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Observations on the White-Faced Ibis, Plegadis Chihi, in Louisiana

Horace William Belknap
Louisiana State University and Agricultural and Mechanical College

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OBSERVATIONS ON THE WHITE-FACED IBIS, PLEGADIS CHIHI, IN LOUISIANA

A Thesis

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Master of Science in The Department of Zoology

by
Horace William Belknap
B.A., College of Idaho, 1953
August, 1957
MANUSCRIPT THESES

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ABSTRACT

The eight-month study deals with the White-faced Ibis, *Plegadis chihi*, in southwestern Louisiana. It affirms the absence of the closely related Glossy Ibis, *Plegadis falcinellus*, as a breeding bird in that area today. Data on feeding habits, social behavior, nesting cycles, and plumage changes in *chihi* are presented as a step toward clarifying the relationship of these two puzzling forms of ibis; but the full significance of these findings cannot be ascertained until more is known about the habits of *falcinellus*. The most important conclusions concern plumage changes. It is shown that published descriptions of plumage and molt in *chihi* contain serious errors. For most of the year individuals of the two forms, both adult and immature, are practically indistinguishable in the field, while some unidentifiable birds are present at all seasons. During the breeding cycle, however, *chihi* assumes a striking facial patch lacking in *falcinellus* and probably also exhibits differently colored soft parts. The very fact that the really trenchant differences between the two forms are confined to the breeding season lends these differences added taxonomic significance, suggesting that they might function as reproductive isolating mechanisms.
should *falcinellus* and *chihi* meet in the same range. Therefore, it would seem that, in the present state of knowledge *falcinellus* and *chihi* should be maintained as separate species despite their similarities. Measurements of carefully sexed birds indicate marked sexual dimorphism in size in White-faced Ibis—a situation hitherto obscured by the seemingly erroneous labeling or sexing of some specimens.
The ibises of the genus *Plegadis* present a very unusual problem. In most species of birds of world-wide distribution that vary geographically, the populations of the Eastern and Western hemispheres develop into distinct subspecies. In the case of these ibis, however, one race, *Plegadis falcinellus falcinellus*, is found on both sides of the Atlantic Ocean. The Glossy Ibises breeding in southern France, Turkestan, the Asiatic mainland, and Africa do not differ in any significant known way from those breeding in New Jersey, South Carolina, Florida, and the West Indies. It is odd enough that these birds have established themselves in five of the major zoogeographic realms of the world without undergoing any apparent evolutionary change. But it is odder still that, in spite of their uniformity over so wide an area, the populations of *Plegadis* are broken up in the Western Hemisphere into distinct forms, two of which occur in the same realm, even in the same life-zone. These two birds are the Glossy Ibis (*Plegadis falcinellus*) and its close relative the White-faced Ibis (*Plegadis chihi*).

In full breeding dress, *P. falcinellus* and *P. chihi* can usually be told apart readily at distances of up to 100 yards.
by an observer using good modern binoculars. The chief distinguishing mark is the feathering about the base of the bill, which is blackish or chestnut in *falcinellus*, white in *chii*. But there are several complicating factors. One is that the Glossy Ibis, as Sprunt (1954: 45) puts it, "sometimes has the skin at the base of the beak white," simulating the white-feathered patch of *chii*. Another is that some White-faced Ibis in breeding condition have only narrow, indistinct white facial markings. And, to make matters really confusing, even adults of the "white-faced" species exhibit the white face only during the few months of the breeding season. At other times, *falcinellus* and *chii* become virtually sibling species, distinguishable only by the most subtle details.

Ornithologists have been slow to realize the full difficulties of the identification problem. Standard field guides tell how to separate adults in the breeding plumage, and some mention that immatures of the two species are for all practical purposes indistinguishable in life. But none make clear that, for the greater part of the year, adults are equally so. The most complete, authoritative, and widely used guide of all (Peterson, 1947) makes no mention whatever of the immature White-faced Ibis and refers to the nonbreeding adult in these uncertain terms: "It is said (italics are mine) that the White-faced Glossy loses the white face in winter." Even museum workers, dealing with
birds in the hand, have often erred. Lowery (1947: 182) has pointed out that three of the five Louisiana specimens of *falcinellus* listed by Oberholser (1933: 79) are actually *chihi*; and the Louisiana State University Museum of Zoology has recently received on loan from the U. S. National Museum an old specimen from Lerma, Mexico, which is labelled *falcinellus* but appears to me to be almost certainly *chihi*.

As a result of this confusion, the true distribution of the two forms remains in doubt. It has repeatedly been implied in the literature that *P. falcinellus* and *P. chihi* occur sympatrically, that their breeding ranges overlap. One of the most important alleged areas of overlap is Cameron Parish in southwestern Louisiana. Holt (1933) describes a visit on May 25, 1932, to a large breeding colony in this parish, where "adult after adult ibis was carefully scrutinized through a 6-power binocular, but not one was seen with a white face." Since he found many young ibis and nests of ibis at this location, he concluded that the Glossy Ibis (*falcinellus*) bred in Louisiana. None of the studies since that time, however, have supported this idea. Lowery (1947: 181) has stated the case as follows: "My associates and I have studied thousands of glossy ibises in the marshes of southwestern Louisiana in the past ten years. These observations include numerous field trips into the region where ibises are plentiful throughout the year, especially during
the breeding season. I have also visited a large nesting rookery in Cameron Parish, the only in the state known to me, and the one which I have every reason to believe is the same colony visited by Holt in 1932. Although Holt identified as falcinellus the birds seen by him at a nesting rookery in Cameron Parish, I have never seen that species anywhere in Louisiana except at Grand Isle, 150 miles east of Cameron, ...

Thus uncertainties regarding the seasonal variations of falcinellus and chihi have led to uncertainties regarding their distributional status. The latter uncertainties in turn have cast doubt on their proper taxonomic relationship. Listing the White-faced Ibis under the heading "Plegadis (falcinellus?) chihi," Hellmayr and Conover (1948: 266) have remarked in a footnote: "the differences separating the two birds are not such as to suggest specific distinctness, and the matter requires further investigation, notably in the field."

The present research was undertaken as a contribution to such an investigation. Extensive life-history studies of the Glossy Ibis were made in Florida many years ago (Baynard, 1913); but I found very little in the literature concerning the habits of the White-faced Ibis. To provide a basis for comparing the behavior, ecology, and developmental stages of the two forms, I began intensive field studies of the dark ibises of southwestern Louisiana, on the very
ground where both species had once been alleged to breed.

The observations on which I am about to report extend from November 10, 1956, to July 2, 1957, and were all made in Cameron Parish, La. In fall, winter, and early spring I made trips to the parish from Baton Rouge at intervals of 17 to 48 days. On April 19, I took up residence at the Rockefeller Wild Life Refuge and Game Preserve, which is situated at Grand Chenier in Cameron Parish. From then on until June 27, when the area was devastated by a hurricane, I made frequent visits to a rookery of ibises and herons on Willow Island in Lacassine Bayou. My intention was to spend every other day in this colony, but reaching Willow Island required an hour and a half of travel by boat, part of it across the unpredictable waters of Grand Lake, and the trip proved impossible during periods of bad weather. For that reason there were several interruptions in the scheduled work at the colony—most notably between May 18 and May 27 and between May 30 and June 4. Nevertheless a total of about 200 hours were spent in the blind erected there. Additional data on the breeding cycle were provided by visits to another rookery on March 30, April 27, and June 11. This was the famous "Burn," just north of Little Chenier, believed to be the scene of Holt's observations in 1932. All in all, I spent a total of 61 full days in the field.

In the course of the study, I collected 28 specimens of Plegadis and in addition critically examined some 1200
living birds at close range through 7 x 50 Hambletonian binoculars or a Baush and Lomb spotting scope with eye pieces of various power. In spite of these efforts, I have never been able to identify a Glossy Ibis (*falcinellus*) in Louisiana. Consequently the present report will deal firsthand and at length only with the White-faced Ibis (*chiti*). Comparative data regarding *falcinellus* will be drawn entirely from the literature, chiefly from the paper by Baynard (1913).

Two of the technical problems that had to be overcome are deserving of comment. The first was to construct a blind from which the breeding cycle could be observed, and the second, to develop a method for analyzing the stomach contents of birds collected.

I had explored Willow Island during the previous breeding season to select a spot from which several nests of the White-faced Ibis could be observed at once. The blind itself had to be so constructed that it could be easily assembled and disassembled, and yet would afford protection from hard driving rains and insects. It had to be elevated five feet above the surface of the water to afford a good view of the surrounding area. The supports would be subjected constantly to the decaying action of water and muck. No firm bottom was encountered; so four-foot stakes were driven three feet into the roots and muck to anchor each corner of the blind stand. Two-by-fours, treated with Penta dip, were used in the construction of the stand and the
supporting frame for the blind. The noisy work of erecting the foundation was carried out on March 29, before nest-building had begun. The blind that was later fitted to this base had a floor made of three-quarter inch plywood, and walls and a roof of three-eighth inch plywood. Screws were used to fasten the parts together so that the whole structure could be taken apart and put back together should the birds move to another location on the island. Observation windows eight inches high and ten inches long were cut in the sides and corners of the blind. These windows were fitted with sliding frames over which screen was tacked. The screens had two purposes, which they served satisfactorily: (1) to keep out mosquitoes, flies, and to some extent rain; (2) to obstruct the vision of any bird looking at the window when the observer was moving about inside. Later on, when the birds became used to the noises I made shuffling about and setting up cameras, the screen frames were removed altogether during observation and photography without disturbing the birds at all.

Two different methods for separating and measuring the various kinds of organisms found in the stomachs of White-faced Ibis were tried. The quantitative data eventually obtained were all lost during the hurricane of June 27 and thus cannot be directly incorporated in the present paper. Nonetheless it may be worthwhile to put on record the
technical experience gained in this type of investigation.

The first procedure was suggested by Mr. James L. Chamberlain, who as part of the research for his doctoral dissertation in marsh ecology had conducted gizzard analyses on various waterfowl. In this method, the bird's stomach contents are dried in a small oven, rubbed between the thumb and forefinger to separate the particles, and blown upward through a clear plastic cylinder. The cylinder has shelves at different levels on the inner surface to collect materials carried up by the column of air. By regulating the velocity of the air, one can separate objects of different weight. This method has proved very successful in dealing with seed eating birds; but with ibis, which may eat crayfish, beetles, and midge larvae in the same meal, results were unsatisfactory.

The method I finally devised to separate the stomach contents consisted of flotation and rotation. As each specimen was skinned, the stomach contents were placed in a seventy per cent alcohol solution and stored in small individual bottles. Later, the contents were placed on a copper screen strainer and washed with 25 to 35 cubic centimeters of water. The water was collected and run through a suction filtration apparatus. The filtrate left on the filter paper was dried and examined under a microscope. Thus, such small objects as fish scales could be recorded. The filtrate was
then measured dry in a calibrated centrifuge tube, any amount less than one-tenth of a cubic centimeter being recorded as a trace. The coarse material that did not pass through the screen was washed into a large finger bowl. By rotation of the bowl, the lighter material was washed away from the heavier material, which remained in place. The principle is the same as that used in separating gold by panning. Next, the different items and their parts were isolated with forceps. After the various groups of items were segregated, they were blotted and placed under a known quantity of water. If one has ascertained the amount of water in the centrifuge tube before the item being studied is submerged, the amount of water displaced can be measured and the volume of even rough, irregular objects determined. This method seemed quite satisfactory, though more than an hour was required to analyze the contents of each stomach. After separation and measurement, the food items were placed in individual envelopes and saved for future reference.
ACTIVITIES OUTSIDE THE BREEDING COLONY

The primary emphasis in this study has been on the activities of the White-faced Ibis during the breeding period, in the breeding colonies. Observations at other seasons and at other places have been fragmentary. Nevertheless, these observations form a desirable preface to the main account.

