

On examining the skeletal remains of the hawk, I noted that the fleshy parts of the legs were still hydrated, indicating that the bird had probably only been dead a few days.

Although the possibility exists that the bird may have been killed by the remaining adult and used as food, it is more likely that the bird was either sick or wounded and died at the nest and was subsequently dismembered and fed to the chick. Because of the chick's age and the completeness with which the skeleton was cleaned, it is unlikely that the chick fed on the entire adult bird itself.

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#### LITERATURE CITED

- BAXTER, L. V. 1906. A tragedy. *Bird-Lore* 8: 68.  
 CLEVENGER, G. A., AND A. I. ROEST. 1974. Cannibalism in Red-tailed Hawk. *Auk* 91: 639.  
 FITCH, H. S., F. SWENSON, AND D. F. TILLOTSON. 1946. Behavior and food habits of the Red-tailed Hawk. *Condor* 48: 225.  
 INGRAM, C. 1959. The importance of juvenile cannibalism in the breeding biology of certain birds of prey. *Auk* 76: 218-225.  
 MATRAY, P. F. 1974. Broad-winged Hawk nesting and ecology. *Auk* 91: 319.  
 TUBBS, C. R. 1974. Pp. 143-144 in *The Buzzard*. London, David & Charles Ltd.  
 UTTENDÖRFER, O. 1952. Pp. 47-48 in *Neue Ergebnisse über die Ernährung der Greifvögel und Eulen*. Stuttgart, Eugen Ulmer.

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**Defense of feeding sites by Orioles and Hepatic Tanagers in Mexico.**—While studying the pollination biology of *Erythrina breviflora* (Leguminosae) in Mexico in September and October 1975, we noted that groups of either Northern (*Icterus galbula bullockii*) or Hooded Orioles (*I. cucullatus*) repeatedly took nectar from the flowers of *E. breviflora* and chased similar-sized tanagers and wrens from the trees. Analysis of floral nectar constituents suggests that these birds can obtain all or most of the nutrients they need from the nectar of the flowers they defend. The days and total hours of observation follow the study sites.

MORELOS: (1) Santa María ca 9 km N of Cuernavaca (21, 26-28 Sep/15 h); MICHOCAN: (2) El Alamo ca 5.5 km SE of rd to Huetamo (30 Sep, 8 Oct/4.3 h); and (3) Ruta 15 ca 3 km NW of rd to Jungapeo (9 Oct/2.5 h). At Santa María we watched the birds from midmorning (1000/h MST) to one-half hour past sundown (1840 h). We were at El Alamo from 1055 to 1415 and 1710 to 1815 and at site 3, 1245 to 1450 and 1530 to 1555. We watched Northern Orioles at site 1 and Hooded Orioles at sites 2 and 3. At sites 1 and 2, the groups included a mature male and female and an immature male. At the third site, the group included a mature male, two immature males, and two females. A male and female Hepatic Tanager (*Piranga flava*) foraged together at sites 1 and 2.

Interactions between the orioles and other similar-sized birds almost always resulted in the displacement of the other birds. At El Alamo, both mature and immature orioles chased Hepatic Tanagers and Gray-barred Wrens (*Campylorhynchus megalopterus*) from the flowering trees. At Santa María, mature orioles chased the Hepatic Tanagers from the feeding territory. On one occasion the immature male was displaced by the male tanager. On a number of occasions, just the appearance of a male oriole made the tanagers or wrens leave or move to the periphery of the feeding territory (6 of the 17 observed interactions). At all study sites, mature birds chased the immature males to the edge or out of the feeding site, but the latter always returned and foraged in the central part of the area, especially when the adult birds were out of sight or absent. No aggressive interactions occurred between mature males and females.

The major exception to oriole dominance was at El Alamo. There, tanagers chased the orioles from a set of trees in which the tanagers fed repeatedly. The trees the tanagers defended were small, more dispersed than those used by the orioles, and were visited sequentially on each foraging trip, in the same way that "trap-lining" hummingbirds visit a series of flowers or inflorescences. In contrast, at Santa María tanagers successfully foraged when orioles were out of sight or were absent from the trees. On one occasion at this site, a jay (*Aphelocoma* sp.) chased the orioles to the edge of the feeding area and then foraged at the flowers for approximately 15 minutes.

