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Author(s) :James A. Rotenberg, Jacob A. Marlin, Liberato Pop, and William Garcia

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FIRST RECORD OF A HARPY EAGLE (*HARPIA HARPYJA*) NEST IN BELIZE

JAMES A. ROTENBERG,^{1,3} JACOB A. MARLIN,² LIBERATO POP,² AND WILLIAM GARCIA²

ABSTRACT.—We present the first description of a breeding record of the Harpy Eagle (*Harpia harpyja*) in Belize, and describe the subsequent fledging of the juvenile. We discovered the nest on 27 November 2010 with a single 4–5 week-old chick, and began focal observations. The juvenile spent 56.3% of 71 observation days feeding, and the parents delivered food to the nest at a rate of one item every 2.04–3.33 days from late January to April. The most frequent food items were the common opossum (*Didelphis marsupialis*), white-nosed coatimundi (*Nasua narica*), and Yucatan black howler monkey (*Alouatta pigra*). We placed a satellite GPS-PPT transmitter on the juvenile Harpy Eagle on 14 April 2011 to track its movement patterns after fledging. Soon after, the parents stopped returning to the nest, the juvenile fledged, and for 28 days we delivered food to the young eagle in place of its parents. The abandonment of the juvenile by the parents may have been caused by low food abundance caused by drought conditions and/or placement of the transmitter may have had a role. The male subsequently returned to feed the juvenile. We believe these eagles represent one of the northernmost known extant breeding pairs of Harpy Eagles in the Americas. Received 12 September 2011. Accepted 23 January 2012.

The Harpy Eagle (*Harpia harpyja*) once ranged from southern Mexico to northern Argentina (Vargas et al. 2006); however, due to deforestation and persecution by humans the Harpy Eagle is now extirpated across most of Central America. The Harpy Eagle is a species of high conservation concern over its entire range and is designated as ‘Near Threatened’ by the IUCN (2011). The species is considered ‘Critically Endangered’ (Meerman and Clabaugh 2010) in Belize and there were only five confirmed observations between 1980 and 2000 (Vargas et al. 2006). Two eagles were observed in 2000, one at Millionario near Las Cuevas in the Chiquibul Forest Reserve, and one at Caracol Archeological Reserve (Lewis 2000). The Harpy Eagle was subsequently considered extirpated in Belize (Matola 2006) and a reintroduction program began with captive-bred birds from Panama (Muela and Curti 2005). We made nine observations of wild (i.e., not introduced and unbanded) Harpy Eagles in the Bladen Nature Reserve (BNR) in the Southern Maya Mountains since December 2005. Two of our observations were especially significant because they were juveniles and young Harpy Eagles typically stay in close proximity (< 2 km) to their nest for at least 1 year (Rettig 1978). We began the Integrated Community-Based Harpy Eagle and Avian Conservation Program for the Maya Mountains Massif follow-

ing our 2005 rediscovery (Jones and Komar 2006) to monitor the species, find nests, and monitor the bird community to test hypotheses on the resources that support flagship species such as the Harpy Eagle (Rotenberg et al. 2009).

We discovered an active Harpy Eagle nest on 27 November 2010 in the BNR (Jones and Komar 2011). We began to monitor, study, and protect the nest, mated adult pair, and nestling. Much of what is known about Harpy Eagle nesting behavior comes from observations in South America (e.g., Seymour et al. 2010) because there are few records of Harpy Eagle nests in Central America (Vargas et al. 2006). In addition, observations of prey provisioned to the young at the nest are limited to South America (Schulenberg 2009). The distributions of prey species differ between Central and South America, and prey choice by Harpy Eagles in Belize could vary from those of birds in South America. Our objectives in this paper are to describe: (1) our observations of Harpy Eagle nest behaviors, (2) fledging of the juvenile eagle and our application of a satellite transmitter, (3) prey species and food delivery rates, and (4) the first breeding record of Harpy Eagles in Belize (H. L. Jones, pers. comm.).

OBSERVATIONS

All observations were in the 40,336 ha Bladen Nature Reserve (BNR), the core conservation area within the Maya Mountains in the Southern Maya Mountains of Belize (Fig. 1), which has the highest protection status of any protected area in Belize. The BNR is among the last large, relatively intact blocks of forest in the Selva Maya region; one of the most pristine, biodiversity-rich areas in this

¹Department of Environmental Studies, University of North Carolina Wilmington, Wilmington, NC 28403, USA.

