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Morelet's crocodile predation by jaguar in the Calakmul Biosphere Reserve in southeastern México

Depredación del cocodrilo de pantano por jaguar en la Reserva de la Biósfera Calakmul en el sureste de México

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Panthera onca is the largest feline in America. Its diet has been studied in several countries, and reptiles have been identified as part of it. Despite being one of the most studied felines in Mexico, the depredation of *P. onca* towards crocodiles had not been documented with photographic evidence until now. This note documents for the first time with a photograph, a *Crocodylus moreletti* depredated by a *P. onca*, in southeastern Mexico.

Key words: Calakmul; carnivores; diet; mammals; whaterholes; wild cats.

Panthera onca es el felino más grande de América, su dieta ha sido estudiada en diversos países, y se ha identificado que los reptiles son parte de ella. A pesar de ser uno de los felinos más estudiados en México, hasta ahora no se había documentado con evidencia fotográfica la depredación de *P. onca* hacia cocodrilos. En esta nota se documenta por primera vez en fotografía un individuo de *Crocodylus moreletti* depredado por un *P. onca*, en el sureste de México.

Palabras clave: Aguadas; Calakmul; carnívoros; dieta; felinos silvestres; mamíferos.

In México, the most important jaguar populations are found in the southeast of the country. An estimated population size of over 900 jaguars has been estimated in the Calakmul region of Campeche alone (Ceballos *et al.* 2002). This area has been classified as high priority for jaguars (Sanderson *et al.* 2002). Actually the potential habitat for jaguar, is mainly found in the Jaguar Conservation Units (JCU) located in the southern and eastern portions of the Yucatán Peninsula, in areas such as Calakmul (including the Maya Reserve in Guatemala and Río Negro in Belize; Rodríguez-Soto *et al.* 2011; Rabinowitz and Zeller 2010). Recently a study to validate a corridor for jaguars in Campeche, Hidalgo-Mihart *et al.* (2015, 2017), found the presence of jaguars in various of the areas considered as part of the Calakmul-Términos Lagoon corridor. Camera trapping showed female jaguars, as well as the presence of animals for more than one season in the same area, which could be considered as evidence of a resident population.

Jaguars are opportunist carnivores whose diet varies according to prey availability, including more than 85 species of mammals, birds, reptiles and large invertebrates (De Azevedo and Murray 2007; Reid 2009; Aranda 2012), in México has been documented as variable but some preys are preferred, such as the white-tailed deer (*Odocoileus virginianus*), the collared peccary (*Pecari tajacu*), the coatimundi (*Nasua narica*) and the nine banded armadillo (*Dasypus novemcinctus*; Aranda and Sánchez-Cordero 1996; Núñez *et al.* 2000). Recently, it has been documented that jaguars have modified their diets to include smaller animals, unlike Pleistocene's Era where they mainly fed on large animals (Ripple *et al.* 2014). Reptile predation by jaguar has been documented in México but mostly on turtles (Emmons 1989; Cuevas *et al.* 2014). The crocodilians also are components of the jaguar diet, especially during the first stages of jaguar life. In Amazonia, jaguars frequently feed on caiman (*Melanosuchus niger*; Cavalcanti and Gese 2010; Da Silveira *et al.* 2010). However, in México crocodilian predation has been poorly documented. For example, in Calakmul, Pérez-Flores (2018) documented jaguar predation on *Crocodylus moreletti*, based on evidence left on a crocodile's dead body.

In this article we report a case of *C. moreletti* captured by a jaguar based on photographic evidences collected by camera traps in the Calakmul Biosphere Reserve (CBR), near waterholes (locally called aguadas) which are the main source of water, both for wildlife and for humans.

These waterholes are the only source of water for wildlife and for most of the human communities that surround the protected area (Reyna-Hurtado *et al.* 2010). This water scarcity in the region makes these waterholes a meeting point for several wild species. The change in rainfall patterns in recent years in Calakmul due to climate change increases the problem of waterholes (Mardero *et al.* 2019).

From February to June 2019 ten digital camera traps: Cudddeback (Non Typical Inc., De Pere, WI, USA), and Browning (Trailcam pro), were deployed in 10 waterholes (calls locally aguadas) located in the CBR with the goal of recording wildlife species visits to southern México. Cameras were tied to a nearby tree at an approximate height of 50 cm and were aimed at the waterhole. The cameras were programmed to take pictures continuously for 24 hours.

On March 19, 2019, a camera located at 18°18'42.27" N and 89°51'22.93" W took a photographic record of a male jaguar carrying, in its mouth, a dead juvenile *C. morelletti* (Figure 1). In Calakmul region, *C. morelletti* is the only species of crocodilians that has been recorded (Barao-Nóbrega *et al.* 2016). The photo shows the jaguar holding the dead C. *morelletti* by the head, apparently transporting it to another place. It is also possible to observe the jaguar's body covered in mud, most likely from getting the crocodile from the waterhole.

This photo is an evidence of a natural jaguar behavior that is reported as very common in South America but has rarely been documented in México, which may be due to the lack of camera traps in wetlands. The photo was taken in March, one of the driest months of the year in the area.

Figure 1. a) Jaguar (Panthera onca) carrying a crocodile (*Crocodylus moreletti*) obtained with camera trap in 18°18'42.27" N and 89°51'22.93" W, in Calakmul Biosphere Reserve on the Yucatán Peninsula, Mexico. b) The jaguar was observed returning to the same camera trap station 5 days later, suggesting that it is a resident of the area.

In the CBR the soil is made of calcareous origin and most of the rain falls percolate underground where there are only a few places for water to accumulate. In 2019, water levels in the waterholes were very low, due to a very poor rainy 2018 season, which made crocodiles an easy prey for jaguars. As seen in the photo, the jaguar was entirely covered in mud, suggesting that it entered the waterhole to capture its prey.

The waterhole where the photograph of a jaguar with a crocodile in its mouth was recorded is approximately a 1 ha area and is surrounded by trees with a dominance of *Haematoxylum campechianum* and *Bucida buceras*, which maintains a high canopy cover over the waterhole. It is a site where is kept a constant presence of tourists, since it is located on the only road to the archaeological zone of Calakmul. In this watering hole the biological monitoring is constant, on the behalf of the CBR. The aguadas in CBR are the main source of water, both for wildlife and for humans. A study by Reyna-Hurtado *et al.* (2019) mentions that the availability of water in the reserve was drastically reduced in early 2018. The level of aguadas in recent years has reduced due to the decrease in precipitation and the prolonged droughts. Recently, rainfall prediction models for the area and for the Yucatán Peninsula suggest that rainfalls have changed dramatically in the last 40 years. Over the past ten years, these changes have been particularly intense for the CBR (Mardero *et al.* 2019).

During the dry season, many aguadas are dry and some with minimum water levels. In the dry season, the fauna uses the waterholes to hydrate and reproduce, among other physiological needs. For example, the white-lipped peccary is one of the main preys of the jaguar, however, this species needs the aguadas for its survival. By decreasing the level of aguadas due to the lack of rainfall, the peccaries are forced to travel greater distances in the search for water. Also, this condition of aguadas has led crocodiles to become easy preys for jaguars. Normally, all the watering holes register presence of crocodiles. Jaguars are likely to stay within their range of activity by taking advantage of available prey, while peccaries make large migrations to more humid sites due to the size of the herd. This record provides information on the behavior of the jaguar and indicates that at least occasionally, it hunts morelet's crocodiles and that they are probably part of its diet in the CBR. All these changes in the ecosystem need to be monitored and understood to elaborate conservation or management actions to preserve Calakmul Biosphere Reserve's endangered species and their interactions.

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