Moore, G. C. 1940. The nesting habits and juvenile development of the Mourning Dove in Alabama. M.Sc. thesis, Alabama Polytechnic Institute, Auburn, Alabama.

Moore, G. C. and A. M. Pearson. 1941. The Mourning Dove in Alabama. Ala. Conserv. Dept. Bull.

Morrison, K. P. 1969. Mourning Dove ecology in south-central British Columbia. M.Sc. thesis, Colorado State Univ., Fort Collins, Colorado.

Murton, R. K. 1965. The Wood Pigeon. Collins Press, London, England.

Neter, J. and W. Wasserman. 1974. Applied linear statistical models. Richard D. Irwin, Homewood, Illinois.

Pettingill, O. S. 1970. Ornithology in laboratory and field. Burgess, Minneapolis, Minnesota.

Tomlinson, R. E., H. M. Wight, and T. S. Baskett. 1960. Migrational homing, local movement, and mortality of Mourning Doves in Missouri. Trans. N.A. Wildl. and Nat. Res. Conf. 25:253–267.

Webb, L. G. 1950. The life history and status of the Mourning Dove, *Zenaidura macroura carolinensis* (L.) in Ohio. Ph.D. diss., Ohio State Univ., Columbus, Ohio.

Wiley, J. W. and B. N. Wiley. 1979. The biology of the White-crowned Pigeon. Wildl. Monogr. 64.

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Observations on the breeding biology of Emerald Toucanets in Costa Rica.—Emerald Toucanets (*Aulacorhynchus prasinus*) are abundant in montane forests of Central America, but their breeding biology has received little study (Wagner 1944; Skutch 1944, 1967). Here I provide data on the roles of sexes in parental care of young Emerald Toucanets and describe nestling diet.

Study area and methods.—The study was conducted in and around Monteverde, Costa Rica (10°18′N, 84°48′W) in scattered cattle pastures and small- to moderate-sized woodlots in montane wet forest. For a more detailed description of the area, see Lawton and Dryer (1980) and Holdridge (1967).

Observations were made during July–August 1984 and March–July 1985. Nests were monitored daily for 1–2 h (alternating mornings and afternoons) with 8 × 35 binoculars for a total of 107 h by me and 5 assistants. During each visit, percent time each sex spent in each activity (e.g., excavation, incubation, waste removal) was calculated. Based on a morphometric analysis of museum specimens (Riley 1986), I could reliably sex most toucanets in the field. Food items delivered to nestlings were classified as either insect or fruit, and more accurate identifications were made when possible. I calculated percent fruit in the nestling diet as well as percent of nests that fledged at least one chick.

Results.—Courtship feeding was first observed in mid-March. I saw males, perched next to a female, offer fruit on 3 occasions. Acceptance of the fruit was followed by copulation in 2 cases. Nest excavation began within a few days of courtship. A total of 13 nests was found, 3 in 1984 and 10 in 1985. All nests were in pastures or forest edges in old snags, except for one in a wooden utility pole along a roadcut. Nests were either enlarged wood-

TABLE 1

MORPHOMETRICS OF FRUITS BROUGHT TO NESTLING EMERALD TOUCANETS DURING 1984 AND 1985 (AS SOME FRUITS WERE NOT REPORTED TO SPECIES LEVEL, THIS LIST MAY UNDERESTIMATE THE DIVERSITY OF FRUITS IN NESTLING DIETS)

Fruit	Mean Length (mm)	Width (mm)	Weight (g)
Ocotea tonduzii	15.3	10.1	1.0
O. tenera	25.4	17.7	6.3
Trema micrantha	3.1	2.5	0.02
Cecropia spp.	44.9	6.9	1.9
Hasseltia floribunda	11.2	10.8	0.8
Passiflora helleri	16.8	17.0	3.0
Rapanea myricoides	0.4	0.4	0.03
Ehretia austin-smithii	15.7	14.2	2.1
Acnistus arborescens	7.7	8.3	0.3
Cestrum spp.	9.5	7.8	0.3
Lycianthes multiflora	11.8	12.3	1.0
Citharexylum macradenium	9.9	9.9	0.8
Rubus rosaefolia	13.7	13.5	1.4
Conostegia bernouliana	7.4	10.1	0.5
Dendropanax spp.	7.6	9.3	0.3
Oreopanax spp.	4.0	4.0	0.05
All species	12.8	9.7	1.2

