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SHORT COMMUNICATION

Synanthropic behavior of the Neotropical palm swift *Tachornis squamata* (Apodiformes: Apodidae) in the Brazilian Caatinga

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ABSTRACT. The Neotropical palm swift, *Tachornis squamata* Cassin, 1853 (Apodidae), inhabits palm forests in the northern, northeastern and central regions of South America. At the Chapada do Apodi, Brazilian Caatinga, we investigated how the Neotropical palm swifts use palm trees to roost in two areas: urban and exurban. From May to November 2011 and from March to June 2012, out of the breeding season of the species, we compared the differences between the descriptive parameters of the palm-roosts and the activity levels of the swifts in urban and exurban roosting. We sampled 30 carnauba palm-roosts in exurban areas and 32 carnauba palm-roosts and 26 Chinese fan palm-roosts in urban areas for a period of 132 days, a total of 528 hours of sampling. The number of wasp nests was greater in carnauba palm-roosts in exurban areas than in palm-roosts in urban areas. However, there were greater numbers of swift nests and swifts in palm-roosts in urban areas than in exurban areas. Moreover, the activity levels (number of entry and exit events of swifts in the palm-roost) during sunrise (05:00-05:20 a.m.) and sunset (05:41-06:00 p.m.) were significantly lower in the exurban area than in the urban area. These results may contribute to establish better management practices for the coexistence between wildlife and humans in cities.

KEY WORDS. Caatinga; carnauba palm; Chinese fan palm; roost; synurbization.

The Neotropical palm swift, *Tachornis squamata* Cassin, 1853 (Apodidae) is a small Apodidae that inhabits palm forests in the northern, northeastern and central regions of South America (Chantler 1999). The species requires specific palm trees to roost and nest in their leaves, especially in fronds of leaves that are cracked at the base and suspended (Sick 1948). Swifts primarily use native buriti palm trees, *Mauritia flexuosa* Lf (Arecaceae), and carnauba palm trees, *Copernicia prunifera* (Mill.) H.E. Moore (Arecaceae), and their dependence can partly explain the close correspondence between the distribution of Neotropical palm swift and palm trees (Sick 2001). Swifts nest and roost across the urban gradient in northern and northeastern Brazil. In urban areas, swifts nest and roost in the exotic Chinese fan palm tree (*Livistona chinensis* Brown ex Martius, 1838, Arecaceae), which has leaves that are morphologically similar to those of the buriti and carnauba palm trees (e.g., Carvalho 1962, Sick 2001).

Species of Apodidae have an ambiguous relationship with humans. On the one hand, human activities have decreased their natural foraging, nesting and roosting habitats (Chantler 1999). For example, nest harvesting can significantly decrease the reproductive success and consequently the population size of some swifts (e.g., Tompkins 1999). On the other hand, many species have benefited from man-made habitats (Chantler 1999). For example, swifts use human constructions to nest and/or roost (e.g., Baldwin & Hunter 1963, Michael & Chao 1973, Collins 2010). Several studies on animals have revealed ecological and behavioral differences in populations of species in urban and exurban areas (review in Luniak 2004).

In this study, we investigated the use of palm trees by Neotropical palm swifts in urban and exurban areas in the Brazilian Caatinga. Our objectives were to 1) compare descriptive parameters of the palm trees used by the swifts to roost, 2) compare the activity levels of the swifts in the communal roosts during sunrise and sunset in the urban and exurban areas, and 3) analyze whether or not swifts exhibit synanthropic behavior in the Brazilian semiarid.

We investigated Neotropical palm swifts' roosting at the Chapada do Apodi, in northeastern Brazil. We studied carnauba palm-roosts in the Caatinga forest in exurban areas (from: 4°48'S, 37°14'W to 5°35'S, 37°57'W) and Chinese fan and carnauba palm-roosts in the urban areas of Apodi city (5°39'S, 37°47'W; 34.763 inh) and Mossoró city (5°11'S, 37°21'W; 259.815 inh, available in: http://www.censo2010.ibge.gov.br). The palm-roosts analyzed were at a distance ⩾ 3 km from each other to ensure independence of sampling.

