Predation of Birds Trapped in Mist Nets by Raptors in the Brazilian Caatinga

Juan Ruiz-Esparza[1,2,5]
Patrício Adriano da Rocha[1,3]
Adauto de Souza Ribeiro[4]
Stephen F. Ferrari[4]

[1] Graduate Program in Ecology and Conservation, Universidade Federal de Sergipe, Avenida Marechal Rondon s/n, 49.100-000 São Cristóvão – Sergipe, Brazil.

[2] PRODEMA, Universidade Federal de Sergipe, Av. Marechal Rondon s/n, 49.100-000 São Cristóvão–Sergipe, Brazil.

[3] Graduate Program in Zoology, Universidade Federal da Paraíba, João Pessoa–Paraíba, Brazil.

[4] Department of Biology, Universidade Federal de Sergipe, Avenida Marechal Rondon s/n, 49.100-000 São Cristóvão – Sergipe Brazil.

[5] Corresponding author; e-mail: juancolorado21@hotmail.com

ABSTRACT

Mist-netting is a widely used procedure for the capture of flying vertebrates such as birds and bats. Once captured and immobilized, the animals are vulnerable to attacks from predators until removed by researchers. Attacks on trapped animals have been recorded at a number of sites, although few systematic data, such as predation rates, are available. We analyzed attacks on birds captured in mist-nets at a site in the Caatinga scrub forests of northeastern Brazil. A total of 979 birds were captured during 6,000 net-hours of sampling, of which 18 (1.8%) were found dead in the nets with signs of predation. While it was not possible to identify the predator in most cases, a Roadside Hawk (Rupornis magnirostris) *was captured together with a dead Flavescent Warbler* (Basileuterus flaveolus), *with injuries similar to those observed on the other victims, which suggests that raptors may have been responsible for the majority of the attacks. It is hoped that more systematic reports of the phenomenon, even when there are no victims, may help provide a database for the identification and resolution of potential problems in this sampling procedure, in order to minimize losses in future studies.*

Resumen:

La red de neblina es una técnica de captura de vertebrados voladores como aves y murciélagos. Una vez capturados e inmovilizados, los animales son vulnerables a ataques por predadores hasta su extracción. Ataques de animales atrapados han sido registrados en diferentes lugares, aunque los datos son poco sistemáticos, tales como clasificación de la depredación están disponibles. Analizamos ataques contra las aves capturadas en redes de neblina en la Caatinga y regiones aledañas en el nordeste de Brasil. Un total de 979 aves fueron capturadas durante 6,000 horas-red de muestreo, donde 18 (1,8%) fueron encontradas muertas en la red de neblina con señales de la depredación. En la mayoría de los casos no fue posible identificar el predador, un Gavilán de los Caminos (Rupornis magnirostris) *fue capturado junto con un Chiví Amarillento* (Basileuterus flaveolus) *depredado, heridas similares fueron observadas en las otras aves, sugiriendo que rapaces pudieron haber sido responsables por los otros ataques. Se espera que informes más sistemáticos del fenómeno, incluso cuando no hay víctimas, pueden ayudar a proporcionar una base de datos para la identificación y la resolución de problemas potenciales en esta técnica de muestreo, para reducir al mínimo pérdidas en los estudios futuros.*

INTRODUCTION

Mist-netting is a standard procedure for the capture of birds (Ralph et al. 1996) and bats and has been used at many different sites worldwide over many decades. However, as this method immobilizes the specimen in an exposed position, it also poses a certain risk with regard to the captured animal's vulnerability to predation. Despite the popularity of the procedure, few data are available on the rates of attack or loss of captured specimens from predation, and it is unclear to what extent this problem of predation may affect mist netting in general, and specific sites or taxonomic groups in particular.

A number of recent studies have reported on predation of captured organisms during the trapping of birds (Recher et al. 1985, Brooks 2000, Garske and Andrade 2004, Brown and Collier 2006, Curcino et al. 2009, Sakai unpubl. field notes) and bats (Brito et al. 2007, Gazarini et al. 2008, Novaes et al. 2010). Identified predators include reptiles, such as the Jesus Christ Lizard (*Basiliscus sp.*) and the Green Parrot Snake (*Leptophis ahaetulla*), mammals, such as carnivores Crab-eating Fox (*Cerdocyon thous*) and Small Indian Mongoose (*Herpestes auropunctatus*), opossums, such as White-eared Opossum (*Didelphis albiventris*) and monkeys, the Blue Monkey (*Cercopithecus mitis*), other birds, such as the Laughing Kookaburras (*Dacelo novaeguineae*) and raptors the African Goshawk (*Accipiter tachiro*), Black Goshawk (*A. melanoleucus*), Brown Goshawk (*A. fasciatus*), Collared Sparrowhawk (*A. cirrocephalus*), Sharp-shinned Hawk (*A. striatus*), White-necked Hawk (*Leucopternis lacernulata*), American Kestrel (*Falco sparverius*), Roadside Hawk (*Rupornis magnirostris*), Northern Pygmy-Owl (*Glaucidium gnoma*), and Red-chested Owlet (*Glaucidium tephronotum*), and even ants (Ralph et al. 2007). However, Recher et al. (1985) and Brooks (2000) are the only two of these studies to provide reliable estimates of the relative frequency of predation.

