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SHORT NOTE

PREDATION ON SCARLET MACAW (*ARA MACAO CYANOPTERA*) CHICKS BY COLLARED FOREST FALCONS (*MICRASTUR SEMITORQUATUS*) IN THE MAYA BIOSPHERE RESERVE, GUATEMALARony García-Anleu¹ · Gabriela Ponce-Santizo¹ · Steve Gulick² · Janice Boyd³ · Donald J. Brightsmith³ · Roan Balas McNab¹¹Wildlife Conservation Society – Guatemala, Avenida 15 de Marzo, Casa No. 3, Flores, Petén, CP 17001, Guatemala.²Wildland Security, 658 W. Onondaga St., Syracuse, NY 13204, USA.³Schubot Exotic Bird Health Center, Department of Veterinary Pathobiology, Texas A&M University, College Station, TX 77845, USA.E-mail: Rony García-Anleu · rgarcia@wcs.org

Abstract · Through efforts of the Wildlife Conservation Society, poaching in an important Scarlet Macaw (*Ara macao cyanoptera*) nesting area in the Maya Biosphere Reserve in Guatemala had been reduced to zero by 2004. However, during long-term monitoring of the nesting success of Scarlet Macaws in the Maya Biosphere Reserve, unexplained or unknown disappearance of chicks from nests was common despite the aforementioned reduction in poaching. To determine the cause of these disappearances, we installed five video camera surveillance systems in the nest cavities during the 2008 nesting season. Fatal attacks on chicks by Collared Forest Falcons (*Micrastur semitorquatus*) were recorded at three of these nests. This result highlights natural predation as a limiting factor for the recruitment of new individuals into the Scarlet Macaw population in the Maya Biosphere Reserve even when poaching is suppressed.

Resumen · Depredación de pichones de Guacamayas Rojas (*Ara macao cyanoptera*) por Halcones Selváticos de Collar (*Micrastur semitorquatus*) en la Reserva de la Biosfera Maya, Guatemala

A través de los esfuerzos de la Wildlife Conservation Society, el robo de pichones de Guacamayas Rojas (*Ara macao cyanoptera*) en una importante zona de anidación de la Reserva de la Biosfera Maya en Guatemala ha sido reducido a cero desde el año 2004. Sin embargo, durante el monitoreo a largo plazo del éxito de anidación de las guacamayas rojas en la Reserva de la Biosfera Maya, la desaparición por razones desconocidas de pichones de los nidos fue común a pesar de la reducción de robos anteriormente mencionada. Para determinar la causa de estas desapariciones, instalamos cinco sistemas de vigilancia de cámaras de video en los nidos durante la temporada de anidación de 2008. En tres de estos cinco nidos se registraron ataques fatales contra pichones por parte del Halcón Selvático de Collar (*Micrastur semitorquatus*). Este resultado destaca la depredación natural como un factor limitante para el reclutamiento de nuevos individuos en la población de Guacamayas Rojas en la Reserva de la Biosfera Maya, incluso cuando se suprime el robo de pichones.

Key words: *Ara macao cyanoptera* · Collared Forest Falcon · Guatemala · Maya Biosphere Reserve · *Micrastur semitorquatus* · Natural predation · Scarlet Macaw

INTRODUCTION

The Scarlet Macaw (*Ara macao*) is the most widely distributed of all macaw species and is classified as *Least Concern* in the IUCN Red List of Threatened Species (BirdLife International 2012). However, the Mesoamerican subspecies, *A. m. cyanoptera*, is threatened in much of Central America by poaching and habitat loss (Britt et al. 2014); in Guatemala, the species is classified as category 2 in the National List of Endangered Species (CONAP 2009). Nesting sites for Scarlet Macaws in Guatemala are located on the western edge of the large block of intact forest in the Maya Biosphere Reserve (MBR) that forms the western flank of the tri-national (Guatemala, Mexico, and Belize) Maya Forest, the largest block of tropical forest remaining in Mesoamerica (Radachowsky et al. 2012). Until the early years of this century, sustained poaching and habitat loss were pushing the Scarlet Macaw towards extinction in the MBR. Since 2003, concerted efforts by Guatemalan government institutions

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Table 1. Information on the fate of Scarlet Macaw (*Ara macao cyanoptera*) natural nests under video surveillance in Laguna del Tigre National Park, Guatemala, during the 2008 nesting season. Internal diameter and cavity depth were estimated and not measured. Hatchlings are the number of chicks that were born in the nest, and fledglings are chicks that survived the entire season and fledged from the nest. All nests were located in *Acacia glomerosa* live trees.

