FORAGING HABITS AND LOCAL MOVEMENTS OF THE WOOD IBIS IN SAN DIEGO COUNTY, CALIFORNIA

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Published records and personal observations indicate that each summer a few Wood Ibises (*Mycteria americana*) visit southern California, particularly the Imperial Valley marshes, Imperial County, and the coastal lagoons of San Diego County. Occasional stragglers have been recorded farther north: Long Beach (Law, 1912); Bixby, Los Angeles County (Daggett, 1903); San Bernardino Valley (Feudge, 1903); Daggett, San Bernardino County (Lamb, 1912); Santa Barbara (Rett, 1954); San Francisco Bay (Cooper, 1887). These annual migrants which are thought to come from the coast of western Mexico, where the species is common, appear in late June or early July and depart by mid-October. The numbers recorded vary considerably from year to year as shown in table 1. Except for the years from 1953 to 1955, when a definite effort was made to locate all individuals within the limits of San Diego County, it is suspected that the recorded numbers are underestimates of the numbers present in the county. Surveys made weekly or biweekly in the summers from 1953 to 1955 showed that the Lt. Maxton Brown Sanctuary (Buena Vista Lagoon), between Oceanside and Carlsbad, is the major foraging area for the Wood Ibis. The Santa Marguerita River mouth, north of Oceanside, and the San Elijo Lagoon at Cardiff are used as foraging areas to a lesser extent. The other lagoons and bays shown in figure 1 are now used only very infrequently. All of these areas have been occupied in the past (Lawrence Huey, personal communication), but probably they have been rendered unsuitable by dredging, filling, and sewage disposal. No Wood Ibises have been recorded recently for lakes Sutherland, Henshaw, Sweetwater, El Capitan, Lower Otay, Hodges, Wohlford, and San Vicente, and none had been observed at these lakes by representatives of the Department of Fish and Game whom I questioned. This is of interest because these lakes would seem to be logical "stop-over" areas if the birds observed in the coastal lagoons come from the Imperial Valley marshes.

Audubon (1835:129) described the rather spectacular feeding and flight habits which are characteristic of the species:

"To procure its food, the Wood Ibis walks through shallow muddy lakes or bayous in numbers. As soon as they have discovered a place abounding in fish, they dance as it were all through it, until the water becomes thick with the mud stirred from the bottom by their feet. The fishes, on rising to the surface, are instantly struck by the beaks of the Ibises, . . . [and], on being deprived of life, they turn over and so remain. In the course of ten or fifteen minutes, hundreds of fishes, frogs, young alligators, and watersnakes cover the surface, and the birds greedily swallow them until they are completely gorged, after which they walk to the nearest margins, place themselves in long rows, with their breasts all turned toward the sun, in the manner of Pelicans and Vultures, and thus remain for an hour or so. When digestion is partially accomplished, they all take to wing, rise in special circlings to an immense height and sail about for an hour or more, performing the most beautiful evolutions that can well be conceived."

Daggett (1903) examined the full crop contents of one bird taken at Bixby, California and found only aquatic insects. Grinnell, Bryant, and Storer (1918) listed the stomach contents of three Wood Ibises taken in Imperial County, California. One contained 3 tadpoles, 4 water beetles, 2 paddle bugs, and some moss [algae?] and slime; another, 9 tadpoles, a water beetle, 9 dragon fly larvae, and a carp; the third held 10 carp, a catfish, 2 bony tails [*Gila robusta*], and a water cricket. Bryant (1919) reported

on another bird with 10 seeds of the screw bean, 2 seeds of mesquite, parts of 4 water beetles and some finely comminuted vegetable material. Holt and Sutton (1926) recorded the stomach contents of some adult birds collected at Alligator Lake, Florida. They found small fishes, reported as *Mollienisia latipinna, Cyprinodon variegatus, Gambusia affinis, Lepomis holbrooki,* and *Adinia multifasciata,* to be present.