Feeding Habitat

Cameron Parish comprises the southwesternmost portion of Louisiana. Fronting on the Gulf of Mexico, it has a coastline more than 100 miles in length. Along parts of the northern boundary, there is fairly extensive dry ground, some of which is periodically flooded for the growing of rice; but most of the 1444 square miles in the parish consist of low-lying marsh, which at some points extends more than 30 miles inland. Several large, shallow lakes, many small lakes, and numerous ponds break the monotony of this vast expanse of marshland. The area is further dissected by rivers, creeks, bayous, and canals, some of which empty directly into the Gulf.

The marsh habitat in the parish is a complex array of plant types, continually changing in many areas with shifts
in the salinity of the water. In general as one proceeds northward from the Gulf Coast, the marsh tends to become increasingly fresh. Where lakes, rivers, and canals flow unobstructed by locks or control dams into the Gulf, however, the vegetation extending back from banks may be subjected to rapid changes in salinity. Such changes are frequently brought about by the action of high tides or South winds, which push the salt water further up these estuaries than normally. During seasons of extremely dry weather, when there is little current in the coastal waterways, intrusion of salt water may appear far inland. On the wildlife refuges of the parish, impoundments and control dams have been constructed in an effort to stabilize these areas and provide more favorable habitat.

Running roughly parallel with the coast at varying distances inland are a series of long narrow ridges that rise some four to twelve feet above sea level. Some of these strips of high ground are miles in length, but they nowhere exceed a quarter of a mile in width and are in most places much narrower. They provide a foundation for stretches of wooded growth, many of which are dominated by live oaks (Quercus virginiana) of great age. From this circumstance, these ridges have come to be called Cheniers. Two highways leading down across the marsh from the north and connecting with roads running along the Cheniers provide the only system of overland travel in the southern part of the parish.
White-faced Ibis apparently range widely over the marsh types that make up the Cameron wetlands. But the ordinary observer has only a limited view of their activity and the amount of time they spend in different habitats. In the fall, winter, and early spring I travelled almost entirely by car or on foot and made most of my observations along Little Chenier, Chenier Perdue, and Grand Chenier. There I found White-faced Ibis feeding in the following kinds of places, listed with the most important first: (1) flooded pasture and open marsh; (2) low, wet places grown up in stands of rattlebox, or coffee bean (Daubentonia drummondii); (3) the edges and shallows of ponds, borrow pits, canals, and ditches. In most of these habitats, the ibis fed where the water was four to eight inches deep. Though no actual tests of salinity were conducted, I believe that the water at the more favored feeding locations was either fresh or only slightly brackish. Though I did on occasion find White-faced Ibis in situations that were definitely brackish, I never encountered them in salt marsh. Prominent plants noted in the feeding areas of the ibis, in addition to coffee bean already mentioned, were bulrush (Scirpus californicus), bulltongue (Sagittaria angustifolia), wiregrass (Spartina patens), and a panic-grass (Panicum repens).

By April 19, when nesting activities were well underway at Lacassine Bayou, White-faced Ibis had virtually disappeared from their familiar haunts along the cheniers. Ab-
normally high water levels, resulting from excessive rain, were doubtless responsible for their departure. Where they foraged after that time is something I was never able to determine definitely. Probably many of them retreated northward into the rice fields, which had recently become flooded. On March 31, I saw a flock of more than 50 ibis in rice country two miles south of Holmwood; and on May 13, I talked with four farmers at Holmwood, all of whom wanted me to come with them and shoot into the huge flocks of ibis which, so they claimed, were knocking down the rice in their fields. On the same day I counted 63 White-faced Ibis in a rice field along Louisiana Highway 19, just west of Lacassine Bayou. I was told at Holmwood that ibis pour into the rice fields in droves in summer.

**Food Habits**

In spite of the fact that the rice fields seem to be a preferred habitat of the White-faced Ibis in summer, none of the farmers with whom I talked actually accused the bird of eating rice. To the best of my recollection, at least eight of the 26 stomachs examined contained no plant remains whatever. Single seeds of the water-shield (*Brasenia shreberi*) were found in two stomachs, while a total of three seeds of the rattlebox (*Daubentonia drummondii*) were obtained from two others. With these exceptions, the vegetable matter recovered consisted entirely of unidentifiable fibrous material present only in small percentages, usually only as
traces. Since the big beak of the ibis would appear to be a rather coarse instrument with which to separate small animal organisms from the plant material near them, it seems likely that much of the vegetal contents of the stomachs, minute enough to begin with, may have been swallowed more or less by accident. Though I cannot say that plant food is never ingested deliberately, I am inclined to believe that the White-faced Ibis is mainly carnivorous. However, none of the birds subjected to stomach analysis were actually taken in the rice fields.

All the stomachs examined contained animal matter. This varied from about 2 c.c. to approximately 8 c.c. Included were the remains of small fish and frogs, crayfish, snails, small bivalves, earthworms, and such insects as bill bugs, whirligig beetles, water tiger larvae, midge larvae and pupae, and dragonfly nymphs. Among these items, crayfish and insect larvae were by far the most important, both from the standpoint of frequency and of volume. Several stomachs were crammed with midge larvae and pupae and contained little else; I counted more than 200 such items from one bird alone. Because all the stomach contents and the records regarding them have been destroyed, I am able to provide a precise identification for only one animal—a small frog, Microhyla carolinensis.

Small pieces of gravel and shell occurred in nearly every stomach; and single pellets of lead shot were recovered from two stomachs.
Feeding Methods

Two methods of procuring food were observed. The first was the ranging method. When feeding in this manner, the ibis walks back and forth over the marsh, stopping to probe thoroughly around the base of clumps of bulrush, wiregrass, bulltongue, or other vegetation. Occasionally it sticks its bill into open potholes. This probing process is an up and down movement reminiscent of the pecking actions of a domestic chicken, but a movement in which the mandibles are rapidly opened and closed. When the ibis catches a small crayfish or a water-beetle, it raises its head in a rapid movement then thrusts it downward, throwing the food backward toward the throat. The action may be repeated several times before swallowing occurs. Throughout the process the bill is held fairly low, never tilted upward above the horizontal. After swallowing, the ibis immediately resumes its search for food. Occasionally it takes a drink while feeding. The bill is withdrawn from the water closed and then is elevated slightly above the horizontal with the mandibles vibrating up and down. While the bird is drinking, much water is dropped, more than when the bill is withdrawn during feeding operations. After drinking, none of the individuals that I watched resumed eating until they had taken four or five steps. When feeding by the ranging method, the ibis are usually catching crayfish, beetles, or other adult forms of insect life.
In the second feeding method, the bird remains in a small area of shallow open water under which lies a soft mucky bottom incapable of supporting a man's weight. These are more permanent bodies of water and have clumps of bulrush growing in and around them. The actions of the ibis when feeding at such ponds are similar to the feeding actions described above except that the bird is more stationary. It stands in one place, its bill swings from side to side through the water, its mandibles vibrate rapidly. Sometimes it swallows without even lifting its bill clear of the water. After thoroughly covering the area in front of it, the ibis probes on either side before moving forward a step or two to begin again. On March 12, 1957, five ibis were collected from a flock of 24 observed feeding by the second method. The stomachs of these birds were full of midge larvae.

Social Behavior

In late fall and early winter, White-faced Ibis most commonly travel in groups of three to 50 birds. Occasionally skeins of up to 100 birds are seen in the sky. Flocks of small to moderate size often congregate about a feeding ground until two or three hundred individuals can be counted in the space of a few acres. In particularly favored situations the number may be much greater. On January 24, 1957, I saw the largest aggregation of White-faced Ibis that I have ever witnessed. Twelve to fifteen hundred of these
birds were feeding amid clumps of bulrush and bulltongue in a marsh at Little Chenier. When I closed the car door, all the ibis rose at once like a cloud of gigantic blackbirds. Some of them settled back into the marsh almost immediately, but the main flock circled the field several times. As they circled, birds continually dropped down and disappeared in the tall vegetation. After feeding resumed, ibis were almost constantly in the air, because the birds to the rear of the flock were rising to fly low over the other ibis and light in the front ranks. Occasionally, while feeding or in flight, the ibis uttered nasal calls of "oink" or "oink, oink."

While looking for food, the ibis pay little attention to one another. I have never observed a quarrel between two feeding ibis even when, as sometimes happens, they bump into each other.

**Interspecific Relations**

The feeding grounds of the White-faced Ibis attract many other species of wading birds. There I often observed Common Egrets (*Casmerodias albus*), Snowy Egrets (*Leucophoyx thula*), Louisiana Herons (*Hyrannassa tricolor*), Little Blue Herons (*Florida caerulea*), and White Ibis (*Eudocimus albus*). Several times I saw White-faced Ibis feeding with Greater Yellowlegs (*Totanus melanoleucus*) and Lesser Yellowlegs (*Totanus flavipes*). All these species seem to ignore one
another's presence completely.

Life in the feeding area would be relatively serene were it not for the continual presence of another species, the Boat-tailed Grackle (*Cassidix mexicanus*). Male Boat-tailed Grackles are in the habit of staging "grackle raids" on the wading birds. Though I have observed such attacks on a number of occasions and though female grackles were always present, I have never seen the latter take part in the foray.

The grackle waits until he sees an ibis catch a large, cumbersome crayfish. While the ibis is pecking at the crayfish or juggling it in his bill, the grackle alights nearby and tries to snatch it away. Sometimes he succeeds; but, when attacked from the side, an ibis can usually avoid a raider by turning in the opposite direction until he has swallowed the food. However, the commotion often attracts other grackles which join in the squabble, surrounding the victim. Then the ibis drops the crayfish and a grackle recovers it.

During one of these "grackle raids" six Herring Gulls (*Larus argentatus*) were circling low over the flock of ibis. Whenever a dispute broke out between an ibis and a grackle, the nearest gull would hurry to the point of the disturbance. If the grackle succeeded in stealing the crayfish, he was chased by the gull and several other grackles for about four hundred yards, as he pursued a dodging, zigzag course toward
the oak trees along the chenier. Such incidents were repeated, with minor deviation, a number of times during the 45 minutes I watched the feeding ibis.

On one occasion, I saw a grackle cause a Snowy Egret (Leucophoyx thula) to fly up in the same manner. The egret evidently swallowed its prey in the air. When they lit, the two birds just looked at each other momentarily before the egret resumed feeding.