Cavity ID	Internal diameter and cavity depth (centimeters)	Entrance height and long (centimeters)	Cavity height (meters)	Recording dates (% , # of days recorded)	# Hatchlings	# Fledglings	Chicks fate
Resumidero 13	30, 30	30x28	16.2	20 March–02 May (53%, 23)	2	0	Falcon attack, predated
Lily	40, 90	15x38	15.9	20 March–30 April (71%, 29)	2	2	Bee attack, survived
P11C	35, 49	35x43	22.4	21 March–29 May (26%, 18)	2	2	Not attacked
TE20	90, 186	76x86	12.59	21 March–15 May (58%, 32)	1	0	Falcon attack, predated
Carolina	30, 56	29x26	19.0	26 March–1 May (67%, 24)	1	0	Falcon attack, predated

and the Wildlife Conservation Society-Guatemala (WCS) have reduced the frequency of macaw poaching and protected nesting sites from deforestation and forest fires (WCS 2010). These conservation efforts have also helped protect the Maya Forest itself by helping to intensify protection efforts where macaws nest, along a deforestation frontier known locally as “The Shield.” Although these interventions are paying dividends and the number of macaw chicks poached every year has been reduced, integrated biological monitoring and protection efforts will be required over the mid-term to sustain the gains in governance registered to date. By 2004, poaching was reduced to zero in one of the principal macaw nesting sites around the archaeological site of Waká-Perú in the Laguna del Tigre National Park (17°15'N, 90°21'W). Nevertheless, WCS-led nest monitoring revealed that chicks were disappearing without explanation from nests that were not being poached (RG-A unpubl. data). To determine the cause(s) of these disappearances we installed video surveillance systems in five nest cavities during the 2008 nesting season.

METHODS

Study site and nests. Our study was carried out in Laguna del Tigre National Park, the largest management unit of the Maya Biosphere Reserve; the topography is relatively flat with an elevation < 300 m a.s.l., and average annual precipitation of 1600 mm (Bestelmeyer & Alonso 2000). There were 10 active nests in the site during the study, all of them in natural cavities located in *Acacia glomerosa* (Acaciaceae) trees. For internal reasons we used cavity IDs to discriminate the nests.

Video surveillance. The five systems were designed and constructed by Steve Gulick. A black-and-white

high resolution cube camera (Sony® PC182XS) and a 950 nm infra-red LED (China Young Sun LED Technology Co., Ltd., Model YSL-R531FR1C-F1) were mounted inside each of the five nest cavities; trees were climbed with rappel equipment and the cameras were fixed to the cavity ceiling with steel wire passed through holes drilled with a portable hand drill. The cameras were connected with a 30.4 m long Audio Video Power Cable to a Neuros OSD® recorder which saved video files to a HITACHI® 160GB hard drive, protected against humidity and dust by a Pelican® 1200 Case (all cable connections were sealed with silicone adhesive). Power was supplied by a 12-volt vehicle battery. The battery and Pelican case were both hidden below the leaf litter. Each system was set to record video in mp4 format 24 hours every day at 30 frames per second and was checked every 10 days to replace the memory and battery. Systems were deployed in five nests (Table 1) with physical characteristics that permit the installation of the cameras inside the cavity and not accessible by the chicks or adults macaws beak. In order to minimize the perturbation to the breeding process, the systems were deployed after the incubation period ended.