Because conditions for observation in the San Diego lagoons are particularly favorable, it has been possible in the present study to identify larger items of food without

Table 1

Maximum Number of Wood Ibises Observed in San Diego County

Year	Number of ibises	Reference[1]
1946	150+	Audubon Field Notes, 1947, 1:20.
1947	22	Audubon Field Notes, 1948, 1:23.
1948	8	Personal observations.
1949	2	Audubon Field Notes, 1950, 1:34.
1950	2	Audubon Field Notes, 1951, 1:38.
1951	70	Personal observations.
1952	57	Audubon Field Notes, 1953, 1:36.
1953	300+	Personal observations.
1954	36	Personal observations.
1955	71	Personal observations.

[1] Published sight records and my personal observations agree closely for all years concerned. Personal observations are entered for those years wherein my cumulative total for a single day's survey indicated more birds or represented a more synoptic observation.

sacrificing birds. In the limited and confined marsh channels of San Elijo Lagoon the major constituent of the diet is a fish, the topsmelt *Atherinops affinis littoralis.* As the Wood Ibis is a rather indiscriminant fish-eater, it is possible that it takes other fish inhabitants of these channels, namely the California killifish, *Fundulus p. parvipinnis*; tidewater goby, *Eucyclogobius newberryi*; arrow goby, *Clevelandia ios*; longjaw mudsucker, *Gillichthys mirabilis*; and probably the shadow goby, *Quietula y-cauda.* Carcasses of all those fishes, except the shadow goby, were found along the banks of the watercourses following a feeding foray by the ibis. In the freshwater San Dieguito Reservoir near Rancho Santa Fe, Wood Ibises were observed eating young black bass, *Micropterus salmoides,* and catfish, *Ictalurus* sp.

Ordinarily the birds were observed to eat their catch immediately after capture, but toward the end of a feeding period they began to appear satiated and would, at times, release their victims although continuing to hunt in the company of the flock with seemingly the same diligence and enthusiasm. On one occasion several thousand decaying carcasses of the topsmelt, killifish, and gobies were found in a single winddrift in the San Elijo Lagoon. Scarred and mutilated bodies suggested that they were victims of ibises, which were observed feeding in the immediate area on the previous day. Live schools of fish still remained in the area at the time of this observation, indicating that the mass mortality was probably not due to other adverse causes.

In feeding, the ibises cooperate by walking in groups, often abreast, or nearly so, through the narrow meandering drainage channels of the marshes. This method effectively extends the ranks of a flock across the entire channel width, which seldom exceeds 30 feet. At times the "marching" group is two or more birds deep. They usually start their feeding forays near the mouth of a channel or at the junction of two channels. From this point the ibises walk slowly and deliberately toward the shallow and nar-

rowing origin. The casual, non-stalking gait of the ibises effectively muddies the water, but it is doubtful that this is a necessary preliminary to catching prey in water that is already roiled or continually turbid. This foot and leg movement disturbs the water enough to herd the schooling-type fishes into shallow and more restricted areas where they are then killed and taken in large numbers. The use of foot activity for feeding may also serve to direct swimming prey animals to the beak (Rand, 1956).

Foraging in the more open waters of the San Dieguito Reservoir or the Lt. Maxton Brown Sanctuary is performed in a comparable manner, the birds working the shallows of these areas in groups of 20 or more.

When feeding in groups, the Wood Ibises do not dart the head at their prey but instead employ a groping method. With the head turned to the side, the partly open beak is immersed in water to a depth of several inches and is then passed through the water sideways like a pair of tongs. Movement of the beak through the water is accomplished either by swinging the head in a semicircular arc or by walking forward with the head turned to the right or left. When contact with a fish is made, the beak is snapped shut and invariably the bird is successful in securing a squirming morsel. It appears that the tactile sensitivity of either the tongue or the tissue lining the inner surface of the bill is remarkably developed to permit such effective feeding under relatively adverse conditions. When birds feed singly, they resort to a visual technique and take their prey by stalking and darting with the bill.

