INSECT ABUNDANCE AS A DETERMINANT OF FORAGING AREA SIZE IN *TYRANNUS MELANOCHOLICUS*

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Abstract. We studied the foraging patterns of the Tropical Kingbird in relation to food abundance. Results from kingbirds observed in the marsh at Palo Verde showed that a significant negative correlation existed between foraging area size and insect abundance, suggesting that food abundance is a major determinant of foraging area size for this aerial insectivore. (EWG)

INTRODUCTION (JLD)

Foraging for food is a significant energy drain for many animals. An animal should limit energy use as much as possible to control the positive feedback loop of increasing energy expenditure and increasing energy requirements. This leads to a need to maximize foraging efficiency; i.e., to minimize the energy used per unit of food captured.

We examined the foraging behavior of the Tropical Kingbird (*Tyrannus melanocholicus*), a flycatcher that occupies open grassy marshes, among other habitats. It feeds on fruits and large insects, including Hymenoptera, Odonata, Lepidoptera, Orthoptera, Coleoptera and Diptera (Stiles and Skutch 1989, Fitzpatrick 1983). During the dry season in Costa Rica, it feeds almost exclusively by catching flying insects (pers. obs.).

Energy is mainly expended on foraging sallies since the kingbird handles its prey quickly. The kingbird can shorten its sallying distance by taking the prey closest to it, thereby reducing energy use. Where insect abundance is greater, more insects should be closer to the bird, permitting shorter sallies. Indeed, the kingbird should have as small a foraging area as the food abundance will allow. Therefore, we hypothesized that foraging area and insect abundance would be negatively correlated.

METHODS (JLD)

We conducted our experiment on 10 January 1992 in the marsh in front of the OTS Station at Palo Verde National Park. Observations were made from 0645 to 1000. Area measurements were taken in the afternoon.

We observed individual birds for 15min to determine the location of perches and the distance/direction of sallies. We then flagged perches and sallying boundaries for later measurement. This served as an outline of foraging area. We measured the foraging areas by breaking them into simple geometric shapes (rectangles, triangles and circles).

We sampled insect abundance after each 15min observation period. This was done by walking an 8m straight line, in a random direction, roughly at the center of the foraging area for a duration of 60sec. We counted each large (honeybee sized) insect seen within a semicircle with a radius of 1m) ahead of us. If the foraging area was small, the walk was reduced to 4m or 6m and 30sec or 40sec, respectively. Short walks were then scaled to the standard 8m, 60sec walk.

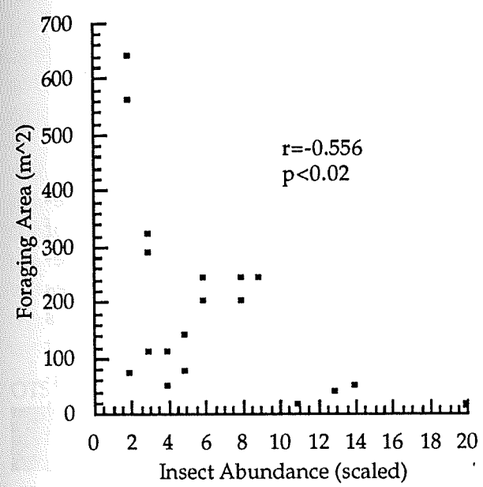

Figure 1. Foraging area size of the Tropical Kingbird in relation to insect abundance.

RESULTS (JAR)

Twenty foraging areas were marked during the observation period, with sizes ranging from $13m^2$ to $638m^2$. Insect abundance ranged from 2 to 20 insects counted for the 8m, 60sec census. A comparison of relative prey abundance and size of foraging areas using a Pearson product-moment correlation resulted in a significant negative correlation ($r^2=0.309$, $p<0.02$; Figure 1).

DISCUSSION (JAR)

The significant negative correlation between the size of foraging area of the Tropical Kingbird and relative insect abundance suggests that prey density may be an important determinant of foraging area size in this species. Other (untested) important factors affecting size of foraging area may include Tropical Kingbird density, wind, and social organization of the species (e.g., foraging area of mated pairs). Additional studies in which prey abundance is manipulated would provide an experimental way of determining if changes in insect abundance directly cause changes in the size of foraging area of the Tropical Kingbird.

Our finding of a negative correlation between foraging area size and prey abundance supports the theory that organisms minimize energy expenditure while foraging. The Tropical Kingbird seems to decrease its foraging area when prey abundance is high, which leads to a maximization of its net energy gain while foraging.

LITERATURE CITED

Fitzpatrick, J.W. 1983. *Tyrannus melanocholicus*. In *Costa Rican Natural History*, ed. D. H. Janzen, 611-613. Chicago: University of Chicago Press.

Stiles, F. and A. Skutch. 1989. *A Guide to the Birds of Costa Rica*. Ithaca, NY: Comstock Publishing Associates, 307-308.