**Seasonal Distribution**

The White-faced Ibis is a migratory bird. It nests as far north as Oregon and Utah but does not ordinarily winter north of southern California, southern Texas, and southwestern Louisiana. Cameron Parish lies near the upper limit of the winter range.

One might expect that some of the Cameron Ibis would leave the parish in fall and that others would come in from the north to take their places. There is as yet, however, no evidence that such movements actually occur. No migrating flocks of White-faced Ibis have been noted in North Louisiana; and changes in the population level in the parish such as would occur with large numbers of birds arriving or departing have not been detectable. There are tremendous numbers of White-faced Ibis in southern Louisiana the year around, as indicated by my own observations and those of others. But there are also such vast expanses of inaccessible habitat into which the birds may disappear that the
number seen varies greatly from day to day. Even the results of the Christmas Bird Counts at the Sabine National Wildlife Refuge and surrounding territory (Louisiana Ornithological Society: 1951-1957), representing coverage of a circle 15 miles in diameter by several people, show severe fluctuations. Counts of White-faced Ibis for seven years were as follows: 131, 68, 4, 1259, 2036, 881, and 250. In all except one of these years, incidentally, the Sabine figure was the highest in the nation. It is unlikely that these variations represent true changes in the population level. Rather they seem to indicate shifts of the population toward and away from the observation points.

Under the circumstances, we cannot tell whether any marked seasonal variations in numbers take place or whether the White-faced Ibis are migratory on more than a very local basis.

Roosting Habits

My data on roosting habits are few. On February 22, 1957, at 5:48 p.m., a flock of White-faced Ibis I was observing took flight abruptly and headed north-northwest across Chenier Perdue. They flew with steady wing beats and at a considerable height—quite a bit higher than they usually fly while searching for feeding places. When I noticed other flocks of ibis proceeding in the same direction, I concluded that they were on their way to roost. I recorded my loca-
tion on Chenier Perdue and extended a north-northwest bearing on to Little Chenier, noting where the line of flight must cross the ridge.

The next evening at approximately the same time I stationed myself at the point of intersection on Little Chenier. Soon the birds began to fly over. I was able to follow them in the spotting scope and see them settle into the marsh at a location that I later decided was the eastern end of the "Burn" (see p. 42).

Since the Burn is the site of a large breeding colony, it is apparent that many White-faced Ibis roost in winter at locations where the species nests, perhaps returning to the same area night after night throughout the year. Personnel at the Lacassine Migratory Waterfowl Refuge, however, who are in a position to check the Willow Island rookery frequently, think that this somewhat more northern location is not used by roosting ibis in winter. On March 29, 1957, just prior to the beginning of nesting, when I first spent the late afternoon at Willow Island, it was apparent that White-faced Ibis were already congregating there to spend the night.

My observations on February 23 had led me to believe that the White-faced Ibis were roosting in vegetation that did not stand very high above the water. This idea was substantiated on March 29 at Willow Island. There the evening flights of White-faced Ibis settled into the growths of
bulrush and Roseau cane (Phragmites communis), while the White Ibis perched in willow trees (Salix nigra).
NESTING ENVIRONMENT

There are two known colonies of White-faced Ibis in southwestern Louisiana—at Willow Island in Lacassine Bayou and at the Burn. The descriptions that follow are based on my observations at these two places.

Location

Both colonies are well isolated. Willow Island in Lacassine Bayou—not to be confused with the chenier of the same name near the town of Cameron—is included in the 31,125 acres that comprise the Lacassine Migratory Waterfowl Refuge. Under the capable management of the United States Department of the Interior, Fish and Wildlife Service, the rookery has been protected from disturbance by man since the establishment of the refuge on December 30, 1937. Although called an island, the area is covered throughout the year by water, varying in depth from six to 45 inches according to season and rainfall. It is reached by a five-mile boat trip from refuge headquarters down a canal and up the twisting course of Lacassine Bayou. The island is situated in a loop of the bayou and is surrounded on all sides by 25 to 80 yards of open water. Lacassine Bayou is a little-used thoroughfare, seldom travelled except by a few fishermen; and it
is unusual for more than five boats to pass the island in a day.

The Burn was created many years ago when the water level dropped very low and fire started in the peat and dry vegetation of the marsh. A long, deep scar was burned into the terrain, running parallel to Little Chenier two or three miles north of the ridge. When the marsh was refilled during the next period of heavy rain, a slender lake gutted of plant life and several miles long was formed. Subsequently the vegetation grew back over much of the area, transforming the Burn into a series of small, open ponds. Today the way to the spot where the ibis nest is too dry for approach by ordinary boat, too wet for travel by foot. It usually can be reached only by mud boat, air boat, or marsh buggy, and sometimes not even by mud boat. A few trappers and duck hunters visit the place in winter, but during the nesting season almost no one ever goes there.

Vegetation

The dominant types of vegetation at Willow Island are Roseau cane or reed (Phragmites communis) and black willow (Salix nigra). The south end of the island is dominated by the willow; the north half is predominantly Roseau cane. The island is encircled by a raft of broken Roseau stalks and a thick mat of water lettuce (Fistea
stratiotes), with a scattering of water hyacinth (*Eichornia crassipes*) and crinum (*Crinum americanum*). The interior of the island is dotted with small bodies of open water and areas of sparse vegetation. In these open areas, the surface is overgrown with duckweed (*Lemna minor*). Buttonbush (*Cephalanthus occidentalis*) occurs sparsely throughout the island; and along the north edge there is a thin growth of bulrush (*Scirpus californicus*). In the spring of 1957 the growth of Roseau cane on the island was definitely thicker and greener than the cane in surrounding areas across the bayou. Duckweed was constantly being consumed by the several families of coypu, or nutria (*Myocastor coypus*) present on the island but never seemed to diminish.

Clumps of willow and buttonbush are scattered through the fresh-water marsh vegetation of the Burn; but the White-faced Ibis there nest at some distance from the trees, in rather extensive pure stands of bulrush that rise some five feet above the surface of the water. Bulltongue (*Sagittaria angustifolia*) is a prominent plant in this habitat.

**Associated Birds**

The great southern rookeries are characteristically occupied by several different kinds of large water birds of colonial habit. The species making up the colony at Willow Island, here listed from most numerous to least numerous, are as follows: Snowy Egret (*Leucophoynx thula*),
White Ibis (*Eudocimus albus*), White-faced Ibis (*Plegadis chihi*), Louisiana Heron (*Hydranassa tricolor*), Common Egret (*Casmerodias albus*), Little Blue Heron (*Florida caerulea*), Anhinga (*Anhinga anhinga*), Black-crowned Night Heron (*Nycticorax nycticorax*), Roseate Spoonbill (*Ajaia ajaja*), and Cattle Egret (*Bubulcus ibis*). Other birds nesting on the island included a colonial passerine, the Boat-tailed Grackle (*Cassidix mexicanus*) and three noncolonial species—the Purple Gallinule (*Porphyryula martinica*), the Common Gallinule (*Gallinula chloropus*), the Red-winged Blackbird (*Agelaius phoeniceus*).

The relative abundance of the species listed above varied somewhat at different periods of the breeding season. In this connection, I find it convenient to recognize two "breeding cycles." In the latter part of May, when most of the young White-faced Ibis on Willow Island were already able to fly but were still being fed by their parents, a new contingent of adults appeared in the colony and began to nest. The activities of these latecomers make up what I call the second nesting cycle. Why the birds involved delayed their breeding so long, one can only guess. I do not believe they were birds that had failed in previous nesting attempts elsewhere. Perhaps they were young of the previous year that came into breeding condition late.
At any rate, changes in the rank order of some species occurred at the start of the second nesting cycle, most dramatically in the case of the White Ibis. During the first cycle, I noticed only half a dozen pairs of White Ibis; they were almost the least abundant colonial nester on the island. During the second cycle, they were nearly everywhere, challenging the Snowy Egret for top rank.

On Willow Island, White-faced Ibis were observed nesting only in Roseau cane or occasionally in a low buttonbush. The Anhingas, Common Egrets, and Cattle Egrets nested together in the larger willows toward the interior of the island. Roseate Spoonbills also nested entirely in willows, but some were on the southern edge of the island. Snowy Egrets, Louisiana Herons, Little Blue Herons, and White Ibis were found nesting in both willows and Roseau cane. The White-faced Ibis and the various other birds which nested in Roseau cane were not in isolated little groups of individual species, but were mixed together throughout the area. The White Ibis were a partial exception to this rule. When the second nesting cycle started on Willow Island, they sometimes completely populated a small willow patch. However, during this same period, they were also seen nesting in Roseau cane among the other birds.

At the Burn, the colony as a whole is spread over a much larger area and is more diffuse. There, however, the two species of ibis nest in nearly pure stands of bulrush,
occupying certain areas pretty much to the exclusion of other species. In the section of the rookery where they occur, the ibis are the most numerous birds, with the White Ibis somewhat the more abundant of the two. Numbers of Snowy Egrets nest in the buttonbush area bordering the bulrushes; and Louisiana Herons and Common Egrets are fairly plentiful in the near vicinity. In fact, all the colonial nesters found at Willow Island, except the Little Blue Heron, the Cattle Egret and the Roseate Spoonbill, were also found at the Burn. Species nesting, or alleged to nest, at the Burn but not noted at Willow Island were the Olivaceous Cormorant (Phalacrocorax olivaceus), Great Blue Heron (Ardea herodias), Least Bittern (Ixobrychus exilis), and King Rail (Rallus elegans).

**Associated Mammals**

Nutria were the only mammals seen in either colony. At Willow Island, two families of these rodents—one with four young, the other with three—were reared on platforms constructed of Roseau cane within two to four feet of nesting herons. One platform was located about a foot from the leg of my blind stand, two feet from a Louisiana Heron nest, two feet from the nest of a Snowy Egret, and five feet from the nearest nest of a White-faced Ibis. The nesting birds paid little attention to these recently introduced mammals except when the trespasser came close enough to the nest.
for the incubating bird to peck at him without leaving the eggs.

Only once during the observation periods did one of these mammals startle a bird from the nest. A large adult nutria was chasing another adult, which swam to a pile of Roseau cane near the nest of a Louisiana Heron. When the nutria climbed from the water, the incubating bird flew to a small buttonbush, where it calmly waited until the intruder finished cleaning his coat of fur and departed. After the nutria left, the heron returned and resumed incubation. The whole disturbance did not last more than four minutes.

While the nutria thus seems to live on fairly friendly terms with its neighbors, it may do them great harm indirectly, through the destruction of habitat. Observations indicate that White-faced Ibis prefer to nest in nonwoody growth, the very sort of vegetation that forms the diet of the nutria. In a short period of time, these mammals have become phenomenally abundant, and they are capable of grazing down the marsh to an extent that has to be seen to be believed. In late March, large areas of the Burn appeared devastated, with only sparse broken stalks of bulrush protruding above the high water—a condition attributed by the trappers to the work of nutria. The damage done to the rushes combined with the flooded state of the marsh, must have made the area nearly uninhabitable for nesting ibis;
and these factors perhaps explain why the nesting cycle there was so long delayed.

