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KING VULTURES (*SARCORAMPHUS PAPA*) FORAGE IN MORICHE AND CUCURIT PALM STANDS

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Feeding on palm fruit, particularly drupes of the African oil palm (*Elaeis guineensis*), has been documented for several Old World species of birds of prey (Thiollay 1978, Barlow 2004). In the New World, fruits of the imported African oil palm have been consumed by the Turkey Vulture (*Cathartes aura ruficollis*; Pinto 1965), Yellow-headed Caracara (*Mitvago chimachima*; Haverschmidt 1962), and Black Vulture (*Coragyps atratus*; Haverschmidt 1947, Pinto 1965, Elias and Valencia 1982). Both vulture species, as well as the Crested Caracara (*Caracara cheriway*), consume flesh of coconuts (*Cocos nucifera*; Haverschmidt 1947, Crafts 1968), and fruits of palms (*Mauritia flexuosa* and *Desmoncus* sp.) have been found in stomach contents of the Black Caracara (*Daptrius ater*; Haverschmidt 1962). American Black Vultures also feed on sweet potatoes (McIlhenny 1945) and avocado (Röhl 1949) when carrion is scarce, and Turkey Vultures ingest leaves, seeds, and bark of cottonwood trees (*Populus* spp.), apparently as casting material (Davis 1983). No published data were found on ingestion of plant matter by King Vultures (*Sarcoramphus papa*), but residents at Hato Las Nieves, Venezuela reported that the species consumes fruits of the moriche (*Mauritia flexuosa*) and cucurit (*Attalea maripa*) palms when carrion is scarce (Y. Carbonell and A. Mendoza pers. comm.). The observations reported in this paper were gathered in an attempt to verify these claims.

STUDY AREA AND METHODS

My observations were part of a long-term study (1994–2000) on the abundance, population structure, movement patterns, and foraging strategies of King Vultures in the Serranía de la Cerbatana, Estado Bolívar, Venezuela. The study was conducted in the southeastern part of the massif at Hato Las Nieves (Sabana Nueva: 6°34'80"N, 66°12'17"W), a ranch located ca. 125 km south of Caicara del Orinoco. The valley of Las Nieves, ca. 20 km long (northwest-southeast) and 9 km wide, is dominated by lowland shrub savanna, mainly 220–260 m above sea level. The bordering mountains reach elevations of 1600 m to the west and 1880 m to the north (Cerro de la Cer-

batana). The moriche palms (*Mauritia flexuosa*) can be found scattered in the gallery forests or in stands (morichales; see González Boscán 1987) in the seasonally inundated areas of the valley. The moriche fruits, 3–7 cm long, ovate to globular and having an oily mesocarp (Borgtoft Pedersen and Balslev 1990), fall to the ground when almost ripe and accumulate in the water among fallen fronds and debris. Cucurit palms (*Attalea maripa* = *Maximiliana regia*) occur as stands within the gallery forests on dry terrain. The fruits, ovate, 5–7 cm long, are also rich in oil (Braun 1997). The observations reported here took place during the rainy season, which lasts April through October or November. The study periods (24 June–24 July 1994, 26 June–14 August 1995, 28 May–14 July 1996, 30 June–18 August 1997) were set up to coincide with the fruiting season reported locally for both palm species. Observations were carried out daily, generally from 0615–1900 H. The length of each monitoring period (up to 5 hr) depended on weather, logistics, and whether or not the King Vultures were present in the valley. The number of sample days for each study period varied from 29–50 d, with the afternoon of arrival and morning of departure being counted if observations were carried out (Table 1). I used 10× binoculars and observed from outcrops and other high points.

RESULTS

In all four years, moriche and cucurit fruit production took place earlier than expected and little remained by mid-July. Both palm species suffered from drought in 1995 and 1996. A mean of 2.1 ± 1.1 (SD) King Vultures (range = 1–4) foraged in four different morichales ($N = 7$ occurrences), and 3.4 ± 1.0 (range = 2–4) foraged ($N = 7$ occurrences) in two of the cucurit stands, primarily during the 1994 and 1995 field seasons (Table 1). This activity was most often carried out by two adults together ($N = 5$) or three adults and an immature ($N = 6$), presumed to be the local birds. Eleven of the 14 occurrences took place when the vultures had not fed on livestock carcasses (natural mortality, including jaguar [*Panthera onca*] predation) or inedible parts of slaughtered animals for 2–3 wk. Four bouts in the cucurit stands (August 1995) followed presumed feeding on the remains of jaguar-killed native wildlife.

On 27 June 1994, at 0947 H, four American Black Vultures flew from the western morichal. As I approached, I sighted an adult King Vulture perched low at the edge of the palm stand and another adult on the ground near-

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Table 1. Mean number of King Vultures per study period (1994–97) seen foraging in moriche and cucurit palm stands and number of occurrences at Hato Las Nieves, Venezuela. Number of days the vultures fed on livestock carcasses and total days of observation are given.

