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DISTRIBUTION, MIGRATION AND MORTALITY OF THE WHITE-FACED IBIS (*PLEGADIS CHIHI*) IN NORTH AMERICA

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The White-faced Ibis (*Plegadis chihi*) is a most interesting inhabitant of many marshes in western North America, breeding in isolated colonies from east-central Oregon to Kansas and southward. Recovery reports of 112 White-faced Ibises (all but one of which were banded in Utah) have been analyzed to add to an understanding of this species' movements and population dynamics, which have largely been unreported (*cf.* Palmer, 1962). The past and present distributions are plotted from data in the literature and reports received from various cooperators.

The taxonomy of the White-faced Ibis is debatable. The A.O.U. Check-List (5th Ed., 1957) considers it a full species, *P. chihi* (Vieillot), whereas Palmer (1962) lists it merely as a subspecies of the Glossy Ibis, *P. falcinellus* (Linnaeus). Vaurie (1965) says, "The systematic relationship of the two birds requires further consideration but the fact that they interbreed in the London zoo, which is cited as evidence of their conspecificity, is not conclusive." In 1886, *P. chihi* nested in a colony of *P. falcinellus* near Lake Washington, Florida (Brewster, 1886). However, recent records of the White-faced form in Florida are considered to be those of rare and non-breeding birds (Sprunt, 1954; Stevenson, 1963). A mixed colony of both forms was found in Louisiana in 1964 by S. A. Gauthreaux, Jr., and others (Stewart, 1964). The isolating mechanisms separating the two forms in this mixed colony are being studied by J. J. Morony, Jr.

PAST AND PRESENT DISTRIBUTION

Historically, the White-faced Ibis has generally had a more extensive range than the Glossy Ibis in the New World. The White-faced Ibis is usually listed as breeding in two discontinuous areas, western North America and the southern half of South America (Cooke, 1913; Palmer, 1962). This disjunct breeding range closely resembles that of the Cinnamon Teal (*Anas cyanoptera*), a common nesting associate of the White-faced Ibis in the Rocky Mountain and Great Basin areas with which I am most familiar.

Within the general breeding range, the specific nesting locations vary considerably from year to year, with certain sites being used

TABLE 1. ESTIMATED BREEDING POPULATIONS OF WHITE-FACED IBIS IN THE UNITED STATES

Place	Past history (Authority)	Status in 1965 Est. breeding pairs (Authority)
California		
Escondido, San Diego Co.	In 1901 (Grinnell & Miller, 1944)	None (Gallup)
San Jacinto L., Riverside Co.	Last nested 1917 (Grinnell & Miller, 1944); 200 nests 1911 (Willett & Jay, 1911) "Breeding" (Grinnell & Miller, 1944)	None (Gallup)
Los Banos, Merced Co.	Bent (1926) listed breeding	None (Kozlik)
Clear Lake	4 nests 1959 (O'Neill)	None (O'Neill)
Tule Lake NWR	15 prs 1963 (Gallup)	10 (O'Neill)
Honey Lake	First nested 1954, 5 prs (Prather); 28 nests 1956; none since 1961	None (Weld)
Salton Sea NWR		None (Prather)
Colorado		
San Luis Valley	60 prs 1946; 20 prs 1949-50 (this study)	10 (this study)
Florida		
Lake Washington	1 nest 1886 (Brewster, 1886)	?
Idaho		
Minidoka NWR	25 nests 1963 (Napier)	20 (Napier)
Deer Flat NWR	"Common summer resident" (F&WS, 1961)	None (Papike)
Kansas		
Cheyenne Bottoms	First nested 1951 (Mossman, 1952); 18 nests 1962 (Schwilling)	12 (Parmelee)
Louisiana		
Plaquemines Parish	50 prs 1959	438 (Sprunt, 1965)
Lafourche & Jefferson Par.	None in 1959	455 (Sprunt, 1965)
Lacassine Refuge Area, Cameron Parish	185 in 1959	700 (Sprunt, 1965)
"The Burr," Cameron Par.	None in 1959	500 (Sprunt, 1965)
Sabine Refuge Area	400 in 1959, thousands in early '60s (Valentine)	950 (Sprunt, 1965)
Minnesota		
Heron Lake	At least 2 prs 1895 and 1896 (Peabody, 1896)	None

TABLE I. ESTIMATED BREEDING POPULATIONS OF WHITE-FACED IBIS IN THE UNITED STATES, continued

Place	Past history (Authority)	Status in 1965 Est. breeding pairs (Authority)
Nebraska Inland, Clay Co.	At least 1 nest 1916 (Swenk, 1917)	None
Nevada Stillwater Area Ruby Lake Area	Apparently nesting in Pershing Co. 1860's Abundant at Franklin L. 1867 (Ridgway, 1877)	500 (Worden) 60 (Lewis)
Oregon Malheur NWR	100 prs 1918 (Willett, 1919); doubtful if 25 nests any year since 1954 (Duebbert)	5 (Duebbert)
Texas (7 colonies listed by R. P. Allen in 1930's not active in 1965)	None in 1959	900 (Sprunt, 1965)
Weller Co.	Not counted in 1959	350 (Sprunt, 1865)
Matagorda Co.	300 in 1959 (Sprunt, 1965)	None (Sprunt, 1965)
Chambers Co.	75 in 1959 (Sprunt, 1965)	None (Sprunt, 1965)
Galveston Co.	75 in 1959 (Sprunt, 1965)	None (Sprunt, 1965)
Brazoria Co.	15 in 1959 (Sprunt, 1965)	None (Sprunt, 1965)
Cameron Co.		None (Sprunt, 1965)
Utah Bear River Marshes	600 prs 1914 (Antwonet & Treganza, 1914); 1500 prs 1944 (Lockerie, 1944)	660 (Reffalt)
Bear River Duck Club	5000 prs in 1928 (Woodbury, ms.)	
Ogden Bay-Howard Slough	5000 prs 1957 (Ryder, 1959)	
Farmington Bay Area	100 prs 1914 (Antwonet & Treganza, 1914)	4000 (this study and Nelson)
Fish Springs NWR	First nested 1964	25 (Dietz) 6 (LeFever)
Wyoming Hutton Lake NWR	Nest attempt in 1964 (Littlefield)	None (Marlatt)