**Reptilian Associates**

With so many birds on the island, I thought it would be an attractive feeding area for alligators and snakes. However, I saw more snakes on the island while setting up the blind, before the birds arrived, than after the nesting activities had started. No alligators at all were seen on or near the island, perhaps because of the persistent hunting of this reptile for its hide. I do not believe there are many alligators left in the area. Three snakes— one Diamond-backed Water Snake (*Natrix taxipolota rombifera*) and two Water Moccasins (*Ancistrodon piscivorus*)— were seen during observations from the blind.

One Water Moccasin about two and a half feet long swam near the blind. A Purple Gallinule followed it for about thirty feet. The bird watched the snake intently and did not utter any calls. Presently, the gallinule accidentally walked too close to a Louisiana Heron nest and received a hard peck on the back. The gallinule then departed, while the snake moved slowly behind some vegetation and out of sight without alarming any of the nesting birds.
This chapter will be concerned with the breeding activities of the White-faced Ibis from the arrival of the birds as the nesting colony up to the laying of the first egg. The major topics reviewed will be the establishment of territory, copulation, and nest building. Nearly all my data on these topics were obtained at the Willow Island rookery, where intensive observations were made from a blind. As already mentioned (p. 26), these observations included parts of two nesting cycles. The discussion regarding the arrival of birds at the colony relates to the first of these cycles. But, since, this earlier cycle was well under way when I began studies from the blind, the rest of the chapter is based on my experiences during the second cycle. Regarding points where the birds of the first cycle may be presumed to have behaved differently from birds of the second cycle, the account must be considered incomplete.

Arrival of Birds at the Colony

On March 29, 1957, while I was setting up the blind stand on the island, I noticed a flock of White-faced Ibis gliding overhead. The time was 3:45 p.m. During the
following half hour, as I finished erecting the stand and floor of the blind, several other flocks passed by. I started the motor on the canoe and went across the river to see if I could determine where the birds were heading. I watched several flocks of White-faced and White Ibis come in from the other side of the island and settle into the vegetation on the south end. Common Egrets had been on the island all day starting nesting activities in the island willows. Now Snowy Egrets, Louisiana Herons, and Little Blue Herons came flocking in from all directions.

At 5:00 p.m. I went to the south end of the island and, by raising the slow running outboard motor from the water and exposing the exhaust noises, flushed the birds from their perches. About six hundred White-faced Ibis rose into the air and circled several times before alighting again. I noticed that the White Ibis always seemed to light in the willows while the White-faced Ibis disappeared in the growths of reeds. Because the ibis were not present when I arrived at noon, the birds may have merely been roosting there. Several times in the two weeks preceding, personnel from Lacassine Refuge headquarters had circled the island looking for birds and had not seen any ibis. The next time I visited the island was on April 25. By this time, many ibis nests were completed and some contained clutches of as many as four eggs.
How many days prior to March 29 the Ibis may have been using the rookery as a roost and what transpired between March 29 and April 25, I cannot say. However, the arrival of birds over the island as early as 3:45 p.m. suggests that already on March 29 they were becoming interested in Willow Island as something more than a place to spend the night. Perhaps the initial phase of the breeding cycle was already then beginning.

Choice of the Nesting Site

At the start of the second nesting cycle, from May 27 to June 4, birds arrived at the island in pairs, mating already having taken place. By that time, most of the young herons of the first cycle, perhaps 65 per cent of them, had left the nest, though they were still being fed by their parents. In the area under observation, only one nesting White-faced Ibis remained. So there were now many empty nests. A newly-arrived male ibis flew to a nest and was immediately chased away by a Snowy Egret, which evidently owned that one. The ibis moved over to some floating reeds and probed with his bill. Several times, he picked up small sticks, juggled them, and dropped them. Then, he selected another nest, flew over, and lit in it. He walked about that nest for a short time, emitting soft, guttural, babbling sounds and rearranging a few stalks of
reed. Finally, he uttered an "oink" similar to the feeding call. This note was repeated several times in calls of one or two syllables until the female joined him. When she arrived at the nest, she answered with an "oink, oink" of her own. The two birds started preening and, after a few minutes, the female hopped down from the nest, which was approximately 20 inches above the water, and started wading about, probing with her bill. The male remained for some time at the nest, calling occasionally, but the female did not return or answer.

Presently a Snowy Egret returned to a nest slightly above the male ibis and drove him away with a brief exchange of bill jabbing. The ibis retreated to some floating reeds about 25 feet away. There he again went through the ritual of probing among the reeds, picking up short pieces, and juggling them in his bill. Next he chose an old abandoned White-faced Ibis nest that was about 25 feet from the blind and some four feet above the water. The structure was situated in a clump of reed (Phragmites communis) and was anchored to both dead stalks and new green shoots that would bear seeds next year. After rearranging some sticks in the nest, the male ibis started calling again. This time when the female came, she was carrying a small piece of reed. The male also took hold of this reed, and, while both birds shook it vigorously, they uttered five "geeeks," the first
loud and each subsequent one softer. Thereupon, they tried repeatedly to push the stick into the nest, sometimes letting it fall.

The male bird remained at the nest for two hours. During this time, the female left him several times and returned. Occasionally she would bring a stick, which the male would try to work into the nest. She rejoined him at 3:15 p.m. and, after a little calling, preened her feathers, sat down, tucked her bill under her left scapalaris, and dozed for 45 minutes. The male ibis stood on some reeds nearby preening and fluffing his feathers loosely. When she awakened, the female ibis started pulling dried leaves of Phragmites into the nest of a lining. The male helped her and then stepped into the nest and started preening the feathers on her back. From past observation, I knew that copulation was about to take place, and by 4:20 p.m. copulation was achieved.

This act marked the end of the search for a nesting site. In this instance, the birds—designated in my notes as pair II-6—had inspected three old nests and rejected two of them. Each time the male had appeared to take the initiative in suggesting the site; and it was mainly he who had made the abortive attempts at nest repair. But the eventual decision seemed to be with the female. Though the whole process had the appearance of a ritual, I cannot
say how typical it is of the behavior of White-faced Ibis in general. I never again witnessed the selection of the nesting location in such full detail. During the first nesting cycle, when no old nests are involved, this step must be considerably modified.

Copulation

I have observed copulation between White-faced Ibis seven times. In all cases, the actions were very ceremonious, without any really significant variations. The description that follows is based on the behavior of pair II-6 immediately after their selection of a nest site.

First, the male takes a position behind and to one side of the female. He preens the feathers of her upper back with his bill. Placing the tip of his mandibles between her shoulders, he moves it down the length of her back until his bill is doubled back under his neck. While in this position, he sometimes vibrates the top of his upper mandible against her rump for several seconds before reaching up between the shoulders and starting down again. This action may be repeated by the male several times in the one to three minutes before he mounts the female. During these caresses, the female preens her own back feathers or those on her upper breast.

When mounting, the male sticks his head around and under the neck of the female, which she is holding firm
and erect, and braces his bill against her breast. At the same time he spreads his wings, raises them above his back, and places one foot upon her shoulder. The joint of his tarso-metatarsus and digits is placed right where her wing joins the body; he seems to grasp the wing and clavicle with his toes. Flapping his own wings enough to maintain his balance, he brings the other foot up onto her other shoulder. Once in this position, the male and female shake their bills sideways very nervously, keeping them pointed straight down. He still occasionally flaps one or both wings to maintain balance. The female remains standing throughout this process. Finally, the male lowers his tail to one side of the female's tail and, with a pumping action of his tail, makes contact. The nervous shaking of the head stops, the male slowly dismounts, and the female begins to preen about the base of her wings.

Both birds of pair II-6 were quite inactive for about five minutes after intercourse was completed. Then occurred an incident unique among my observations. Both uttered the "geeeek" note at the same time, whereupon the female took off for another part of the island. The male stood awhile near the nest then flew over to a young ibis approximately three weeks old that was resting on some floating reeds. He attempted copulation with the young bird, which offered no resistance. After the male had dismounted, his mate returned to a place near the nest and he rejoined her.
Subsequent events indicated that this pair must have performed their initial act of copulation several days before entering the observation area. In some cases the male continued to mount the female even after egg-laying had begun. One male was observed doing so two days after the clutch of eggs was complete. It did not appear that, in these later attempts at copulation, coition was actually achieved.

**Nest Building**

After the act of copulation and its odd sequel, described in the preceding section, pair II-6 applied themselves seriously to the task of renovating the chosen nest—the one at which copulation had taken place. During the tour of inspection, the female had gathered bits of reed and the male had clumsily attempted to fit them into the various nests. Now their roles were reversed: the male brought most of the material, and the female placed it about the nest. The male had no particular area for collecting nesting material. Upon finding an old nest, he would make several trips to it for material, but he would soon lose interest in this nest and start looking elsewhere. This procedure was very different from that of the egrets and herons, which would return to an old nest time and again until it was completely disassembled.
The work of rebuilding occupied the rest of the afternoon and all of the following day. On the birds’ third day in the observation area, the first egg was laid. I watched only one other pair renovating a nest. Their behavior differed in a single small detail: once in awhile the female carried material to the nest herself.

The nests of White-faced Ibis at Willow Island were constructed entirely of reed (*Phragmites communis*). Stalks of this plant, ranging in diameter from 1-16 to 1-2 inch, had been used in assembling the shallow-cupped platforms, which were usually attached at the sides to upright stalks and held up beneath by bent-over reeds. Both dead and growing stalks were used for support. In the case of nests build in *Phragmites*—and these made up the vast majority—the minimum distance from the bottom of the cup to the surface of the water was 20 inches, the maximum distance, four and a half feet. The average elevation was approximately three feet. At the first of the season, when the eggs of the first nesting cycle are laid, the platform is sometimes very sparsely assembled, perhaps consisting only of a couple of dozen stalks with a few leaves for lining. As incubation progresses the male continues intermittently to carry pieces of reed to the nest. If the female is sitting, she usually arranges this material; but sometimes the male brings the reed with him when he comes for nest
relief, and at such times he usually undertakes the work of placement himself. This reinforcement of the nest is done mainly along the edges of the platform, with the result that the structure becomes more and more cup-shaped. Even after long occupation, however, the rim of a reed-supported nest seldom exceeds two and a half inches in thickness.

Two of the 21 nests examined at the island were placed not in Phragmites but on snags of buttonbush. These nests barely cleared the surface; there was not more than six inches between the bottom of the inside of the cup and the water beneath. They were rather extensive mounds of reeds completely covering the support; one of them measured two feet in diameter and was eight inches thick. The shallow cups of these nests, like those of all nests examined in this colony, were lined with leaves of Phragmites. The nests at the Burn were similar to the reed nests at Willow Island except that bulrushes took the place of Phragmites both as support and as the material of construction.

 Territory

After definitely taking over a nest as their own, the ibis show aggressive action toward egrets, herons, or other ibis that came close to the clump of reeds supporting the nest. The territory that they defend diligently from all other birds seems to extend two feet from all sides of the nest. Soon thereafter an arrival post, representing
the spot where the birds most commonly alight when returning from feeding, and preening posts are established. All other White-faced Ibis are driven away from the area surrounding these posts. The nest usually lies near one end of the territory and the arrival or preening post near the other end. Thus several ibis nests may be relatively close together, within four feet of one another, with the larger area of the territory radiating from the nests in different directions. Occasionally these territories may extend to an over-all length of as much as fifteen feet; but the average, I believe, is only about six feet.