A comparison of the sugar and amino acids in the nectar with an estimate of the birds' caloric and protein requirements suggests that the trees provide enough nectar to satisfy the birds' nutritional requirements. The number of flowers at Santa María, as estimated from a photograph, was minimally 3,000. No counts of flowers were made at El Alamo or site 3, but the number of open flowers was in excess of 1,500. The mean amounts of sugar per flower from the three populations were 4.9, 10.0, and 12.4 mg, respectively (Cruden and Toledo 1977). If nectar is removed from a flower, nectar secretion resumes at a rate sufficient to assure complete replacement once a day. Thus the minimal caloric value of sugar available to the birds per day was approximately 108, 111, and 137 kcal, respectively.

King's (1974) formula was used to estimate the daily caloric requirements for the orioles, i.e.  $\log DEE = \log 317.7 + 0.7052 \log W$ , where DEE = daily energy expenditure in kcal and W = weight in kg. The weights of male *I. c. trochiloides* ( $\bar{X} = 26.6 \pm \text{S.E. } 0.3 \text{ gm}$ ; N = 32) and male *I. g. bullockii* ( $\bar{X} = 35.5 \pm \text{S.E. } 0.6 \text{ gm}$ ; N = 35) were obtained from specimens in the Museum of Vertebrate Zoology, University of California, Berkeley. We used the weights of *I. c. trochiloides* and *I. g. bullockii* males because they were (1) larger than the females, (2) larger than males of *I. c. californicus* and *I. g. parvus*, respectively, and (3) similar to those of the subspecies we studied. Using these weights, we estimate that a Hooded Oriole requires 24.6 kcal per day and the larger Northern Oriole requires 30.2 kcal per day. Thus the minimal amount of sugar available in the flowers and that required by the orioles are of the same magnitude. Further, a rapidly foraging Hooded Oriole at El Alamo or site 3 would need to spend approximately 20% of its time foraging to obtain sugar with a caloric value of 26.6 kcal during a 12-hr day. This estimate is based on 12 min foraging/hr at a rate of 5 fls/min, 10 mg sugar/flower, and 3.7 cal/mg sugar. The estimated foraging time is similar to those reported by Gill & Wolf (1975) and Wolf (1975) for territorial sunbirds. The Northern Orioles at Santa María, because of lower amounts of sugar per flower, coupled with larger body size, would have to spend approximately 50% of their time foraging during a 12-hr period.

In addition to sugar, the nectar contains 18 amino acids, including all those that Fisher (1972) lists as necessary for growth and maintenance. The mean amounts of amino acids were 0.19, 0.32, and 0.25 mg per flower for the three populations (Cruden and Toledo 1976). The maximum figure for the minimal amount of the 11 amino acids that are necessary for growth and/or maintenance is 0.821 mg per gm body weight (see Fisher 1972). Based on this figure the Hooded Orioles would need to visit only 68 and 87 flowers at El Alamo and site 3, respectively, to acquire minimal amounts of amino acids. The equivalent figure for the Northern Orioles at Santa María is 188 flowers. Even if we assumed minimal metabolic interconversion of amino acids, i.e. that twice the number of flowers must be visited, the birds could consume sufficient amino acids in 2-3 hr of foraging to satisfy their protein requirements.

The aggressive behavior of Northern and Hooded Orioles toward tanagers and wrens and the latter's avoidance behavior, plus the aggressive behavior of the tanagers toward the orioles at El Alamo, is evidence that both orioles and tanagers actively defend their feeding grounds. That the resource is worth defending is clear from the amounts of sugar and amino acids in the nectar. Although orioles (Slud 1964, Howell 1972) and tanagers (Slud 1964) are known to travel in pairs or groups, and a male Northern Oriole (*I. g. galbula*) has been reported as defending a feeding territory (Schemske 1975), this is to our knowledge, with the exception of ant-tanagers that feed on arthropods and fruits (Willis 1966), the first instance of oriole groups and pairs of tanagers defending feeding grounds.

