By "hopping" north from one town to the next along the Paraguay River, they penetrated Mato Grosso (Sick, Bol. Mus. Nac. Zool. n.s. 207, 31 p., 1959). In Maraba, the House Sparrows are situated for potential colonization along the Transamazon highway.

Unfortunately, House Sparrows may also help spread Chagas' disease, an infection sometimes fatal to man. In Sao Paulo state, they have been found carrying first instar nymphs of *Triatoma sordida* (a reduviid bug and known vector of Chagas' disease) in their feathers (Forattini et al., Rev. Saude Publ., S. Paulo, 5:193, 1971). These nymphs can be picked up easily from around nests and carried from house to house.

Accepted for publication 7 January 1972.

FOSSIL BIRDS FROM THE LATE PLEISTOCENE INGLESIDE FAUNA, SAN PATRICIO COUNTY, TEXAS

ALAN FEDUCCIA

Department of Zoology
University of North Carolina
Chapel Hill, North Carolina 27514

The large, late Pleistocene vertebrate fauna known from the freshwater pond deposits of Ingleside Pit, San Patricio County, Texas, includes a number of well-preserved avian fossils which are described below. Though the age of the fauna is late Pleistocene, determination of the precise age during which the bones were deposited is problematical and is discussed in detail by Lundelius (1972). The bones were recovered approximately one mile from the coast in San Patricio County, Texas, and the birds described in this paper could be accounted for by the same climatic and ecological conditions known in the Ingleside area of today. Specimen numbers of the birds described below refer to the collection of the Texas Memorial Museum, the University of Texas at Austin.

Podilymbus podiceps. Pied-billed Grebe. A nearly complete coracoid (30967-738-D) and a tarsometatarsus (30967–1691) are indistinguishable from similar elements of the modern Pied-billed Grebe. The Pied-billed Grebe occurs throughout much of Texas as a common migrant and may be found wintering along the coast.

Ciconia maltha. Asphalt Stork. A fragment of the distal end of a tibiotarsus (30967–1735), a fragment of a tarsometatarsus (30967-2092), and a complete tarsometatarsus (30967-426) are those of a large stork.

C. maltha, the Asphalt Stork, was common during the North American Pleistocene, and has been recorded from the Upper Pliocene and Pleistocene deposits of California, Idaho, Nebraska, Arizona, Florida, and Cuba (Brodkorb 1963; Feduccia 1967; Phillips 1968; Jehl 1966).

The three Ingleside bones are very similar to those of the modern Central and South American stork *Jabiru mycteria*, and *C. maltha.* Because of the great similarity between bones of *J. mycteria* and *C. maltha* and the great variation in the bones of modern storks, the Ingleside bones must be assigned at present to *C. maltha.* All of the large fossil stork remains from the North American Pleistocene are now assigned to a single species, *C. maltha* (Miller 1932; Howard 1941); but, because Florida specimens were originally assigned to *Jabiru* (see Brodkorb 1963), because the modern *J. mycteria* is very close in osteology to *C. maltha* (especially in postcranial elements), and because *J. mycteria* is at present unknown from the fossil record, I suggest that the problem of North American Pleistocene storks should be reopened.

Measurements of the tarsometatarsus (30967–426) are: total length, 281 mm; minimum width of shaft, 10.3 mm; greatest breadth across trochleae, 25.8 mm; breadth of trochlea for digit III, 9.2 mm. Measurements for the tibiotarsus (30967-1735) are: depth through condyles, 24.6 mm; breadth through condyles, 19.3 mm.

Branta canadensis. Canada Goose. The distal end of a humerus (30967-16) and the distal end of a tibiotarsus (30967-1063A) are those of a goose and are indistinguishable from bones of larger specimens of the modern *B. canadensis*, which is at present a common migrant throughout Texas.

Duck (Genus and species ?). A fragmentary coracoid (30967-1750), which is that of a duck approximately the size of the modern Shoveler (*Spatula clypeata*), is impossible to identify to species with certainty.

Anas sp. Teal. A coracoid (30967-1693) is inseparable from that of the modern Blue-winged Teal (*A. discors*), but because there is much overlap in size of bones of modern teal species, only a tentative identification is offered.

Meleagris gallopavo. Turkey. There are six bones in the Ingleside collections which represent the modern North American Turkey. Except for a distal fragment of a tibiotarsus (30967-1063B) which is that of a female, the others are from males. They include a nearly complete coracoid (30967-1741), the proximal two-thirds of a tarsometatarsus with a spur (30967-1169), a complete tarsometatarsus with complete spur (30967-1467), and the distal ends of tibiotarsi (30967-1564, and -1139). The Turkey was a common Pleistocene bird of North America (Brodkorb 1964). Peterson (1960) records the distribution of native Turkeys in Texas as, ". . . most numerous in the Edwards Plateau and coastal prairies and ranches from cent. coast nearly to the Rio Grande."

Measurements for tarsometatarsus (30967-1467) are: total length, 161.7 mm; greatest breadth across trochleae, 23.6 mm; spur length, 17.3 mm; breadth of trochlea for digit III, 9.9 mm. Measurements for tibiotarsus (30967-1139) are: depth through condyles, 19.9 mm; breadth through condyles, 21.7 mm; minimum width of shaft, 11.7 mm.

Colinus virginianus. Bobwhite. The distal end of a tarsometatarsus (30967-1753) represents the modern Bobwhite, a common Texas resident.

Limnodromus sp. ?. Dowitcher. The distal end of a tibiotarsus (30967-2091) appears to represent a dowitcher, but positive identification seems unwarranted.

Corvus brachyrhynchos. Common Crow. The distal end of a tarsometatarsus (30967-1754) is that of a Common Crow, a very common Texas species.

