

NATURAL HISTORY NOTE

Opportunistic predation events of bats entangled in mist nets by margay *Leopardus wiedii* (Schinz, 1821) in northwest Honduras: recommendations to avoid preventable casualties

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DOI:<https://doi.org/10.14709/BarBJ.14.1.2021.04>

Keywords: *Artibeus jamaicensis*, Central America, cloud forest, Felidae, mist-netting, trophic interaction

received: December, 15th 2020
 accepted: April, 14th 2021

ABSTRACT

Predation of entangled bats captured in mist-nets is common but infrequently documented. As such, this welfare issue is often not considered when mist-netting surveys are being designed. Margays (*Leopardus wiedii*) are small neotropical cats that are known to have a varied diet and exhibit opportunistic hunting behaviour. Despite bats not having been frequently reported as a prey item for margays, studies on this felid's feeding ecology remain scarce. We discuss the potential for margays to feed on bats when they become entangled in mist nets, providing two examples from Cusuco National Park, Honduras. In light of this, we provide recommendations as to how such opportunistic predation events can be mitigated in future surveys.

The margay (*Leopardus wiedii* (Schinz 1821)) is a small, solitary, mainly nocturnal felid inhabiting tropical and subtropical forests from Mexico to Uruguay (de Oliveira 1998, de Oliveira et al. 2015, Quintero-Angel & Ospina-Reina 2011). Information about its behaviour and diet remains limited (Reid 2009), although it displays greater adaptability for climbing trees than other neotropical felids, and frequently predated on arboreal mammals (Bianchi et al. 2011). Studies conducted in Brazil, Venezuela and Belize have described the margay's feeding ecology from faecal samples and stomach content analysis (Mondolfi 1986, Konecny 1989, Wang 2002, Bianchi et al. 2011). None of these studies listed bats as a prey item, despite most species in their results being nocturnal. However, Da Cunha et al. (2017) indicate that knowledge of margays' dietary habits remains incomplete, and that their dietary niche is in likelihood broader than current research suggests.

Neotropical bats are known to be predated by many species of mammals, birds, arthropods, reptiles and amphibians (Molinari et al. 2005, Mikula 2015, Mikula et al. 2016, Tinoco & Camacho 2015, Brown & Diotallevi 2019). Predation on bats by felids is infrequently reported in the literature (e.g., Moreno et al. 2006, Rocha-Mendes & Bianconi 2009). Here we report two events of margay predated bats entangled in mist-nets during surveys within the buffer zone of Cusuco National Park (CNP), north-western Honduras, a protected area of tropical montane cloud forest

and adjacent lowland habitats. The events occurred during monitoring surveys run by Operation Wallacea Ltd to study the bat community in CNP (see Medina-van Berkum et al. 2020). This is a long-term project where mist-net surveys are conducted at 31 independent trapping sites over an eight-week period running between June and August each year. Mist-netting sites were surveyed in rotation. Once a mist-netting site was sampled, it was not surveyed again for at least three nights.

Nets in this survey were opened just before sunset and kept open for six hours, with net checks being completed every 15-30 minutes. The opportunistic predation events observed were in a mist-netting site located in a riparian forest habitat surrounded by shaded coffee plantations (15° 30' 41.04"N, 088° 11' 07.9"W) at an elevation of 999 m a.s.l.

First event

The remains of four bats were found, attached to three separate mist nets, during a survey on 7th July 2018 at approximately 23:30. The species of these bats could not be determined given that they had been partially eaten. Shortly after this, a margay was observed sitting near (c. 15m) the mist-netting area (Fig. 1). The surveyors decided to keep the nets open and check the nets every 10 minutes for the rest of the night, but soon observed the margay again in the vicinity of the nets. Thereafter, nets were closed and

the survey cancelled (after c. 5hrs 30min of being open). The same site was surveyed again as part of the ongoing monitoring project on the 13th of July and no further incidence of opportunistic predation occurred. The team therefore decided to continue surveying the area, checking the nets at more regular intervals (always 15 minutes) to deter further predation events.

Second event

The second opportunistic predation event occurred on 17th July 2018 at the same survey site. The remains of four bats were found during the final net check of the night at 00:30, all showing evident signs of cat predation (distinctive puncture marks and wounds on the wings and body consistent with felid claws). Shortly after arriving at the site, a margay was spotted walking slowly along the mist nets (as if checking them for bats) and then leaving the site. The remains of two of the predated bats could be identified as juveniles of the species *Artibeus jamaicensis* (Leach 1821) (Fig. 2). On 19th July, during a mist-netting survey 2 km upstream from the site where these events occurred, another margay was observed in the vicinity of the survey site, but on this occasion it did not approach the nets.

