

- HINES, J. E., AND G. J. MITCHELL. 1983. Breeding ecology of the Gadwall at Waterhen Marsh, Saskatchewan. *Can. J. Zool.* 61:1532-1539.
- JENKINS, D., M. G. MURRAY, AND P. HALL. 1975. Structure and regulation of a Shelduck *Tadorna tadorna* population. *J. Anim. Ecol.* 44:201-232.
- KEITH, L. B. 1961. A study of waterfowl ecology on small impoundments in southeastern Alberta. *Wildl. Monogr.* 6.
- LOW, J. B. 1945. Ecology and management of the Redhead, *Nyroca americana*, in Iowa. *Ecol. Monogr.* 15:35-69.
- MCGILVREY, F. B. 1969. Survival in Wood Duck broods. *J. Wildl. Manage.* 33:73-76.
- MENDENHALL, V. M. 1976. Survival and causes of mortality in Eider ducklings on the Ythan estuary, Aberdeenshire, Scotland. *Wildfowl* 27:160.
- REED, A. 1975. Reproductive output of Black Ducks in the St. Lawrence estuary. *J. Wildl. Manage.* 39:243-255.
- ROHWER, F. C. 1985. The adaptive significance of clutch size in prairie ducks. *Auk* 102: 354-361.
- SAS INSTITUTE, INC. 1982. SAS user's guide: statistics. 1982 ed. SAS Institute, Inc., Cary, North Carolina.
- SMITH, R. H., AND A. S. HAWKINS. 1948. Appraising waterfowl-breeding populations. *Trans. N. Amer. Wildl. Conf.* 13:57-62.
- MARIANNA HEINS-LOY, Range and Wildl. Manage., Texas Tech. Univ., Lubbock, Texas 79409. (Present address: 314 Hickory Dr., Ames, Iowa 50010.) Received 16 June 1985; accepted 16 Apr. 1986.

Status and Seasonal Patterns of Abundance of Turkey Vultures in Puerto Rico.—

Turkey Vultures (*Cathartes aura*) are resident on all major islands of the Greater Antilles (Bond 1979), but seasonal migrants also visit the islands (Darrow 1983). In most cases, it is not known whether migrants overwinter or merely pass through on their way to Central or South America (Smith 1980). We describe the range and seasonal abundance of Turkey Vultures in Puerto Rico and discuss conflicting reports of the general history of this species in the Greater Antilles.

Study area and methods.—Since they were first reported in Puerto Rico, Turkey Vultures have been restricted to the southern region of the island (Biaggi 1974, Perez Rivera and Cotte Santana 1977, Wetmore 1927). Southern Puerto Rico is in the subtropical dry-forest life-zone, whereas the rest of the island is mostly within subtropical moist- and subtropical wet-forest life-zones (Ewel and Whitmore 1973).

We conducted 22 road censuses between December 1981 and July 1983 in the range of the Turkey Vulture in Puerto Rico. The census route was divided into 4 sections: (1) along highways 116, 305, and 303 between Lajas and Guanica (22.6 km), (2) along highways 2 and 116 between Guanica and Tallaboa (26.0 km), (3) along highway 52 between Ponce and Coamo (25.6 km), and (4) along highway 52 between the municipalities of Coamo and Salinas (33.4 km). During 15 censuses the total 108-km route was covered, and during 7 censuses only some sections were covered. Twelve of the censuses were conducted driving east and 10 driving west. We conducted all censuses between 0900 and 1800 when no rain was falling, and while driving at 65-80 km/h. The driver recorded the number of Turkey Vultures observed flying and perched along the route.

The habitat within 1 km of the transect route was subjectively classified into 3 categories: agricultural fields, open woods/scrub/pasture mixture, or urban/scrub mixture. Habitat along section 1 was 100% open woods/scrub/pasture mixture; along section 2 it was 70% open woods/scrub/pasture mixture and 30% urban/scrub, and along sections 3 and 4 it was 92% open woods/scrub/pasture mixture and 8% agricultural fields.

History of Turkey Vultures in the Greater Antilles.—There have been doubts as to whether or not Turkey Vultures were present in the Greater Antilles at the arrival of Europeans (Garrido and Garcia Montana 1975); however, Turkey Vultures were present in Cuba and the Bahamas as far back as the Pleistocene (Arredondo 1984, S. L. Olson and W.