The order of dominance suggested by my observations of the birds around the blind is as follows: first, the White-faced Ibis; second, the Snowy Egret; and third, the Louisiana Heron. This is not to say that the ibis go about the area bullying all the other birds. It merely means that on neutral ground the egret and the heron give way to the ibis. But when any of these birds are on their own territories, woe to the intruder that crosses the boundary, regardless of the birds' position in the social hierarchy. In one instance, a White-faced Ibis lit on a perch that was in the territory of a Snowy Egret. The egret advanced with ruffled feathers and lowered wings, unnoticed by the ibis, and landed a blow with his bill on the back of the trespasser. The ibis immediately flew off without
any form of retaliation. On another occasion, a White-faced Ibis pecked an intruding Louisiana Heron on the back and took hold of the feathers and skin between its shoulders. Voicing a long drawn out "gheeeeee", the ibis then delivered several blows with its wings. The heron leaned forward stretching its neck and flapping frantically until it pulled free from the ibis' grasp.

Observations at the Burn

My few observations at the Burn did not extend much beyond the stages of the nesting cycle treated in this chapter. On my first excursion to this area on March 30, 1957, no nests of any kind were found. However, there were many Black-crowned Night Herons present--400 in one distant section of marsh that was unapproachable. Common Egrets were also visible in distant trees, but we saw no nests near them. The second trip to this area was on April 27. A few Anhingas and Louisiana Herons were building nests, but only one of all the nests examined contained an egg. Common Egrets were sitting on nests; so I assume they were incubating eggs. Still no White-faced Ibis were seen, except for an occasional flock passing overhead.

On the third trip, on June 11, I found an estimated 1400 White-faced Ibis nesting in the bulrush. Many of the nests were still under construction. I feel fairly certain
that these were the first serious nesting attempts of ibis at the Burn in 1957, and by this time birds of the year at Willow Island were already able to fly. Such delayed breeding activity is not a normal characteristic of the population at the Burn, for at this locality Holt (1933) found young on May 25 at a stage comparing favorably with their development on the same date in 1957 at Willow Island. The comparison shows how seriously adverse circumstances may retard the breeding cycle.

**Early Stages of the Cycle in the Glossy Ibis**

The nests of the Glossy Ibis discovered by Baynard (1913) were either in elder bushes or willow trees, at heights of 10 to 15 feet above the ground. Sprunt (1954: 43) mentions grass clumps as additional sites in Florida. All the White-faced Ibis nests I have examined or read about were in reeds or rushes or on buttonbush snags and never more than five feet above the surface of the water. It is unlikely that these apparent differences in nesting habitat have much significance, for the *Handbook of British Birds* mentions nests of *falcinellus* on reed-beds.

Sprunt states that the nest of the Glossy Ibis is constructed of sticks and twigs; Baynard does not mention nest composition but alludes to the use of twigs. I never found any material except reeds or rushes in nests of the White-faced Ibis, even where twigs were easily available. Again
the apparent contrast is perhaps not truly valid. The Handbook mentions nests of *falcinellus* built of sticks and others constructed of reed stems, while Holt (1933) speaks of nests at the Burn containing twigs as an accessory material.
EGGS AND INCUBATION

Clutches of the first breeding cycle were already complete when I began studies from the blind at Willow Island. Therefore, I did not witness the egg-laying phase in the life of the White-faced Ibis until the start of the second breeding cycle. Incubation was observed in both cycles but not in full day-to-day continuity in either.

Eggs

The eggs of the White-faced Ibis are greenish blue, close to Nile Blue, deeper in tone than the eggs of other heronlike birds nesting in Louisiana. Seven eggs, representing two clutches, were measured. The average dimensions were: width, 36.0 mm.; length, 51.2 mm. A full clutch usually contains three or four eggs, the mean being close to three. Data for 16 clutches are given in Table I. It will be noted that three of the nests inspected on May 6 held only two eggs. Since the number had not increased by May 8, it is unlikely that any further laying took place in these nests. However, as the record for no. 8 shows, eggs may disappear from a clutch. Thus sets no. 4, 6, and 10 may originally have been larger. Nests no. 10 and 13 could not be located on May 8.
Table I. — Number of eggs in nests examined

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<th>Nest No.</th>
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Total 16 49 43
Average 3.06 3.07
Egg Laying

My original impression, based on experience with two nests, was that the female White-faced Ibis deposits eggs on the average of one every other day. This surmise was later re-enforced by the striking inequalities in the size of the developing young (p. 59). However, Baynard, who apparently made daily observations of two pairs of Glossy Ibis in Florida, reported that the female of the first pair laid four eggs, one each on four consecutive days, while the second female deposited three eggs, one each on three consecutive days, and added a fourth five days later! At first I thought that my own data for the White-faced Ibis presented a very different picture, but upon re-analyzing them, I must admit that they are not necessarily inconsistent with Baynard's findings.

The dates included in Table II are the only dates on which I was present in the colony during the period when eggs were being laid in the two nests. As a result, a wide latitude of interpretation is possible. Female II-10 could have layed eggs on the consecutive dates of May 30, May 31, and June 1, producing the incomplete clutch noted at 10 a.m. on June 4. The fourth egg could have been deposited any time after 10:00 a.m. on June 4 and before 9:20 a.m. on June 6. Thus the laying schedule may have been three eggs on three consecutive days plus a fourth egg three to five
<table>
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<th>Date</th>
<th>Time</th>
<th>Pair II-10</th>
<th>Pair II-4</th>
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<tr>
<td>May 30</td>
<td>5:00 p.m.</td>
<td>1 egg</td>
<td>no eggs</td>
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<tr>
<td>June 4</td>
<td>10:00 a.m.</td>
<td>3 eggs</td>
<td>2 eggs</td>
</tr>
<tr>
<td>June 6</td>
<td>9:20 a.m.</td>
<td>4 eggs</td>
<td>3 eggs</td>
</tr>
<tr>
<td>June 10</td>
<td>10:20 a.m.</td>
<td>4 eggs</td>
<td>4 eggs</td>
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Table II. -- Increasing clutch size in two nests
days later, exactly as in the case of Baynard's second female. Pair II-4 were still copulating on May 30. In their case, eggs may have been laid on June 3, 4, and 5, producing the observed result of two eggs on June 4 and three on June 6. The fourth egg, first recorded on June 10, could actually have been deposited any time after 9:20 a.m. on June 6. Thus all four eggs could have been laid on successive dates.

Incubation

In the two nests where incubation was closely noted--both of them nests of the second breeding cycle--the parents began to cover the eggs more or less continuously soon after the laying of the first egg. I therefore assumed that incubation had begun, and sought to calculate the incubation period as the time elapsing between the laying of the first egg and its hatching. In one case I was partially successful. The nest in question was empty at 5 p.m. on May 28, and no bird had yet even claimed ownership. I was absent from the colony on the 29th, but at 10 a.m. on May 30 I noticed that one egg had been deposited. Since it is unlikely that the female would lay immediately after the selection of a nesting site, I am inclined to believe that I discovered the egg very soon after it had been deposited. On June 21, I conducted observations until 1 p.m. and none of the eggs had hatched at that time. At 10 a.m. the next day
when I returned to the colony, there was one young bird in the nest. The time elapsing between my first observation of an egg in this nest and my first observation of a young bird was thus exactly 22 days. Conceivably the incubation period may have been as much as 29 hours longer or as much as 19 hours shorter.

In attempting to standardize the term "incubation period," Nice (1954) has defined it as the length of time a newly laid egg takes to hatch with regular, uninterrupted incubation. She further points out that this period can be most satisfactorily approximated by the field observer as the time elapsing between the laying of the last egg and the hatching of the last young. The reason is that the development of the embryo in the last egg continues without the interruptions to which the earlier eggs are subjected. I was unable to measure the incubation period of the White-faced Ibis in this manner. It is my opinion that in the case of the White-faced Ibis an incubation period calculated by the preferred method would differ little from one calculated by the method I employed. If differences do occur, these differences are as interesting a part of the biology of the species as the figure arrived at by following Mrs. Nice's recommendation would be.

Baynard (1913: 107), writing of the Glossy Ibis, states: "After twenty-one days had elapsed, three of the eggs hatched." Since he does not specify from what point the elapse
of 21 days was calculated, the exact significance of the statement remains obscure. Baynard also says that, while parent Glossy Ibis stand watch at the nest continuously during the egg laying period to ward off Fish Crows (Corvus ossifragus), incubation does not begin until a full day after the last egg is laid. If his observation can be accepted as a valid generalization, chihi and falcinellus differ remarkably in this respect.

In both forms, however, the male and female parents share the task of incubation. In the case of the White-faced Ibis at least, the male appears to do most of the incubating during the daylight hours.

An Afternoon of Incubation

The following carefully timed account concerns the pair of White-faced Ibis designated as I-2, one of the four pairs that could be fully observed from the blind during the first nesting cycle. The nest was a mound of reeds which protruded about eight inches above the surface of the water. The date was May 14--toward the middle of the incubation period. All the birds around the blind would leave when I entered it.

12:10 As usual, male G2 is back on nest about one minute after I enter the blind. He preens feathers for about two minutes before settling on eggs.
12:43 He stands, preens feathers briefly, and touches eggs with tip of bill before resuming incubation.

1:00 Male begins to pant as the nest is in the open and the day is sunny and hot, with very little breeze. Temperature in blind is about 90 degrees Fahrenheit. Other birds are panting also.

1:27 He rises, preens breast feathers for about a minute, and touches eggs with bill.

1:54 He repeats the process.

2:41 Male again stands, preens feathers, and touches eggs with bill. This time he gets tip of bill under eggs and moves them about considerably.

3:08 The standing, preening, egg-touching routine is repeated.

3:40 Male rises and preens for about three minutes, which is longer than usual, before settling down on eggs again.

4:00 I-2 mate returns directly to nest. Male utters a greeting call, which may be written "geeeeeek, geeeek, geeeek, geeeek, geeeek" and seems to beg. He then gets up and walks off the nest onto some floating reeds. The female flies off to another part of the island. She may have heard the sound of the camera, as I am trying to record this nest relief on movie film. Male preens for three minutes and then stares at the uncovered eggs some six feet away. He stretches his neck while looking, returns to nest, and settles back on eggs.

4:12 Female returns again and both birds call from the nest. Male then moves off a short distance, preens for about a minute, and flies off to the east. The female looks more alert. She is facing south-southeast.
5:00 She rises, preens, and settles on eggs facing north-northwest.

5:11 She stands, preens, and returns to south-southeast direction.

5:38 She rises, preens for a brief period, and resumes north-northwest position.

5:40 Female rises and walks to edge of nest, where she preens for some time and scratches neck with foot.

5:52 She walks back to eggs and settles down on them, facing south.

6:15 Again she rises and preens, this time settling in a south-southeasterly direction.

6:27 She stands, preens, and scratches back of head with right foot, later stretching right wing and leg to fullest extent. She resumes incubation in the same direction.

6:30 She stands and does considerable probing in nest with bill, throws out some small pieces of leaves, and settles down in a west-northwest direction.

6:33 She shifts to face the east.