Our observations support previous research by Rocha-Mendes & Bianconi (2009) suggesting that margays may predate on bats in Brazil. This note provides the first evidence of margay predated on bats in Honduras. In the events described above, the margays may have initially approached the nets due to being alerted by the distress calls produced by the trapped bats. Distress calls are a type of loud, audible social call emitted by bats in distress (August 1985, Middleton et al. 2014). They appear to have two main functions: alerting other bats to the presence of a danger and communicating a request for assistance (Russ et al. 2004, Middleton et al. 2014). Thus, bats often respond to these calls by flying towards the source of the sound (August 1985) which can subsequently increase mist-net capture rates if the bat emitting the sound is trapped. The volume of distress calls on the nights of the opportunistic predation events was greater than normal as these coincided with periods of relative high mist-net capture rates; 43 individuals caught on the 7th July, and 37 individuals caught on 17th July, compared to an average of 23 bats captured per night for this site (based on 2006-2018 capture data), including multiple juvenile *A. jamaicensis* on both nights. The observations of margays at the same site on different occasions and the “net checking” behaviour exhibited by the felids (also reported by Rocha-Mendes & Bianconi 2009) may suggest that local populations recognized our mist-netting site as a potential food resource area.

A study on the stomach content of an ocelot (*Leopardus pardalis* (Linnaeus 1758)) from eastern Ecuador found remains of four bats from two different species, suggesting that this felid may also predate on bats more frequently than previously reported (Tinoco & Camacho 2015). Since other felids (both large and small) have been confirmed to predate bats, it is expected that margays will prey on bats when they are available. However, evidence of this trophic interaction is still scarce and more research is needed.



Fig. 1 - Margay (*Leopardus wiedii*) observed near mist nets in the buffer zone of Cusuco National Park, north-west Honduras.



Fig. 2 - Corpses of two *Artibeus jamaicensis* killed by a margay (*Leopardus wiedii*) in Cusuco National Park, north-west Honduras. Both individuals were found entangled in a mist-net.

Opportunistic predation attempts of entangled bats by other species have also been previously observed during our fieldwork in CNP. In 2015, an individual of the Near Threatened species *Bauerus dubiaquercus* (Van Gelder 1959) was found dead in the upper shelf of the net, presumably killed by an owl. Also in 2015, an opossum (*Didelphis* sp.) was observed predated an *A. jamaicensis* individual. Although such events are generally rare during surveys in CNP, they nevertheless represent a cause for concern, especially given the presence of globally and regionally threatened species in the park such as *B. dubiaquercus* and *Hylonycteris underwoodi* (Thomas 1903) (Medina-van Berkum et al. 2020).

Predation of entangled bats captured in mist-nets is infrequently documented (Serra-Gonçalves et al. 2017). As such, this welfare issue is not often taken into account when mist-netting surveys are being designed. Best practice recommendations for mist-netting currently state that nets should be checked every 15-20 minutes and the lowest shelf of the nets set at a safe height (Bosco Breviglieri & Pedro 2010, de Carvalho et al. 2016, de Carvalho et al. 2018, Serra-Gonçalves et al. 2017). To reduce the possibility of predation events, we recommend that the minimum time

threshold described in these sources (15 minutes) should be used, and emphasize that these checking intervals should be completed at all times (even when bat activity is low). Additionally, if bats at a site are predated repeatedly, the site should no longer be used, and a different survey location (separated by a distance appropriate to the home range of the predating species in question) should be chosen to avoid further attacks. Given that opportunistic predation events such as these may be more widespread than currently thought, due to low reporting rates (de Carvalho et al. 2018), we encourage researchers to publish similar observations. This could improve bat welfare during mist-netting surveys as well as provide further valuable information on their potential predators.

ACKNOWLEDGMENTS

This research was supported by Operation Wallacea Ltd. We thank Joxan Orlando Ayala and Marcy Kanuka for their invaluable help with bat surveys during this expedition. We also thank Expediciones y Servicios Ambientales de Cusuco for logistical support, and Instituto Nacional de Conservación y Desarrollo Forestal, Áreas Protegidas y Vida Silvestre (ICF) for providing the necessary permit to complete this research. Finally, we thank two anonymous reviewers for their helpful and constructive comments on an earlier version of the manuscript.

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