The present study provides quantitative data on the loss of birds to predation during mist-netting at a site in the Caatinga, the semi-arid scrubland of northeastern Brazilian.

METHODS

The study took place at the Serra da Guia in the northwestern extreme of the Brazilian state of Sergipe, between Oct 2008 and Sep 2009 (for a full description, see Ruiz-Esparza 2010). Each month, a standardized sample was collected, in which ten 3 x 12-m mist-nets were set at the same net lanes along existing trails. The nets were opened for three days each month at a site in the scrub vegetation (Caatinga proper) at 09° 58' 09" S, 37° 51' 52"W (420 m), and for a further three days in a small enclave of cloud forest known locally as "brejo de altitude" at 09° 58' 55" S, 37° 52' 06" W (750 m).

The nets were opened in morning (0500-1200 hrs) and afternoon (1600-2100 hrs) sessions to best sample both diurnal and nocturnal bird species. The nets were checked at hourly intervals throughout each session, the maximum interval recommended by Ralph et al. (1996). Each captured specimen was retrieved carefully from the net and transported in a cloth bag for processing. The trapping was authorized by the Brazilian Environment Institute (IBAMA) through special license 15900-1 and followed the recommendations of the Federal Bird Protection Center (CEMAVE 1994).

RESULTS

During the 12 months of the present study, a total of 979 birds were captured in 6,000 net-hours of sampling effort. These specimens represented 98 species belonging to 27 families (Ruiz-Esparza 2010). However, 77 (7.8%) of the specimens were found dead in the nets. Three-quarters of these individuals (59) had died from unidentified causes, which probably included stress or hyperthermia, given the lack of any external signs of injury. The other 18 (1.8% of the total sample) presented clear signs of predation.

Most of the 12 species that suffered predation were recorded only once (Table 1), and only one species, the Pileated Finch (*Lanio pileatus*), was recorded more than once in a given month. The most striking pattern in the data is the concentration of records on a single day in October, when six individuals, one third of the total for the month, were found dead, including the three *L. pileatus*, as well as Rufous-browed Peppershrike (*Cyclarhis gujanensis*), Olivaceous Woodcreeper *Sittasomus griseicapillus*) and Rufous-crowned Greenlet (*Hylophilus poicilotis*). While these events occurred throughout the morning (0500-1200 hrs) and late afternoon (1600-1700 hrs), it seems possible that at least some are related to the behavior of a single predator, and in fact, two of the *L. pileatus* were found almost simultaneously during the same net check, and the *C. gujanensis* and *S. ruficapillus* were found together in the same net. If the records from this day are excluded from the analysis as a possibly anomalous occurrence, the predation rate would decrease to 1.2% (n = 979 captures).

Table 1. Records of birds that suffered predation while trapped in mist nets at Serrs da Guia, Sergipe, between October 2008 and September 2009.						
			Mean[1] Adult Body			
Taxon	Species	Common Name	Length (cm)	Weight (g)	N	Month of Mortality
Columbidae	*Leptotila verreauxi*	White-tipped Dove	26	130	3	Nov, Jul, Jan
Thamnophilidae	*Thamnophilus pelzelni*	Planalto Slaty-Antshrike	18	18	1	May
Dendrocolaptidae	*Sittasomus griseicapillus*	Olivaceous Woodcreeper	`14	11	1	October
Tyrannidae	*Hemitriccus margaritaceiventer*	Pearly-vented Tody-tyrant	9	7	1	February
	Myiarchus tyrannulus	Brown-crested Flycatcher	18	25	1	November
	Tolmomyi8as flaviventris	Yellow-breasted Flatbill	11	10	1	January
Vireonidae	*Cyclarhis gujanensis*	Rufous-browed Peppershrike	15	22	1	October
	Hylophilus poicilotis	Rufous-crowned Greenlet	10	7	1	October
Turdidae	*Turdus amourochalinus*	Creamy-Bellied Thrush	22	53	2	April, May
Thraupidae	*Schistochlamys ruficapillus*	Cinnamon Tanager	18	20	1	October
Emberizidae	*Lanio pileatus*	Pileated Finch	12	14	3	October
Parulidae	*Basileuterus flaveolus*	Flavescent Warbler	14	14	2	Nov, Jul
[1] Data from the present study (see Ruiz-Esparza, 2010).						