6:35 She rises, probes in nest, and resumes incubation facing northwest.

6:38 She reaches out of nest for small stick, which she places on nest near her.

6:42 She stands, moves eggs about, preens, and takes up a west-northwest position.

6:59 She rises, preens, and turns to face the southwest.

7:18 Female is probing about eggs again. Settles facing north.
7:26 She stands, scratches neck with foot, and resumes incubation still facing north. Darkness is fast approaching and the first chorus of green tree frogs (*Hyla cinerea*) starts up. Visibility is becoming so poor that I leave the blind.

**Nest Relief**

Nest relief takes place two or three times a day—that is to say, two or three times during the daylight hours. One such exchange is described in the entries for 4:00 and 4:12 p.m. in the preceding section. Often the byplay involved is more elaborate.

In one instance, on May 8, the male called several times while still covering the eggs and did not rise when the female walked half way around the edge of the nest. She seemingly tried to push her bill under him and shove him away. Finally he rose and flew to the floating reeds along the edge of the island. There he selected a short length of cane that suited him and took it back to the nest. The female stood up, accepted the stalk from the male, and worked it into the edge of the nest. He then returned to the same area and selected another piece, which he also carried to the female. Then he spent some five minutes preening before flying off to the feeding grounds.

According to Baynard (1913), the male Glossy Ibis (*Plegadis falcinellus*), coming in to serve his turn at the
nest, utters a call while still about 50 feet away. The female immediately replies, springs into the air, and passes him in flight while he is still approximately 25 feet from the nest. The male always flies directly to the highest branch in the nesting tree and, after preening for five minutes or so, gives three or four calls and drops down to the nest. After examining the eggs for a few minutes, he may go stalking through the bushes until he finds a suitable twig to break off and add to the nest. In contrast, not one of the incubating White-faced Ibis observed by me arose until its relief had entered the territory, and usually the change-over took place on the nest. Baynard further describes the prolonged "billing and cooing" that goes on between mated Glossy Ibis upon the return of the female to the nest. After the start of incubation, I never observed any physical display of affection between the male and female White-faced Ibis.

**Egg Losses**

The observation area on Willow Island represented a disturbed situation. Whenever I approached or left the blind, all the birds within a 25-foot radius would fly off. During the first two weeks of my operations, some of them were so perturbed that they abandoned their eggs completely. Included among the deserters were two pairs of Snowy Egrets, two pairs of Louisiana Herons, and three pairs of White-faced
Ibis. Louisiana Herons were the most timid birds in the colony. They were the first to leave the nest upon my approach, and the last to return. Often, they would stand up by the nest as they detected movements in the blind that none of the ibis and egrets seemed to notice.

When nesting birds were startled into flight, the old winter enemies of the ibis, the Boat-tailed Grackles, were usually on hand to take quick advantage of the opportunity. As usual the male grackle was the one to assume the initiative. He would alight in a nearby willow, pick out an unguarded nest, fly down to it, and peck open an egg. His mate would watch from a nearby perch or sometimes from the edge of the nest. After taking a couple bites, the male would let her eat. Sometimes he flew off by himself; at other times, he would wait until the female had finished and both would go off together. I never saw a grackle break more than one egg during a raid, and often after breaking it, he seemed satisfied to take only a bite or two before leaving. Nor did I ever observe more than one pair of grackles plundering nests at a time.

The reactions of the owners of the nests, upon returning to find one of their eggs ruined, varied. One pair of egrets simply resumed incubation and succeeded in rearing young. One female White-faced Ibis, after carefully removing the parts of the nest lining spattered with the contents of the egg, settled back on the remaining eggs but
abandoned the whole effort a day later. The other parent birds never reappeared at all. In their cases, I was not always sure whether destruction of the egg caused desertion or desertion caused the eventual destruction of the eggs.

At any rate, as the birds became more accustomed to my comings and goings, and as their ties to the eggs became stronger with the progress of incubation, desertions became less and less frequent. For one stretch of 20 observation days not a nest was abandoned to my knowledge, not an egg lost. During this period the birds returned so promptly to the nest after I had disappeared into the blind that the grackles never had a chance to carry out their depredations. Curiously enough, one pair of Snowy Egrets and one pair of Louisiana Herons that were nesting only some 20 inches from the legs of the blind stand and were thus exposed to maximum disturbance, succeeded in hatching all their eggs and rearing all their young. Perhaps these nests were so close to the blind that predators were afraid to molest them.

All the wading birds nesting about the blind showed definite hostile activity toward every grackle that came near their nest. If any of these waders was standing some distance from his nest when a grackle lit near the uncovered eggs, he would utter a threatening cry and fly toward the intruder with ruffled feathers.
The Red-winged Blackbird, which fed on ants and other insects that lived on the reeds, could hop under and about the nests of these same birds without drawing more than a casual glance from the owners. But the wading birds showed a threatening display towards any gallinule that came within three feet of the nest. I could not determine the reason for this hostility, for the gallinules did not seem to bother the nests until after they were visited by a grackle. On one occasion I saw a Common Gallinule eat the shell of an ibis egg that a grackle had knocked into the water after eating the contents. The gallinule then climbed into the nest and ate the rest of the broken shells.
The plumages of the White-faced Ibis, including those of the immature stages, are described in detail in the final chapter. The present discussion will be confined mainly to other aspects of the development of the young. Most of the data are drawn from observations in the first breeding cycle.

**Hatching**

My records concerning the hatching of young White-faced Ibis are even less complete than the data concerned with the laying of the eggs. At 9:42 a.m. on May 27, I noted one newly hatched ibis and two unpipped eggs in a nest. Twenty-six hours later, the nest still contained one chick and two unpipped eggs. Unfortunately, the subsequent history of this nest is unknown, and it may possibly be that the two unpipped eggs were infertile. Therefore, the observation provides no real evidence regarding the sequence of hatching. My other data are similarly inconclusive.

There was a great disparity in size, however, among the young nesting ibis of a brood—great enough to suggest that hatching had not occurred on the same day or even on consecutive days. For some reason, the first two chicks to appear usually looked rather similar in the beginning.
But by the time there were three young in the nest, each member of the brood seemed to be of a different size. Generally, when the fourth chick emerged, the first one to hatch appeared more than half again as large as the newcomer. After the first three weeks of development, size differences became less noticeable again.

I was unable to obtain data that quantitatively demonstrates the size disparity among nestlings. Since Willow Island is on a federal refuge, specimens could not be collected there; but I had intended to make frequent checks on the living weights of the young birds in the study area. However, I soon discovered that the parent birds would desert the nest if I handled the young, even though I wore rubber gloves. This phase of the project was abandoned after only two birds had been weighed.

**Feeding of the Young**

Exactly how soon after hatching the chick begins to receive food from the parents, I do not know. But the basic feeding procedure, once begun, remains much the same throughout the period of parental care.

Both parents bring food to the young. When the adult is ready to feed the chicks, it nudges them gently with its bill. The little bird responds by pecking at the adult's bill, which is slightly opened. When a young bird gets its
bill between the mandibles of the parent; it follows them upward toward the parent's mouth, where a lump of regurgitated food is waiting. The young may eat from the corner of the old bird's mouth for seven to 15 seconds. Then the adult lifts up its head, forcing the young to withdraw their beaks, and reswallows the food remaining.

The following additional details are taken from notes on male I-11 feeding four nestlings, the smallest of which was approximately three days old:

Male arrived at 11:20 a.m. and stood on edge of nest, preening its feathers for 10 minutes before commencing to feed the young. During the next 37 minutes, the young made 63 trips to the parent's mouth for food. At times the lump of regurgitated material was plainly visible. The young would pull off a portion with its bill and gulp it down as fast as possible, usually swallowing six or seven times before withdrawing its head. Ordinarily only one young eats at a time, but on four of these occasions two birds were fed at the same time, one from each corner of the parent's mouth.

When begging for food the young White-faced Ibis extended their wings, moved the head up and down slightly, and uttered a vibrating call that may be written as "cheeeeeeeeeeuu." Baynard was unable to detect any call made by young Glossy Ibis except when they were disturbed by man and uttered "a squawking note of fear."

**First Week of Life**

The young White-faced Ibis continued in the natal down (see p. 68) throughout the first week after hatching.
They were quite inactive during this period. Their only observed movements were at feeding time and when they were panting or tried to move out of the rays of the sun.

Throughout this first week at least one of the parents was on the nest continually. During the hottest part of the day, the adult shielded the young from the sun by standing over them and dropping its wings until the tips of the primaries rested on the nest. At other times, the parent covered the nest in much the same manner as when incubating eggs.

One chick, about 30 hours old, tipped the scales at 38 grams. For the reasons already stated, I have no other data on the weight of the nestlings.

Second Week

Along toward the middle of the second week, pin feathers began to appear in the alar and caudal tracts. By the end of the week the pin feathers in these areas had become very conspicuous, and much shorter pin feathers had begun to show up in the other tracts.

Meanwhile the nestlings had begun to notice their surroundings. Some showed signs of fear of man; a few even climbed out of the nest at my approach. When undisturbed they were farly quiet and calm; I never saw them argue or fight among themselves. Young *falcinellus*, on the other hand, are said to be very active during the second week.
climbing out to the end of the branches of the tree in which the nest is located. Baynard says, however, that they always return to the nest for feedings.

Toward the end of the second week, both parent White-faced Ibis would be absent from the nest and territory for considerable lengths of time, varying from one-half to three hours. I assume they were off looking for food, but they never returned to the nest together. Occasionally both were present but usually not for more than 12 minutes at a time unless they were adding material to the nest.

**Third Week**

By the beginning of their third week, the young ibis had lost all their down and the first feathers of the juvenile plumage were just starting to emerge from the sheaths. So the birds were less completely covered than when they hatched.

The young birds now became very active. They left the nest to walk about on the floating vegetation nearby and spent most of the rest of their time flapping their wings and preening their newly arrived feathers.

By the last of the week the parents were feeding the fledglings away from the nest but still within the territory, unlike the Glossy Ibis, which are supposed to call the young back to the nest for every meal (Baynard, 1913). The adult White-faced Ibis in my study area never flew directly to the
young out of the nest but always lit a short distance away and made the young come to them to feed. After the fledg-lings had made two or three trips to the parent's mouth, the latter would move to another location three to twelve feet away, and the young would have to follow to continue the meal. Frequently a young bird would stand in one spot and try to make the parent come to it, but I never saw the older bird comply.

**Fourth Week**

By the fourth week, the young white-faced Ibis were fairly well feathered except for the bald spot on the head. The remiges were well developed, and the birds began to make short flights and to wander about outside the territory. During these early flights, which are only some six or eight feet in length, the bird beats its wings continually, just clearing the floating vegetation and sometimes assisting the flight by pushing with its long legs. Most of the time, however, was still spent in walking about the reeds.

**Fifth Week**

The feathers lengthened during the fifth week, but otherwise the appearance of the young ibis remained much the same. By this time, the birds could fly rather well, rising 30 to 50 feet into the air and gliding for short intervals on outstretched wings. Yet I did not notice any of them leaving the vicinity of the island. At this stage
the young probed energetically in the water with their bills but still received food from their parents. According to Baynard, *falcinellus* do not fly until the sixth week.