Hilgartner, pers. comm.). In 1680 Turkey Vultures were "to be found everywhere" in Jamaica (Sloane 1707). Cory (1899) reports them from Cuba, Jamaica, and the Bahamas. It seems that Turkey Vultures were present on Cuba, Jamaica, and the Bahamas when Europeans arrived, but the situation on Hispaniola and Puerto Rico is less certain.

The first records of vultures from Hispaniola are by Buffon (1770) and Ritter (1836) and from Puerto Rico by Ledru (1810), but these reports have been questioned (Gundlach 1878, Wetmore 1927, Wetmore and Swales 1931). The avifaunas of Puerto Rico and Hispaniola were surveyed extensively in 1873 and 1916–1928, respectively (Gundlach 1878, Wetmore and Swales 1931), but no vultures were found on either island.

Wetmore (1927) speculated that vultures had been introduced to Puerto Rico from Cuba by the Spaniards. Turkey Vultures have also been rumored to have been introduced into Hispaniola in the 1930s (Annabelle Stockton de Dod, pers. comm.) and into the Bahamas (Blake 1975). These uncorroborated reports have been widely accepted (e.g., A.O.U. 1983, Bond 1979, Brown and Amadon 1968, Garrido and Garcia Montana 1975, Long 1981, Raffaele 1983, Stockton de Dod 1978), but supporting historical records are lacking.

Although Turkey Vultures could have arrived at Hispaniola and Puerto Rico by deliberate introduction, we believe natural range expansion is a more plausible explanation. Turkey Vultures have the ability to make long-distance dispersal movements and migrations over land and water (Darrow 1983, Smith 1980, Stewart 1977); they have been repeatedly reported as vagrants or migrants on Caribbean islands where they do not breed (Bond 1979, Brudenell-Bruce 1975, Hundley and Hames 1960, Moore 1985, Olson et al. 1981, Sprunt 1962). In the Greater Antilles, islands are close enough to each other that vultures could easily colonize islands on their own, given enough time and the presence of adequate habitat and resources.

Puerto Rico and probably much of Hispaniola were completely covered by closed-canopy forest and had a depauperate mammalian fauna until the late 1400s (Allen 1911, Wadsworth 1950). The scarcity of open habitat and food resources probably prevented vultures from successfully colonizing these islands until the forests had been cleared and livestock introduced in the 1800s. Cuba, Jamaica, and the Bahamas were closer to mainland areas and frequent colonizations of these islands from continental North America or Central America were more likely.

Range and status in Puerto Rico.—It is puzzling that the range of Turkey Vultures in Puerto Rico has expanded only slightly eastward since Wetmore described it in 1927. In contrast, Turkey Vultures in Hispaniola have now spread over an area roughly the size of Puerto Rico (Stockton de Dod 1978, pers. comm.).

Turkey Vultures are most abundant in the subtropical dry-forest life-zone of southern Puerto Rico, and their numbers dwindle within this life-zone near the subtropical moist-forest and wet-forest life-zones to the north and east. During our 22 road censuses we counted 959 vultures. Turkey Vulture abundance decreased from west to east along the southern coastal plain of Puerto Rico. The mean number (\pm SD) of vultures/10 km for each section of the transect was: (1) 9.38 ± 5.01 , (2) 5.71 ± 4.77 , (3) 0.91 ± 1.22 , (4) 0.02 ± 0.08 . Differences among these sections were significant ($F = 35.8$, $df = 3,75$, $P < 0.001$, log-transformed data). The higher proportion of agricultural fields, which seem to be poor habitat for vultures, might partly explain lower numbers in sections 3 and 4.

Range cattle seem to be an important source of food for vultures in Puerto Rico. Differences in abundance of range cattle may partly explain the absence of vultures in northern Puerto Rico. Density of range cattle is 50% greater in southern Puerto Rico than in an equivalent area in the north (18 cattle/100 ha vs. 12 cattle/100 ha, calculated for two sample areas of approximately 540,000 ha each (U.S. Dept. of Commerce 1978). In addition to the greater potential carcass biomass in the south, flesh from carcasses is available for longer periods in dry tropical areas than in wet areas (Cornaby 1974).

Factors such as availability of nesting sites (Rivera Cianchini and Mojica Sandoz 1981) or the presence of favorable soaring conditions do not seem to explain the observed distribution of vultures. Adequate sites for nesting appear to be more abundant in the rugged limestone areas of the north. Winds of similar magnitude blow over both the north and south of Puerto Rico providing similar soaring conditions (N.O.A.A. 1981).