RESULTS

The systems recorded 26–71% (Mean = 55%, SD = 18%, n = 5) of the days between deployment and last record date of each system (Table 1). System failures were due to unexplained failures of the battery system, followed by malfunctioning of the hard disk or the camera due to humidity. Three Collared Forest Falcon (*Micrastur semitorquatus*) attacks on macaw chicks of different ages were recorded (Figure 1). One case of an attack by Africanized bees was also recorded. Each case and major cavity nest dimensions are detailed below and summarized in Table 1.

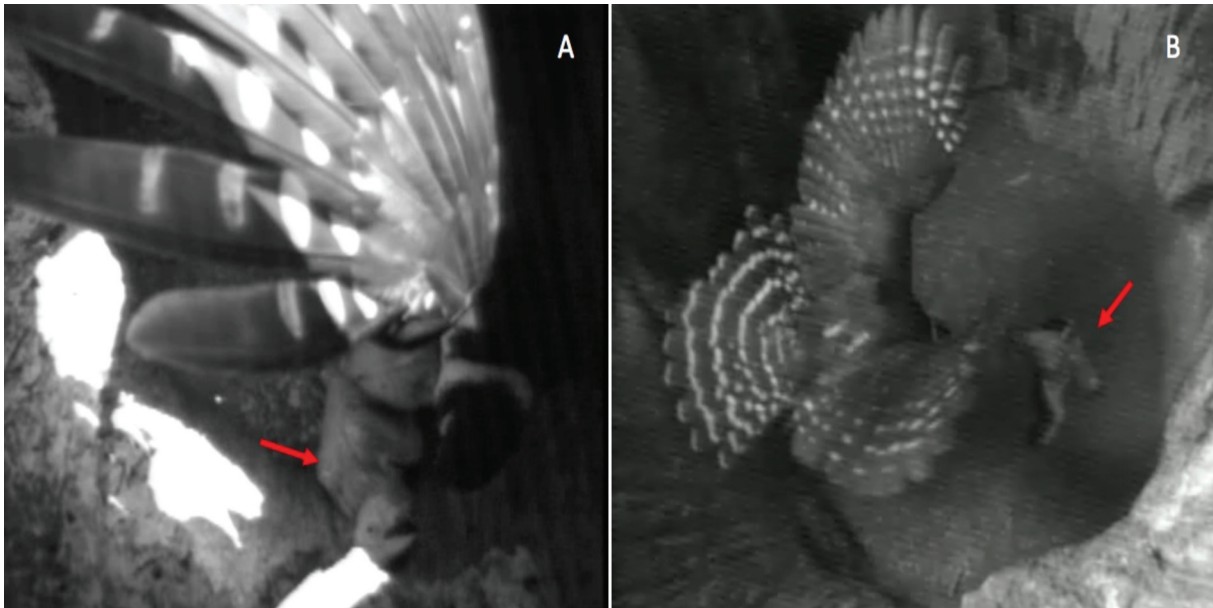


Figure 1. Collared Forest Falcon (*Micrastur semitorquatus*) preying on Scarlet Macaw (*Ara macao cyanoptera*) chicks in Laguna del Tigre National Park. Actual frames extracted from the videos obtained 31 March with the video surveillance systems installed inside Resumidero 13 (A) and 27 March inside TE-20 (B) cavity nests during 2008 nesting season. Macaw chicks indicated with a red arrow.

Case 1 (Nest TE20). One chick 20–25 days old was predated on 27 March, 18 minutes after the two adult macaws left the nest. The attack lasted about 180 seconds, and the two adult macaws returned to the nest 41 seconds after the falcon left the nest. The falcon spent considerable time in the nest because the cavity was large enough (internal diameter approximately 90 cm) for the falcon to kill the single chick inside the nest before removing it from the nest.

Case 2 (Nest Resumidero 13). The nest had an internal diameter of approximately 30 cm and contained two chicks that were inside the nest and one aged 10–15 days was predated on 31 March at 12:10 h. The falcon entered the nest, grabbed the chick, and flew quickly from the nest in an attack lasting less than three seconds. Before the attack one adult had been in the nest but left at 12:08 h, two minutes before the attack. One of the parents entered the nest at 12:13 h, three minutes after the attack. The second chick in the nest disappeared between 8–15 April but the recording system was not working at that time.