²Belize Foundation for Research and Environmental Education (BFREE), P. O. Box 129, Punta Gorda, Belize.

³Corresponding author; e-mail: rotenbergj@uncw.edu

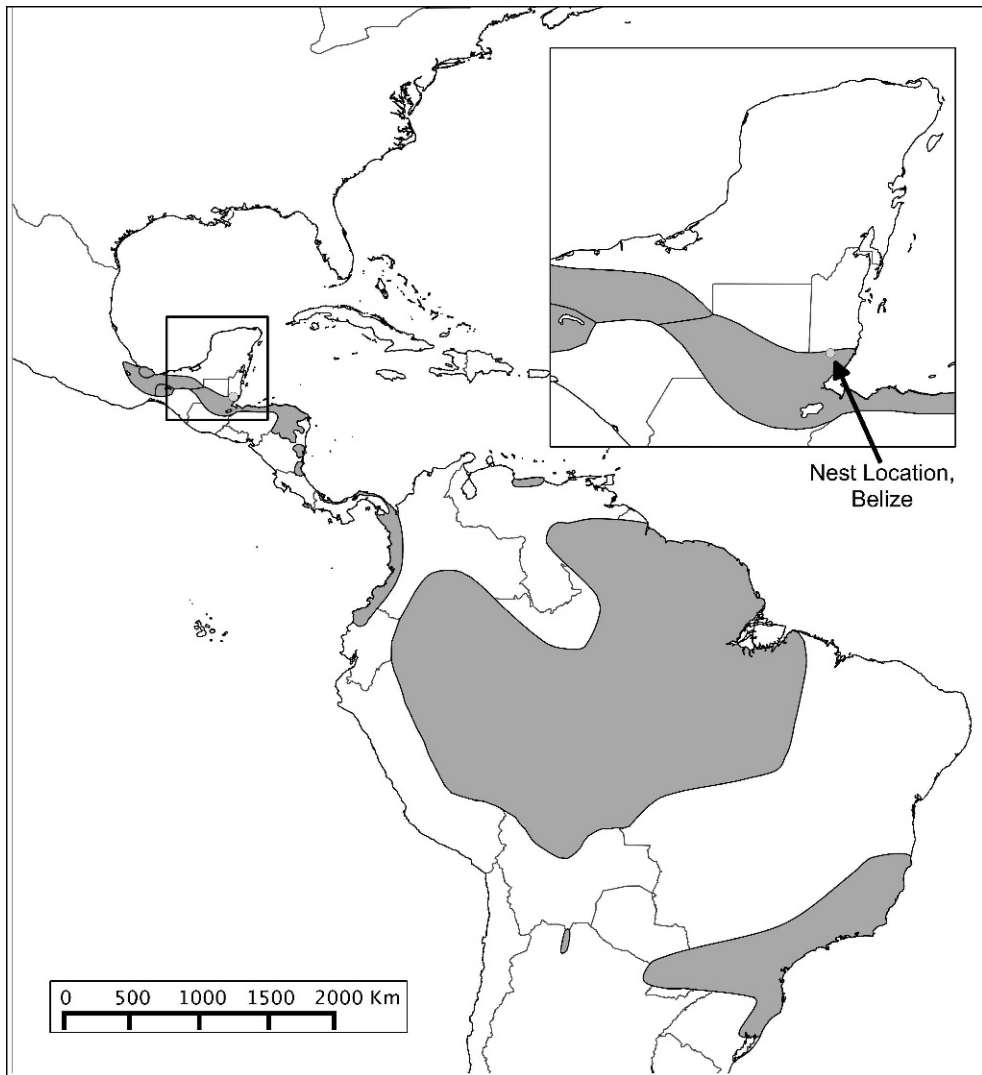


FIG. 1. Distribution of the Harpy Eagle (*Harpia harpyja*) in Central and South America. Inset is the nest location in Belize. Distribution data provided by NatureServe in collaboration with Robert Ridgely, James Zook, The Nature Conservancy—Migratory Bird Program, Conservation International—CABS, World Wildlife Fund—US, and Environment Canada—WILDSPACE.

