Population ecology and reproduction of the white-eared opossum *Didelphis albiventris* (Mammalia, Marsupialia) in an urban environment of Brazil

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The seasonal variation in numbers of individuals, causes for death, breeding season and litter size of the white-eared opossum, *Didelphis albiventris*, were studied in two small urban forest fragments of southern Brazil. In order to trap opossums, 30 live traps were used once a week in a forest fragment (5 ha) between February 1995 and January 1996. In addition, 10 traps were used twice a month in another area (2.5 ha) between November 1996 and February 1997. Individuals trapped were sexed, aged, and released. Females with litter had their pouch young counted. The bait used was banana with codfish liver oil. As results after an effort of 1770 traps set, 37 opossums were captured (20 females and 17 males) with the sex ratio being significantly equal ($p > 0.40$). Juvenile individuals were captured seasonally during the wet season (spring and summer). Since juveniles represented the most common individuals trapped, total abundances were higher during the wet season. Immigrations (plus births) rather than emigrations were thought to be the main factor for abundance variations. Moreover, road kill by cars and fights with dogs were the main causes for death of opossums. Based on time of captures of recently weaned opossums and females with litters, the breeding season showed mainly two periods of births (between August and November), though two litters were seen in April of two years. The mean litter size was 9.0 young (N = 14 litters). The white-eared opossum revealed a great potential to colonize urban environments where there are forest fragments, with its higher numbers of juveniles compensating adult deaths mainly by anthropical factors.

*A variação sazonal na abundância de indivíduos, as causas de morte, estação reprodutiva e tamanho de ninhada do gambá-de-orelha-branca, **Didelphis albiventris**, foram estudados em dois fragmentos florestais urbanos do sul do Brasil entre 1995 e 1997. Para as capturas dos animais, 30 armadilhas foram utilizadas semanalmente em uma das áreas (5 ha) e 10 armadilhas duas vezes por mês na outra área (2,5 ha). A isca utilizada foi uma mistura de banana com óleo de fígado de bacalhau comercial. Após um esforço de 1770 armadilhas armadas, 37 animais foram capturados (20 fêmeas e 17 machos) com a proporção sexual sendo significativamente igual ($p > 0,40$). Indivíduos jovens foram capturados mais sazonalmente, principalmente durante a estação úmida (pri-*

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mavera e verão). Como jovens foram capturados proporcionalmente em maior número, as maiores abundâncias foram observadas durante a estação úmida. As imigrações, junto aos nascimentos, foram os principais fatores a influenciar na variação das abundâncias. Atropelamentos por carros e brigas com cães foram as causas de morte observadas para a espécie. Baseando-se nos períodos de capturas de jovens recém-independentes das mães e de fêmeas com ninhadas, a estação reprodutiva de ***D. albiventris*** *apresentou dois períodos principais de nascimentos (entre agosto e novembro). O tamanho médio de ninhada foi de 9,0 filhotes (N = 14 ninhadas). O gambá-de-orelha-branca apresentou grande potencial para colonizar ambientes urbanos onde existem fragmentos florestais, com elevados números de jovens compensando as mortes de adultos principalmente por fatores antrópicos.*

Although the white-eared opossum, *Didelphis albiventris* Lund, 1841 (Fig. 1), shows a wide distribution in South America (1), only a few studies provide ecological data (2,3,4) such as the population dynamics of this marsupial (5,6), but several were conducted on reproduction (6-12). The present study presents data on some aspects of the population dynamics, breeding season and litter size of *D. albiventris* in two small urban areas of southern Brazil.

Study areas are in Curitiba, state of Paraná (25°25'S; 49°18'W), at 940 m above sea level. The first of them, namely COPEL, is 5 ha in size. The other area, namely UFPR, is 2.5 ha. They are 8 km apart and are composed of disturbed primary mixed ombrophyllous forests and surrounding open forests (about 10% sampled by traps in COPEL and 20% in UFPR; see below). There is a wet season (September to March) and a drier season (April to August) in the region, but not well-defined. The mean annual temperature is 16.5°C and the mean annual rainfall ranges from 1100 to 1600 mm (13).