The feeding periods are usually from pre-dawn to about three hours after sunrise and for a comparable period prior to and following sunset. After feeding, the birds usually retire to dry ground near the last feeding site, where they remain during the daylight hours. Birds separated from the flock sometimes continue to feed for longer periods. After feeding, short sortie flights are made to re-establish the flock. In the early summer, shortly after their arrival, they are very gregarious and all post-feeding resting is done as a unit. Dispersal, however, becomes more common later in the season, particularly during the month of September.

Although the feeding activities of the Wood Ibises produced a surplus of fish, no other birds were noted associating with them at this time. It was particularly noticeable that the gulls (*Larus heermanni* and *L. californicus*) which were fishing at other points in the lagoon stayed away from the Wood Ibis and did not serve as a "clean-up" detail for the fish left to spoil. The Great Blue Herons (*Ardea herodias*), American Egrets (*Casmerodius albus*), Snowy Egrets (*Egretta thula*), Black-necked Stilts (*Himantopus mexicanus*) and terns (*Sterna antillarum* and *Thalasseus maximus*) which were present in the lagoons also seemed to avoid the immediate vicinity of the ibis.

Following the partial digestion of a meal the ibis reportedly takes to the air to soar (Audubon, 1835). Here again the behavior of the Wood Ibises as observed in southern California does not follow the described pattern. The short flights made by the summer visitors have been mentioned above, but the more spectacular soaring flights have been restricted almost entirely to the end of the summer. Soaring in gyres the ibises rise to heights that require binoculars to keep them in sight. On overcast days, they often disappear into the cloud cover. I have observed the spectacular plummeting dive from these high altitude flights only once (Rechnitzer, 1954). Following these flights the birds were not observed to return to the lagoon, indicating that they probably continued over the coastal range, either into the Imperial Valley or to the Gulf of California.

Dawn and dusk flights were a conspicuous part of the daily activities prior to the 1955 visit. Throughout previous summers the ibises regularly vacated San Elijo Lagoon at dusk and flew to the drainage area of the San Dieguito River (air distance about two miles). The flock usually rose into the air in tandem, and staggered their numbers so