Mesoamerican hotspot for biodiversity (Iremonger and Sayre 1994). We used the Belize Foundation for Research and Environmental Education (BFREE, www.bfreebz.org) field site as our operations base.

Our first direct evidence for breeding Harpy Eagles in Belize was the observation of copulations of a mated pair in April 2008. We made these observations during 14.5 hrs of focal observations over 2 days from a mountain lookout established to observe a steep-sided valley for eagles; our first

observation of the juvenile was also made from this location. The valley is mostly north-south, 2.5 km long by 0.5 km wide, and is characterized as primarily evergreen tropical forest (Beard 1944). We saw an eagle repeatedly returning to the same tree within the forest on 26 November 2010 and on the following day at 0900 hrs we located the nest in this tree from the ground underneath it. The nest was 35 m from the ground in the crown of a *Virola koschny* tree. The nest was observed from a hill 325 m distant and it was from this location that we

TABLE 1. Prey items observed at the Harpy Eagle nest, Belize, 2010–2011.

Species	Common name	<i>n</i>	Percent
<i>Didelphis marsupialis</i>	Common opossum	4	23.5
<i>Nasua narica</i>	White-nosed coatimundi	3	17.6
<i>Alouatta pigra</i>	Yucatan black howler monkey	3	17.6
<i>Crax rubra</i>	Great Curassow	2	11.8
<i>Ateles geoffroyi</i>	Central American spider monkey	1	5.9
<i>Potos flavus</i>	Kinkajou	1	5.9
<i>Tamandua mexicana</i>	Northern tamandua	1	5.9
<i>Anhinga anhinga</i>	Anhinga	1	5.9
<i>Iguana iguana</i>	Green iguana	1	5.9
Totals		17	100

confirmed the presence of a nestling that we estimated to be 4–5 weeks of age.

We made 601 hrs of focal observations over 71 days between late January and May 2011. Observation periods lasted an average of 6 days, beginning just after sunrise and ending before sunset. The juvenile fed on 40 of the 71 observation days (56.3%) and spent a total of 48 hrs of its time feeding (8.03%). Feeding was coupled with the juvenile's submissive begging posture (wings held down) and calling. Behaviors other than feeding observed consisted of standing (4.6 hrs/day, 35%) and sleeping or resting (3.7 hrs/day, 27%). All other behaviors accounted for 1% or less of the bird's behavior per day. Prey items delivered to the nest were variable with common opossum (*Didelphis marsupialis*), just slightly more common than white-nosed coatimundi (*Nasua narica*) and Yucatan black howler monkey (*Alouatta pigra*) (Table 1). We observed one prey item delivered every 2.04 days at the juvenile's approximate age of 4 months, increasing to one delivery every 3.33 days at 6 months (Table 2). The adult female provided nearly all of the food (female: *n* = 14, 82%; male: *n* = 3, 18%). We also made periodic observations of the female cutting, collecting, and bringing green branches to the nest from an adjacent *Ceiba pentandra* tree.

We placed an Argos System/CLS Satellite GPS-PPT (Global positioning system-platform transmitter terminal) transmitter and VHF transmitter on the juvenile Harpy Eagle on 14 April 2011 to track its post-fledging movements in cooperation with experts from The Peregrine Fund, Boise, Idaho, USA. The hope was to follow the young eagle for up to 3 years to map Harpy Eagle territory size and habitat. We predicted this procedure would have little or no effect on the

feeding and care of the young, but decided not to place any device on the adults as they currently represent the only known breeding pair of Harpy Eagles in Belize. The juvenile was released into the nest after deploying the satellite transmitter. The parents made only one feeding attempt after transmitter deployment on 17 April 2011, after which neither adult was observed at the nest.

Between 2 and 14 May 2011, after finding the juvenile perched, branching, and/or flying 5–30 m from the nest on low branches (< 3 m), we decided the parents were not returning and we had to feed the fledged eagle or watch it die. We used a technique similar to that used for the 'soft release' of a captive-bred eagle (Muela et al. 2003). We followed only the feeding protocol, which consists of feeding the eagle at a designated location behind a blind so the bird does not associate food with people. Our goal was to feed the bird until it could start to hunt by itself and then gradually reduce the food provided to wean the bird and encourage hunting.

