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FEEDING OF THE BAT FALCON (*Falco rufigularis*) IN AN URBAN ENVIRONMENT

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The bat falcon (*Falco rufigularis*) inhabits a variety of forested areas and forest clearings throughout the Neotropical region (Beebe 1950, Haverschmidt 1962, Iñigo-Elias 1993). Beebe (1950) made a detailed analysis of feeding behavior of a pair of these birds in a mountainous forest in Venezuela. He found that 16% of the vertebrates taken by the falcons were bats. Small birds, however, comprised the bulk (75%) of prey. Additional aspects of feeding are discussed by several authors (Wetmore 1965, Brown and Amadon 1968, Kirven 1976, and Chavez-Ramirez and Enkerlin 1991). The occurrence of bat falcons in urban areas has also been reported. Wetmore (1965) and Tostain (1986) mentioned them hunting bats and insects in small towns. However, details on feeding ecology of this species in urban environments are lacking. In this paper I analyze prey taken by three bat falcons, a pair and a juvenile, in an urban environment and compared it to the data available in the literature.

STUDY AREA AND METHODS

My observations were made in Guanare, a city of some 100 000 people located in the llanos of Venezuela (9°2′40″ N, 69°44′30″W). The northern part of the city is bordered by hills and low plateaus covered by forest relicts and savanna-like vegetation. The rest is mostly surrounded by savannas and deforested areas dedicated to agriculture and cattle ranching. The climate of the region is biseasonal, with a rainy season that extends from May to October, and a dry season that goes from December to March. April and November are transitional. The annual precipitation is 1473 mm and the average annual temperature is 27.1°C.

My observations began on 4 December 1993 when I saw one bat falcon perching on the top of the tallest (seven stories) building in the city. From December 1993 to February 1994, only one bat falcon was seen at a time. A pair was rarely seen during March and early April. On April 23 the presence of a third falcon, likely a fledgling of the pair, was noted. The pair of falcons had nested in another building 200 m from my observation point (M. Gonzalez pers. comm.). The prey remains left under perches were collected at irregular intervals between 5 February and 20 July 1994.

RESULTS AND DISCUSSION

Remains of 47 vertebrates were found (Table 1). Moths, grasshoppers, beetles, and butterflies were also occasionally found, but a more precise identification and quantification of these items was not attempted. The relatively high number of prey found during May probably reflects the presence of three falcons. After June the frequency in which the falcons were seen declined. That may explain the small number of remains found during that month.

These results confirm the importance of bats as prey of bat falcons; bats made up almost 64% of the identifiable vertebrate remains. All bat remains that could be identified to species were mastiff bats (*Molossus molossus*). Chase et al. (1991) calls this bat an almost strictly crepuscular species whose large colony size and predictable foraging times makes it particularly vulnerable to hawk predation.

Even though birds comprised a relatively small number of the prey taken, they represent a high proportion (at least 73.5%) of the biomass. Some of the birds, as for example the least bittern (*Ixobrychus exilis*) and the purple gallinule (*Porphyrula martinica*) may be as heavy or heavier than bat falcons (Karr et al. 1990, ffrench 1991). Capture of relatively large prey by bat falcons has been mentioned by Sick (1993) and Chavez-Ramirez and Enkerlin (1991).

Some of the remains found belonged to common birds in Guanare, e.g., mockingbirds (*Mimus gilvus*) and ruddy-ground doves (*Columbina talpacoti*). Fringillidae remains were probably those of saffron finchs (*Sicalis flaveola*), a species seen frequently in the area. The carib grackle (*Quiscalus lugubris*), another very common bird in the city, was not found in the prey remains even though I saw a bat falcon unsuccessfully chasing one of those birds. The most striking finding was the occurrence of aquatic birds among the prey captured by the falcons. Aquatic birds represented 35.2% of all bird remains and at least 51.9% of total vertebrate biomass. No wetlands or bodies of water occur within the city. Aquatic birds may have been captured along the Guanare River some 6 km to the southeast. Foraging by bat falcons in aquatic habitats has been reported (Stiles and Skutch 1990) or may be inferred from other published or unpublished evidence. Brown and Amadon (1968) pointed out that bat falcons were a "terror" to least grebes (*Tachybaptus dominicus*) in a locality in El Salvador. Iñigo-Elias (1993) found that these raptors

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Table 1. Prey of bat falcons in an urban area of Venezuela. Cumulative weight of prey was calculated taking the minimum mass value for each species.