Estimated breeding pairs in the United States in 1965—about 10,000

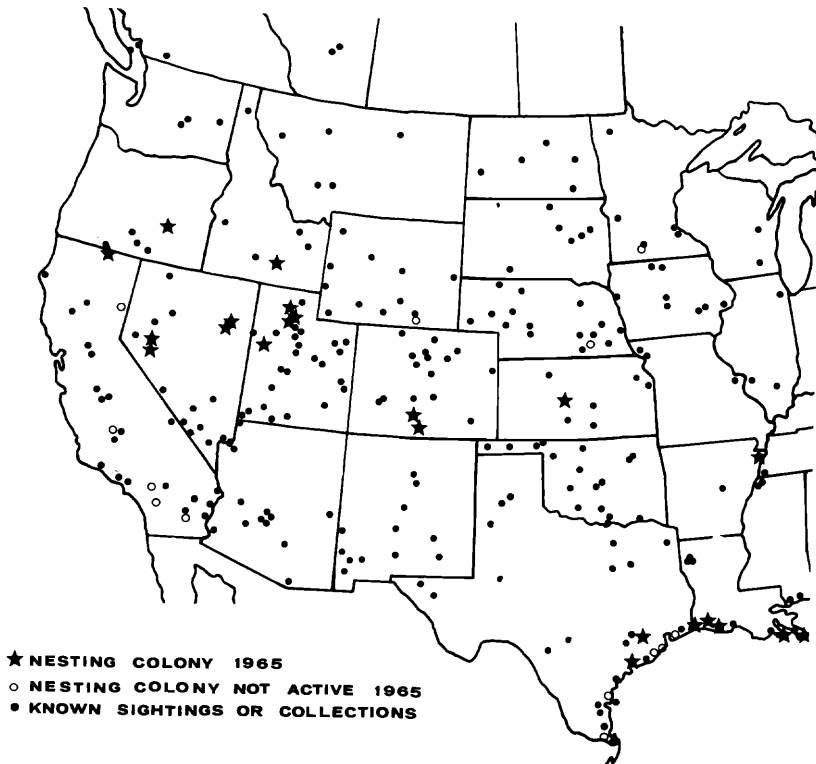
repeatedly (marsh conditions permitting), while other outlying areas are occupied only intermittently. California was apparently much more important as a breeding area in the early days of settlement (*cf.* Grinnell and Miller, 1944), but because of disturbance by humans and loss of wetlands due to agriculture, White-faced Ibises have not nested in the Central Valley since 1954 or 1955 (W. Anderson, pers. comm.). They reared young successfully on the Salton Sea National Wildlife Refuge in 1956, 1960, and probably in 1961. However, since 1961 no nesting has occurred there, apparently because suitable habitat is lacking (R. H. Prather, pers. comm.). Tule Lake National Wildlife Refuge and the state-owned Honey Lake Waterfowl Management Area in northern California seem to be the only places where ibises have nested in the state since 1962 (see Table 1).

In Oregon, the only definitely known nesting area is on the Malheur National Wildlife Refuge, where ibises were first reported nesting in 1912, when L. A. Lewis observed 200 adults and found several nests. They may have nested earlier, but there are few records of birds in general for this area prior to 1908. The Malheur ibis population has fluctuated through the years, with lows of 20 adults estimated in 1946 and 1965 (H. F. Duebbert, pers. comm.). A. B. Claggett (pers. comm.) has circumstantial evidence that a pair of ibises nested at Summer Lake about 100 miles southwest of Malheur in 1963.

Nevada and Utah are apparently the main nesting areas in the Great Basin, although there are isolated colonies at Malheur, mentioned above, and Minidoka National Wildlife Refuge in Idaho. As early as the 1860's, the Carson Sink area in west-central Nevada and the Ruby Lake area in east-central Nevada were reported as ibis nesting areas (Ridgway, 1877). However, these areas, too, are only intermittently occupied, depending on water conditions. For example, ibis nested in only 7 of the 17 years (1949 to 1965) for which fairly detailed data are available for the Stillwater Wildlife Management Area near Fallon, Nevada. Due to severe drought in 1960-62 and subsequent deteriorated marsh conditions, ibises failed to nest from 1960 until 1965 (P. A. Schwabenland, pers. comm.). The small colony at Ruby Lakes, approximately 150 miles to the northeast, nested successfully during those years as well as earlier (D. E. Lewis, pers. comm.).