Migrants in Puerto Rico.—Eleven censuses were conducted in sections 1 and 2 (a combined total of 48.6 km) during October–March, when migrants and winter residents might have been present (Koester 1982, Smith 1980); 9 censuses were conducted in these sections during April–September when migrants should have been absent. The number of vultures per 10 km seen during the migratory period (8.4 ± 4.4) was not significantly different ($t = 1.21$, $df = 18$, $P > 0.05$) from that during the nonmigratory period (6.2 ± 3.1). This is very different from the pattern observed in Central and South America where vulture populations increase dramatically from October to March with the arrival of northern migrants (Smith 1980). Along a comparable 44 km transect in Colombia, *Cathartes* vultures increased from 4.4 ± 1.2 per 10 km to 28.1 ± 12.9 per 10 km during the winter months (calculated from Koester 1982). Puerto Rico does not seem to be an important wintering area for migrant vultures.

Acknowledgments.—V. Apanius, G. Geller, F. Nunez, D. Smith, and J. Morton helped us conduct censuses. S. Furniss (Cabo Rojo National Wildlife Refuge), J. Vivaldi (Departamento de Recursos Naturales), and D. Rusch (University of Wisconsin Cooperative Wildlife Research Unit) provided logistical support. We thank L. Keith and S. Olson for their useful suggestions on this manuscript. The study was funded by the U.W. Graduate School and the Green Tree Garden Club.

LITERATURE CITED

- ALLEN, G. M. 1911. Mammals of the West Indies. *Bull. Mus. Comp. Zool.* 54, No. 6, pp. 173–263.
- A.O.U. 1983. Checklist of North American birds. Allen Press, Lawrence, Kansas.
- ARREDONDO, O. 1984. Sinopsis de las aves halladas en depositos fosiliferos pleisto-holocenicos de Cuba. Reporte de investigacion del Instituto de Zoologia No. 17. Acad. de Ciencias de Cuba, Habana.
- BIAGGI, V. 1974. Las aves de Puerto Rico. Editorial Universitaria, San Juan.
- BLAKE, C. H. 1975. Introductions, transplants and invaders. *Am. Birds* 29:923–926.
- BOND, J. 1979. Birds of the West Indies. Collins, London.
- BROWN, L. H., AND D. AMADON. 1968. Eagles, hawks and falcons of the world. Country Life Books, London.
- BRUDENELL-BRUCE, P. G. C. 1975. The birds of the Bahamas. Taplinger, New York.
- BUFFON, G. L. L. 1770–1783. *Histoire naturelle des Oiseaux*. Paris.
- CORNABY, B. W. 1974. Carrion reduction by animals in contrasting tropical habitats. *Biotropica* 6:51–63.
- CORY, C. B. 1899. The birds of the West Indies. Estes and Lauriat, Boston.
- DARROW, H. N. 1983. Late fall movements of Turkey Vultures and hawks in the Florida Keys. *Fla. Field Nat.* 11:35–39.
- EWEL, J. J., AND J. L. WHITMORE. 1973. The ecological life zones of Puerto Rico and the U.S. Virgin Islands. USDA For. Serv. Res. Paper ITF-18.
- GARRIDO, O. H., AND F. GARCIA MONTANA. 1975. Catalogo de las aves de Cuba. Acad. de Ciencias de Cuba, Habana.
- GUNDLACH, J. 1878. Apuntes para la fauna Puerto-Riquena. *Anal. Soc. Esp. Hist. Nat.*, VII. Madrid.
- HUNDLEY, M. H., AND F. HAMES. 1960. Bird life of the lower Florida Keys. *Fla. Nat.* 33:152–153.
- KOESTER, F. 1982. Observations on migratory Turkey Vultures and Lesser Yellow-Headed Vultures in northern Colombia. *Auk* 99:372–375.
- LEDRU, A.-P. 1810. *Voyage aux Iles de Tenerife*. Paris.
- LONG, J. L. 1981. Introduced birds of the world. Universe, New York.
- MOORE, A. G. 1985. Winter status of birds on Grand Cayman Island. *Bull. Br. Ornithol. Club* 105:8–17.
- NELLIS, D. W. 1979. Record of Puerto Rican Screech Owl, Turkey Vulture and Osprey from St. Croix, U.S. Virgin Islands. *Wilson Bull.* 91:148–149.
- N.O.A.A. 1981. Climatological data: Puerto Rico and Virgin Islands. Vol. 27. Natl. Climatic Center, Asheville, North Carolina.