When the parent arrived at the territory and could not see the young, it would utter two guttural calls, which may be written as "goick, goick." Soon its young would come flying over and light three or four feet away. The immature bird would then advance toward the parent, flapping both wings, and uttering the begging call, "cheeeeeeau." After permitting its offspring to feed once, the parent would fly to another spot in the territory and wait for the young to come for another serving. The young one would beg a while without any results, and then its hunger drive seemed to subside. When the parent gave only one "goick," the young responded by flapping one wing and stretching the neck forward. When the adult uttered the complete feeding call "goick, goick," the young ibis reacted by flapping both wings and giving the begging call. Finally the young bird would make its way to the parent to be fed again.

At this point, my observations were terminated by hurricane Audrey, which swept over both rookeries in Cameron Parish with devastating results.
Mortality Among the Young

Mortality among young White-faced Ibis is heavy. During the last week in June, I was able to count only 14 to 18 young ibis of flying age at the upper end of the island, in an area where there had been not fewer than a dozen nests in the first breeding cycle. These results would indicate a survival rate of not more than one bird and a half per nest. One pair of ibis that had hatched four young were feeding only two by the third week, and by the fourth week one of these had disappeared. Another pair that also started out with four young had lost three of them by the third week.

In spite of the length of time I spent in the rookery, I never found a young ibis that had hung itself in a crotch or in crossed cane as young herons and egrets so often do, and I never saw a predator kill a young ibis. However, on five occasions I watched male Black-crowned Night Herons swallow young egrets or herons. I can think of no particular reason why young ibis should be immune to such attacks. They would seem particularly vulnerable to this large and dangerous predator during the second and their week of development.

On July 2, when I visited the Willow Island colony for the last time, I counted more than 20 Snowy Egrets that had apparently been drowned during the hurricane, but saw several
surviving young still in the climbing stage. Nearly all the nests in the rookery had been destroyed. I observed no dead White-faced Ibis; but, of the more than 600 adults and young that had been present on June 22, only seven birds could be seen. One of these was an immature in juvenal plumage; one was an adult with a crippled wing; the rest were adults that could fly.
My original intention was to procure live specimens of the White-faced Ibis and to study their sequence of plumage and molt in captivity. This plan could not be carried out as part of the present research. My present firsthand data on plumage development, being limited to observations and collections from late November to early July, are incomplete. However, some of the information I did obtain is so much at variance with published statements on the subject that I feel obliged to present my preliminary findings and conclusions in full detail.

Natal Down

The newly hatched White-faced Ibis is covered with a somewhat sparse coat of soft brownish black down, darker and more dense on the dorsal surface than on the flanks, abdomen, and breast. On some parts of the body, the bare light-colored skin shows through. There is usually a small patch of white down, approximately 5 x 9 mm. in area, on the back of the crown and more rarely a few narrow, transverse whitish bands on the lower throat. All the six living downy chicks closely examined by me had the crown patch and lacked the throat markings; but one of the two day-old nest-
lings collected by Dr. Lowery at the Burn on May 28, 1942, shows the opposite condition. The spot on the head where the white tuft usually occurs is bare, and two white marks 2 to 3 mm. in width cross the lower throat. The bill of the living chick is pale flesh-color and is encircled by three blackish bands, one at the tip, one at the middle, and one at the base.

Baynard's description (1913: 108) of young *falcinellus* in the downy stage differs in striking particulars. Where the white down on the crown should be, he speaks of a patch of "bright orange color crossed by a band of black midway." Presumably he is referring to a bare patch, but in the preserved White-faced Ibis chick discussed above, the bald spot is entirely concolor with the dried skin of the rest of the body. In describing the bill, Baynard mentions only one blackish band about halfway up its length. Though these points of disagreement are difficult to account for, they seem not to be real species differences. The account of nestling *falcinellus* in the *Handbook of British Birds* (p. 124) states that the bird usually has a white patch on the crown and some white bands on the throat and that the bill is pink with three blackish bands—at the base, in the middle, and at the tip. Thus, though the appearance of downy *chii* in Louisiana seems to differ appreciably from the appearance of downy *falcinellus* in Florida as seen by Baynard, it agrees almost exactly with descriptions of European *falcinellus*. 
Indeed the only point of real difference I can perceive is that the European chicks are said usually to have throat bands, whereas Louisiana chihi rarely do.

Postnatal Molt

The changes that take place in the downy chick have already been sketchily indicated in the preceding chapter. Toward the middle of the second week after the bird hatches, pin feathers begin to pop up, appearing first in the alar and caudal tracts. By the end of the week these feathers have lengthened noticeably, and shorter pin feathers are visible in the other tracts. At this point the bird appears more naked than in the downy stage. The feathers of the juvenal plumage start to emerge from their sheaths in the third week. The Louisiana State University Museum of Zoology has in its collection a young White-faced Ibis, taken by Dr. Lowery in the Burn on May 28, that I would judge to be in its fourth week of development. It is well covered with juvenal feathers, fairly well formed on the back, wings, and tail but soft and diffuse on other parts of the body. The neck covering especially has a downy texture, though the natal feathers have been replaced by new ones. Much of the natal down is still retained on the top of the head, where wisps of white, now spread in a ragged line, mark the site of the disrupted crown patch. In the young birds observed in life on Willow Island, however, a
bare area of light orange-colored skin developed during the third week to take the place of the white crown patch. This bald spot was similar to the one described by Baynard for downy Glossy Ibis, but was not traversed by a black band. The bare patch is still visible in a specimen in nearly full juvenal plumage taken in the Burn on May 29, 1941. Even this bird shows a few tufts of natal down on the top of the head.

**Juvenal Plumage**

Bent (1926: 54-55) has written thus of the juvenal plumage: "rich chestnut hues are wholly lacking; the head, neck and under parts are dull grayish brown; but the plumage of the upper parts, back, wings, and tail is a rich, glossy metallic green."

To this it may be added that the head, including the throat, is finely but rather densely flecked with white and that there is a very faint cast of dull purplish or lavender in the under parts in some angles of light, appearing dull greenish in others. The neck is unstreaked. One of the young White-faced Ibis in juvenal plumage observed at Willow Island had narrow white bands on the throat—a character sometimes found in Glossy Ibis at the juvenal stage.

During this step in development, the young ibis still retain the three bands on the bill, which is very short when the juvenal plumage is completed, only about three-
fifths as long as it will eventually become. The bands are said not to disappear until September (Bent, 1926: 54).
I do not know when the bill reaches full length.

First Winter Plumage

The last feathers of the juvenal plumage to come in are those on the face and upper throat, if we except the feathers that eventually must cover the bare spot on the crown. The neck at this time is almost solid dull brown both dorsally and ventrally. Later a postjuvenal molt occurs—Bent says in September—producing a definitely streaked neck. This molt is only partial; Bent implies that the feathers on the rest of the body are not involved. Therefore, the first winter plumage may be little more than the juvenal plumage plus a streaked head and neck.

On the other hand, the Handbook of British Birds states that in falcinellus the juvenal body plumage, "but apparently not wings and tail, is molted Aug.-Sept."

Do falcinellus and chihi differ in the extent of the postjuvenal molt? I doubt that. Then which authority is correct? I have no certain specimens of chihi for the months of June to October inclusive and therefore can only guess, but I am inclined to believe that the plumage on the back and under parts is molted. I base this surmise on the fact the dorsal feathers of our May specimen in juvenal plumage show no purplish reflections whatever, whereas in all
20 winter *chihi* examined by me such reflections are detectable to some degree. I consider it highly unlikely that this moderately large winter series includes no first-year birds at all. Therefore it appears that White-faced Ibis in the first winter do have traces of purplish iridescence on the back that the juvenal plumage lacks—a character seemingly attainable only by postjuvenal molt.

Two *falcinellus* taken at Grand Isle, La., on July 23, 1944, are in what I take to be first winter plumage. Compared with specimens of *chihi* also presumptively in first winter plumage, these birds have more deeply green, less bronzy tones on the back, overlaid with a definitely blackish cast lacking in *chihi*. If all Glossy Ibis and White-faced Ibis in winter plumage were like the examples taken in Louisiana, it would be a fairly easy matter to distinguish between specimens of the two forms in the hand. However, an ibis taken at Lonoke, Arkansas, on September 21 and still retaining the juvenal condition on the throat is intermediate in the color of the back. Thus not all *Plegadis* are readily identifiable even when collected.

I have been unable to distinguish first-year birds undergoing the first prenuptial molt from older birds in the course of later prenuptial molts. So I shall pass directly to the breeding plumage.
Nuptial Plumage

At the height of the breeding season, the adult White-faced Ibis presents a striking picture. The top of the head and the hind neck are glossed with metallic Magenta,¹ and rich iridescent purples, violets, and greens mingle on the rest of the upper parts. The remiges are mainly metallic green and bronze, but the wing coverts show purplish tones, most prominently at the bend of the wing. Most of the under parts are chestnut brown of a shade very close to Bay.

The lores and the skin about the base of the bill are bare and very near Amaranth Purple in tone. The legs are of the same color; the bill is blackish gray; and the iris is blood red. In fact, the eyes of all the fully-grown White-faced Ibis I collected, with one exception, were very definitely red. The aberrant bird had the iris reddish brown. The normal color of the eye is worthy of emphasis, because the iris of *falcinellus* has been described as dark brown.

The most critical feature of the breeding plumage is the white facial patch separating the bare purple skin from the dark feathers of the rest of the head. In all *chihi* where this patch is present, it is feathered and extends

¹Capitalized color names used in this paper are those standardized by Ridgway (1912).
completely around the back of the eye--two points that distinguish it from the bare white facial rim sometimes found in *falcinellus*. The white area is, however, extremely variable in extent. In most breeding adults it is quite prominent on the forehead, being usually about 8 mm. in width, while the part that extends around the eye and continues along the lower border of the bare lores is 3 to 4 mm. in width. Typically the chin is less purely white and provides a seeming break in the complete encirclement of the face. A female in the Louisiana State University Museum of Zoology shows the patch in its extreme development. White feathers streak back from the forehead over the dark plumage behind, invading the darker area to a distance more than 15 mm. from the fore border of the patch. At some points along the side of the face, the white extends back solidly for 12 mm. or more. The chin is pure white, as is the median portion of the throat to a point 30 mm. posterior to the base of the bill. At the other extreme, a bird feeding young on Willow Island appeared through seven-power binoculars at a distance of 200 feet to lack the facial patch entirely. Closer scrutiny through a 60-power spotting scope revealed that the bird did have a narrow white facial border but one flecked with small dark markings. This experience explains how Holt using six-power binoculars (see p. 3) could have mistaken some White-faced Ibis for Glossy Ibis in the Burn.
It does not explain how he could err with regard to them all. He did not state, however, how close he came to the birds.

The Glossy Ibis in breeding plumage has the feathering of the face largely blackish. The dark area is more extensive than the white area of chihi. It extends over the cheeks, chin, and upper throat and up over the forehead onto the anterior part of the crown. The anterior limits of the facial feathering are sometimes outlined by a border of bare white skin in Florida birds. The back of breeding falcinellus is somewhat darker than in chihi, and the flight feathers are more purely green, with less golden bronze.