The Bear River Marshes and nearby areas in northern Utah have long been noted as important nesting grounds for various waterbirds. Ridgway (1877) reported a few White-faced Ibises around Great Salt Lake in May and June, 1869, and considered the species an abundant breeder. Allen (1872) reported the "Glossy Ibis" as common in the Ogden Area, but he was assured by local people that it had only "recently" (a few years prior to 1872) become so. In 1956 and 1957 I found ibises most abundant in the Ogden Bay-Howard Slough Areas which are owned and managed by the Utah Fish and Game Department. In 1957, I estimated at least 5,000 pairs were nesting there in three separate colonies. Since that time, J. E. Nagel (pers. comm.) believes that ibis numbers

Figure 1. Known locations of breeding colonies, sightings or collections of *Plegadis* sp. west of the 89th meridian, based upon published records and reports from numerous observers listed in the acknowledgments.



in Utah have declined, especially in Box Elder County, although N. F. Nelson (pers. comm.), Superintendent of the Ogden Bay Waterfowl Management area, believes there are still about as many nesting ibises in the Ogden Bay-Howard Slough colonies in 1965 as there were in 1957. Data from Bear River National Wildlife Refuge for 1946-1965 (W. Reffalt, pers. comm.) indicate a decline in the total fall population of ibises from 1953 to 1959 but a marked increase from 1960 to 1964. Estimated breeding populations there have been fairly constant from 1946 through 1965, except for a pronounced increase in numbers in 1959 to 1961. Lesser numbers of ibises nest on the Farmington Bay and Fish Springs refuges south of the main concentrations in the Ogden Bay-Bear River Bay areas (Fig. 1 and Table 1.).

The Utah colonies shift specific locations in a given marsh in response to drought, water diversions and grazing. For example, Knudson's Marsh, 5 miles southwest of Brigham, had a thriving colony in 1952, when Warren M. Petersen banded 800 young ibis. However, by 1955 ibises no longer nested there because of habitat

deterioration (Weller, Wingfield and Low, 1958). Nevertheless, collectively the larger colonies in the Bear River, Ogden Bay and Howard's Slough marshes are probably the most persistent and reliable producers of any colonies of White-faced Ibises in North America.

White-faced Ibises have probably nested on what is now the Minidoka National Wildlife Refuge since about 1914 (Arvey, 1947), and it is suspected that there is at least one other nesting colony in Idaho (E. G. Bizeau, pers. comm). Ibises were first reported in the San Luis Valley of Colorado in 1875 (Sclater, 1912). Bailey and Brandenburg (1941) reported 60 pairs nesting at Trites Lake south of Saguache, a colony which I have followed since 1949. Ibises also nest in a small colony some 40 miles to the south, near Alamosa. Both of these colonies are over 7,500 feet in elevation, probably the highest nesting sites for this species north of Mexico. White-faced Ibises frequented the Hutton Lake National Wildlife Refuge near Laramie, Wyoming, during the summer of 1964, and at least one nest was established but was unsuccessful (C. D. Littlefield, pers. comm.). Ibises were seen in the same area in 1965 but left before the nesting season (L. B. Marlatt, pers. comm.).

Outside of the Great Basin and Rocky Mountain regions, the main breeding concentrations of White-faced Ibises have been and still remain in the coastal marshes of Texas and Louisiana. Bent (1924) tells of one colony in Refugio County, Texas, that contained over 2,000 pairs in 1923. However, the Texas colonies particularly have fluctuated greatly, at least in the past 30 years. Seven colonies listed by R. P. Allen in the 1930's no longer existed in 1965. Four colonies counted in 1959 were inactive in 1965, whereas two new colonies were noted (Sprunt, 1965). The nesting situation in Louisiana seems similar to Texas, with several large colonies that shift about depending on marsh conditions (see Table 1).

In Kansas, the White-faced Ibis was first reported nesting at the Cheyenne Bottoms in Barton County in 1951 (Mossman, 1952). They nested there again in 1962 (Zunanich, 1963), not in 1963 (M. D. Schwilling, pers. comm.), but did again in 1965 (D. F. Parmelee, pers. comm.). Elsewhere in the Great Plains, isolated nesting attempts of one or two pairs have occurred in Nebraska in 1916 (Swenk, 1917) and in Minnesota in 1894 and 1895 (Peabody, 1896). In 1965, the successful nesting of the Glossy Ibis was reported for northeastern Arkansas (Stewart, 1965).

The White-faced Ibis is known to nest in Mexico, but I am still seeking information on its present status there.

BANDING

More than 2,800 White-faced Ibis have been banded in North America, primarily in Utah (Table 2), but with lesser numbers in California, Oregon, Kansas and Colorado (Table 3). With few exceptions, mainly botulism victims in Utah, the ibises were banded as large nestlings nearly capable of flight. In 1965, J. J. Morony, Jr., banded 60 nestlings in the mixed colony of White-faced and

TABLE 2. PLACES AND DATES OF BANDING WHITE-FACED IBIS
IN UTAH, 1916-1957

Year	Place of Banding	Bander	Number Banded	Number Recovered	Percent
1916	Bear River Marshes	A. Wetmore	104	1	0.95
1933	"Utah"	?	16	0	—
1934	"Utah"	?	3	0	—
1937	"Utah"	?	4	0	—
1938	Bear River NWR	Refuge Personnel	2*	0	—
1939	" " "	" "	1*	0	—
1939	Farmington Bay	A. Woodbury	13	1	7.70
1940	Bear River NWR	Refuge Personnel	1*	0	—
1941	" " "	" "	3*	0	—
1947	" " "	" "	3	0	—
1948	" " "	" "	27	1	3.70
1951	Brigham City Area	W. Petersen	742	31	4.18
1952	" " "	" "	800	24	2.88
1952	Bear River NWR	Refuge Personnel	1	0	—
1953	Brigham City Area	W. Petersen	24	1	4.17
1954	" " "	" "	16	0	—
1956	" " "	" "	713	41	5.90
1956	Ogden Bay Refuge	R. Ryder	100	7	7.00
1957	" " "	" "	135	4	2.96
(16 years)			2708	111	4.13

*Probably botulism victims. May have been adults. All others nestlings.