- OLSON, S. L., H. F. JAMES, AND C. A. MEISTER. 1981. Winter field notes and specimen weights of Cayman Island Birds. *Bull. Br. Ornithol. Club* 101:339-346.
- PÉREZ RIVERA, R., AND R. COTTE SANTANA. 1977. Algunas notas sobre los Falconiformes de Puerto Rico. *Science-Ciencia* 4:89-95.
- RAFFAELE, H. A. 1983. A guide to the birds of Puerto Rico and the Virgin Islands. Fondo Educ. Interamericano, San Juan, Puerto Rico.
- RITTER, K. 1836. *Naturhistorische Reise nach der west indischen Insel Hayti auf Kosten Sr. Majestät des Kaisers von Oesterreich*. Stuttgart.
- RIVERA CIANCHINI, O., AND L. MOJICA SANDOZ. 1981. Pajaros notables de Puerto Rico. Editorial Universitaria, San Juan.
- SLOANE, H. 1707. A voyage to the islands Madera, Barbados, Nieves, St. Christophers and Jamaica with the natural history of the herbs and trees, four-footed beasts, fishes, birds, insects, reptiles, etc. of the last of those islands. London.
- SMITH, N. G. 1980. Hawk and vulture migrations in the neotropics. Pp. 51-65 in A. Keast and S. Morton, eds. *Migrant birds in the Neotropics: ecology, behavior, distribution, and conservation*. Smithsonian, Washington, D.C.
- SPRUNT, A., JR. 1962. Birds of the Dry Tortugas. *Fla. Nat.* 35:35-40.
- STEWART, P. A. 1977. Migratory movements and mortality rate of Turkey Vultures. *Bird-Banding* 48:122-124.
- STOCKTON DE DOD, A. 1978. Aves de la Republica Dominicana. *Mus. Hist. Nat., Santo Domingo*.
- U.S. DEPARTMENT OF COMMERCE. 1978. Bureau of the Census; Census of Agriculture. U.S. Dept. Comm., Washington, D.C.
- WADSWORTH, F. H. 1950. Notes on the climax forests of Puerto Rico and their destruction and conservation prior to 1900. *Carib. Forest.* 11:38-47.
- WETMORE, A. 1927. The birds of Porto Rico and the Virgin Islands. *Sci. Survey of Porto Rico and the Virgin Islands, IX*. N.Y. Acad. Sci., New York.
- , AND B. H. SWALES. 1931. The birds of Haiti and the Dominican Republic. U.S. Natl. Mus. Bull. 155. Gov. Print. Office, Washington, D.C.
- EDUARDO SANTANA C., *Department of Wildlife Ecology, University of Wisconsin, Madison, Wisconsin 53706 and Institute of Tropical Forestry, Southern Forest Experiment Station, Rio Piedras, Puerto Rico 00928*, GREG A. POTTER, *Box 3306, San German, Puerto Rico 00753*, AND STANLEY A. TEMPLE, *Department of Wildlife Ecology, University of Wisconsin, Madison, Wisconsin 53706*. Received 27 Sept. 1985; accepted 16 Apr. 1986.

Adaptability of Parental Behavior in the Mourning Dove.—We report a nesting of the Mourning Dove (*Zenaida macroura*) that suggests individuals have enough behavioral adaptability to respond to unusual disturbances of the nest and its contents. On 1 October 1982 at about 1430 h, Krebs saw an adult dove squatting on a mowed lawn beneath the branches of a tall (12 m) eastern red cedar (*Juniperus virginiana*) on the campus of St. Mary's College of Maryland. A loosely formed stick nest lay on the ground about 1.5 m from the bird. One passerby reported that the bird had been there since noon.

At about 1500 h we approached the bird and when Krebs bent to pick it up, it flew into the overhanging branches, uncovering a vigorous nestling. Inspection of the surrounding ground revealed a dead nestling of the same apparent developmental age near the nest. From measurements of the dead nestling and the formula of Holcomb and Jaeger (*J. Wildl. Manage.* 42:843-852, 1978) the estimated age at death was 5 d. Apparently the accident had happened that morning, as the dead nestling was cold but still quite fresh. We estimate from its appearance that the survivor was also 5 d old, but it may have hatched a day before or after its dead nest mate (Nice, *Auk* 39:457-474, 1922).

We tied the nest into a convenient fork near the end of a low, drooping branch at a height of 1.8 m, and set the surviving nestling on the nest. The next day, 2 October, we saw an adult brooding on the nest and on 3 October Krebs saw one adult brooding and feeding the nestling with a second adult perched nearby in the same tree. By 6 October the