Considering these same 12 records as a more representative sample of the phenomenon, one potentially meaningful pattern is the fact that the two largest-bodied species, White-tipped Dove (*Leptotila verreauxi*) and Creamy-Bellied Thrush (*Turdus amaurochalinus*), accounted for almost half (41.7%) of the attacks. This suggests a relationship between body size and predation rates, which may either be related to their greater potential value as prey and/or their greater visibility. Certainly, the largest of the species, *L. verreauxi*, was attacked at a considerably higher rate than expected by chance; i.e., three of the 15 animals captured or 20.0%, as against 1.8% in the general sample. The numbers are less conclusive in the case of *T. amaurochalinus*, given that 52 birds were netted.

The exclusion of this day from the analysis as an outlier from the monthly data, no more than three records were collected in any given month. While the sample size is small, there is little evidence of any systematic variation among months. In fact, the most striking monthly pattern is the lack of predation events in the two months in which most birds were netted; i.e., December and June (Fig. 1). By contrast, October was the month with the lowest tally of captured birds (n = 40). This would appear to contradict the hypothesis that predation events were stimulated by the availability of potential prey (number of trapped birds). It supports the conclusion that these predation events were determined by more or less random factors, unless the exceptional events recorded in October are somehow linked to the fact that this was the first month of mist-netting at the site.

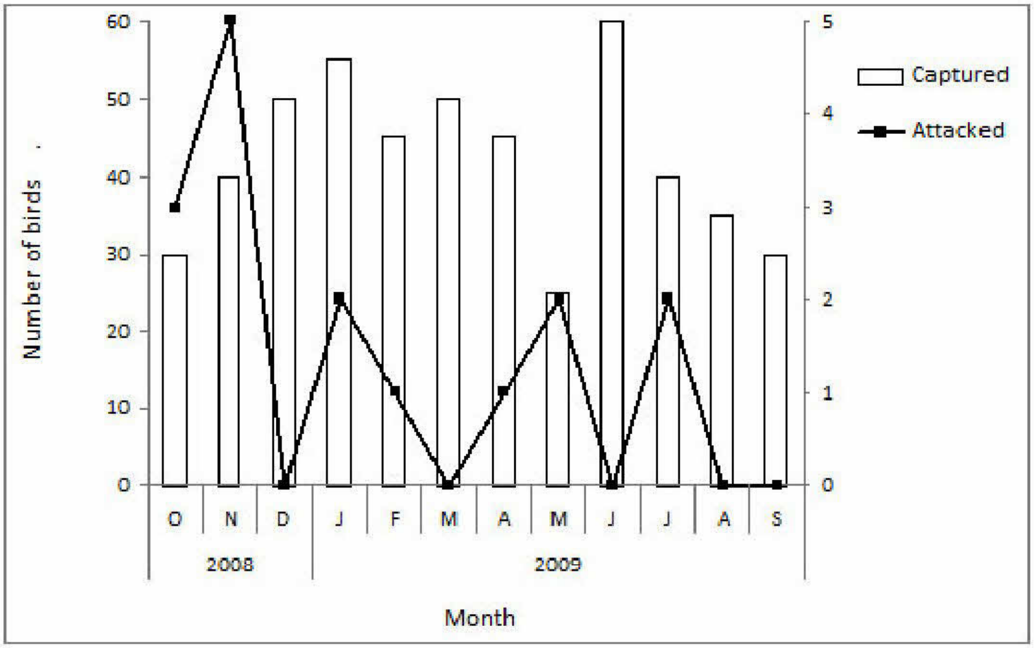

Fig. 1. Number of birds captured and the number of predation events per month at Serra da Guia, Sergipe.