Glossy Ibises in Plaquemines Parish, Louisiana. He was unable to identify to species most of those banded and, as of January 1966, no recoveries have been reported.

THE NESTING SEASON IN UTAH

White-faced Ibises generally arrive in the Bear River-Ogden Bay marshes early in April. They feed in nearby flooded alfalfa and small-grain fields, as well as around lakes and ponds, but roost in the marshes each evening. Most are nesting by mid-May, although there is some variation year to year and colony to colony. For example, in 1956 the ibises in one colony at Ogden Bay Refuge were laying eggs on May 7, whereas few ibises in the same colony in 1957 had laid by May 31. By June 24, 1957, most ibises in this colony had hatched and were about two-thirds grown. On that date a larger colony about a mile away had fresh eggs and various aged young, including some fully fledged. In Knudson's Marsh near Brigham, Utah, Petersen found young ibises were large enough to band as early as May 26 in 1952.

TABLE 3. SUMMARY OF BANDINGS OF WHITE-FACED IBIS IN THE
WESTERN UNITED STATES

Place of Banding	Number Banded	Number Recovered	Percent Recovered
Utah	2708	111	4.1
California	96	1	1.0
Oregon	17	0	0
Kansas	21	0	0
Colorado	6	0	0
Western U. S.* (states unknown)	26	0	0
Totals	2874	112	3.9

*Bandings prior to 1932, mainly of small numbers from which no recoveries have been reported.

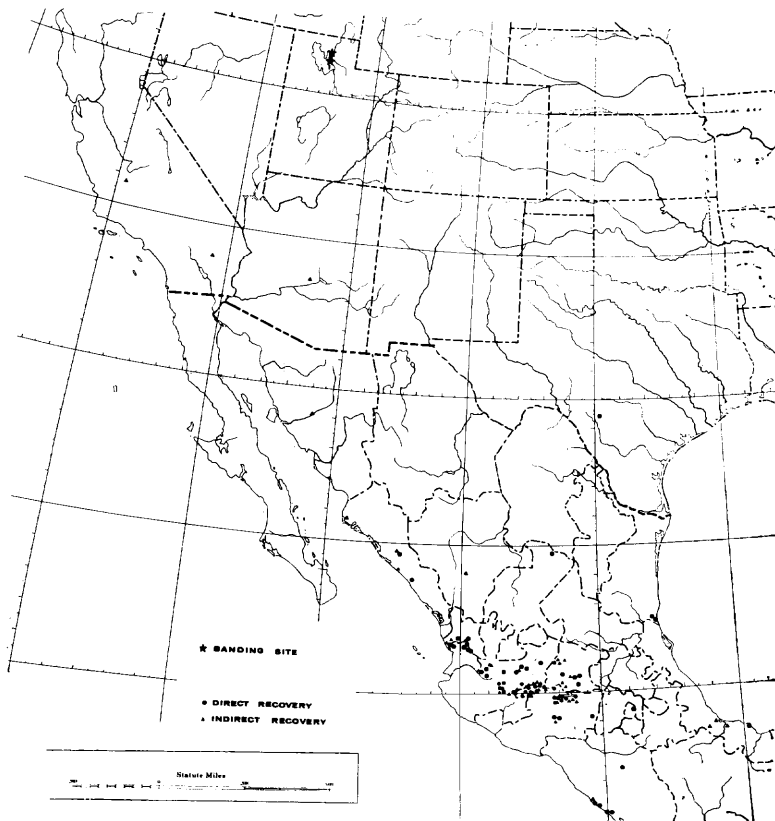
Most nests I have observed have been in cattail (*Typha latifolia*), hardstem bulrush (*Scirpus acutus*), or alkali bulrush (*Scirpus paludosus*) and generally were located in mixed colonies of, or near colonies of, Great Blue Herons (*Ardea herodias*), Black-crowned Night Herons (*Nycticorax nycticorax*) and Snowy Egrets (*Leucophoyx thula*). The ibises generally nested later than the two herons but somewhat earlier than most of the egrets. American Coots (*Fulica americana*), Franklin's Gulls (*Larus pipixcan*), Redheads (*Aythya americana*) and Ruddy Ducks (*Oxyura jamaicensis*) also nested within one large colony in alkali bulrush.

Following nesting, the ibises feed in larger marshes as well as in irrigated fields and wander rather widely in the Great Salt Lake Valley, usually roosting nightly in dense marshes. In the 1940's as many as 1,500 to 2,000 ibises roosted each evening in late summer in the Decker's Lake area near Salt Lake City prior to migration (Lockerbie, 1943). Peak populations of adults and young-of-the-year are noted at Bear River Refuge usually early in August, but in the unusually early nesting season of 1952 peak numbers were recorded July 3. An estimated 10,500 ibises were recorded at Bear River September 16, 1964 (W. Reffalt, pers. comm.).

