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NESTING AND NEST-PROVISIONING OF THE RED-THROATED CARACARA (*IBYCTER AMERICANUS*) IN CENTRAL FRENCH GUIANA

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The Red-throated Caracara (*Ibycter americanus*) is found in lowland tropical rainforests from Central America to southern Brazil. Recent morphologic and molecular analyses placed it in its own monotypic genus, a sister group to the genus *Caracara* (Griffiths 1999). Although *I. americanus* is reported to be a specialist predator of paper wasp colonies, it also consumes bees, termites, fruits, millipedes, other arthropods (Skutch 1959, Thiollay 1991), lizards (Lowery and Dalquest 1951), and items such as ants stored in the nest of wasps (Voous 1969).

The breeding biology of *I. americanus* is not well known. Some form of cooperative brood care with more than two birds engaging in nest-guarding and provisioning has been reported (Thiollay 1991, Whittaker 1996), but neither the nest itself nor the young have been described. Here, we present data obtained from video recordings at two nest sites in Central French Guiana that provide the first glimpse of nesting and provisioning behavior of *I. americanus*.

METHODS

From 25 January to 16 March 2008 and 27 January to 19 April 2009 we observed *I. americanus* at the Nouragues research station in French Guiana (4°05′N, 52°41′W) where Thiollay (1991) also conducted his studies. The topography around the research station is dominated by a 400-m granitic inselberg, the top of which is bare rock, grading into rock savannah, low forest, and dense tropical lowland rainforest. *Ibycter americanus* forages primarily in the lowland forests (Thiollay 1991).

We located one nest in each of 2008 and 2009 by following *I. americanus* in daylight and by observing and listening for caracara vocalizations. At dawn, members of the group called loudly and flew together from their night roosts to the nest tree. There, they called again several times before departing. During this ''morning chorus,'' the brooding bird was replaced by another group member.

The 2008 nest was in a large *Aechmea* bromeliad on a branch of a mature *Chrysophyllum lucentifolium* (Sapotaceae) tree 45 m aboveground (Fig. 1), as determined by a laser rangefinder/inclinometer (LaserAce 300®, Measurement Devices, Aberdeen, Scotland). The 2009 nest was in another large *Aechmea* bromeliad 40 m aboveground in a tall tree (Fig. 1) of unknown taxonomic identity (due to its lack of flowers or fruit during the observation period). This site was 300 m to the southeast of the 2008 nest site, and was likely used by the same group of birds.

To record the behavior of *I. americanus* at these nests, we installed video recording equipment. In 2008, we fitted the nest with a video camera attached to a digital video recorder (Honeywell Systems HDR4X4, Honeywell Security, Louisville, Kentucky, U.S.A.). We installed the camera on a branch ca. 1.2 m above the nest, pointing down; camera installation including climbing up and down the tree took 2 hr. We recorded a total of 99.9 hr of behavior during the daylight hours (06:00–18:30 H) of 6–16 March, with 2 d of down time due to technical difficulties. The video recorder was set to record, with motion activation, 10 frames per second at a 640 × 480 resolution with no audio input. A mostly-feathered nestling was present during camera installation in 2008.

In 2009, we fitted the nest with two video cameras and a Swann DVR41150® digital video recorder (Swann Communications, Santa Fe Springs, California, U.S.A.). We installed one camera on a branch 70 cm above the floor of the nest pointing down, and the other on a branch lateral to, and 1 m away from, the nest. Camera installations took a total of 7 hr, which we limited to 2 hr/d to minimize disturbance to the birds. We recorded 448 hr of behavior during the daylight hours (06:00–18:30 H) of 5 March to 18 April, with 5 d of down time. A single egg was present during camera installations in 2009.

To retrieve the DVR and to change batteries, we visited both the 2008 and 2009 nest before dawn and after sunset,

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Figure 1. Trees in the Nouragues Reserve (French Guiana) bearing a large *Aechmea* bromeliad 40–45 m aboveground (indicated by arrow) that served as a nesting platform for a group of Red-throated Caracaras (*Ibycter americanus*) in 2008 and 2009.

thus minimizing disturbance to the birds. When we had remained at the nest site until after dawn, we egressed as quietly as possible. We terminated video recordings in both years when field assistants had reached their maximum allowed stay of 3 mo.

