didelphis* group (p = 0.0378 for 100% of the variance in the 1st function, with 96.15% of the cases correctly classified). The significant (p = 0.0002) measurement was litter density (LD).

The discriminant analyses for both *Didelphis aurita* and *Metachirus nudicaudatus* by the stepwise method were significant (p = 0.0000 and a classification of 94.23% and p = 0.005 and 93.27% of correctly classified groups, respectively). Significant measurements are in Table II. In *D. aurita* analyses, notice that the F value for LD is almost three times the value of the second variable selected and an order of magnitude above all others. In other words, LD was the most important microhabitat measurement for *D. aurita*, while for *M. nudicaudatus* significant measurements had same importance (the same order of magnitude).

Diet analysis

Invertebrates, vertebrates and fruits remains were found in the faeces of both *M. nudicaudatus* and *D. aurita* (Tab. III). For a complete description of the items found, also the discussion upon the use of vertebrates and fruits, see Santori *et al.* (1995).

Invertebrates, mainly from the litter, is the most important food resource for both species (100% of occurrence in *D. aurita* and 84% of occurrence in *M. nudicaudatus*). *M. nudicaudatus* seems to be more insectivorous than *D. aurita*, although there were no significant differences between the relative frequency of samples containing invertebrates (U = 60.0, P = 1.000). The latter species showed a wider spectrum of items consumed (Tab. III). Among the invertebrates consumed, *M. nudicaudatus* focused on Blattariae, Hymenoptera (mainly ants), Coleoptera and Isoptera were the commonest taxa.

TABLE II

Variables included in the stepwise discriminant analysis for *Didelphis aurita* and for *Metachirus nudicaudatus*.

Species	Variable	Tolerance	F for removal
D. aurita	LD	0.6506439	33.144
	HSD140	0.3340434	11.416
	HSD80	0.3378853	9.0974
	HSD40	0.7974202	8.6231
	WSD100	0.3555248	6.6894
	WSD180	0.7016911	4.1968
	DBH	0.7784402	4.0403
	HSD180	0.3752588	3.3474
	HID	0.7789811	2.9009
	HOE3	0.7192569	2.8480
	STU	0.8421140	2.5696
	WSD80	0.4395983	2.4687
	HSD200	0.4522981	2.3472
	HSD100	0.3913056	1.1704
M. nudicaudatus	HSD20	0.5826297	7.7277
	HOE3	0.4692809	5.1195
	WSD100	0.7499743	4.0024
	HOE2	0.4297401	3.3147
	HSD200	0.7503054	3.1694
	HSD80	0.4201012	2.9313
	SSE	0.7282350	2.5443
	LD	0.7772080	2.0490
	HOE1	0.4471349	2.0007
	HID	0.7721394	1.8827
	HSD140	0.4433060	1.0610

TABLE III

Main categories of items found in faeces of *Didelphis aurita* and *Metachirus nudicaudatus*. N.S.: number of samples; P.O.: percentage of occurrence, calculated as the number of samples containing each item divided by the total of samples collected, multiplied by 100; n.i. = not identified.

	Didelphis aurita n=52		*Metachirus nudicaudatus* n=19	
	N.S.	P.O.	N.S.	P.O.
VERTEBRATES (Total)	16	30.8%	5	26.3%
INVERTEBRATES				
Molusca	1	1.9%		
Crustacea	1	1.9%		
Arachnida	3	5.8%	3	15.8%
Miriapods	23	44.2%	2	10.5%
Orthoptera	18	34.6%	3	15.8%
Blattariae	35	67.3%	18	94.7%
Coleoptera	20	38.5%	13	68.4%
Hymenoptera	36	69.2%	16	84.2%
Isoptera	1	1.9%	13	68.4%
Diptera	1	1.9%	1	5.3%
Hemiptera	1	1.9%	1	5.3%
Dermaptera	1	1.9%		
INVERTEBRATES (Total)	52	100.0%	16	84.2%
FRUITS	28	53.8%	2	10.5%

We confirmed the preferentially terrestrial habits of both species by recording the use of litter fauna as their main food resource. *M. nudicaudatus* is stated to be predominantly terrestrial, while *D. aurita* may occasionally climb trees (Cerqueira *et al.*, 1990; Emmons & Feer, 1990; Grand, 1983; Reig *et al.*, 1987).

Didelphis is usually considered as omnivorous (Cordero & Nicolas, 1987; Emmons & Feer, 1990; Périssé *et al.*, 1988; Robinson & Redford, 1986; Streilein, 1982; Santori *et al.*, 1995). In another study (Santori *et al.*, 1995), *Didelphis aurita* presented a higher diversity of invertebrates eaten, and a more varied diet, using vertebrates, invertebrates and fruits. The importance of the litter fauna in its diet can be assessed from the fact that 100% of the samples contained invertebrates, mainly Hymenoptera (ants), Blattariae (cockroaches). *Metachirus nudicaudatus* has a more insectivorous diet (Emmons & Feer, 1990 and Santori *et al.*, 1995). The principal insects preyed by *M. nudicaudatus* were the same preyed by *D. aurita* but the former used more termites. The termite-eating habits of *M. nudicaudatus* were also recorded by Redford (1987) and Emmons & Feer (1990). According to Santori *et al.* (1995) the difference in the diversity of invertebrates consumed by *D. aurita* in the same locality suggests a certain degree of prey partitioning between those species.

The significant variables obtained in the discriminant analysis used for *D. aurita* were those related to litter density (LD), coinciding with the results of the stepwise procedure to choose better variables. These results showed that the presence of *Didelphis aurita* depended, chiefly, on the microhabitat litter density, what is probably related to the diet of this species (litter invertebrates). These results suggest that the presence of this species is related to the presence of food resources, microhabitat factors being of secondary importance.

The significant microhabitat variables for *M. nudicaudatus* were the ones related to the cover of the low herbaceous layer (0.20m) and the obstruction level beyond 1.0m. *M. nudicaudatus* also feeds mainly on litter fauna (Santori *et al.*, 1995). However, for *M. nudicaudatus*, the microhabitat characteristics are important, occupying microhabitats with denser lower and higher layers. The presence of stems in the low layer and the obstruction on the higher layers provides protection.

If one considers the size of these animals, litter density is clearly not related with protection. Therefore, it seems that *Metachirus nudicaudatus* not only chooses specific, denser microhabitats, while also looking for food, while occurrence of *Didelphis aurita* in a certain location seems linked to mostly to the presence of food. Maybe this species is not too dependent of habitat in the scale we studied, though in larger scales it certainly is (Cerqueira, 1985).

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