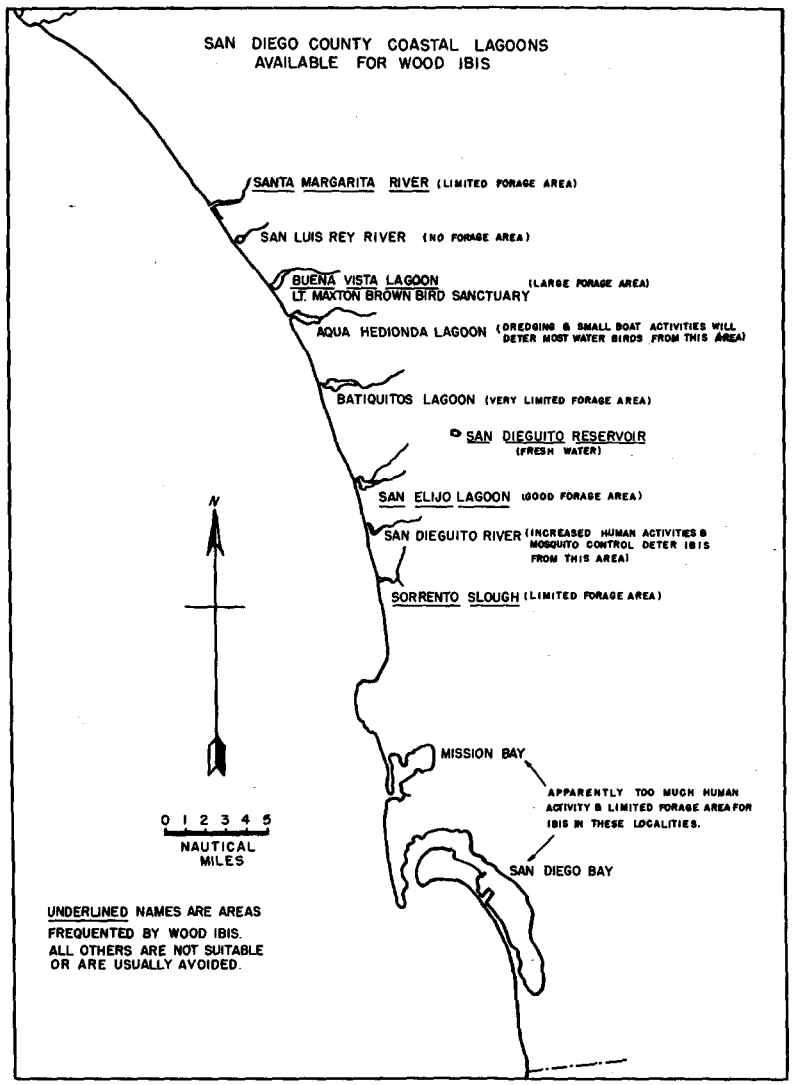

Fig. 1. Principal marsh and lagoon areas of San Diego County, California. Only San Elijo and Buena Vista lagoons, and the mouth of the Santa Marguerita River continue to attract Wood Ibises.

that the procession was intermittent but confined to a relatively short period of each day, once near sunset and again on the following morning for the return flight. The birds gained only enough altitude to permit short glides and to pass over the low ridge of hills adjacent to the lagoon. No flights other than these intra- and inter-lagoon flights were noted. In 1955 the inter-lagoon flights were completely interrupted. An increase in aircraft activities, coupled with a heavy application of a strong insecticide to the impounded waters of the lower San Dieguito drainage area probably discouraged the birds from this former summer habitat. All of the Wood Ibises remained within the San Elijo Lagoon until July 28, 1955. At this time they were frightened out of the marsh area by a "con-

trolled brush fire," which engulfed all of the watercourse with dense smoke and destroyed the lush stand of the marsh weed *Salicornia* that blanketed the exposed areas of the lagoon. Subsequent visits to the lagoon revealed a complete exodus of Wood Ibises until early October, when the southward migration began. At this later time the birds stayed in the lagoon for only a single day or less.

After the abandonment of San Elijo Lagoon on July 28, 1955, a group of 48 birds temporarily relocated in the San Dieguito Reservoir, which is situated inland about five miles from the lagoon and relatively close to the main drainage channel that feeds the lagoon during the winter run-off (if any). After three weeks the reservoir was devoid of ibises. The number of birds in the Lt. Maxton Brown Sanctuary and the Santa Marguerita River mouth had, at this time, attained a cumulative total comparable to that observed earlier in the season at the more southerly San Elijo Lagoon.

Photographs of Wood Ibis in Florida (Bent, 1926) indicate their preference for tall trees as roosting sites. Although all the areas visited in San Diego County have trees nearby, I have yet to see a Wood Ibis occupy the apparently suitable trees, while the Great Blue Heron, American Egret, and Snowy Egret often rest in tall eucalyptus trees.

Each fall the ibises begin to move south gradually when there is a drop in the night temperatures. The daytime temperatures remain fairly high, and that there is an apparent reluctance in this movement southward, is evidenced by the occupation of the marsh or lagoon next to the south for a day or two before the ibises move on. Most of the birds leave the coastal lagoons of San Diego County after reaching San Elijo Lagoon, but a few stop four miles to the south, temporarily, at Sorrento Slough.

SUMMARY

Wood Ibises continue to visit southern California coastal lagoons as summer migrants, probably from the west coast of Mexico. They are conspicuous among the aquatic birds because of their size and their white plumage, and because of the general paucity of vegetation and obstructions in the marsh areas visited. The Wood Ibis, despite the awkward appearance of its large bill, is a very efficient feeder, particularly on small fishes and aquatic insects. The beak is immersed several inches into the turbid water and held agape while being passed to and fro like a large pair of forceps. Upon contact with a fish the bill is snapped shut. The ibises feed in flocks of 20 or more, which permits them to span the narrow drainage channels of the lagoons and thereby effectively to herd the fish into shallow water. Flight activities are not a conspicuous part of their behavior while in southern California, but soaring to great heights has been observed toward the end of summer. The amount of available forage space is being reduced by urban development along the coast, and only one sanctuary area remains as the principal area visited by Wood Ibises.

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