To facilitate recognition of individual birds and to study their behavior and role as group members, we captured some birds in 2009 and affixed a colored Darvic band (Avinet Inc., Dryden, New York, U.S.A.) to one tarsus. Birds were lured by a hand-crafted and -painted conspecific decoy made of closed-cell polystyrene foam and placed next to the net, and by playback of recorded calls emitted from a Roland Microcube portable guitar amplifier (Roland Corporation, Los Angeles, California, U.S.A.). We captured one bird twice in 2008 and four different birds in 2009; we weighed three of the birds captured in 2009 (females: 600 g and 678 g, respectively; male: 550 g), and took blood samples from all birds captured in 2009 as well as feather samples from the 2009 nestling, for PCR-based sex identification (Griffiths et al. 1998).

Four birds had colored bands on their tarsi, allowing us to compare their behavior and that of at least two unmarked birds. Viewing our 2008 and 2009 video data using the video editing software VirtualDub (Lee 2007), we were able to determine when the single egg hatched in 2009. We also attempted to identify all food items brought to the nest and classified them into prey types for analyses of the nestling's diet. For each of 2008 and 2009, we determined the proportion of each food type in the diet, calculated provisioning and visitation rates, and compared these rates between the two years. For statistical analyses of these data we employed a Wilcoxon rank-sum test using normal approximation and the software program S-Plus 8© (Insightful Corporation).

Results

Based on our observations from the ground and during camera installations in nest trees, we concluded that there was no nest structure and no nesting material other than bromeliad leaves that adult birds shred lengthwise. This shredding behavior apparently clears an area in the center of the bromeliad in which the egg or nestling resides. The bromeliad serves as a shelter for a single egg and nestling.

The egg, observed in 2009, was ovoid, circa 6 cm in length, and light tan speckled with purple-brown. It hatched on 28 March, as determined from video recordings.

We noted that early in development, the young nestling in 2009 was covered dorsally in fuzzy gray down (Fig. 2), with white down on thighs and the cloacal area, similar to

Figure 2. Nestling Red-throated Caracaras (*Ibycter americanus*) residing in *Aechmea* bromeliads. (A) Nestling 5 d post-hatching on 1 April 2009; (B) The same nestling as in (A) on 18 April 2009; (C) Unknown-age nestling on 21 February 2008 provisioned with a large millipede and remains of a wasp nest; (D) The same nestling as in C on 5 March 2008.

the pattern on adults. Down beneath the mandible was patchy and white. The face and throat were bare, as in adults. The eyes were chestnut brown in color and the skin of the face and throat was yellow, as were the cere and the legs. In 2009, when the nestling was about 22 d old, the skin of the face and throat was becoming gray. The bill was black in contrast to the yellow bill of adult birds. On 1 April 2009, five days post-hatching, the nestling had a large parasitic fly larva inside the right orbit, with the spiracular plate slightly protruding through the lower eyelid (Fig. 2A). Neither this maggot nor evidence of it was found on 18 April, although there was another protruding just behind the head. Feathers of the 22-d-old nestling included primaries, secondaries, primary coverts, greater coverts, and alula in the pin stage, with some barbs breaking free (Fig. 2B).

For the 2008 nestling on 21 February (Fig. 2C), contour feathers such as the scapulars were well-developed. On 5 March 2008, nearly all juvenal feathers were developed (Fig. 2D). From our video recordings and photographs,

it was difficult to precisely deduce the length of the nestling period. The 18 April 2009 nestling in Fig. 2B was 22 d old and less developed than the 2008 nestling (shown on 21 February, Fig. 2C), which fledged 35 d later as determined by P. Chatelet (CNRS Guyane). Thus, it may take at least 57 (22 + 35) d from hatching to fledging. The 2009 chick fledged at an undetermined date. We observed and recognized it in 2010 based on the color band on its tarsus.

During the egg phase, adult birds made 0.56 (±0.18 SD) visits/hr to the nest (n = 22 d), during daytime hours in 2009. Daytime incubation bouts lasted on average 1.46 (±1.20 SD) hr.

During the nestling phase, adult birds visited the nest 2.20 (±0.45 SD) times/hr (n = 10 d) in 2008 and 1.76 (±0.52 SD) times/hr (n = 18 d) in 2009. Visitation rates were significantly greater in 2008 than in 2009 (rank-sum normal statistic: 2.78, $P < 0.05$).

Adult birds brought food to the nest on average 1.77 (±0.37 SD) times/hr in 2008, and 0.91 (±0.30 SD) times/hr in 2009. Food provisioning was significantly greater in 2008 than in 2009 (rank-sum statistic: 4.08, $P < 0.05$). Based on colored leg bands and sex-determination tests, at least six adult-plumage birds (two confirmed females, two males, two unknown sex) attended and provisioned the nestling in 2009. One adult female performed all of the overnight egg incubation and overnight brooding of the female nestling.