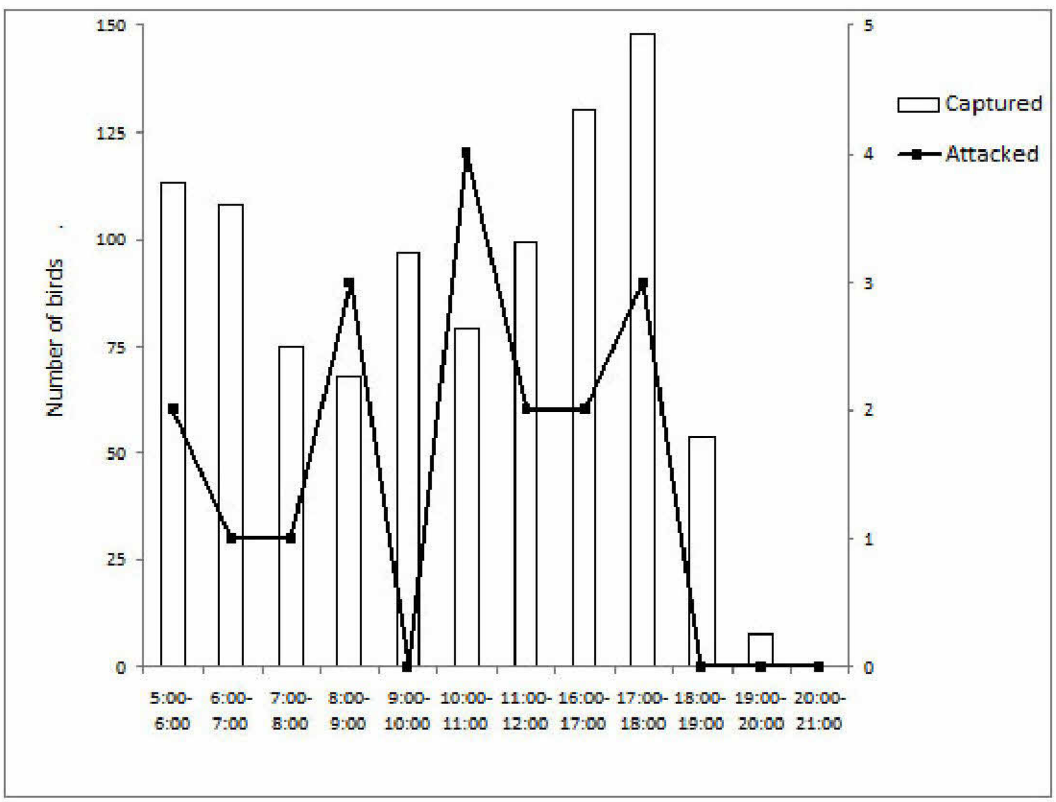

Fig. 2. Number of birds captured and the number of predation events per hour at Serra da Guia, Sergipe (October 2008 through September 2009)

Similarly, there was no evidence of any effect of the time of day on predation rates (Fig. 2), although the relatively small number of records probably precludes any reliable conclusion here. The only possible pattern is a lack of predation after 1800 hrs, which indicates the potential importance of visual cues, although the reduced number of birds netted during this period precludes a more definitive conclusion. During the rest of the day, predation rates did not appear to be influenced by capture rates, given that the largest number of predation events (4) was recorded at 1000-1100 hrs, one of the least successful hours for netting, while three events were recorded at 1700-1800 hrs, the peak time for bird captures.

With one exception, it was not possible to confirm the identity of the animal responsible for the mortality of the trapped birds. The one documented case was that of a Roadside Hawk, *Rupornis magnirostris*, which was captured together with a dead Flavescent Warbler (*Basileuterus flaveolus*) in November on the forest trail. This warbler presented characteristic wounds on the dorsum and head, which were consistent with those found on all the other attacked specimens. The other species predated upon were the Olivaceous Woodcreeper (*Sittasomus griseicapillus*), Planalto Slaty-Antshrike (*Thamnophilus pelzelni*), Pearly-vented Tody-tyrant (*Hemitriccus margaritaceiventer*), Brown-crested Flycatcher (*Myiarchus tyrannulus*) and Yellow-breasted Flatbill (*Tolmomyias flaviventris*). They presented characteristic signs of predation, including the lack of the head and wounds to the back, head, and abdomen.

Two other species of raptor, the Bicolored Hawk (*Accipiter bicolor*) and the Tropical Screech-Owl (*Megascops choliba*), were also trapped in the mist nets. While owls were encountered in the mist-nets on six different occasions, they were only captured during the first hour of the day and after 1800 hrs, which is consistent with their nocturnal habits, and would appear to be unlikely candidates for the majority of the recorded predation events (Fig. 2). A single adult *A. bicolor* was captured in November, and a second *R. magnirostris* was netted in February.