We provided three dead Domestic Chickens (*Gallus gallus*) to the juvenile from 15 to 25 May 2011. The young eagle fed on each chicken until all of the body parts were consumed. We provided

TABLE 2. Mean prey delivery rates per age (by month) of the juvenile Harpy Eagle in Belize including one delivery after placement of the satellite transmitter at the onset of the 7th month.

Juvenile age	Mean delivery rate	<i>n</i>
4 months	2.04	7
5 months	2.33	5
6 months	3.33	4
Post transmitter	4	1
Overall average	2.93	17

a live chicken on 27 May 2011 at 0900 hrs to encourage the young eagle to hunt and capture the chicken on its own. The juvenile observed the live chicken for ~15 min from a branch 3 m off the ground. The eagle flew directly towards the chicken and inserted its talons into the chicken's breast. The kill seemed immediate upon impact, after which the eagle flew a short distance from the feeding station to a log on the ground. The eagle plucked breast feathers off the chicken for 5–10 min before feeding and then consumed nearly the entire chicken that morning before 1200 hrs. The Harpy Eagle subsequently hunted, captured and fed on four additional live chickens until we ceased our feeding program on 11 June 2011. We attempted to emulate adult delivery rates while feeding the juvenile as reported in observations in both Panama and South America of ~2–3 days (Rettig 1978, Seymour et al. 2010) and our own previous observations, resulting in a rate of one chicken every 2.15 days over a 28-day period.

We did not find the Harpy Eagle at the feeding station on 14 June 2011. The GPS satellite data showed the juvenile eagle had flown ~500 m north of the nest, the furthest distance the juvenile had flown from the nest up to that date. We located the juvenile on 27 June 2011 using the GPS satellite data and the VHF signal in a large (~45 m) *Ceiba pentandra* tree 300 m northwest of the nest. The adult male Harpy Eagle was with the juvenile and offered an unknown prey item to the juvenile. The young eagle explored the entire valley after this date, and proceeded on to a smaller, similar valley directly adjacent in July 2011 for a total travel area of ~3.2 km² between 14 April and 20 July 2011 (tracked by satellite only between 27 Jun and 20 Jul 2011).

DISCUSSION

Our discovery of an active Harpy Eagle nest is the first official nest record for Belize (H. L. Jones, pers. comm.). We believe the pair in the BNR represents one of the northernmost known extant breeding pairs of Harpy Eagles in the Americas (Fig. 1). There has been only one published account of a juvenile (3rd yr bird) Harpy Eagle north of Panama in recent years (2002), at the Marengo Biological Station in the Oso Peninsula, Costa Rica, which suggests the presence of a breeding pair (Jones 2002), and only one observation of a nest and pair previous to that in 1994 from Oaxaca, Mexico (Peterson et al. 2003). All other Harpy Eagle reports north of

Panama are of single adults, and suggest a continued presence of Harpy Eagles in these areas (Table 3). There was an observation of a single adult Harpy Eagle possibly constructing a nest in Chiapas, Mexico outside of published accounts in the ornithological literature, as cited in a local newspaper in February 2011 (Morales 2011), which remains unconfirmed.

Our observations of prey delivery at the nest do not differ significantly from data collected in South America. On average, our rates in Belize (2.04–3.33 days) are similar to those reported by Rettig (1978) (2.5–3.5 days) and Seymour et al. (2010) (2.1–2.4 days); however, both studies reported fewer days per delivery (i.e., delivery with greater frequency) as the nestling grew. We observed the opposite trend in Belize; observed prey deliveries occurred with a greater number of days in between (i.e., deliveries with less frequency) (Table 2). We also note the male made significantly fewer deliveries (3, 18%) than the female (14, 82%) while, in the South American studies, males had a much greater role. For example, Rettig (1978) observed male prey delivery at one prey item every 3.5 days until about 20 weeks of age at which time the male remained at the nest while the female hunted more frequently, and Seymour et al. (2010) observed male prey delivery at one prey item every 2.4 days over this same period. We observed the male make one final visit to the nest in Belize when the juvenile was about 21 weeks of age. The behaviors of the Belizean Harpy Eagles were similar to those in Serra da Bodoquena National Park in Brazil (Martins Pereira and Salzo 2006) where the male also visited the nest only a few times.