Data were collected from May to November 2011 and from March to June 2012, between 05:00-12:00 a.m. and 12:00-19:00 p.m., outside the breeding season of the species. We sampled 30 carnauba palm-roosts in exurban areas and 32 carnauba palm-roosts and 26 Chinese fan palm-roosts in urban areas for a period of 132 days, a total of 528 hours of sampling. We recorded the following descriptive parameters of the palm trees used as communal roosts by Neotropical palm swifts: 1) palm height; 2) trunk circumference at breast height (CBH, measured 1.37 m above the ground); 3) length of the palm's crown (vertical distance from the top of the leaves to the inferior extremity of the lowest suspended leave); 4) number of wasp nests in the palm crown; 5) number of swift nests present in the palm crown (swift nests remain in the palm crown also during the non-breeding period in the Brazilian semiarid, pers. obs.); 6) number of swifts (mean of censuses of swifts that left and did not return up to one hour before sunrise (05:00-06:00 a.m.) and that entered and remained for at least one hour after sunset (05:00-06:00 p.m.), in a same day for each studied roost); and 7) number of palm trees within 10 m and within 11-100 m (census of palm trees in a circular area of 10 m and between 11-100 m radius around the roost, respectively).

The activity levels (number of entry and exit events of swifts in the palm-roost) were estimated by focal observations during the periods of sunrise and sunset. During each focal observation, we recorded the number of entry and exit events of the swifts in the roost at ten consecutive-minute intervals and recorded the activity level in the roost as the total number of entry and exit events of the swifts within sunrise and sunset periods. During each week of sampling, we made observations on the activity levels in all three conditions – carnauba palm-roosts in urban and exurban areas and Chinese fan palm-roosts in urban areas – to avoid the influence of variations on sunrise and sunset times in the data analysis.

We used the one-way (based on 1,000 bootstrap samples, Adams & Anthony 1996) and post hoc Tamhane tests for the analysis of variance (equal variances not assumed), to test for differences in the descriptive parameters of roosts of Neotropical palm swifts in carnauba palm trees in urban and exurban areas, and Chinese fan palm trees in urban areas. Chi-Square analyses and the adjusted residual (-2.8 > AR > 2.8, Zar 1999) were used to compare activity levels of swifts in palm-roosts during three time intervals during sunrise and sunset in urban and exurban areas.

In this study, of the eight descriptive parameters investigated for Neotropical palm swift roosts, five were significantly different among the three conditions: carnauba palm-roosts in urban and exurban areas, and Chinese fan palm-roosts in the urban area (Table I). The carnauba and Chinese fan palm-roosts did not differ in height, length of the tree crown or presence of other palm trees in a 10 m radius (Table I). However, palm trees were more common in a radius of 11-100 m in the exurban area than in the urban area. The number of wasp nests was also significantly greater in carnauba palm-roosts in the exurban area than in palm-roosts in the urban area. Furthermore, we observed wasps building their nests on swifts' nests (Fig. 1). On the other hand, the number of swifts' nests and swifts were greater in palm-roosts in the urban area than in the exurban area (Table I). The activity levels in the roost during sunrise and sunset were significantly lower in the exurban area (χ^2 = 129.06, N = 2,535, df = 10, $AR_{05:00-05:20am}$ = -5.7, $AR_{05:41-06:00pm}$ = -3.6, $p < 0.001$) than in the urban area (Fig. 2).

In this study the number of wasp nests was greater in carnauba palm-roosts in the exurban area than in palm-roosts in the urban area. Moreover, the number of swift' nests and swifts was greater in palm-roosts in the urban area than in the exurban area. It is likely that the smaller number of wasp nests found in palm-roosts in urban areas favor the permanence of the swift in these areas. Other factors, for instance the levels predation on swifts' nests and food supply may also influence the permanence of the swifts in urban areas (see Luniak 2004, Chace & Walsh 2006) – since the diversity of predators is greater in exurban areas and the density of prey probably is greater in urban areas (pers. obs.). Swifts were more common in Chinese fan palm than in the carnauba palm. This result may be associated with the size of the leaves and consequently with the greater availability of roosting areas, since Chinese fan palm

Table I. Descriptive parameters of the palm trees used by the Neotropical palm swifts for roosting in the Brazilian semiarid region. Significant p-values: ^{abc} $p \leqslant 0.05$; ns = non-significant; *CBH = trunk circumference at breast height.