As recorded on videos in 2008 and 2009, adult birds brought 186 and 192 items, respectively, to the nestling. Most of them (58.6% in 2008; 78.6% in 2009) were wasp nests or fragments thereof (Fig. 3). They were delivered to the nest significantly more often than all other food types combined in both 2008 (rank-sum statistic: 2.34, $P < 0.05$) and 2009 (rank-sum statistic: 4.30, $P < 0.05$). Wasp nests often were brought attached to substrate such as leaves or twigs. Large spirostreptid millipedes (Fig. 2C) were the second most commonly delivered food item, accounting for 21% of food items in 2008 and 12.5% in 2009. Of millipede carcasses, only the anterior segments 1–4 were fed to the nestling. Small fruits from several plant species were also brought to the nest but these could not be conclusively identified from the video footage. The remaining 8.6% of food brought to the nests in 2008 and 5.7% in 2009 could not be identified but all were smaller than the other items.

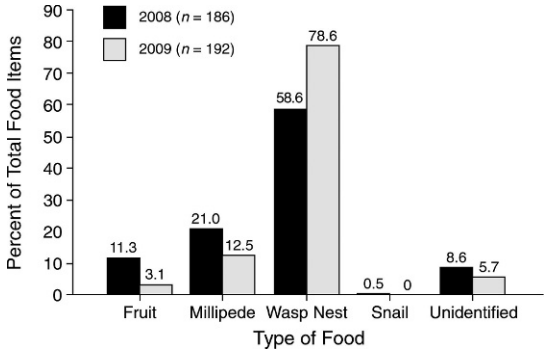

Figure 3. Food items provided to a single nestling of *I. americanus* in each of two years. Data were compiled based on 112.4 hr and 448 hr of video recordings of provisioning behavior during the daylight hours (06:00–18:30 H) of 6–16 March 2008 and 5 March to 18 April 2009, respectively. Numbers above bars indicate the percent of a respective food type in 2008 or 2009.

DISCUSSION

We provide the first detailed observations of the nest of *I. americanus*. Both Thiollay (1991) and Whittaker (1996) report nest trees as large trees with many epiphytes but do not report details of the nest structure or nesting behavior. Our data indicate that *I. americanus* may not construct a nest but instead utilize natural platforms such as bromeliads as nesting sites.

Our video recordings and observational data substantiate earlier reports that *I. americanus* may be a cooperative breeder. Using video recordings of nestling provisioning, we found that food items brought to the nestling included wasp nests, fruits, and millipedes, as previously reported by Thiollay (1991) but did not include positively identified bees, termites, ants (Skutch 1959, Thiollay 1991) or vertebrates (Lowery and Dalquest 1951) as dietary constituents. Brood-containing wasp nests were the most prevalent of all food items that were provided to the nestling. On each day, many wasp nests were brought to the nest, implicating wasp larvae as an important dietary component for the nestling's development. The ecological niche of *I. americanus* as a regular predator of wasp nests seems unique in the American neotropics. Wasp nests with mature brood as a ready source of concentrated protein are usually well-defended by adult wasps (Smith et al. 2001), suggesting that *I. americanus* can overcome the wasps' defense while preying on their nests.

Although we present new information on the nesting and nest-provisioning biology of this intriguing raptor species, many aspects are yet to be studied. These include, but are not limited to, (1) the relatedness and role of group members in the group studied here and those in neighboring groups; (2) comparison of the social structure of *I. americanus* with that of other cooperative-breeding raptors; and (3) the strategy that enables *I. americanus* to prey on well-defended nests of social wasps.

ANIDACIÓN Y APROVISIONAMIENTO DE NIDOS DE *IBYCTER AMERICANUS* EN GUYANA FRANCESA CENTRAL

RESUMEN.—Utilizamos cámaras de video para estudiar un nido en cada una de dos estaciones reproductivas de un grupo de *Ibycter americanus* en Guyana Francesa. Encontramos que *I. americanus* no construyó un nido, sino que utilizó plataformas naturales, como bromelias, para anidar. Las aves adultas trajeron alimento al nido en promedio 1.77 (±0.37 DE) veces/hr en 2008 y 0.91 (±0.30 DE)

veces/hr en 2009. La mayoría de los ítems alimenticios (58.6% en 2008; 78.6% en 2009) fueron nidos de avispas o fragmentos de éstos. Con base en anillas coloridas y determinación del sexo, por lo menos seis individuos con plumaje de adulto (dos hembras, dos machos, dos de sexo desconocido) atendieron y aprovisionaron a los polluelos en 2009.

[Traducción del equipo editorial]

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