SHORT COMMUNICATIONS

THE APPARENT USE OF ROCKS BY A RAVEN IN NEST DEFENSE

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While conducting a study on raptor populations in Wheeler County, Oregon in 1973, on 7 May, John Barss and I witnessed an incident involving the use of rocks by a pair of Common Ravens (*Corvus corax*). In the early afternoon we were searching a cliff for a raven nest and observed two ravens individually enter and leave a vertical crack on a 20 m cliff. This crack extended the height of the cliff, and the birds entered it about 13 m above the base. The opening was approximately 2.5 m wide at the cliff face and 3 to 5 m deep.

When we approached the base of the opening, both ravens silently departed. Because Bowles and Decker (Condor 32:192–201, 1930) reported that ravens are "usually wild" after the nest has been discovered, it is possible that these birds had not noticed our presence. The nest contained 6 young. Although the young were fully feathered, the wing and tail feathers had not completed their growth. The nestlings demonstrated no fear towards us and dozed much of the ten minutes we spent taking notes and collecting pellets. We started our descent and were 4 and 6 m below the nest when both ravens staged an extremely vociferous attack approaching within 3 m of us. The two birds then took up positions on the cliff top 13 m above us, still calling loudly. One bird stationed itself at the top of the opening.

As soon as we resumed our descent, a rock the size of a golf ball fell past my face and landed next to my feet. We assumed that it had accidentally been kicked loose by the raven. However, when we looked up, we both saw a raven with a rock in its beak perched at the top of the opening on the opposite side. With a slight flip of its head the raven tossed the rock down and across the opening towards us. From what shelter we could find, we watched the raven toss 6 more rocks from its position at the cliff top. One of these rocks struck me on the lower leg. The largest rock was 8 cm in diameter and 2.5 cm thick, and marks on it showed that it had been partially buried.

When we returned later that day to photograph this behavior, the ravens immediately flew at us and called. Again, one stationed itself in the same place at the top of the opening, but apparently no more rocks were available as only grit was thrown. The bird hopped about the cliff top with its wings partially extended and eventually dropped to a perch below the cliff edge closer to us. It appeared that the bird was searching for more loose rocks as it pried at the cliff at each perch. The raven eventually moved some distance away, still calling loudly. Assuming that no more loose rocks were available, we placed many rocks at the original perch and elsewhere on the cliff edge. On succeeding visits defensive behavior diminished and rock throwing was never repeated. On the last visit before the young fledged, the parents just perched together some distance down the cliff. They neither attacked nor called at us as they had earlier.

Except for the rock throwing behavior, nest defense was similar to that reported by Bowles and Decker (1930) and Harlow (Auk 39:399–410, 1922) including the aggressive vocal attack by both birds and the eventual perching together some distance away. Nine other raven nests, 7 of which were cliff nests, were visited during 1973 and 1974. The birds did not throw rocks at us at these nests, but none of the sites offered both loose rocks above the nest and a place from which they could be thrown. The nest site on the cliff face where we were pelted with rocks in 1973 was not occupied in 1974.

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FOOD AND FORAGING ECOLOGY OF THE AMERICAN KESTREL IN JAMAICA

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The American Kestrel (*Falco sparverius*) in the western hemisphere ranges from northern Alaska to southern Argentina and in the West Indies from the Bahamas to Aruba. Although the kestrel has been investigated in the northern part of its range (Bent 1938, Willoughby and Cade 1964, Heintzelman 1964, Smith et al. 1972, and others), no detailed information is available on its biology in the southern part of its range. To my knowledge the only references concerning the food habits of this species in southern latitudes are Greer and Bullock (1966) who examined the stomach contents of Chilean birds of prey, and Jenkins (1969) who observed the food habits of wintering kestrels in Costa Rica.

The present study was conducted in Jamaica during the summer and winter of 1969, spring and summer of 1970, and summers of 1971 and 1972. My objectives were to obtain information on the food, foraging ecology, and home range of this species in a tropical insular environment. In Jamaica, kestrels are fairly common and widely distributed, occurring in open and semi-open habitats and recorded from sea level to at least 1300 m. I saw kestrels in cultivated areas, coconut and citrus groves, wooded pas-

TABLE 1. Food habits of the American Kestrel in Jamaica, 1969–1972.