STUDY PERIOD	NUMBER OF KING VULTURES $\bar{x} \pm SD$ (RANGE)	FREQUENCY		NUMBER OF DAYS	
		MORICHE	CUCURIT	LIVESTOCK CARCASSES	OBSERVATION
1994	2.2 \pm 1.0 (1–4)	3	3	15	29
1995	3.3 \pm 1.3 (1–4)	3	4	11	50
1996	3.0 \pm 0 (3)	1	0	26	48
1997	0	0	0	15	49

by at the base of the only fruiting moriche in the area. This bird, with head down, just out of sight, seemed to be nibbling on something. When both birds flew to nearby palms, I could see that their crops were extended. Their flight attracted a Turkey Vulture that walked around the area but did not feed. At the site, I found one unripe moriche fruit with half the mesocarp freshly scraped off longitudinally on one side, the marks clearly imprinted on the nut, and a large piece of overripe mesocarp from another fruit. No debris, no carrion, and no live animals were present. I concluded that the King Vulture had consumed the missing pulp, but this would not explain crop extension. The next day after the rains stopped (1620 H), I observed an adult sunning in the main cucurit stand. As I penetrated into the gallery forest, I came across another King Vulture rummaging in the litter at the base of a cucurit palm. The debris contained no animal matter, only cucurit fruits, whole or rotting or partially eaten, pieces of mesocarp, and clean kernels. Several wedged-capped capuchin monkeys (*Cebus olivaceus*) were in the stand. Two days later (30 June 1994), two adults were observed in a morichal at ca. 1100 H and in a cucurit stand in the afternoon, and the following day three adults and an immature were in the same cucurit stand at mid-day. Capuchin monkeys were present both days. The last sighting in 1994 took place on 7 July, 2 d after the vultures had consumed a dead horse. At 0737 H an adult was again perched low at the edge of a morichal. It was raining hard (1000 H) when I found the adult foraging under the only fruiting moriche in the area. The bird flushed upon seeing me, but then returned to the morichal again, weaving in and out of the vegetation and foraging on the ground as I tracked it for ca. 90 min. Moriche fruits were present in the areas where the bird had foraged. I found no carrion or live animals. The vulture's crop was extended, indicating it had ingested food while in the morichal.

On 28 June 1995, at 0722 H, two adult King Vultures and an American Black Vulture perched at the edge of a morichal. An hour later another adult King Vulture and an immature joined them, and one of the first adults flew to the ground near a palm with fruit. When I investigat-

ed, I found several fruits with the mesocarp wholly or partially scraped off. No carrion was present, but a medium-sized savanna tortoise (*Geochelone carbonaria*) was in the area and could have been feeding on the fruits earlier. Later (1157 H), I located the immature bird feeding at the base of another fruiting moriche. Again, the mesocarp on several fruits had been freshly scraped off. No debris or carrion was found, and no live animals were nearby. I concluded that the King Vulture had eaten the pulp. Two days later, at 0740 H, an adult perched in the gallery forest north of the central camp, and at 0913 H I found it foraging on the ground among the few palms that remained of a remnant morichal. No carrion was present. On 29 July 1995, 8 d after a carcass had been consumed, two adults suddenly flew up from one of the gallery-forest floors (1645 H) in an area that had fruiting moriche, but I was unable to investigate further. Then, on 5–6 and 9–10 August 1995, three adults and an immature, presumed to be the same birds as above, were sighted in a cucurit stand. Eight Turkey Vultures were also present. The King Vultures perched within the upper strata of the canopy of the broad-leaved trees, occasionally going to the top of the trees to sun or dry, and spent the mornings in the stand. A troop of ca. 30 wedged-capped capuchin monkeys, with many females transporting infants, was foraging there on the first two days. The area was strewn with large pieces of bark and fallen branches. On the last 2 d, fewer capuchins were present, but were seen with a pair of red-howler monkeys (*Alouatta seniculus*). I found no remains of carrion.

On 8 June 1996 at 0913 H, 4 d after the vultures had eaten livestock carrion, I came upon two adult King Vultures and an immature resting on a low shrub at the edge of a morichal and next to a fruiting moriche palm. Three American Black Vultures were feeding on the ground at the base of the palm. The crop of one King Vulture was slightly extended. I found no carrion and no live animals, only palm fruits lacking part of the mesocarp and showing signs of having been scraped. I concluded that both vulture species had been feeding on the fruits. This was the only time the King Vultures were observed to forage in a morichal in 1996, but very few moriche palms were

fruiting ($\leq 10\%$ in the major stands). No foraging took place in the cucurit stands, but only two cucurit palms had fruit, although fermenting drupes were found at the base of others. Livestock carrion was abundant (Table 1), and jaguars were in the area.