pecker holes (Skutch 1944) or excavations in rotten trees. Nest height varied from 3.2 to 7.4 m ($\bar{x}$ = 5.4 m, N = 3). Hole openings were oval shaped and averaged 7.3 cm wide, 7.7 cm long and 57 cm deep (cf. Skutch 1944). I observed excavation activity for 2 h at 2 nest sites. Females were responsible for 58% of the excavation. Once excavation was complete, 3–5 eggs were laid directly on the wooden floor of the cavity.

I observed incubation activity for 7.8 h at 2 nests in 1985. The first nest was monitored for 7 days in late May, after which it was destroyed by White-faced Monkeys (*Cebus capucinus*) (B. Haber, pers. comm.). The second nest (with 3 eggs) was watched for 2 days in late June prior to being lost to predation. During these brief observations, both adults incubated for short periods (females $\bar{x}$ = 15.5 min, N = 15; males $\bar{x}$ = 11 min, N = 20), with females incubating 66% of the time. Although I did not follow the entire cycle of any one nest, Skutch (1967) found the incubation period to be 16 days.

Nestling diet.—Fruits, arthropods, and a bird's egg (delivered by a male) were brought to >30-day-old nestlings at 6 nests. Nestlings fledged at 5 of these sites. Percent fruit delivered to nestlings at those 5 sites ranged from 85 to 97%. The remainder of nestling diets were arthropods. At the remaining site, I observed food deliveries for 12 of the first 15 days after hatching. Nestling diet consisted of 67% fruit for the 12 observation days (13 h, N = 88 deliveries).

Adults of both sexes fed at similar rates (females, $\bar{x}$ = 2.48 ± 0.53 deliveries/h, N = 244 food items; males, $\bar{x}$ = 2.88 ± 0.59, N = 296 food items), but males fed insects more frequently (0.67 insects/h, N = 76) than did females (0.36 insects/h, N = 36). Sixteen species of fruit (Table 1) comprised 79% of 539 food items delivered. All species of fruits delivered to young were also common in the diets of adults. Arthropods (21% of food items) included a spider (Arachnida), 2 centipedes (Diplopoda), Orthoptera (Phasmatidae [12], Gryllidae [1], Tettigoniidae [2]), Homoptera (1), Coleoptera (14), Lepidoptera (6), Diptera (11), and Hymenoptera (1). The remaining 64 arthropods could not be identified.

Nest sanitation.—The adults removed wood chips following excavation and carried nestling fecal sacs and regurgitated seeds from the sites. Females performed 78% of the 167 waste removal acts I observed at 9 nests.

Nesting success.—I was able to determine the outcome of 10 of the 13 nesting attempts I watched. Six fledged at least one chick (3 clutches of 4, 1 clutch of 3, 1 clutch of 1). Two nesting attempts were second clutches fledging 1 and 4 chicks. At the sixth nest I saw young with adults, but was unable to determine the exact number fledged. Two nests failed to fledge young due to treefalls, 2 nests failed due to predation, and one nest was abandoned before excavation was complete. The outcome of 2 nesting attempts was unknown.

Discussion.—Skutch (1944, 1967) reported findings for 11 nests in Costa Rica, all of which were in pasture clearings, 2.1–27.4 m high in woodpecker cavities. Most nests contained 3 or 4 eggs that were incubated equally by both adults for 16 days; although others had slightly longer incubation sessions and more male incubation. Young fledged at 43 days of age, and second broods were common.

Skutch (1944) and Wagner (1944), who observed a single nest of an Emerald Toucanet in Chiapas, Mexico, also observed that nestlings were fed a diet consisting mainly of fruits and only a few insects. Skutch (1967) observed toucanets occasionally feed eggs and nestlings of other birds to young.