Case 3 (Nest Carolina). The nest had an internal diameter of approximately 30 cm and only one chick aged 10–15 days old that was predated on 8 April at 12:12 h. The falcon dropped to the bottom of the nest, grabbed the chick, and quickly flew from the nest in an attack lasting about two seconds. Two adults had been inside the nest but left 19 minutes before the attack at 11:53 h. They returned and perched at the entrance of the cavity at 12:54 h, 42 minutes after the attack.

Case 4 (Nest Lily). An Africanized bee (*Apis mellifera scutellata*) infestation or attack lasting about three hours was recorded in the nest on 30 April. The exact time was not available due to an error in the time setup of the recorder, but it seems that it occurred during day light. From the beginning of the attack, the chicks were moving around the nest cavity, shaking the head and trying to climb to the entrance of the cavity. The parents were not inside the nest during the attack, but entered the nest cavity a few minutes after the attack finished and tried (apparently unsuccessful) to feed the chicks. The two chicks of about 60 days of age survived.

DISCUSSION

The Collared Forest Falcon has been reported as a nest predator of several different Neotropical psittacine species: Military Macaw (*Ara militaris*) in Mexico (Bonilla et al. 2014, de la Parra et al. 2015), and Red-and-Green Macaw (*Ara chloropterus*) (Guedes 2003) and Hyacinth Macaw (*Anodorhynchus hyacinthinus*) (Guedes 2009) in Brazil. In addition, the falcon has been reported as a nest competitor for Hyacinth Macaw (Carrara et al. 2007, Guedes 2004) and Red-and-green Macaw (Carrara et al. 2007, Silva et al. 2005) in Brazil, Military Macaw in Mexico (de la Parra et al. 2015), and Scarlet Macaw in Costa Rica (Vaughan et al. 2003) and Guatemala (RG-A unpubl. data).

It was impossible to determine if the same Collared Forest Falcon individual was involved in the three documented attacks. The events occurred over a period of 12 days, and the nests were separated by 295 to 979 m. The home range reported by Thorstrom

Table 2. Breeding success of Scarlet Macaw (*Ara macao cyanoptera*) nests monitored at the Maya Biosphere Reserve, Guatemala. Hatchlings are the number of chicks that were born in the nest, and Fledglings are chicks that survived the entire season and fledged from the nest. Percentage of chicks which disappeared are the hatchlings that did not fledge divided by total number of hatchlings (Hatchlings – Fledglings)/Hatchlings x 100). Based on WCS (2011, 2012, 2013, 2014, 2015).

Season	Nest monitored	Hatchlings	Fledglings	% of chicks which disappeared
2011	24	46	29	37
2012	32	80	49	39
2013	27	48	20	58
2014	29	38	28	26
2015	25	36	28	22

(2012) for individual Collared Forest Falcons in Tikal National Park (17°13'N, 89°37'W) was 944 ha, 85 times the area of the polygon formed by the three nest trees of the attack events (11 ha), so the same individual could certainly have carried out all three attacks. Of the five nest cameras placed four (80%) registered attacks on the chicks. The forest-falcons could be contributing a great deal to the disappearance of the 22% to 58% of the macaw chicks that hatched at our site from 2011–2015 (Table 2). Although two chicks in the Lily cavity nest survived the Africanized bee infestation or attack, probably because they were fully feathered, younger chicks (with limited body feather coverage) could die during similar events due to the bee stings.

The high rates of chick disappearance at our study site (Table 2) could seriously hamper the recovery of the local macaw populations. As a result, more information is needed at other nesting sites in Guatemala, Belize, and Mexico to properly evaluate the magnitude of the impacts of Collared Forest-Falcons and Africanized Bees on the reproduction and recovery of Scarlet Macaws.

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