The King Vultures were not seen foraging in the palm stands in 1997, even though more moriche and cucurit were fruiting than in 1996. A small troop of capuchin monkeys was present twice in the study area, and domestic carrion was not often available (Table 1), as most livestock had been removed from the valley. The vultures picked over the debris at former carcass sites on 12 d and followed a jaguar. This feline was known to have come through the valley on four occasions, and the King Vultures presumably fed on the remains of kills on native wildlife at or near Las Nieves on 5 d.

DISCUSSION

My observations support the claims that the King Vultures at Hato Las Nieves eat fruits of the moriche palm, particularly when carrion is scarce. Eating moriche fruits may partially compensate the lack of carrion, 100 g of fresh pulp having 10.5 g of fat and 3.0 g of protein, but the fruits could have been ingested for their vitamin-mineral content (see González Boscán 1987, Borgtoft Pedersen and Balslev 1990). From the remains of the fruits found at the feeding sites, I conclude that the mesocarp was scraped off longitudinally, but judging from the size of extended crops of some vultures, some fruits, probably the smaller ones, may have been swallowed whole. Both feeding techniques are used by the Palm-nut Vulture (*Gypohierax angolensis*) when consuming drupes of the African oil and *Raphia* palms, the ingested kernels being regurgitated later (Thiollay 1978). Only once in my observations was a potential fallen-fruit consumer present—a tortoise. My observations also lend support to claims that American Black Vultures eat *Mauritia* fruits (Y. Carbonell and A. Mendoza pers. comm.). Moriche fruit-eating appears to be an activity carried out by vultures local to the study area; however, because northwestern Bolívar state is one of the few areas in the Venezuelan Guayana that has a high concentration of morichales (see González Boscán 1987), moriche fruit-eating by King Vultures could be more widespread than at Hato Las Nieves.

On the other hand, I was not able to confirm that King Vultures eat cucurit fruits, although their consumption is plausible considering the oil content of the mesocarp (Braun 1997). Whenever the King Vultures foraged in the cucurit stands, wedge-capped capuchin monkeys were also present, which suggests that a foraging association may exist between the two species. The monkey troops were also attended by the Turkey Vultures. Raptor-monkey associations usually involve opportunistic feeding on flushed invertebrates, particularly insects (e.g., Fontaine 1980), and sometimes on vertebrates displaced by

the movements of monkey troops (e.g., arboreal snakes: Zhang and Wang 2000).

How could King Vultures benefit from associating with *Cebus* monkeys? Is it only to profit from occasional primate mortality? Although 55% of the wedge-capped capuchin's diet consists of plant matter, particularly ripe fruits, invertebrates are searched out by peeling off loose bark, digging into rotting material and sifting through leaf debris on the ground (Robinson 1986). Perhaps the King Vultures benefit from larvae that are exposed or fall to the ground while the troop forages; vultures are known to scoop up maggots from decomposing carcasses (Houston 1988). Of greater interest is the occasional predatory behavior of the capuchins on vertebrates. For example, the viscera of lizards may be eaten but the muscular part left, and the remains of captured frogs discarded (Robinson 1986). In *Cebus capucinus*, after wrestling with an *Iguana* sp., a monkey managed to break off 30–40 cm of the iguana's tail, stripped some meat from it, and dropped the rest (Baldwin and Baldwin 1977). By following wedge-capped capuchin monkeys, the vultures could glean the remains of discarded vertebrate prey. However, eating moriche fruit or monitoring monkeys did not seem to be as beneficial as picking over the scattered remains of former carcasses and following jaguars to consume the remains of kills. These observations illustrate some opportunistic feeding strategies used by King Vultures.

SARCORAMPHUS PAPA FORRAJEA EN MORICHALES Y EN GRUPOS DE PALMAS DE CUCURITO

RESUMEN.—Este trabajo se realizó durante las épocas lluviosas desde finales de junio de 1994 hasta mediados de agosto de 1997 en la Serranía de la Cerbatana, Hato Las Nieves, Estado Bolívar, Venezuela. Los datos recolectados sostienen las afirmaciones del personal del hato de que *Sarcoramphus papas* come frutos de la palma moriche (*Mauritia flexuosa*), principalmente cuando escasea la carroña. Una media de 2.1 individuos de *S. papa* (rango = 1–4) forrajearon en los morichales ($N = 7$ avistamientos). No pude confirmar las afirmaciones de que *S. papa* come también frutos de la palma de cucurito (*Attalea maripa*). Los frutos de ambas especies de palma contienen aceite. En mis observaciones, una media de 3.4 individuos (rango = 2–4) se encontraron vigilando tropas del mono capuchino *Cebus olivaceus* que habían venido a forrajear a los rodales de cucuritos. Sugiero que *S. papa* podría asociarse con los monos para aprovechar los invertebrados que espantan, como las larvas de insectos, los restos de vertebrados que capturan y ocasionalmente los cadáveres de monos.

[Traducción del autor]

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