Opossums were captured using 30 live traps (40x20x20 cm) in COPEL and 10 traps in UFPR which were uniformly placed in these areas at fixed points (following a grid pattern). These live traps were baited during the afternoon and checked for opossum captures the following morning once a week in COPEL (February 1995 - January 1996) and twice a month in UFPR (November 1996 - February 1997). The bait used was ripe banana and codfish liver oil. After capture, animals were sexed, aged (7,8), marked by combinations of holes on each ear (4) and released. Females with litters had their pouch young counted. Additional reproductive data were obtained through opossums randomly collected at other sites of Curitiba, usually near the study areas, until 1999. In COPEL, immigration data were obtained by dividing the number of new individuals in the area every two months by the number of "old" individuals captured there during the previous two months (14). The emigration data were calculated inversely, taking into account the exit of individuals outside the area. The cause for death of opossums was verified occasionally through direct observation in the study area and surroundings, besides other animals collected at other sites in Curitiba. The breeding season of opossums was determined by the time when pouch young and recent pouch released opossums were present in the population as well by the degree of their development (15).

During the field work, 1770 live traps were used which resulted in 37 individuals of *D. albiventris* captured (20 females and 17 males) and a total of 82 captures and recaptures. The sex ratio observed (56% females versus 44% males) did not differ significantly from the expected rate ($p > 0.40$, $df = 1$, Chi-Square test).

Abundances of *D. albiventris* were high during the spring and summer and low during winter months (Table 1). Similarly, in the COPEL area, the immigration of new individuals was more pronounced between August-September 1995 and December-January 1996 (from 75 to 230% of new individuals, respectively, in relation to the 'resident' individuals). During April to July, the immigration was only 20%. The emigration was high during October to January when 100% of individuals left the COPEL area. This exit rate was lower between April and September when emigration averaged 50%.

Regarding age structure, infant individuals appeared seasonally in the areas during the spring and summer months. Subadults appeared later, mainly in the autumn. Adult individuals were dominant during the winter months. In both study areas pouch young occurred at low rates in all seasons (Fig. 2) but additional data from other sites of Curitiba revealed eight litters during August-September (57%), four litters during November-January (29%) and only two litters in April (14%) out of a total of 14 litters seen.

The main causes for death of opossums were road kill (N = 10) and, secondarily, fights with dogs (N = 3). Adult males of age class 5 were mainly found killed on roads while adult females in general were killed by dogs or cars. Some of these had pouch young.

The mean litter size was found to be 9.0 ± 2.2 (range: 5 to 12; modal classes: 8 and 12; N = 14 litters). The mean number of teats was 11.3 (N = 10 females). Two younger females (age class 3) weighing 550 and 575 g were seen with litters in January 1996 and February 1999. Two females with well-developed teats but without litters (young left in the den?) were trapped in September and November 1995.

Figure 1. *Individual of the white-eared opossum,* ***Didelphis albiventris****, in a tree in the COPEL area, Curitiba, southern Brazil.*

Table 1 - Relative abundance (number of individuals/number of traps used) of the white-eared opossum, *Didelphis albiventris*, in an urban region of southern Brazil.

	Spring	*Summer*	*Autumn*	*Winter*
Number of individuals trapped	17	18	6	5
Total abundance	0.038	0.040	0.014	0.012
Adult abundance	0.013	0.002	0.007	0.012
Number of traps used	450	450	450	420

Pouch young were not considered.

The sex ratio seen here for *D. albiventris* is similar to those found by other investigators that have worked with *Didelphis* in South America (4,5,14, 16,17,18). The population levels observed here are also similar to others found elsewhere (4,5) but they were lower than those sympatric marsupial, *D. aurita*, in the COPEL area (14). The abundance was high in the wet season because it is the time of the appearance of many recently weaned opossums in the population (15). This is confirmed by the fact that the number of pouch young in *D. albiventris* was higher than that of adults and subadults (14,16). This situation is caused by the high mortality of young opossums killed by predators (19).