Most tropical fruit-eating birds feed their nestlings much greater proportions of animal material (Snow 1976) than that found for toucanets. Wheelwright (1983) found that nestling Resplendent Quetzals (*Pharomachrus mocinno*), another hole-nesting species at Monteverde, received 70% animal food, although adults seldom eat anything but fruits. Lengthy development periods have been documented for several frugivorous species (Snow 1962). Morton (1973) suggested that nestling diets high in fruits are not favored for most birds because resultant slow growth would subject young to increased predation pressures. Emerald Toucanets and other ramphastids fledge at 35–43 days after hatching (Van Tyne 1929; Skutch 1944, 1945, 1967; Todd et al. 1973). Despite this long nestling period, Emerald Toucanets in my study were preyed on at only 2 of 10 nests. Toucanets may experience low rates of predation because of nest type and location, as well as their aggressive behavior toward intruders. Skutch (1966) found that nesting success was greatest in tropical species with deep hole nests in second growth habitats, the nesting pattern of Emerald Toucanets.

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LITERATURE CITED

HOLDRIDGE, C. 1967. Life zone ecology. Rev. ed. Tropical Science Center, San José, Costa Rica.

LAWTON, R. AND V. DRYER. 1980. The vegetation of the Monteverde Cloud Forest Reserve. Brenesia 18:101–116.

MORTON, E. S. 1973. On the evolutionary advantages and disadvantages of fruit eating in tropical birds. Am. Nat. 107:8–22.

RILEY, C. M. 1986. Foraging behavior and sexual dimorphism in Emerald Toucanets in Costa Rica. M.Sc. thesis, Univ. Arkansas, Fayetteville, Arkansas.

SKUTCH, A. F. 1944. Life history of the Blue-Throated Toucanet. Wilson Bull. 56:133–151.

———. 1945. Incubation and nestling periods of Central American birds. Auk 62:8–37.

———. 1966. A breeding bird census and nestling success in Central America. Ibis 108: 1–16.

———. 1967. Life histories of Central American highland birds. Nuttall Ornithol. Club Bull. 7.

SNOW, D. W. 1962. The natural history of the oilbird (*Seatornis caripensis*) in Trinidad, W.I. II. Population, breeding ecology, and food. Zoologica 47:199–221.

———. 1976. The web of adaptation. Bird studies in the American tropics. Cornell Univ. Press, Ithaca, New York.

TODD, F. S., N. B. GALE, AND D. THOMPSON. 1973. Breeding Crimson-rumped Toucanets at Los Angeles Zoo. Int. Zoo Yearbook 13:117–120.

VAN TYNE, J. 1929. The life history of the toucan *Ramphastos brevicarinatus*. Univ. Michigan Mus. Zool. Misc. Publ. 19:1–43.

WAGNER, H. O. 1944. Notes on the life history of the Emerald Toucanet. Wilson Bull. 56:65–76.

WHEELWRIGHT, N. T. 1983. Fruits and the ecology of Resplendent Quetzals. Auk 100: 286–301.

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Seabird densities and aggregations during the 1983 El Niño in the Galapagos Islands.— The El Niño-Southern Oscillation (ENSO) phenomenon of 1982–1983 was one of the most severe ever recorded in the Pacific Ocean, with major changes in fisheries, climate, and bird populations (Barber and Chavez 1983). In the Galapagos Islands, approximately 1000 km off the west coast of South America, Valle (1985) documented major breeding population decreases of Flightless Cormorants (*Nannopterum harrisi*) and Galapagos Penguins (*Spheniscus mendiculus*) and observed mortality of Blue-footed Boobies (*Sula nebouxii*), Magnificent (*Fregata magnificens*) and Great (*F. minor*) frigatebirds, and Brown Pelicans (*Pelecanus occidentalis*). Effects appeared to be more severe than during previous occurrences of El Niño, when adult mortality was not reported (Boersma 1978, Harris 1979). The widespread adult mortality and reproductive failure reported for breeding seabirds (Valle 1985) most probably were caused by reductions in food resources in the marine environment (e.g., Boersma 1978) during the 1983 El Niño. Unfortunately, there has been little information on seabird distribution and numbers at sea during El Niño events in the Galapagos. We report seabird densities and flock sizes recorded on 6 transects made within the archipelago during and after the 1983 El Niño.

Methods.—Birds were counted on continuous transects between islands, using the vessel Beagle III, cruising at 8 knots (Fig. 1). Sea-surface temperatures (SST) were taken with bucket