PALEOECOLOGY

As Lundelius (1972) has pointed out, "The Ingleside faunal assemblage has ecological implications for both the pond in which the bones accumulated and for

the general area of that part of the Gulf Coastal Plain." Freshwater conditions are certain because of the occurrence of catfishes, freshwater drum, gars, and sunfish (Swift 1968), and abundant frog material. The mammal fauna shows great diversity and probably indicates a concomitantly diverse habitat in the area. In addition, the occurrence of large tortoises (*Geochelone* and *Gophorus hexagonata*) certainly indicates at least milder winters than are known for south Texas today. Lundelius (1972) felt also that the age structure of *Tanupolama mirifica* indicated seasonality of a climatic factor, perhaps rainfall.

The Ingleside avifauna could be accounted for by the present-day ecological setting along the south Texas coast. Most of the species are known from the present-day south Texas fauna. It is difficult to assess the significance of the extinct stork *Ciconia maltha*, since modern storks occur in a wide variety of habitats and areas of the world. In the present-day fauna of south Texas, there is one stork (*Mycteria americana*) which occurs primarily in swamps, marshes, and ponds. The modern storks are typically warm climate, freshwater birds, but they may breed in more northern latitudes and migrate southward at the onset of cold.

I wish to thank Ernest Lundelius for placing the Ingleside specimens at my disposal and Larry D. Martin for helping in the identification of some of the fossils. The fossils were identified by comparisons with skeletons from the collections of the Museum of Natural History, the University of Kansas, and the collection of Pierce Brodkorb, the University of Florida. Pierce Brodkorb kindly criticized the manuscript.

LITERATURE CITED

BRODKORB, P. 1963. Catalogue of fossil birds, Part I (Archaeopterygiformes through Ardeiformes). Bull. Florida State Mus. 7:180–293.

BRODKORB, P. 1964. Catalogue of fossil birds, Part II (Anseriformes through Galliformes). Bull. Florida State Mus. 8:195–335.

FEDUCCIA, J. A. 1967. *Ciconia maltha* and *Grus americana* from the Upper Pliocene of Idaho. Wilson Bull. 79:316–318.

HOWARD, H. 1941. A review of the American fossil storks. Carnegie Inst. Wash. Publ. 530, paper VII, p. 187–203.

JEHL, J. R., JR. 1966. Fossil birds from the Sand Draw local fauna (Aftonian) of Brown County, Nebraska. Auk 83:669–670.

LUNDELIUS, E. L., JR. 1972. Fossil vertebrates from the late Pleistocene Ingleside Fauna, San Patricio County, Texas. Bull. Texas Bur. Econ. Geol., in press.

MILLER, L. H. 1932. The Pleistocene storks of California. Condor 34:212–216.

PETERSON, R. T. 1960. A field guide to the birds of Texas. The Riverside Press, Cambridge, Mass.

PHILLIPS, A. R. 1968. Geologic age of *Ciconia maltha*. Auk 85:315.

SWIFT, C. 1968. Pleistocene freshwater fishes from Ingleside Pit, San Patricio County, Texas. Copeia 1968 (1):63–69.

Accepted for publication 25 March 1972

TECHNIQUES FOR COLOR-MARKING HUMMINGBIRDS

F. GARY STILES

c/o Organization for Tropical Studies
Apartado 16
Ciudad Universitaria
Costa Rica

AND

LARRY L. WOLF

Department of Zoology
Syracuse University
Syracuse, New York 13210

For most kinds of birds, color-banding is a convenient method of marking individuals for subsequent recognition in the field. Hummingbirds cannot be color-banded in the same manner because their very small, short tarsi make conventional bands impossible to see under field conditions. In the course of field work in California and Costa Rica, we have found two techniques for color-marking hummingbirds to be useful: painting spots on the upper back; and affixing a plastic tag to the leg. These techniques have enabled us to follow the movements and activities of individual hummingbirds in the field for periods of up to several years.

The first technique involves painting one, two, or three colored spots in a row across the upper back between the shoulders (fig. 1). During painting, the bird's body is held firmly against the index finger by the thumb and the middle finger securing the wings below the body (see fig. 1). In this way the bird is prevented from struggling, which in addition to disarranging the paint can easily result in a dislocated wing. We found Flo-Paque paint and Testor's or Pactra airplane dope to be about equally effective. It is important that the paint be fairly dry before the bird is released. This marking method works best for long-billed hummingbirds (e.g., *Phaethornis*) that cannot preen the upper back with the tip of the bill. Many shorter-billed hummingbirds will preen out much or all of the paint shortly after marking. However, if a bird fails to preen off the paint within a day or two, it will often ignore it thereafter, and the markings will frequently last until the next annual molt. This method of marking has been used successfully for periods of up to several months (Stiles, Univ. Calif. Publ. Zool. 97, 1972; Wolf and Stiles, Evolution 24:774, 1970).

The plastic tag technique is an elaboration of a marking method devised by Ortiz-Crespo (Unpubl. MA thesis. Univ. Calif., Berkeley. 1967. 161 p.), who attached plastic streamers of several types to the legs of Rufous and Allen (*Selasphorus* spp.) and Anna (*Calypte anna*) Hummingbirds in California. Ortiz was able to follow territorial occupancy of several individuals for up to 4 months, including one *Selasphorus* that left the study area and reappeared 3 months later. Compared to Ortiz's streamers, the plastic tags described here have the advantages of better observability and a greater number of possible color combinations. The technique may be somewhat more tricky to master, but a good tag can last for a year or more. The design of the tags and the method of affixing them to the bird's leg is shown in figure 2. The tag measurements given are for use on a 5- to 6-g hummingbird, and should be modified appropriately for use on larger or smaller birds. The