Prey	Collection Dates				Cumulative Prey Mass, g
	February	May	June	July	
Bats	2	16	5	7	330[a]
Birds					
Podicipedidae					
Tachybaptus dominicus	1	1	—	—	250[b]
Ardeidae					
Ixobrychus exilis	1	—	—	—	80[b]
Unidentified	—	1	—	—	80[b]
Rallidae					
Laterallus exilis	1	—	—	—	32[b]
Porphyrula martinica	—	—	1	—	205[b]
Columbidae					
Columbina talpacoti	—	1	1	—	94[b]
Dendrocolaptidae					
Dendrocincla fuliginosa	—	1	—	—	37.1[c]
Tyrannidae					
Unidentified	1	—	—	—	30
Mimidae					
Mimus gilvus	1	—	—	—	49.5
Thraupidae					
Thraupis episcopus	—	1	—	—	30[b]
Fringillidae					
Oryzoborus angolensis	—	—	1	—	10
Unidentified	—	—	1	—	10
Passeriformes					
Unidentified	—	—	3	—	10

[a] Minimum mass value (11 g) reported by Chase et al. (1991).
[b] Minimum mass values reported by Karr et al. (1990).

were more frequently seen in riparian forest (0–100 m from the edge of the river) than in any other natural or disturbed vegetation type in the Lacandon forest. Bat falcons have been seen along riparian forests and large rivers foraging on aquatic birds, swifts, and swallows (E. Iñigo-Elias (pers. comm.). Kirven (1976) pointed out that one characteristic of suitable habitat for bat falcons is the presence of mesic conditions (streams, rivers, ponds). A bat falcon collected in May 1981 in a wetland area in Venezuela (Ciénagas de Jaun Manuel, Zulia state) had a stomach full of dragonflies (A. Seijas unpubl. data). Dragonflies were often mentioned in the diet of the bat falcon (Wetmore 1965, Brown and Amadon 1968, Kirven 1976, Cade 1987, Sick 1993) which may indicate the importance of aquatic habitat for this species.

The ability of bat falcons for taking and transporting prey from distant places was mentioned by Beebe (1950), but those prey were mostly small Passeriformes and Apodiformes. Chavez-Ramirez and Enkerlin (1991) also suggested that bat falcons hunted far from the perch where they were usually seen.

These results highlight the ecological plasticity of the bat falcon in the wide variety of habitats used and the wide spectrum of animals this falcon preys upon. The importance of aquatic prey, however, had not been emphasized in previous reports.

RESUMEN.—Se identificaron los restos de presas dejados por tres Halcones Golondrina (*Falco rufigularis*) bajo sus perchas en un edificio céntrico de la ciudad de Guanare, Venezuela. Se recolectaron restos de un total de 47 vertebrados. Los murciélagos representaron el 64% de las presas, el resto pertenecía a diversas aves. Al considerar el peso de las presas, las aves conformaron no menos del 73.5% del peso total de los vertebrados capturados. Se identificaron seis aves acuáticas, pertenecientes al menos a 4 diferentes especies. Las aves acuáticas representaron el 51.9% de la biomasa total. Estas aves deben haber sido capturadas fuera de la ciudad, ya que no existen humedales dentro de sus límites.

[Traducción Autore]

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ESTIMATING AGE CLASSES IN KING VULTURES (*Sarcoramphus papa*) USING PLUMAGE COLORATION

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Researchers conducting field studies on sexually monomorphic vultures have utilized molt and plumage characteristics to identify individuals (Snyder et al. 1987, Wallace and Temple 1987). Such characteristics are valuable in determining age classes needed to detail survivorship patterns (Todd and Gale 1970). No reliable criteria are known for age class determination in king vultures (*Sarcoramphus papa*). Wallace and Temple (1987) distinguished six age classes in this species, but they failed to describe which plumage characters they considered. Additionally, Heck (1968) provided scant details of plumage color patterns with no discussion of 5 and 6 yr age classes. In order to determine reliable criteria for age determination in the wild, I examined known-age king vultures in captivity, and documented gross plumage coloration. For a detailed description of the definitive plumage coloration in king vultures, consult Friedmann (1950). A description of natal downs is detailed by Ramo and Busto (1988) and Schlee (1994).

METHODS

Twenty-seven photographs of 16 known-age birds (four males, four females) and eight of unknown sex were taken as follows: three photographs of 1-yr olds, nine of 2-yr olds, five of 3-yr olds, three of 4-yr olds, four of 5-yr olds, two of 6-yr olds, and one of a 7-yr old. Individual birds were photographed from one to five times. Five birds were permanently housed outdoors in San Antonio, Texas. The remaining 11 were maintained at the Detroit Zoological Garden in Detroit, Michigan. The birds in Detroit were exhibited outdoors during the summer months and housed indoors under artificial lighting during the winter months (T. Schneider pers. comm.). Only feathers that change from black to white with maturity were considered: the interscapular and dorsal regions of the spinal tract, ventral tract, and under-tail coverts of the caudal tract. Also considered were the white alar-tract feathers including the seven upper middle coverts, carpal coverts, and all underwing coverts. The final region changing from black to white includes the feathers of the femoral and crural tracts (Fisher 1943).

RESULTS AND DISCUSSION

Five age categories were tentatively distinguished by plumage coloration in captive birds (Table 1) that were consistent with descriptions by Nuttall (1832), Dickey and van Rossem (1938), and Heck (1968). The categories conflict with statements by Brown and Amadon (1968) who indicate that second-year birds have all white underparts and third-year birds are in definitive plumage except for some black in the interscapular region. My findings also are inconsistent with Ruschi (1979) who stated that adult plumage is attained in the second year of life.

Throughout the first year, all contour feathers including retrices and remiges are sooty black (Fig. 1). White down feathers on the femoral and crural tracts can also be considered characteristic of this stage. During the bird's second year flecks of white begin to appear on the femoral,