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#### LITERATURE CITED

- CRUDEN, R. W. AND V. M. TOLEDO. 1976. Oriole pollination of *Erythrina breviflora* (Leguminosae): Evidence for a polytypic view of ornithophily. *Plant Syst. Evol.* (in press).
- FISHER, H. 1972. The nutrition of birds. Pp. 431-469 in *Avian biology* (D. S. Farner and J. R. King, Eds.). New York, Academic Press.
- GILL, F. B. AND L. L. WOLF. 1975. Economics of feeding territoriality in the Golden-Winged Sunbird. *Ecology* 56: 333-345.
- HOWELL, T. R. 1972. Birds of the lowland pine savanna of northeastern Nicaragua. *Condor* 74: 316-340.
- KING, J. R. 1974. Seasonal allocation of time and energy resources in birds. Pp. 4-70 in *Avian energetics* (R. A. Paynter, Jr., Ed.). Publ. Nuttall Ornithol. Club No. 15.
- SCHEMSKE, D. W. 1975. Territoriality in a nectar-feeding Northern Oriole in Costa Rica. *Auk* 92: 594-595.

- SLUD, P. 1964. The Birds of Costa Rica. Distribution and ecology. Bull. Amer. Mus. Nat. Hist. 128: 3-430.
- WILLIS, E. O. 1966. Ecology and behavior of the Crested Ant-Tanager. Condor 68: 56-71.
- WOLF, L. L. 1975. Energy intake and expenditures in a nectar-feeding Sunbird. Ecology 56: 92-104.

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**Helpers at the nest in Barn Swallows.**—Auxiliary feeding of nestlings by immature Barn Swallows (*Hirundo rustica*) has been recorded often, as in studies by Forbush (1929, Birds of Massachusetts and other New England states, vol. 3, Norwood, Massachusetts, Norwood Press), White (1941, Brit. Birds 34: 179), Williamson (1941, Brit. Birds 34: 221-222), Armstrong (1947, Bird display and behavior, London, Lindsay Drummond, pp. 191-192), and Skutch (1961, Condor 63: 198-226). All these reports assume the helpers to be siblings from previous clutches, but none verifies the identity of the immature helpers, quantifies the amount of help given, or indicates the presence of adult helpers.

We conducted a study on three colonies of color-banded Barn Swallows in Portage County, Ohio during the 1975 breeding season to ascertain if the above stated behavior existed in these colonies and if any additional aid is given by other adults of the colony. Helpers performed a substantial proportion (6-28.5%) of the total feeding visits at 8 of the 21 nests where feeding observations were made (Table 1). A feeding visit is defined here as actual food delivery to begging chicks by any bird of the colony.

At one nest (Nest BOF, Table 1) where helping was noted, immature offspring from the first clutch were seen feeding newly hatched siblings, verifying the aforementioned observations of other authors.

TABLE 1  
SELECTED FEEDING INFORMATION FROM 8 BARN SWALLOW NESTS

Colony	Nest number	Total feeding visits noted	% feeding by helpers (adults unless noted)	Fraction of clutch fledged
1	G11	137	28.5	4/5
1	G3'	67	6.0	4/4
1	G21	122	20.5	4/5
1	G1	19	15.8	4/5
1	G8	129	7.1	4/5
1	G8 <sup>1</sup>	26	26.9	2/4
3	BOF	154	26.0	3/5
3	BOF <sup>1</sup>	324	12.3 (immatures) 7.2 (adults)	5/7

<sup>1</sup> Second clutch 1975 breeding season.

Between 22 and 25 July a flock of 17-19 unidentified individuals joined the parents and immature offspring in feeding duties, indicating that in addition to immature offspring of the year, non-colony-members also help parental adults feed nestlings. In this case, helpers' activities exceeded 19% of the total feeding observed.—GERALD R. MYERS AND DAVID W. WALLER, *Department of Biological Sciences, Kent State University, Kent, Ohio 44242. Accepted 10 May 1976.*

**Leapfrog feeding in the Great Egret.**—I studied the feeding behavior of Great Egrets (*Casmerodius albus*) during the breeding season in a mangrove lagoon in San Blas, Nayarit, Mexico, daily for 7 weeks. Except for brief feeding stops in the early morning by large numbers of departing roosting birds, rarely were more than 20 Great Egrets feeding at once, despite the presence of 40 pairs nesting nearby. The feeding ground (described more fully by Dickerman and Juarez 1971) was along the shallow side (less than 30 cm deep) of a large body of open brackish water (0.7 km × 0.4 km) among growths of a grass-like plant that grew to a maximum of 45 cm above the water. When only small numbers were present, the egrets fed in the "stand and wait" or the "wade or walk slowly" manners (Meyerriicks, 1960a).