Other potential avian predators were seen in area (Ruiz-Esparza 2010), as the Great Black-Hawk (*Urubitinga urubitinga*), Southern Caracara (*Caracara plancus*), Yellow-headed Caracará (*Milvago chimachima*), American Kestrel (*Falco sparverius*), Gray-headed Kite (*Leptodon cayanensis*) and Barn Owl (*Tyto alba*). Also the possibility of non-avian predators exists, in the area they had been found (Rocha et al. in prep), as the Jaguarundi (*Puma yagouaroundi*), White-eared-opossum (*Didelphis albiventris*), Crab-eating Fox (*Cerdocyon thous*) and Little spotted cat (*Leopardus tigrinus*).

DISCUSSION

The predation of birds captured in mist-nets is reported infrequently in the literature, possibly because the phenomenon is rare in most cases and, as such, is likely to go unrecorded. Alternatively, there may be a tendency for events to go unreported when the predator was not identified, as was the case for all but one of the incidents recorded in the present study. Even when they are available, most published reports provide only anecdotal information on these events (Brown and Collier 2006, Curcino et al. 2009, Sakai unpubl. field notes), so it is almost impossible to ascertain any estimate of their frequency, in terms of either the number of studies affected, or the rate of occurrence of the phenomenon under different sampling conditions, or in different regions or bird communities.

In the present study, the distribution of predation events did not appear to be related clearly to factors such as season, time of day or habitat, but seemed to have occurred randomly. The only identified predator was a Roadside Hawk (*Rupornis magnirostris)*, coincidentally, the same species recorded by Cucino et al. (2009) in Goiás, Brazil. Brooks (2000) recorded two attacks by African Goshawk (*Accipiter tachiro)* in Kenya, while Recher et al (1985) recorded attacks by Brown Goshawk (*Accipiter fasciatus)* and Collared Sparrowhawk (*A. cirrocephalus*) in Australia. A Bicolored Hawk (*Accipiter bicolor*) was captured in the present study, but there is no reliable evidence of its involvement in the predation of trapped birds. While Tropical Screech-Owl (*Megascops choliba*) was captured in almost half the months of the study period, these owls were only active during the crepuscular and nocturnal periods, which exclude them from most predation events.

Almost all other recorded attacks on captured birds (and bats) have involved mammals (Brooks 2000, Brown and Collier 2006, Brito et al. 2007, Gazarini et al. 2008, Novaes et al. 2010, Ruiz-Esparza et al., in prep.). Most of the events recorded by Brooks (2000) involved the blue monkey (*Cercopithecus mitis*), although the only primate that occurs in our study area was the common marmoset (*Callithrix jacchus*), which is probably too small (adult body weight = ~300 g) to prey effectively on birds trapped in mist-nets (Lyra-Neves et al. 2007). The wounds found on all the dead birds in our study were consistent with those inflicted by *R. magnirostris* on *Basileuterus flaveolus*; i.e., they were almost certainly caused by some type of raptor.

Even if the exceptional day in October 2008, when six predation events were recorded, is excluded from the analysis as an anomalous occurrence, 1.2% of the birds netted during the present study were the victims of predation. Recher et al. (1985) recorded rate of 1.3% in their Australian study (53 mortalities in 4,184 captured birds). By contrast, Brooks (2000) recorded a predation rate of only 0.6% in Kenya (almost 4,000 birds netted), and Spotswood et al. (2011) found a mean mortality of only 0.23% in a review of the data from 22 organizations that use mist nets in the USA and Canada. Given the lack of data from other studies, it is unclear to what extent either of these rates may be typical of studies of this kind.

The loss of any birds during trapping is undesirable, especially when it involves the members of endangered species, which fortunately was not the case here. While the present study provided reliable data on predation rates, insights into determining factors were lacking. Although the nets were checked every hour, the maximum interval recommended by Ralph et al. (1996) for studies of this kind, one possibility is that, under certain circumstances, more frequent inspections might be required, although the exact circumstances remain unclear. Certainly, other authors have recommended much shorter monitoring intervals. Bonter (1999) recommends 15 to 30 minute intervals, for example, while Churchwell and Barton (2006) advocate the participation of volunteer predator patrollers. During the present study, however, the lack of personnel and the relative isolation of the study site impeded the implementation of either strategy.

What is clear from this study is that more information is required on the phenomenon in order to provide more reliable estimates of predation rates and insights into possible determinants, which could be compensated for in research design. It would thus be extremely useful if more researchers who capture birds using mist nets reported on this aspect of their fieldwork, even when no predation occurs, or the predators are not identified.

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