Adult Winter Plumage

According to Bent (1926: 55) a complete postnuptial molt apparently occurs in July and August, producing a plumage in which the head and neck are "streaked with brown and dull white, as in the first winter; but the upper parts are glossed with purple, green, and bronze reflections, but little duller than in spring, and the under parts are a rich chestnut brown."

If this description were correct, it would be easy to distinguish the birds of the year in the first winter plumage, which lack the rich chestnut brown, from winter adults, which are suppose to have it. Unfortunately, Bent is almost certainly mistaken. I have examined 14 White-faced Ibis
collected from November 10 to February 28 inclusive. None of them have chestnut brown under parts, though some of them at least are surely adults. This fact is unquestionably established in the case of one of the November 10 birds, which still retains five chestnut brown breast feathers from its nuptial dress. The under parts of this bird are mostly Deep Slaty Brown with a vinaceous overcast and with some dull, dark metallic green reflections on the breast. Other winter specimens are similarly dull beneath, some being darker, some lighter.

I should perhaps explain that the breast feathers of the nuptial plumage are dull grayish toward their bases, but in the exposed portion they are wholly chestnut brown, so that in normal position they create unbroken expanses of the latter color. The five breast feathers of the November 10 specimen discussed above are feathers of that character, and their worn condition further marks them as remants of the breeding plumage. In a few of my winter specimens there are scattered dabs of chestnut brown of a different sort. These are produced by markings on the median anterior portion of the feather which occupy only part of the exposed area. Since the feathers involved are new, it is apparent that small amounts of chestnut brown occasionally occur as a true part of the winter plumage.

In spite of these details, I am not yet entirely certain how to distinguish between winter adults and birds of
the year. The brown of the under parts may be lighter in young birds, for there is a great range in variation in this respect in the Museum's series. However, nearly all my winter specimens taken in 1956-57 are darker below than the darkest of the other birds of the series, which were collected more than a dozen years ago. I therefore suspect that the problem is complicated by postmortem fading. In many known adults in winter plumage, there is a patch of purplish chestnut at the bend of the wing, a feature that young birds seem to lack. When a larger series is available for study, it may turn out that this character is a reliable means of separating the two age classes. Since the adult winter plumage is so similar to the first winter plumage, it follows that adult falcinellus and chihi are as difficult to distinguish in winter as immatures of the two forms. In fact, they may be even more so.

**Preenuptial Molt**

I observed the first birds in breeding plumage on March 12 and collected one bird out of a flock of 200 ibis. The flock was feeding in an area which was overgrown with coffee bean (Daubentonia drummondii) and therefore the birds could not be observed except when they flew. I saw only one other brilliantly plumaged ibis plainly in this flock. Although I had only a passing glimpse of them, the other ibis appeared to be in winter plumage. After this date, I began to see
ibis in various intermediate stages of molt between the old winter and the new nuptial plumage.

The bird collected on March 12 was a female containing an ovum 8 mm. in diameter. Her body plumage had changed to nuptial dress everywhere except on the abdomen. But the facial patch was still only a thin white line along the lores and the dorsal side of the base of the bill, and this indistinct line was broken with specks of blackish. Seen through binoculars in feeding posture, this female would have appeared to be a bird at the height of its breeding plumage without a white face. Consequently the field observer cannot safely assume that every brilliantly colored ibis lacking a perceptible white face patch is a Glossy Ibis. I believe that typically the white feathers of the face are among the last to molt in completely.

From March 12 until the last of May, I continued to observe ibis in various intermediate stages of plumage—many of them not as far advanced in molt as the March 12 specimen. Along with the birds partially or wholly in nuptial dress, others continued to be seen in the streaked-necked, greenish-backed, dull-breasted winter or immature plumage. The data show that such individuals, which of course entirely lack the white face, can be found in any month of the year. In March they predominated among the birds scrutinized in the field, and in that month I collected six specimens
in this plumage. In April all the White-faced Ibis had disappeared from their winter haunts along the cheniers, and my time was mainly occupied in the Willow Island breeding colony, which was populated by birds in nuptial dress. During that month, I noted no dull-plumaged ibis, but the Museum has a brown-breasted, streaked-necked specimen taken on April 2, 1942, at Little Chenier. On May 13, 1957, I discovered an individual in the dull plumage in a flock of 63 White-faced Ibis feeding in a flooded rice field just west of Lacassine Bayou. By the end of May, birds of the year in juvenal plumage are already able to fly, though they probably do not leave the rookeries and are still recognizable as juvenals because of their short bills. On June 18 at Chenier Perdue, I observed one of the drab-colored birds with a bill of normal length in a flock of eight ibis. On this day I collected from a third flock a male partly in breeding plumage with considerable streaking on the upper part of the neck. The specimen was destroyed before I had established whether the bird was molting into or out of the nuptial feathering. By July, the birds hatched in early May are widely distributed outside the breeding colonies, and they continue to wear the drab juvenal or first winter plumage until the following spring. It is true that in April and May streaked-necked, brownish-breasted ibis seem far outnumbered by birds that are
assuming, or have assumed, more brilliant colors. But these drab individuals have disproportionate importance from the distributional point of view, because the nonbreeders, not being tied down to the nesting habitat, are the very birds most likely to wander far out of range. All the records of *Plegadis* for North Louisiana, Arkansas, and Alabama appear to be based on birds in this puzzling plumage.

**Sexual Dimorphism**

I found no plumage character that would help in distinguishing the sexes of the White-faced Ibis. However, the species seems to exhibit marked sexual dimorphism in size. One adult male in breeding condition weighed 606 grams, while two females in nuptial plumage weighed only 455.4 and 464.5 grams respectively. Bill length in millimeters for 11 males and 25 females was as follows: males, 130.0 to 144.1 (average 138.9); females, 100.7 to 122.7 (average 106.5).

Two specimens in the collection at the Louisiana State University Museum of Zoology were omitted from this series. Both were alleged males, one with a bill length of 103.4 mm. and the other with a bill length of 109.7 mm. These measurements are so far out of line with the others that I suspect the birds were either mis-sexed or mislabeled. Both were sexed in the field, and neither is accompanied by any data on the state of the gonads. In the case of the remaining
specimens—most of them dissected by me under ideal laboratory conditions—there is a distinct gap between the bill length of males and females.

The size differences—of which the length of the bill is only one expression—were very evident between the members of mated pairs in the field. These differences formed the basis for the sex identifications arrived at in connection with the life-history notes.

The low ratio of male specimens to female specimens seems characteristic of all collections. During the breeding season the disproportion can be explained by the probability that the male is incubating during the time of day when most of the collecting is being done at the feeding grounds. But the Louisiana State University series is made up mostly of winter-taken specimens.
SUMMARY AND CONCLUSIONS

Two dark ibises occur in the United States. They are the Glossy Ibis, *Plegadis falcinellus*, and the very similar White-faced Ibis, *Plegadis chihi*. The true relationship of these two forms is obscured by our imperfect knowledge of their distribution, intraspecific variation, and habits. The present paper has sought to provide additional data regarding these matters.

The study is based in the main on a direct field investigation of the large populations of White-faced Ibis in Cameron Parish, Louisiana—an area where the Glossy Ibis is alleged to have once bred but apparently does not do so now. Field work extended from November 10, 1956, to July 2, 1957. It included trips through ibis habitat, the collecting of a series of specimens, and intensive observations from a blind in a breeding colony. The field investigations were supplemented in the laboratory by analyses of stomach contents and the critical comparison of specimens. Important data were destroyed in the hurricane of June 27, 1957, which interrupted the study.

During the fall and winter, White-faced Ibis travel most commonly in groups of three to 50 birds, feeding in marshland and inundated pastures and sometimes assembling.
there in concentrations of more than 1000 birds. They sub-
sist mainly on an animal diet consisting of crayfish and
various forms of insect life and, in quest of this prey,
are frequently harried by marauding bands of Boat-tailed
Grackles, *Cassidix mexicanus*. When the water rises much
above eight inches in depth, they seek other feeding grounds,
probably moving inland toward the rice fields.

Louisiana colonies are in flooded patches of reed
(*Phragmites communis*) or bulrush (*Scirpus californicus*) at
isolated locations. There, in a shallow saucer-shaped nest
of the same material, placed low above the water, the female
lays three to four greenish blue eggs. The nest marks one
end of a territory that extends for a length of as much as
15 feet and is vigorously defended against trespass by other
White-faced Ibis. Though the species is single-brooded,
there are two nesting cycles, one beginning in April, the
other in late May or early June. Birds of the second cycle
take over old nests, with both members of the pair particip-
ating in the choice of a site and the renovation of the
nest.

Incubation begins soon after the laying of the first
egg and is carried on by both parents. In approximately
22 days, the first downy black chick hatches. The young
of the completed brood differ strikingly in size, enough
to suggest that they do not hatch on the same day, as has
been assumed, or even on alternate days. Fed by both
parents, the nestlings fledge in four weeks but continue to receive parental care outside the nest for at least another week.

The present data regarding the breeding cycle of *Plegadis chihi* in Louisiana differ from the findings of ornithologists studying *Plegadis falcinellus* in Florida in numerous details: the type of nesting site, the manner of nest relief, the timing of incubation and hatching, and the external appearance of the young. However, it appears possible, even likely, that these points represent individual variations rather than true species differences. Although the life histories of both forms are in need of further study, their breeding biology seems very similar.

The most important conclusions developed in the present report are perhaps those concerned with plumage change. It is revealed that published descriptions of plumage and molt in White-faced Ibis contain serious errors. Immatures in their first winter, with their streaked heads and necks and their dull grayish brown under parts, are practically indistinguishable from young *falcinellus* in the field and are often difficult to identify even in the hand. The adult winter plumage is so similar to the first winter plumage that the two species can never be satisfactorily distinguished in life except in the breeding season. Even then the problem is complicated by the occurrence of some streaked-
necked, drab-breasted *chihi* in every month of the year.

The very fact that *Plegadis falcinellus* and *Plegadis chihi* are so nearly identical during most of the year gives the characters of the breeding birds—*the different facial coloration and the probable differences in the color of the soft parts*—*added taxonomic significance*. Since these features are assumed only during the breeding season, they are probably intimately concerned with nuptial behavior and may be reproductive isolating mechanisms that would serve to keep the two kinds of ibis apart should they meet in the same breeding range. Therefore, I feel that in the present state of our knowledge, *falcinellus* and *chihi* should be maintained as separate species despite their similarities.

Measurements of carefully-sexed birds indicate marked sexual dimorphism in size in the White-faced Ibis—a situation hitherto obscured by the seemingly erroneous labeling or sexing of some specimens.
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BIOGRAPHY

Horace William Belknap was born on January 5, 1931, in Nampa, Idaho. He attended grammar school and high school at Nampa and continued his education at the College of Idaho, graduating in 1953 with the degree of Bachelor of Arts. He was married to Barbara June Melton shortly after graduation and worked for the Idaho Fish and Game Department until August 1953, when he was inducted into the army. Two years later he was released from the service and enrolled in the Graduate School of Louisiana State University in September 1955. He has attended two regular sessions and one summer term and is a candidate for the degree of Master of Science in August 1957.
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