THE FALL MIGRATION

From band recoveries (largely from Mexico) and from field observations reported in places between Utah and Mexico, it appears most ibises leave the Utah marshes in late September and early October, although occasionally a few linger as late as November and, rarely, even into December (Cottam, Williams and Sooter, 1942). Flocks of as many as 300 birds have been observed feeding in fields south of Salt Lake City in mid-September (Behle, 1938). From the Salt Lake Valley most ibises seem to travel south-southwestward, stopping in the Clear Lake-Fillmore-Delta area in Sanpete and Sevier Counties, where D. E. Neilson (pers. comm.) reported

Figure 2. Places of recovery of 111 White-faced Ibises banded in Utah as nestlings.



flocks of up to 100 birds feeding in flooded fields. Ibises apparently also stop in the Virgin River Valley of extreme southwestern Utah and northwestern Arizona (R. H. Wauer, pers. comm.), as well as on Lake Meade and near Las Vegas, Nevada (C. G. Hansen and J. L. Schippleck, pers. comm.; Gullion, Pulich and Evenden, 1959). Very likely these fall sightings contain ibises from the Nevada, Oregon and Idaho colonies as well as the Utah colonies. The limited data available suggest that the main southward migration is down the Colorado Valley in western Arizona, as ibises are fairly abundant near Yuma each fall (C. F. Lard, pers. comm.). Appreciable numbers also move southward through the Phoenix-Tucson-Nogales area (S. H. Levy and W. C. Royall, Jr., pers. comm.). Smaller numbers of ibises probably migrate into New Mexico and then down the Rio Grande, as is evidenced by one band recovery near Sabinal, Texas, and numerous sightings in

TABLE 4. PLACES OF RECOVERY OF WHITE-FACED IBISES BANDED
IN UTAH AS NESTLINGS

Places of Recovery	Number of Recoveries	Percent
Arizona	1	0.9
California	2	1.8
Texas	1	0.9
Utah	5	4.5
Mexico (Total recoveries 102, 92.0 percent)		
Durango	1	0.9
Guanajuato	11	9.9
Guerrero	6	5.4
Jalisco	27	24.3
Mexico, D. F.	1	0.9
Michoacan	30	27.0
Nayarit	12	10.8
Queretaro	1	0.9
Sinaloa	6	5.4
Sonora	1	0.9
Tamaulipas	2	1.8
Vera Cruz	3	2.7
Zacatecas	1	0.9
	111	100.0

both New Mexico (W. E. Gueswel, B. K. Harris, and W. S. Huey, pers. comm.) and western Texas (K. P. Baer, pers. comm.). The fall sightings in these states and particularly those on the Pecos River of New Mexico (R. D. Johnson and V. Montgomery, pers. comm.) could well include ibises from the colonies in Colorado. I suspect the fairly regular fall sightings of ibises in Oklahoma (G. M. Sutton, pers. comm.) and in the Panhandle of Texas (M. R. Evans and R. L. Perry, pers. comm.) and near Midland, Texas (F. Williams, pers. comm.) represent fall migrations from the Kansas colony as well as post-breeding dispersal from the Gulf Coast colonies.

PLACES OF RECOVERY OF BANDED IBISES

All but one of the 112 recoveries of White-faced Ibis so far reported have been from Utah bandings. One ibis banded as a nestling near Merced, California, June 26, 1932, was found injured May 23, 1935, at Bear River Refuge, Utah. Most of the 111 recoveries from the Utah bandings were reported in Mexico with comparatively few from places enroute to the main wintering grounds in the states of Jalisco and Michoacan (see Fig. 2 and Table 4). The single ibis banded in Utah and later recovered in Arizona (near Mesa) and the one recovered in Texas (near Sabinal) probably indicate routes

taken southward to Mexico, whereas the two recoveries in California, one near Tulare (Wetmore, 1923) and another near Blythe, may indicate migration routes to wintering areas in California. These California recoveries and the California-banded ibis recovered in Utah are perhaps evidence of interchange between Utah and California breeding colonies.

Five of the Utah-banded ibises were recovered in Utah, three in the year of banding but some 10 to 20 miles from the banding sites. One ibis was found dead near the site of banding but four seasons later, while another was found five years after banding some 10 miles from the banding location. The last two recoveries are the only specific evidence I have of philopatry to nesting sites.

WINTERING GROUNDS

As many as a hundred ibises still winter as far north as the Los Banos area in California (F. M. Kozlik, pers. comm.), and as recently as the 1950's several thousand wintered in the Imperial Valley (W. Anderson, pers. comm.). Rarely, ibises winter in Arizona near Yuma (Monson, 1944) and near Tombstone (Cooke, 1913). However, most White-faced Ibises winter in Mexico (band recoveries) or along the Gulf Coast in Texas and, more abundantly, in Louisiana (see Audubon Society Christmas Bird Counts). For example, Sabine National Wildlife Refuge in southwestern Louisiana consistently winters several thousand White-faced Ibises (a peak of 7,000 in 1964, J. R. Walther, pers. comm.). In contrast, the major refuges in coastal Texas usually winter at most only a few hundred each (M. G. Sheldon and R. H. Shields, pers. comm.).

By far most of the ibises banded in Utah apparently winter in Mexico, primarily in the interior highlands but also in the coastal plains on both coasts. Sixty-nine percent of the Mexican recoveries were in the region which Leopold (1959) refers to as the Bajio and valleys of the volcanic cordillera. This would include the states of Jalisco, Guanajuato, Queretaro, Michoacan, and the Federal District of Mexico. Particularly important were areas around Lakes Chapala and Cuitzeo, and to a lesser extent, Lakes Patzcuaro and Yuriria. These locales have long been significant wintering grounds for waterfowl, although their importance has declined alarmingly in the past few decades because of drainage and other land-use practices (Leopold, 1964; Saunders, 1964).