Immigration plus births contribute greatly to the population fluctuations of *D. albiventris*, as was reported for *D. aurita* in southern Brazil as well (14). The high rate of immigration seen here probably occurs due to the changes caused by the onset of the breeding season (20). Besides the higher number of litters during August and September, the onset of breeding might be determined by the occurrence of released young during wetter periods of year, which is well known in *Didelphis* (6,7,14,21). Thus, the onset of breeding for *D. albiventris* here is thought to be during the start of the winter (July)(11), a period that precedes the wetter months. Breeding individuals arise from two rather than three birth peaks that usually occur in this genus (6,14,15,16,22,23). The breeding season of *D. albiventris* in southern Brazil appears to end in the autumn as is usually the case for *Didelphis* (10,11,12, 14,23). This time is indicated by the dominant numbers of subadults and adults in the population (Fig. 2).

As mentioned previously (14), anthropical factors are the main causes for opossum mortality in urban environments (2). Taking into account opossum deaths on roads, the low time of permanence of individuals in the fragment (24), and the high emigration/immigration rates (mainly in the wet season), an almost complete population turnover of *D. albiventris* is expected in about 1 year in mixed forest fragments of southern Brazil (14). In addition, juveniles grow rapidly (25) and reach high numbers in the wet season and are therefore probably strong competitors for resources in small forest fragments. Thus the white-eared opossum revealed a great potential to colonize urban environments where there are forest fragments, with its higher numbers of juveniles compensating adults killed on roads and by dogs.

The mean litter size of *D. albiventris* is about 77% of its mean number of teats. This rate is higher than the 50% reported for several marsupials in Venezuela (26). In another study in the COPEL area, a similar rate was found for *D. aurita* (76%) (23). In southeastern Brazil, a rate of 93% was seen for *D. albiventris*, and the teat number limited the litter size there (4). However, latitudinal and altitudinal variations may be the most important factors to control litter sizes in *Didelphis* (8,15,21). In this view, the mean litter size observed here is relatively high when compared with other studies at lower latitudes and altitudes (4,8,9,10,27) except, however, for the case reported in Argentina (12). ■

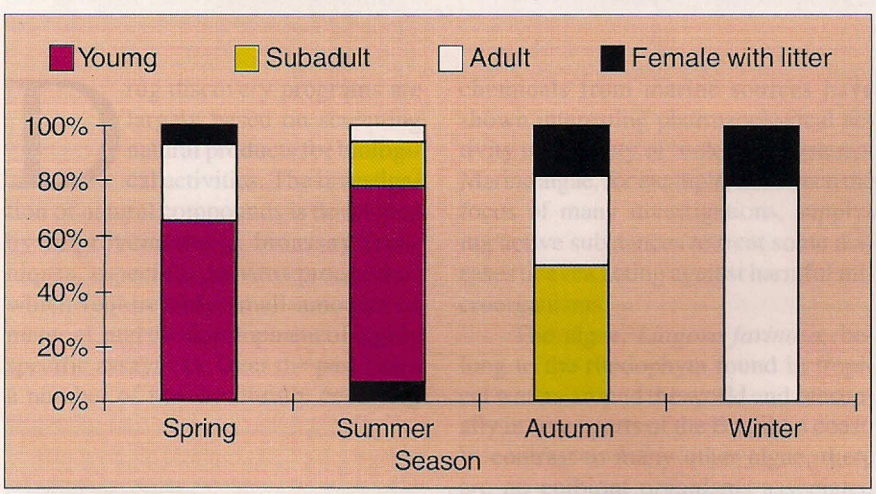

Figure 2. *Relative abundances of the white-eared opossum,* ***Didelphis albiventris****, captured in two small forest fragments of Curitiba, southern Brazil, between 1995 and 1997. All black columns at the top are adult females except for a black column at the bottom that belongs to a young female with litter. Adults are presented excluding pouch young females.*

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