Prey	No. Individuals	Percent Individuals	Estimated[1] Biomass (gms)	Percent Biomass
Invertebrates				
Odonata	2	2	0.4	0.11
Orthoptera	55	50	27.5	8.03
Hemiptera	1	1	0.2	0.06
Coleoptera	4	4	1.2	0.35
Lepidoptera	4	4	1.2	0.35
Subtotal Invertebrates	66	61	30.5	8.90
Vertebrates				
Reptiles				
Anolis sp.	33	30	165	48.0
Birds				
Tiaris sp.	2	2	14	4.1
Coereba flaveola	1	1	8	2.3
Sturnus vulgaris	1	1	65	19.0
Unidentified small birds	2	1	15	4.4
Total birds	6	5	102	29.8
Mammals				
Bats	2	2	20	5.8
Rodents (Mus)	1	1	15	4.3
Unidentified small mammals	1	1	10	2.9
Total mammals	4	4	45	13.0
Subtotal vertebrates	43	39	312	90.8
Total	109	100	342.5	99.7

[1] All weights are from specimens collected in Jamaica.

TABLE 2. Records of kestrel prey in the West Indies.

Prey	Locale
Invertebrates	
Insecta	
Orthoptera	Puerto Rico (1, 2, 3)*, Hispaniola (4), Vieques (5), Antigua (6), Aruba (7), Mona (8), St. Martin (9), St. Eustatius (9)
Coleoptera	Aruba (7)
Diplopoda	Puerto Rico (3)
Chilopoda	Puerto Rico (3)
Arachnida	Aruba (7)
Vertebrates	
Reptilia	
Anolis	Puerto Rico (1, 2, 3), Hispaniola (4), Vieques (5), Antigua (6), Aruba (7), Mona (8)
Cnemidophorus	Aruba (7)
Ameiva	Puerto Rico (2)
Unidentified small lizards	Puerto Rico (1), Hispaniola (4)
Snake (Unident.)	Hispaniola (4)
Aves	
Columbigallina passerina	Aruba (7)
Coereba flaveola	Aruba (7)
Loxigilla portoricensis	Puerto Rico (2)
Zonotrichia capensis	Aruba (7)
Mammalia	
Rattus	Mona (8)
Mus	Puerto Rico (2, 3)

* (1) Bowdish 1902, (2) Wetmore 1927, (3) Danforth 1931, (4) Wetmore and Swales 1931, (5) Wetmore 1916, (6) Danforth 1934, (7) Voous 1955, (8) Barnes 1946, (9) Danforth 1930.

tures, woodland-savannah, scrub woodland, and suburban areas.

Most of my data were obtained in wooded upland pastures in Lluidas Vale (Worthy Park), St. Catherine Parrish, elevation 400 m. Some of the characteristic trees include: Jamaican cedar (*Cedrela odorata*), guango (*Samanea saman*), trumpet tree (*Cecropia peltata*), sweetwoods (*Nectandra* spp.), prickly yellow (*Fagara martinicensis*), and figs (*Ficus* spp.) (for a more detailed description of the area see Cruz 1972).

FOOD AND FORAGING ECOLOGY

The foraging patterns of kestrels in Jamaica are similar to those in North America and can be classified as follows: (1) observations from a vantage point, whence if suitable prey is detected, the bird flies directly to the spot and attempts the capture. In the study areas the vantage point usually consisted of the exposed upper branches of large trees, such as guango and trumpet trees. (2) Search in low flight over the terrain, covering the entire area by a combination of flying, hovering, and soaring. If a kestrel detects prey, it usually hovers over the spot, before swooping down to attempt the capture. (3) Aerial capture of prey, in which the kestrel either perched or in flight, observes a bat or a bird and attempts to overtake the prey and grab it with its talons.

Of the 356 recorded attempts at prey capture, 89% were towards prey on or near the ground and 11% were towards aerial prey. Of the former, 73% began from a perch and 27% from flight. Kestrels were successful in 42% of the attempts, with the highest rate of success registered against prey on or near the ground and the lowest rate against aerial prey.

In 109 cases, I saw and identified the prey items through binoculars. Of these items, 61% were insects and 39% were vertebrates, representing five insect orders and three vertebrate classes (table 1). Although insects were more numerous (66), than vertebrates, the latter provided most of the biomass (90.8%).

Anoles were the most abundant vertebrates found in the diet (table 1), representing 78% of the total vertebrate prey and 53% of the total vertebrate prey biomass. The high incidence of these lizards in the kestrel's diet is not surprising since they are among the most common of vertebrates in Jamaica. No data are available for Jamaica, but in certain Puerto Rican habitats, the density of anoles exceeds 800 per acre (Turner and Gist 1970). Birds, either captured on the ground or in aerial pursuit, were also represented in the diet, accounting for 14% of the

total vertebrate prey and 33% of the total vertebrate prey biomass.

Bats, which have not been reported as prey items in other areas of the West Indies (table 2), accounted for 5% of the total vertebrate prey and 6% of the total vertebrate prey biomass. The presence of bats in the kestrel's diet is also not surprising since Jamaica has 24 species of bats (Goodwin 1970), many of which were common in the Worthy Park area. Bats were captured at dusk, kestrels overtaking them in flight, grabbing them, and carrying them without pause to a favorite butchering tree. Small rodents, which are important components of this falcon's diet in more northern latitudes (Fisher 1893, Bent 1938, Tordoff 1955, Heintzelman 1964, Smith et al. 1972) were not well represented in the diet (2% of total vertebrate prey). This is probably because of the low diversity and numbers of these mammals in Jamaica. The endemic rice rat (*Orizomys antillarum*) is very rare or extinct (Hall and Kelson 1959) and the introduced *Mus* is uncommon in the study area. Although the introduced *Rattus* was common in the study area, it is apparently too large to be suitable prey. In contrast, many of these rats were taken by Barn Owls (*Tyto alba*), which were present in parts of the study area (Cruz, pers. observ.). Little is known about kestrels in other parts of their West Indian range, but available information on food habits is summarized in table 2 for comparison with the Jamaican data. This table also shows a similar high proportion of anoles and insects, and a low proportion of rodents, but few birds and no bats as prey items. Jenkins (1969) reported that wintering kestrels in Costa Rica fed on large insects, anoles, and snakes, but he observed no warm-blooded prey or attempts on same. He noted that suitable mammals are uncommon and their place in the diet of temperate zone kestrels is largely filled in the tropics by the abundant reptiles and large insects. My investigations on Jamaica plus the data from other West Indian islands (table 2) support Jenkins' observations. In addition, the diet of West Indian kestrels appears to be more diverse than that in the temperate zone since birds, bats, and rodents were also recorded as prey items (tables 1 and 2). This diversity may be a result of the absence in the West Indies of other small birds of prey and other animals with similar feeding habits that may compete for some of the same food resources.

SIZE OF FEEDING TERRITORIES

Home ranges for six breeding pairs of kestrels in the Worthy Park area were determined during the 1970 and 1971 breeding seasons (see Craighead and Craighead 1956 for methods used). The average diameter for the kestrel's range was 0.66 km for the two years (0.47 to 1.11). By comparison, average diameters for North American kestrels ranged from 0.82 km in Utah (0.5 km in 1969 and 1.13 km in 1970, Smith et al. 1972) to 2.42 km in Wyoming and Michigan (Craighead and Craighead 1956). The smaller average home ranges in Jamaica may be a result of 1) the greater diversity and abundance of certain prey that occur in North America and perhaps 2) the absence in Jamaica of food competitors. Schoener (1968) found that the home ranges of birds of prey (including the kestrel) expanded if the number of prey per unit area diminished, and Craighead and Craighead (1956) reported that the "abundance of prey was a major factor influencing the size of the range of Michigan raptors."

Scarcity of suitable nesting sites may also keep kestrel populations low in certain areas. In the United States, the use of nest boxes has helped to increase kestrel populations (Heintzelmen and Nagy 1968). In Jamaica, kestrels nested in natural cavities, woodpecker holes, or the bases of palm fronds. Of 20 nesting sites found in Jamaica, 16 (80%) were in woodpecker holes. Since there is only one species of woodpecker (*Melanerpes radiolatus*) in Jamaica and there are many species of birds (kestrel, Yellow-billed Parrot [*Amazona collaria*], Black-billed Parrot [*A. agilis*], Guiana Parrotlet [*Forpus passerinus*], Jamaican Owl [*Pseudoscops grammicus*], Stolid Flycatcher [*Myiarchus stolidus*], Dusky-capped Flycatcher [*M. barbirostris*], Rufous-tailed Flycatcher [*M. validus*], Starling [*Sturnus vulgaris*], and Saffron Finch [*Sicalis flaveola*]) that use woodpecker holes for nesting, the availability of suitable nest holes may limit the kestrel population on Jamaica.

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RAPTOR MORTALITY DUE TO DROWNING IN A LIVESTOCK WATERING TANK

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On 9 July, 1974 in Oneida County, S.E. Idaho, we discovered the partially decomposed remains of seven American Kestrels (*Falco sparverius*), and two unidentified passerines at the bottom of an empty livestock watering tank. The tank was circular, 4.9 m in diameter, 0.5 m deep and constructed of corrugated steel with a cement bottom. We assumed that the birds drowned after entering the tank for unknown reasons.

Two similar tanks in other parts of the region were later investigated and found to contain small avian remains in one, while a White-footed Deer Mouse (*Peromyscus maniculatus*) and Western Meadowlark (*Sturnella neglecta*) were in the other. Portions of Black-tailed Jackrabbits (*Lepus californicus*) were found in both of these tanks, their condition suggesting that they had been eaten by raptors. In addition, we found castings of Burrowing Owls (*Speotyto cunicularia*) at two of the three watering tanks.

Enderson (Auk 81:332–352, 1964) noted that a Prairie Falcon (*Falco mexicanus*) drowned in a stock tank. The bird was an adult female, nesting approximately 500 m from the stock tank in which it died, in the spring of 1961 (Enderson, pers. comm.). We have found no other references to this type of mortality in the literature. Our observations extend Enderson's record to another species of raptor and suggest that additional raptor species as well as smaller bird and mammal species may suffer similar deaths.

Perhaps raptors enter stock tanks for any of several reasons. Tanks may serve as a perch, as is evidenced by the presence of probable prey remains and castings in them. The raptor may enter the water to retrieve dropped prey items and then be unable to extricate itself. The water itself may be an attraction to the raptor. Lastly, and perhaps most logically, the raptor may be drawn to the tank by the presence of potential prey species which themselves have been attracted and trapped by the water. Thrashing movements of a trapped and drowning animal probably would trigger intense investigative and hunting behavior by raptors as well as other predators. Young inexperienced raptors, newly fledged from nests near stock tanks would be most vulnerable.

During the spring, summer, and fall when livestock are pastured in the vicinity, the tanks usually contain water. One rancher stated that he drained his tanks when they were not in use to prevent hawks from drowning in them, an occurrence he had seen several times (Elison, pers. comm.).

Drowning in livestock watering tanks may be significant due to the widespread use of such tanks throughout the arid and semi-arid western United States. This cause of death could be reduced simply by floating a large block of wood in the tank; this could facilitate escape from the water for trapped animals.

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THE EVOLUTION OF COLOR DIFFERENCES BETWEEN NASHVILLE AND VIRGINIA'S WARBLERS

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Within the parulid genus *Vermivora*, the Nashville Warbler (*V. ruficapilla*) and Virginia's Warbler (*V. virginiae*) are closely related (Griscom and Sprunt 1957, Mengel 1964, Lowery and Monroe 1968, Stein 1968). Mayr and Short (1970) regarded the two forms, plus the Colima Warbler (*V. crissalis*), as component species of a superspecies, while Phillips et al. (1964) treated all three as conspecific, based on vocalizations and behavior. Although standard references (e.g., A.O.U. 1957) imply that *V. ruficapilla* and *virginiae* are locally sympatric during the breeding season in northern Utah and southern Idaho, and therefore have proved their biologic species status, a review of verifiable breeding distributional records demonstrates that the two forms are strongly allopatric (Johnson 1976). Thus, continued main-