Descriptive parameters	Carnauba palm-roost in exurban area^{a} (N = 30)	Carnauba palm-roost in urban area^{b} (N = 32)	Chinese fan palm-roost in urban area^{c} (N = 26)	ANOVA F (df = 2, 85)
	Mean ± SD	Mean ± SD	Mean ± SD	
Tree height (m)	11.8 ± 3.9	10.4 ± 2.6	10.5 ± 4.4	1.449^{ns}
*CBH (m)	0.8 ± 0.2	0.8 ± 0.2	1.2 ± 0.2	$35.330^{ac, bc}$
Length of the tree crown (m)	5.3 ± 2.4	5.3 ± 1.4	5.6 ± 1.8	0.263^{ns}
Number of wasp' nests	2.4 ± 2.2	1.2 ± 1.5	0.7 ± 1.5	$6.968^{ab, ac}$
Number of swifts' nests	4.1 ± 2.1	10.0 ± 6.2	13.0 ± 6.6	$20.229^{ab, ac}$
Number of swifts	4.8 ± 3.1	13.1 ± 11.8	24.5 ± 17.8	18.398^{abc}
Number of palm trees within to 10 m	22.4 ± 37.9	6.8 ± 3.9	7.3 ± 3.7	4.694^{ns}
Number of palm trees within to 11-100 m	31.0 ± 27.2	11.2 ± 4.6	5.7 ± 4.3	19.157^{abc}

Figure 1. Wasps building their nest on Neotropical palm swift nests. Photo by Vitor O. Lunardi.

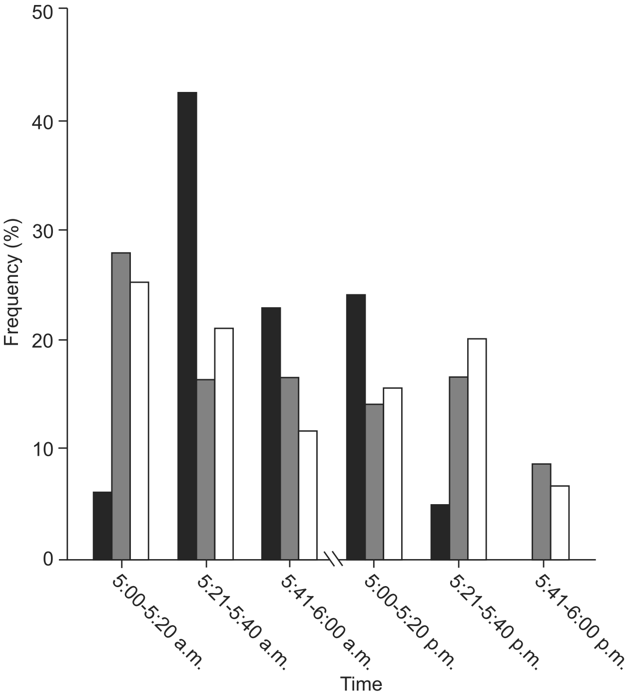

Figure 2. Frequency of activity level of Neotropical palm swifts in carnauba palm-roosts in (■) urban and (▨) exurban areas and (□) Chinese fan palm-roosts in the urban area, in northeastern Caatinga, Brazil, according to sunrise and sunset times.

trees have wider and longer foliar blades than carnauba palm trees (pers. obs.) and swifts use these leaves to roost.

When we analyzed the activity level of the swifts in the roosts, we detected that the diurnal activity period of these swifts in the urban area was longer than in the exurban area. The influence of artificial lighting in the urban area is probably one of the most plausible explanations (see Luniak 2004), considering that urban areas in the Caatinga where the species is common (e.g., squares and avenues) are illuminated by artificial light at night. For example, alpine swifts, *Tachymarptis melba* (Linnaeus, 1758) (Apodidae), were observed feeding under artificial light at night in Switzerland (Freeman 1981). The american robin, *Turdus migratorius* (Linnaeus, 1766) (Turdidae), begins to sing sooner in areas where artificial light is intense than in areas where it is not (Miller 2006). Visual forager shorebirds also consumed more prey in areas with low-intensity artificial light during the night in the Tagus Estuary, Portugal (Santos *et al.* 2010).

The comparative analysis of the characteristics of swift roosts in urban and exurban areas revealed behavioral adjustments to live in cities. The presence of carnauba and Chinese fan palm trees in cities in northeastern Brazil is improving the safety of nesting and roosting in the urban landscape (see Sick 2001). Although the presence of swifts in northeastern Brazil is sometimes undesired by humans because they produce large amounts of feces (Sick 2001), the species may be seen as a potential biologic control of vectors (e.g., Diptera, see Collins & Thomas 2012) of human diseases in the Neotropical region. Our results indicate that swifts form larger aggregations to roost in urban areas than in exurban areas. This result may contribute to establish better management practices for the coexistence between wildlife and humans in cities, since the presence of natural elements (e.g., native birds) in the cities can improve the quality of life of people and contribute to the provision of ecosystem services (Whelan *et al.* 2008).

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