LONG-DISTANCE MOVEMENTS OF CATTLE EGRETS

By JOAN A. BROWDER

INTRODUCTION

The Cattle Egret, *Bubulcus ibis ibis* (Linnaeus), a recent immigrant to the New World from the African region (Blake, 1961), has apparently established migratory patterns in its new range. As yet, these are poorly known. Long-distance movements in addition to migration might also be taking place.

This report augments recorded observations on the movements of Cattle Egrets in North America, summarizes available information on their movements in Africa, discusses the "wandering" phenomenon widespread in the heron family (Ardeidae), and presents a possible genetic mechanism for the control of long-distance movements. Feeding conditions for Cattle Egrets in the Dry Tortugas, a stopping-over place for these birds en route to and from continental United States, are also described.

MOVEMENTS THROUGH THE DRY TORTUGAS

The Dry Tortugas (24°30'N, 83°W) are a group of small rubble coral islands on the northern edge of the Florida Straits approximately 65 miles west of Key West and 90 miles north of Cuba. The largest of the group, Loggerhead Key, holds a 500-foot lighthouse. The second largest, Garden Key, is almost completely surrounded by a brick fort built prior to the Civil War. Ft. Jefferson is now a national monument.

Cattle Egrets arriving singly or in flocks of up to 60 or more descend on these islands during the year except in December and January (Z. Kirkland, Park Manager, pers. comm.). Often several dozen birds are on the islands at one time, but two seasonal peaks in their occurrence are obvious. The largest peak begins in March and probably represents migrating birds returning to North America from their wintering grounds. (Movement of Cattle Egrets through the Florida Keys and up the Florida peninsula is noticeable at this time [Meyerriecks, 1960].) The next peak period of Cattle Egrets in the Dry Tortugas is in September, diminishing by late November. It likely consists of birds migrating to wintering grounds. Cattle Egrets seen in the Dry Tortugas at times other than spring or fall might be young-of-the-year wandering away from their place of hatching; they may pass through the Dry Tortugas coming from the United States, South America, Central America, islands of the Caribbean, or all of these places. (Wandering juveniles will be discussed more extensively later in this report.)

From the top of the lighthouse on Loggerhead Key, I watched the arrival and departure of Cattle Egrets from the islands in the fall of 1971 and the spring of 1972 in order to determine flight directions. The following is an account of my observations.

12 October:

18:30—A flock of Cattle Egrets left the island, flying SSW and disappearing over the horizon.

13 October:

08:00—Two Cattle Egrets departed from the island, heading WSW.

09:30—Seven Cattle Egrets flew in from the north. At first appearing indecisive, they circled the island, starting to continue their journey, before turning back and lighting on metal pilings at the north shore.

7 May:

07:15—Three Cattle Egrets left Loggerhead Key, first circling the island, then heading due east, passing just north of Garden Key.

07:45—Five more birds took off from Loggerhead Key, heading in the same direction as those at 07:15.

Birds flying away from the island WSW and SSW in October were probably en route to western Cuba or Yucatan. (Cattle Egrets banded as nestlings in Florida and Georgia have been recovered in Cuba, Mexico, Honduras, Guatemala, and El Salvador [Ligas, 1958; Hopkins, 1972].)

Birds departing toward the east in May were heading in the direction of the United States mainland.

(In addition to the above sightings, Captain Clifford Green and I, enroute to the Dry Tortugas on the National Park Service boat M/V Tortuga in October, saw two separate flights of Cattle Egrets cross the wake of the boat, flying in a southeasterly direction. If they had continued on that course, eventually they would have arrived at Eastern Cuba, Hispaniola or Puerto Rico; so there is also some movement, perhaps migration, of Cattle Egrets in this direction in the fall.)

Many of the Cattle Egrets seen in the Dry Tortugas are weak and emaciated. Numbers are found dead, the cause of death probably being starvation.

More egrets seem to die in the Dry Tortugas in the spring than in the fall, suggesting that the birds have come from a greater distance or that food supplies are more limited at that time. Orthopteran populations in particular are much reduced in early spring because individuals hatched the previous spring have by then fallen to predation and disease and not yet been replaced by new hatchlings (H. F. Strohecker, pers. comm.).

According to David Hoover (pers. comm.), National Park Service ranger formerly stationed on the island, birds generally die in the fall only after a storm or hurricane has passed through the area.

Fred Whitehead (pers. comm.), former Coast Guard officer stationed at Loggerhead Key, told me that he did not find any dead Cattle Egrets on Loggerhead during the spring and summer of 1969 when a bulldozer was used there for a construction project. He said the Cattle Egrets followed in the wake of the bulldozer and fed on rats, grubs, and other organisms that were turned up from the soil. Martin Schultz (pers. comm.) reported that egrets often followed the mowing machine around the Coast Guard grounds.

On several occasions in 1971 and 1972 I watched Cattle Egrets foraging on Loggerhead Key. Once, 10 birds feeding in a grassy area made a total of only 10 successful strikes in a 30-minute period (they made a few unsuccessful strikes). Another time I saw one Cattle Egret make two successful strikes in a 10-minute period but no successful strikes during the next 20 minutes. Another Cattle Egret made three strikes, at least two of them successful, in a 10-minute period. This is a very low feeding rate compared to the average of 1 to 7 strikes per minute, depending on time of day and habitat, observed in South Africa by Siegfried (1971).

I saw Cattle Egrets picking up dead birds. One was able to swallow the bird, probably a warbler, although it had to work to get it into its mouth and down its throat. Another egret, unable to swallow the carcass it was carrying around, dipped it in a bucket of water several times, then left it floating there.

Sooty and Noddy terns nest on Bush Key in the Dry Tortugas. Perhaps some Cattle Egrets eat the eggs of these birds when they are available, but this has not been confirmed (W. Robertson, pers. comm.).

I weighed and examined the stomach contents of 16 of the many birds found dead in the Dry Tortugas from 3 May to 9 August 1971. Wet weights of the stomach contents ranged from 0.3 to 3.1 g (1.1 g average), as compared to stomach contents weights from 0 to 51.9 (16.1 g average) of the 106 Cattle Egrets collected in Hendry County in July 1968 (Browder, 1973).

The principal items in the stomachs of the Dry Tortugas birds were *Pangaeus bilineatus*, a tiny black ground bug, and *Blapstinus alutaceus*, a black beetle. These are small, and have highly sclerotized exoskeletons. The stomach of one Cattle Egret specimen obtained in the Dry Tortugas at an earlier date was literally crammed with the hemipterans. Perhaps the ratio of sclerite to soft parts in the body of this small bug made it inadequate food for a Cattle Egret, even when many were eaten. The 16 dead birds, all obviously emaciated, weighed from 156.8 to 201.1 g, about one-half the weight of the "normal" Hendry County Cattle Egrets ($N = 86$; $\bar{x} = 363.6$ g).

In order to determine whether or not suitable food for Cattle Egrets was available on the islands, I collected arthropods on Bush, Loggerhead, and Garden keys in October, November, and May. Collections were made by hand and by sweeping a net over the vegetation. Efforts were concentrated in the grassy areas where egrets had been feeding. Also collected were organisms such as noctuid moths that had been trapped and died inside the buildings.

Most of the species (Table 1), particularly the Orthoptera, are suitable prey for Cattle Egrets, but the observed infrequency of captures by foraging egrets on the islands suggests that population densities of these insects were low. Both the ground bug and the darkling beetle were abundant. Numbers were seen flying about the lights of the buildings at night. The flower fly was fairly numerous on the island in October; remains of small noctuids were invariably encountered on stairways of the lighthouse and fort.

TABLE 1. Arthropoda[a] collected in the Dry Tortugas in October and November 1971 and May 1972.

Odonata		
	Anomalagrion hastatum	a small damsel fly
Dermaptera		
	Labidura riparia	an earwig found under litter along sea beaches and riverbanks.
Orthoptera		
	Schistocerca sp. (nymph)	large grasshoppers, the adults of which are very strong fliers that usually light on the branches of trees.
	Orphulella sp. (nymph)	a large grasshopper that does not fly very well. Possibly this is the seaside species, but a definite determination cannot be made from the nymph.
	Gryllodes sigillatus	a medium sized cricket
	Cycloptilium antillarum	a small cricket
	Neoconocephalus triops	the broad-tipped conehead, a large green or brown katydid.
Hemiptera		
	Nezara viridula	the southern green stink bug.
	Pangaeus bilineatus	the ground or borrowing bug, a very small black insect with extremely scleritic wings and exoskeleton.
Coleoptera		
	Blapstinus alutaceus	a small darkling beetle.
Diptera		
	Volucella esuriens	a large black flower fly (Syrphidae).
Hymenoptera		
	Formicidae (and other)	numerous ants and several wasps were on the islands.
Lepidoptera		
	Erebus odora	the black witch, a very large migratory noctuid moth. It was probably on migration when collected on Bush Key.
	Erinnyis ello	a sphinx moth.
	Xylophanes tersa	a sphinx moth.
	Colias eurytheme	an orange sulfur butterfly.
	Noctuidae	several other small noctuid moths were seen.

Three arachnids were found on the islands: *Argiope argentata, Centruroides gracilis,* a scorpion, and *Mastigoproctus giganteus,* a whip scorpion.

[a]includes only organisms 5 mm or longer.

Plant ecology of the Dry Tortugas was described by Millspaugh (1907) Bowman (1917), and Davis (1942). The islands are low and flat, composed almost entirely of sand that has filled in the depression within a ring of coastal dunes rising only a few feet from sea level. As the sand is porous and rains are seasonal, with annual rainfall only 36.21 in. (average based on U. S. Coast Guard records, 1951-1960), the islands are extremely xeric. The vegetation of the islands is made up almost entirely of low seaside halophytes, upland xerophytes and grasses such as *Sporobolis* spp., *Distichlis spicata, Cenchrus* spp. and sea oats *Uniola paniculata.*

The general lack of water that determines the plant life of the islands might have limited the insect life, resulting in a relatively small number of insect species and low population densities compared with those of more typical feeding habitats of Cattle Egrets. The absence of large herbivores or any sustained agricultural activity on the islands further restricts the Cattle Egret's ability to forage successfully there. Not all Cattle Egrets that land in the Dry Tortugas die there; so evidently there is enough food for some or else they leave before using up stored energy resources. As Cattle Egrets and many other insectivorous birds stop to forage on the Dry Tortugas while on migration, seasonal studies of the ecology and population dynamics of the insects of the Dry Tortugas are badly needed.

Why numbers of Cattle Egrets land in the Dry Tortugas is puzzling. Are Cattle Egrets, when flying over water, programmed to light on any land mass they sight, or are they forced to land on the islands because their energy supply has run out? In other words, do they deplete their fuel reserves while foraging on the Dry Tortugas, or were these reserves already exhausted when the birds arrived? If the first is the case, then the Dry Tortugas are acting as an "energy sink" for these birds. But if the latter is true, then, in the absence of islands, the birds would have died in the ocean.

With a species that has only recently traveled the width of the Atlantic Ocean to colonize the New World, inability to traverse the Caribbean seems unlikely. But colonization of a new land area by a species requires only that a few individuals survive the crossing; others making the attempt are lost. Mortalities in the Dry Tortugas likely involve weaker (or less adaptable) individuals.

Over the Caribbean in the spring, fairly strong winds often exert a force against the direction of migratory flights. Wind patterns are unpredictable and can change completely in a few hours, as evidenced from Figure 1, which illustrates changes in wind direction during selected 24-hour periods in March, April, and May 1971 and 1972. Erratic wind patterns suggest that Cattle Egrets may find it necessary to land on the islands and are perhaps unwilling or unable to leave until the winds change.

However, Cattle Egrets flying over water often fly very low, immediately above the surface, and undoubtedly avoid much of the wind's action this way. (In Puerto Rico, I watched Cattle Egrets flying to and from their island heronry across a large bay. A strong wind was blowing against the birds flying out to the heronry; these birds all flew only a few feet above the surface of the water. Birds flying away from the heronry with the wind crossed the bay at an altitude of 40 feet or more.)

CATTLE EGRETS IN SOUTH FLORIDA

In order to understand the movements of Cattle Egrets through the Dry Tortugas, a review of their status in the United States, particularly south Florida, is necessary.

Bubulcus ibis is absent from most of the United States during the winter, reappearing at roosting and rookery sites throughout the country in the spring (Valentine, 1958). Cattle Egrets are present,

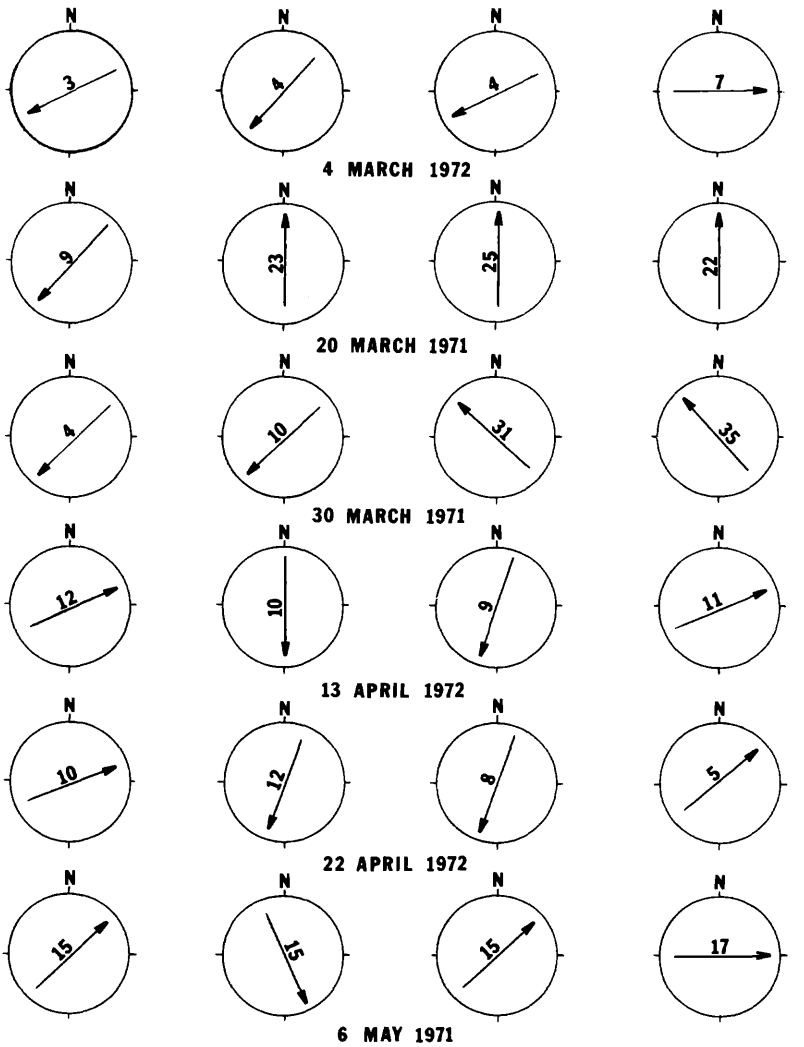

FIGURE 1. Changes in the direction of the wind in the Dry Tortugas over six selected 24-hr. periods during the spring. Numbers are velocities in knots. Wind measurements obtained by U. S. Coast Guard at height of approximately 100 ft.

however, in much of Florida all year, but their numbers are greatly reduced during winter months, suggesting that some are permanent residents, whereas others are summer residents, winter residents, or transients.

Three active heronries were known to me in southeast Florida in 1972. The birds arrived at West Arsenicker Key, a mangrove island

in south Biscayne Bay, in April. The Taylor Slough heronry, a willow head in Everglades National Park, reportedly became active in June (J. Kushlan, pers. comm.). It and a nearby heronry, also in the Park but not used in 1971, usually become occupied every June or July (J. Ogden, pers. comm.); the birds are not found in this heronry site or in the immediate area before that time. Cattle Egrets are seen at the Greynolds Park heronry in north Dade County throughout the year and have become permanent residents on the several mangrove islands in this park. They nested throughout the winter of 1971-72, which was unusually warm (V. Hoffman, pers. comm.).

MIGRATION IN AFRICA

The time and general direction of migration of Cattle Egrets in the New World are probably a reproduction of those established in the Old World.

Chapin (1932) outlined some of the migratory movements of Cattle Egrets in central Africa. They were based on his observations and collections made in the Congo region as well as on reports from elsewhere (Fig. 2).

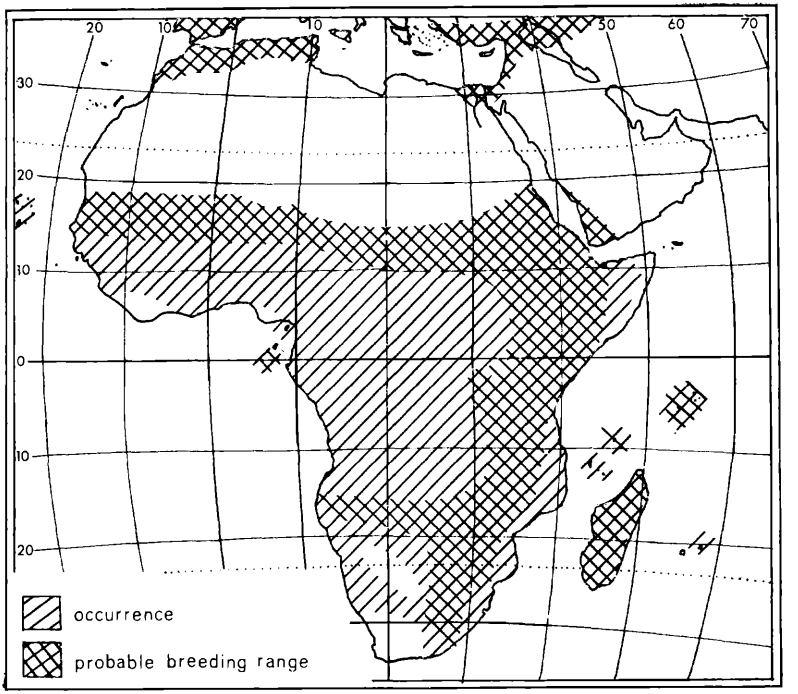

FIGURE 2. Distribution and breeding range of *Bubulcus ibis ibis* in 1932 in Africa (from Chapin, 1932).

Birds that bred in the savannas south of the Sahara (14°-18°N), particularly in Haussa Land in northern Nigeria, departed from these regions during the hottest part of the year, spending the time from January to May in the southern Congo and Angola. Cattle Egrets were obviously only transient in the northern Congo and the southern forested region of the Cameroun, as they were seen for a few weeks only in November and again for a short time in April, but in East Africa they nested on the equator. Nesting probably also occurred in extreme western Africa (Bannerman, 1930).

Chapin (1932) had evidence that birds from South Africa migrated to the southern edge of the Congolese forest belt; so birds from both hemispheres migrated toward the equator or across it.

Riddell (1944) noted that the number of Cattle Egrets in southern Spain fluctuated during the year, with a decrease coming in autumn and winter. This suggests that some of the Cattle Egrets of Spain also are migratory.

WANDERING JUVENILES

Migration and wandering are two separate phenomena. In migratory birds, some degree of "Ortstreue" (faithfulness to the place of hatching or that general area) is usually present, at least in one sex. Migration movements have some regularity to them, as they are repetitive year after year. Time, direction, and distance are predictable. Terminal points are fairly well defined.

Wandering is generally nondirectional and apparently without the influence of "Ortstreue," since return to the home-place or point of departure does not occur. Wandering is believed to involve primarily juveniles and take place some time shortly after the breeding season (Coffey, 1943).

Juvenile wandering is commonplace in the Ardeidae. It is likely the mechanism by which herons colonize new areas. Although this dispersion of some heron species might occur regularly after every breeding season, the present distribution of these species suggests that wandering only occasionally results in successful colonization. Cattle Egrets might have been landing on the northern coast of South America for many years before they finally became established. This is suggested by reported sightings in 1877, 1882, and again in 1911 (Palmer, 1962), as well as in 1937, after which time they began to be seen regularly. Cattle Egrets are probably, in fact, still coming to the Americas from the Old World.

Juvenile wandering might also serve indirectly as a mechanism for population control, because the number of individuals taking part in dispersal flights after each breeding season is likely a function of the number of young produced at that time. It might also be a function of population density, perhaps acting through stress caused by crowding, inadequate food supplies, or some other factor (Wynne-Edwards, 1962). Lack of direction to dispersal flights suggests that they might terminate anywhere on the globe. Birds fledged in the south are even known to fly north in the fall (Pettingill, 1970; Hopkins, 1972).

Colonization of a new area can occur, providing conditions are suitable and a sufficient number of birds is present. Probably more often than not Cattle Egrets, as well as other ardeids, do not arrive at places suitable for colonization. Many probably die of starvation in remote places where there is a lack of appropriate food. Many more might perish at sea.

This is suggested by a report of Francis Williams, associate research biologist of the Scripps Tuna Oceanography Research program. According to Williams, the NMFS research vessels "David Starr Jordan" and "Townsend Cromwell" were touring an area of the eastern tropical Pacific in November and December of 1971 when 11 separate sightings of Cattle Egrets, each involving from 1 to 24 birds, were made. Totaling 106 individuals, they were sighted in an area between 6° and 13°N and 115° and 121°W, at least 1,100 miles from the nearest mainland (southern California). The nearest land mass, Clipperton Island, was several hundred miles away. Many emaciated birds landed on the ships. