Opportunistic Foraging of Western Kingbirds on Aggregations of Tiger Beetles

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From 1 through 12 July 1976, at a large pond in Willcox, Arizona, I observed several Western Kingbirds (*Tyrannus verticalis*) using two dramatically different foraging modes, depending upon the prey distribution. When prey were clumped, these birds discontinued sallying and exhibited a foraging behavior that exploited the unusually high prey densities. These observations demonstrate the ability of Western Kingbirds to shift foraging modes and to forage "opportunistically" on a prey population undergoing diurnal changes in density.

I observed the kingbirds feeding upon a pondside population of tiger beetles (*Cicindela sedecimpunctata*) during the peak abundance of the beetles around the pond. After 13 July, tiger beetle numbers dropped by 80%, and I observed no Kingbirds foraging on these beetles for the remainder of July and August.

C. sedecimpunctata are highly active diurnal predators in beach areas. The activity and density of individuals appeared to be greatly influenced by daily temperature patterns. During morning hours (0730–1000), individuals were widely dispersed over the beach area. As the temperature increased, tiger beetles became clumped along the pond edge, probably due to the cooler temperatures, higher humidity, and high prey abundance on the wet sand. Under mid-afternoon temperature (48°C), the beetles clustered in the shade of a short sand ledge created by the eroding action of fluctuating pond levels. Such thermoregulatory behavior is typical of tiger beetles (Dreisig 1980).

On 3 separate mornings, two adult Western Kingbirds were observed sallying after insects from perches near (20 m) the pond. Movements of tiger beetles on the beach attracted the kingbirds, provoking low sweeping flights over the beach. Over the 3 days, 42 such flights resulted in 12 captures of tiger beetles. In each instance the bird returned to its original perch. Eight captured beetles were fed to juveniles. During 12 of the attempts, the Kingbirds turned and maneuvered abruptly in pursuit of tiger beetles that had not flown directly in front of the foraging bird. Five of these pursuits succeeded. The Western Kingbirds were observed foraging for tiger beetles a total of 2.5 h during the 3-day period.

In the same area at 1600 on 9 July, one adult Western Kingbird perched on the beach itself and periodically hovered over the eroded ledge. Wingbeats of the kingbird flushed many tiger beetles from the shade onto the open sand. In one 5-min period, 11 bouts of hovering resulted in four aerial captures and three beetles gleaned from the sand as they returned to the shade. The following afternoon, an adult behaved similarly for periods of 1 and 3 min, hovering over the eroded ledge 3 and 5 times, respectively. While great numbers of beetles again flew from the shade, the exact number captured could not be determined, because the skittishness of the kingbird precluded close observation.

Although conclusions cannot be drawn from so few observations, the two foraging behaviors would appear to differ greatly in terms of time and energy expenditures. During the hot afternoon, a shaded ledge serves to aggregate the prey in one location. In this situation one bout of hovering flushes many beetles and several can be gleaned per flight. This reduces not only search and pursuit time for each prey item but also the total time for successive captures, compared to the sallying mode.

The cessation of Western Kingbird predation on *Cicindela* when beetle numbers are low suggests a functional response to seasonal availability of this prey species. Within this response, the Kingbirds exhibit further behavioral flexibility in shifting foraging tactics as prey densities change during a single day. Although other examples of short-term shifts in foraging modes are known (Holmes et al. 1978, Robinson 1978, Robinson and Cunningham 1978), most studies and foraging models (Norberg 1977) involving shifts in foraging mode have focused on seasonal changes in prey density. Foraging theory may benefit from the consideration of opportunistic responses by predators to temporary localizations of food resources.

Literature Cited

Dreisig, H. 1980. Daily activity, thermoregulation and water loss in the tiger beetle *Cicindela hybrida*. Oecologia 44: 376–389.

Holmes, R. T., T. W. Sherry, & S. E. Bennett. 1978. Diurnal and individual variability in the foraging behavior of American Redstarts (*Setophaga ruticilla*). Oecologia 36: 141–149.

Norberg, R. A. 1977. An ecological theory on foraging time and energetics and choice of optimal food-searching method. J. Anim. Ecol. 46: 511–529.