Twenty-four percent of all ibises recovered in Mexico were reported from the Pacific Coast states of Sonora, Nayarit, Sinaloa and Guerrero; five percent from the Gulf Coast states of Tamaulipas and Vera Cruz; while only two percent were from more northern plateau areas (Durango and Zacatecas). Probably these recovery locations are somewhat biased, as they are mainly from areas of high human population (*cf.* Tamayo, 1962) where it is more likely for ibises to be shot and their band numbers reported. However, these same areas seem to offer similar combinations of marshes and irrigated fields as are found in preferred nesting and feeding areas in the United States.

TABLE 5. CAUSES OF DEATH REPORTED FOR WHITE-FACED IBIS
BANDED IN UTAH

Number of Recoveries	Percent of Recoveries	Reported Cause of Death
92	82.9	Shot
9	8.1	Found dead
3	2.7	No information
2	1.8	Found injured
1	0.9	Caught in trap
1	0.9	Killed by hawk
1	0.9	Botulism
1	0.9	Sick when captured
1	0.9	Band removed (no more information)

111 Total Recoveries

METHODS OF RECOVERY

Most (82.9 percent) of the banded ibises which were reported as recovered were shot, and a fairly high proportion (8.1 percent) were listed merely as "found dead" (Table 5). Many of the latter were probably also victims of shooting. Other causes of death reported included botulism (*cf.* Wetmore, 1918), hawk predation, and accidental trapping. Thousands of ibises were said to have died in Utah of botulism in November 1910 (Woodbury, Cottam and Sugden, 1948). Of four Mexican citizens whom I wrote regarding their recoveries of banded ibises, three replied that ibises were commonly shot and eaten in Jalisco and Guerrero, while the fourth respondent said the bird was not common in his area in Jalisco and was considered inedible. Federal regulations in Mexico protect the ibises, but few hunters are aware of the laws nor are there adequate funds and personnel to enforce them (G. B. Saunders, pers. comm.). Saunders further noted: "The fact that ibises (*cocos* in Spanish) are considered edible is attested by their being on sale in a few of the public markets in rural areas. In the public market at Villa Hermosa, Tabasco, I saw both glossy and white ibises for sale in numbers up to two dozen. I was interested to note that almost all of the beak of each ibis had been broken off. Whether some of the local people consider the bills of these birds to have medicinal properties, I was unable to learn."

In the United States, the ibises are not afforded protection under the Migratory Bird Treaty Act (Bureau of Sport Fisheries and Wildlife, 1965). Arizona, California, Colorado, Texas and Utah protect ibises under "catch-all" regulations which prohibit the taking of species not otherwise specifically mentioned in their laws. New Mexico laws do not protect the ibis (K. P. Baer, pers. comm.). Until 1915, the White-faced Ibis was considered a game bird in California, with an open season from October 15 to March 1

and a daily bag of 20 birds permitted (Grinnell, Bryant, and Storer, 1918). Pearson (1936) reported, "... people of the Malheur country esteem them highly as food, and despite the law they are at times killed and eaten. In the coastal regions of Texas these ibises are met with in various sections and here also they are shot. . ."

In Utah I occasionally observed, and had several reports of, duck hunters shooting at V-formations of ibises. I also heard a few complaints from farmers that ibises, in their feeding, "trampled" irrigated small grains and alfalfa. U. S. Game Management Agents in Utah find that ibises are easily frightened from such fields by gunfire (J. H. Hogue, pers. comm.).

RECOVERY RATES

Only 3.9 percent of all White-faced Ibises banded in North America have so far been recovered (Table 3). For the Utah bandings, the rate varied from no recoveries some years and less than 1 percent of the 1916 bandings to 7 percent or more in some 1956 and 1939 bandings. This suggested increase in recovery rates might indicate that more ibises are being shot, or a higher proportion of the recovered bands are being reported, or a combination of the two explanations. Elsewhere, 90 of 5,018 Glossy Ibises banded in Hungary since 1912 were reported, for a recovery rate of only 2 percent (Warga, 1954). However, the multilingual problem of reporting, as well as loss of records in time of war, probably bias these Hungarian data. Too few Glossy Ibises have been banded in North America to provide a comparison.

At any rate, the 3.9 percent recovery for White-faced Ibises banded in North America is considerably lower than that usually reported for legally hunted ducks (*e.g.*, 14.5 percent for Mallards and 12.8 percent for Redheads) but very close to the 3.8 percent reported for a legal game bird, American Coots banded in Utah (Ryder, 1963). The ibis recovery rate is also generally higher than the 2.9 percent reported for Black-crowned Night Herons, which are frequently shot as fish predators (Hickey, 1952).

MORTALITY RATES

When the recovery data for White-faced Ibises banded in Utah were arranged in a composite life table (Hickey, 1952), a mean annual mortality of 50 percent was computed (Table 6). The mortality rate in the first year of life was 54 percent, whereas thereafter it was 43 percent. In Table 7, these mortality statistics are compared with those computed for Glossy Ibises banded in Hungary. Most of the Hungarian bandings were recovered locally in the same years as when banded. It would appear (Table 7) that White-faced Ibises banded in Utah have a lower first-year mortality rate but a higher rate in later years than is the case with other Ciconiiforms for which data are known. The Utah ibises, however, have lower mortality rates than those reported for the American Coot and the Canvasback, but about the same as those reported for the Mallard in North America.