We speculate as to why these behavioral differences occur based on two factors. First, Belizean Harpy Eagles are breeding at the fringe of their natural range where prey choice and availability may be limited. Harpy Eagles in the south of their range prey on sloths (*Bradypus* spp. and *Choloepus* spp.), and a variety of species of monkeys with these mammals comprising large parts of eagle diets (Galetti and de Carvalho 2000, Lenz and Marajó dos Reis 2011). Belize is north of the range for sloths and only supports two primate species. Thus, one would predict the diet of Harpy Eagles in Belize would be quite different, as indicated by our observations. We observed troops of Central American spider monkey (*Ateles geoffroyi*) in close proximity to

TABLE 3. Harpy Eagle observations north of Panama, 1990–2011.

Years	Date	Observation type	Location, Country	Citation
2011	Jan–Jun 2011	Mated pair, juvenile, nest	Bladen Nature Reserve, Belize	Rotenberg et al. (this paper)
	Aug 2011	Adult	Chiapas, Mexico	Mandujano 2011
	Feb 2011	Adult, nest (?)	Chiapas, Mexico	Morales 2011 ^a
2001–2010	Nov 2010	Mated pair, juvenile, nest	Bladen Nature Reserve, Belize	Jones and Komar 2011 ^b
	Oct 2010	Adult	Thousand Foot Falls, Belize	Jones and Komar 2011
	Nov 2009	Juvenile	Bladen Nature Reserve, Belize	Conference presentation ^{bc}
	Apr 2008	Mated pair	Bladen Nature Reserve, Belize	Conference presentation ^{bc}
	2006–2008	Adults (6 sightings)	Bladen Nature Reserve, Belize	Conference presentation ^{bc}
	Dec 2005	Juvenile	Bladen Nature Reserve, Belize	Jones and Komar 2006 ^b
	2002	Juvenile	Oso Peninsula, Costa Rica	Jones 2002
1991–2000	Mar 2000	Adult	Chiquibul Forest Reserve, Belize	Lewis 2000
	Feb 2000	Adult	Caracol Archeological Reserve, Belize	Lewis 2000
	2000	Adult	Peten, Guatemala	Vargas et al. 2006
	1998	Adult	Chiapas, Mexico	Puebla-Olivares et al. 2002
	Apr 1994	Adult	Esperanza Camp, Toledo District, Belize	Jones et al. 2000
	1994	Adults, mated pair, nest	Oaxaca, Mexico	Peterson et al. 2003
	1991	Adult	Chiapas, Mexico	Morales-Pérez 1998
1990	1990	Adult	Aguacate Village, Toledo District, Belize	Jones et al. 2000

^a Unconfirmed sighting.

^b Observations by Rotenberg et al. (this paper).

^c XIII Congress of The Mesoamerican Society for Biology and Conservation, J. A. Rotenberg, J. A. Marlin, and W. Garcia, 2009.

the nest, but this was a rare prey item ($n = 1$). Instead, the eagles preyed upon non-primate species such as *D. marsupialis* and *N. narica*. More observations are necessary, and it remains unclear as to why *A. pigra* was selected in similar numbers to the mammal species over *A. geoffroyi* when spider monkeys seemed abundant. Observations of reintroduced Harpy Eagles in northern Belize (A. Muela, unpubl. data) also found eagles more commonly fed on *N. narica* rather than primates. Second, drought conditions may have had an adverse effect on our Harpy Eagle parents. Belizean climate is characterized by wet and dry seasons with the wet season from mid-May through November. The wet season in 2011 did not commence until mid-June, and the dry season was pronounced with extensive fires across the country. Lack of food due to a drought-stressed habitat may have caused the Harpy Eagle parents to abandon the chick or they may have deserted the juvenile because of human interference.

We believe there may be additional Harpy Eagle breeding pairs within the BNR and Maya Moun-

tains. This secretive species may not have been observed in these areas due to the rugged terrain and remoteness. Additional Harpy Eagle research and monitoring in Belize similar to that conducted in Panama (Vargas González and Vargas 2011) are necessary to examine survivorship and population size, as well as territories and home ranges in the northernmost extent of their range.

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