Robinson, M. D. 1978. Nutritional ecology of a Na-

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mib Desert sand dune lizard, *Aporosaura an-chuetae.* Abstract, 2nd Intern. Congr. Ecol. (IN-TECOL), Jerusalem, Israel.

————, & A. B. CUNNINGHAM. 1978. Comparative

diet of two Namib Desert sand lizards (Lacerti-dae). Madoqua 11: 41–53.

Homogeneity of Vegetational Cover around the Nest and Avoidance of Nest Predation in Mockingbirds

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Reproductive failure by open-nesting passerines is largely caused by predators of eggs and nestlings (Lack 1954, Nice 1957, Best and Stauffer 1980). Besides active parental defense, two major antipredator tactics might be expected: (1) placement of the nest in a well-concealed site and (2) placement of the nest in a site where predator access or abundance is reduced. To determine the existence of such tactics would require both assaying the effect of nest-site characteristics on nesting success and testing for nest-site choice (independently of such confounding influences as territoriality). Several workers have quantified the mean density of vegetation around nests and related it to nesting success (Gluck 1979, Wray and Whitmore 1979), but none has examined the effect of the homogeneity of such vegetational coverage. We report here the results of an assay of the effects of nest-site characteristics upon nesting success in Mockingbirds (*Mimus polyglottos*) and describe an apparatus for measuring density and homogeneity of vegetation near nests.

The study was conducted in three southcentral Louisiana parishes—east Lafayette, west St. Martin, and south St. Landry. Nests were located along fence rows and the edges of thickets that were bordered by pastures and cultivated fields. During the breeding seasons of 1980 and 1981, 50 and 58 nests were studied, respectively. Once an active nest was located, we monitored its status on alternate days by using a mirror attached to a pole to view the contents (Parker 1972). The effects of the investigator's presence were assumed to be minimal (see Willis 1973, Anderson and Storer 1976, Gottfried and Thompson 1978). Nests yielding at least one fledgling were defined as successful. Losses were attributed to predation when whole clutches of eggs or whole broods of unfledged young disappeared (Skutch 1976).

Measurements of the vegetation were made after each nest became vacant. The primary species of vegetation surrounding the nest was recorded. The 14 variables measured, or computed from measurements, at each nest were: (1) and (2) distance continuous vegetation extended directly above nest (DA) and below nest (DB); (3) average of DA, DB, and four measurements, separated from one another by 90°,

of distance of continuous vegetation lateral to the nest (DM); (4) height of nest from ground (H); (5) maximum height of vegetation supporting nest (TH); (6–8) mean percentage of reduction in light transmittance lateral to nest (ML), above nest (MA), and below nest (MB); (9) mean percentage of reduction in light transmittance lateral to, above, and below nest (MLAB); (10–12) standard deviation of percentage of reduction in light transmittance lateral to nest (SDL), above nest (SDA), and below nest (SDB); (13) mean standard deviation of percentage of reduction in light transmittance lateral to, above, and below nest (SDLAB); (14) qualitative score for degree of isolation of site (ISOL), assigned values of 1 = along line of continuous woody vegetation, 2 = along broken line of woody vegetation, 3 = an isolated mass of woody vegetation.

Variables 6–13 were derived from photometer readings of a standard light-source to obtain a relative measurement of the density of vegetation immediately around nests. This procedure was performed only at night in essentially complete darkness except for that light provided by the standard light-source. The photometer used was a Science and Mechanics Model 102. The apparatus employed to establish measuring points consisted of a central wooden disc with a diameter of 10 cm. A 250-mA light bulb at the center of the disc was powered by a 6 V battery. Six wooden dowels could be inserted laterally into holes along the lateral margin of the disc separated by angles of 60°. Four holes on the top of the disc held four dowels at 60° angles to the flat surface of the disc. When the disc was turned upside down, readings could be obtained for four points under the nest. The distance from the distal end of the dowels to the light bulb was 61 cm. By placing the light probe of the photometer at the distal end of each dowel, the amount of light from the bulb that passed through the intervening vegetation could be recorded. This was converted to a relative measurement of the percentage of light reduction by comparing each reading with equivalent readings taken without any vegetational barrier. Before the disc was placed in the nest, light readings were recorded in an open area near the nest site where there were no