TABLE 6. AN ABRIDGED LIFE TABLE FOR WHITE-FACED IBIS
BANDED IN UTAH

(Based on nestlings banded from 1916 to 1957. Age intervals are in years and start August 1.)

Age Interval in years	How Recovered (dx) Found dead or dying	Reported Shot	Total Mortality	Alive at start of year (lx)	Mortality rate % per year (qx)
0-1	8	52	60	111	54 ± 1
1-2	4	21	25	51	 43 ± 1
2-3	1	7	8	26	
3-4	2	6	8	18	
4-5	1	3	4	10	
5-6	1	2	3	6	 50 ± 1*
6-7	1	0	1	3	
7-8	0	0	0	2	
8-9	1	1	2	2	
Totals	19	92	111	229	

*Mean for entire sample, plus or minus the standard error of the mean as computed by methods described by Haldane (1955).

The limited data available on the productivity of White-faced Ibises indicate that they normally are well able to withstand the calculated mortality rates. Thus, *if* all ibises breed in their first year and *if* each pair raises an average of 1.9 young to August 1 (the start of the banding year), the mortality rates in Table 6 would permit a stable population. However, it seems likely that ibises may not breed until their second or third year (see White Ibis discussion in Palmer, 1962). Although direct evidence is lacking for Utah, it seems reasonable that ibises there usually fledge at least 2 or more young per nest. At Malheur in 1962, E. Kridler (pers. comm.) found 30 young were fledged from 14 nests; at Honey Lake, California, in 1963, F. Gallup (pers. comm.) found 30 young in 9 nests. The normal clutch in Utah seems to be at least 2.75, probably more. May 26, 1935, Lockerbie counted 994 eggs in 361 nests, but as Woodbury, Cottam and Sugden (1948) pointed out it is likely some clutches were incomplete. Belknap (1957) found an average of 3.06 eggs in 16 nests he followed in Louisiana. Nevertheless, assuming an average clutch of only 2.8 eggs, then losses of 0.5 eggs per nest prior to hatching and 0.4 young per nest after hatching would theoretically be tolerable *if* ibises nest when one year old.

However, as discussed earlier, success of specific ibis colonies (particularly on the periphery of the range) seems to be a matter of "boom or bust." The birds either fail to nest because of drought or nest in wet years with good fledging success of young. The centers of ibis breeding abundance in Utah and on the Gulf Coast may in normal years provide a surplus of birds which periodically try to establish colonies in seasonably favorable sites (for example, Wyoming, and some years ago Minnesota and Nebraska) outside

TABLE 7. COMPARATIVE MEAN ANNUAL MORTALITY RATES OF VARIOUS WATER BIRDS AS CALCULATED FROM BAND-RECOVERY DATA

Species	Av. Ann. Mortality First Year	Rates (%) Subseq. Years	Overall Average	No. of Recoveries Place Banded Authority
White-faced Ibis (<i>Plegadis chihii</i>)	54	43	50	111*, Utah, this study
Glossy Ibis (<i>P. falcinellus</i>)	90	22	69	90*, Hungary, calculated from Warga (1954)
Black-crowned Night Heron (<i>Nycticorax nycticorax</i>)	61	31	44	141*, North America, Hickey (1952)
Great Blue Heron (<i>Ardea herodias</i>)	71	29	—	349*, North America, Owen (1959)
Common Heron (<i>Ardea cinerea</i>)	69	31	—	195*, England, Lack (1949)
American Coot (<i>Fulica americana</i>)	88	60	83	501**, Western North America, Ryder (1963)
Canvasback (<i>Aythya valisineria</i>)	77	52	70	253*, North America, Geis (1959)
Mallard (<i>Anas platyrhynchos</i>)	55-75	38-55	58	?, North America, Keith (1961)

*Banded as nestlings or flightless young.

**Banded as young (most likely still incapable of flight).

the normal breeding range. Apparently these extra-limital nesting attempts sometimes succeed, as in Kansas.

In view of the apparent reproductive potential of the White-faced Ibis in Utah, shooting of wintering birds in Mexico, although illegal, can probably be tolerated by the species. However, a series of adverse nesting seasons or increased decimation on the wintering grounds could upset this population stability.

LONGEVITY

Although a captive White-faced Ibis lived at least 14 years in the San Diego Zoo (Stott, 1948), in the wild the oldest banded bird so far reported has been only slightly over 9 years. However, it would seem likely, from application of Haldane's (1955) method of calculating mortality, that some of the Utah-banded birds will live to 11 years. Warga (1954) reported that one Glossy Ibis banded in Hungary lived to be 10 years old.

EXTRA-LIMITAL WANDERING

Post-breeding dispersal, often northward, seems to be a common occurrence in many herons (*cf.* Palmer, 1962; Olsson, 1958; Rydzewski, 1956), but I have only limited evidence that it regularly

TABLE 8. OBSERVATIONS OF PLEGADIS SP. NORTH OF NESTING AREAS FAIRLY REGULARLY OCCUPIED SINCE 1951

Place	When first seen in relation to nesting season			Remarks
	Before	After	Unspecified	
British Columbia	0	1	2	1902 or earlier
Alberta	2	0	0	1 6/18/41 (W.R. Salt) 1 6/1/64 (Lister, 1964)
Washington	2	1	0	Fall observation 1909
Idaho (northern)	0	0	1	(Cooke, 1913)
Montana	6	3	0	All since 1958
North Dakota	4	1	1	
Minnesota	4	2	0	
Wyoming	21	2	2	Regularly near Casper since 1955
South Dakota	8	2	0	
Nebraska	18	2	0	
Iowa	6	3	0	Only know of observa- tions since 1954
Kansas (northern)	3	0	0	
Missouri	3	1	0	
Colorado (northern)	37	5	0	Mainly from Bailey, 1965
TOTALS	104	28	6	

occurs in the White-faced Ibis. White-faced Ibises do wander widely. They have been observed in a "number of instances" in Hawaii (Munro, 1960) and at least twice in Alberta (Lister, 1964). However, almost four times as many of the sightings and collections north of the regular breeding areas have been *before* the nesting season as *afterward* (Table 8). This would suggest that adults are more likely to wander northward, perhaps in search of suitable nesting habitat, than are immatures and adults to wander northward in search of food after the nesting season. These data may be biased, as observers may well be afield more in the spring than in late summer and fall. Ages of post-breeding wanderers, as summarized in Table 8, were generally not noted by the various observers. Sexes of ibises at all times of the year and ages prior to breeding are not readily discernible in the field.

Seasonal depletion of the food supply in the vicinity of heronries is advanced as the main cause of post-breeding dispersal (often northward) in Common Herons which nest in Scandinavia (Olsson, 1958). Schüz (1931) used the term "Vorzug" to describe post-breeding wandering of immature Glossy Ibises banded in Hungary which were recovered in late summer or fall in Norway, Holland (2 birds) and central Russia. More recent data from these Hun-

TABLE 9. NUMBERS OF FOOD ITEMS FOUND IN 209 WHITE-FACED IBIS STOMACHS COLLECTED IN NORTHERN UTAH, 1951 TO 1953 (PETERSEN, 1953)

Food Item	Period of collection (No. of Stomachs in Parentheses*)			Totals
	May-June (76)	July-Aug (34)	Sept-Oct (99)	
Insects	1632	668	2238	4538
Orthoptera	0	11	11	22
Ephemera	0	17	0	17
Odonata	15	61	407	483
Plecoptera	0	0	1	1
Homoptera	0	1	0	1
Hemiptera	1	22	736	759
Coleoptera	1242	87	749	2078
Trichoptera	0	4	0	4
Lepidoptera	62	9	15	86
Diptera	302	456	319	1077
Hymenoptera	10	0	0	10
Earthworms	1482	406	1152	3040
Leeches	56	97	27	180
Snails	73	27	3	103
Spiders	1	2	13	16
Crayfish	0	0	1	1
Fish (carp)	0	1	0	1
Small mammal bones	0	1	3	4
Weed seeds	0	1	4	4

*Fifty-two of the 209 stomachs were from immature ibises feeding with adults.

garian bandings as compiled by Warga (1954) lead me to believe that, even in Europe, post-breeding dispersal northwards is less common than earlier writings would suggest. In Australia, the Glossy Ibis, the Straw-necked Ibis (*Threskiornis spinicollis*) and the Australian White Ibis (*T. molucca*), adults and young alike, seem more nomadic than the White-faced Ibis in western North America. The wide nomadic movements of the Australian ibises are ultimately controlled by a variable rainfall pattern that produces unpredictable floods and resultant food supplies (Carrick, 1962). In view of the feeding habits of the White-faced Ibis (Table 9) and the apparent abundance of their preferred foods in the Utah and Colorado nesting areas, there probably is little need for ibises in those areas to wander widely. However, more quantitative data on food availability and food preferences throughout the year are needed.

H. F. Duebbert (pers. comm.) does not believe there is any significant movement of ibises to Malheur after the nesting season. Thus it would seem unlikely that there is any post-breeding dispersal to Malheur from Utah or Nevada. In Idaho, data from Deer Flat (via R. V. Papike) and Camas Refuges (via R. C. Twist) indicate that small numbers of ibises wander to those areas after the nesting season, most likely from the Minidoka colony, possibly from Utah.

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SUMMARY

1. The White-faced Glossy Ibis now nests in isolated colonies from east-central Oregon to Kansas and southward at least to the Texas and Louisiana coasts. Centers of nesting abundances seem to be in Utah, Texas and Louisiana.

2. As of 1964, recoveries of 112 White-faced Ibises have been reported from slightly more than 2,800 which were banded primarily in Utah, but with lesser numbers in California, Oregon, Kansas and Colorado.

3. Most ibises leave the Utah marshes in late September and early October and migrate to central Mexico, probably via the lower Colorado River Valley and the west coast of Mexico. Ninety-two percent of the recoveries have been in Mexico, largely in the high central valleys, especially around Lakes Chapala and Cuitzeo.

4. Most banded ibises which were reported as recovered were shot, probably to be eaten as human food.

5. White-faced Ibises in North America apparently have a lower first-year annual mortality than do Glossy Ibises banded in Hungary but a higher annual mortality rate in later years.

6. The limited data available on the productivity of White-faced Ibises indicate that they normally are well able to withstand the calculated mortality rates *if* they first nest at one year of age.

7. White-faced Ibises wander widely and have been reported in Hawaii and Alberta. Extra-limital wandering seems to be more pronounced *before* the nesting season than *afterward* and may result from drought conditions on the normal nesting areas.

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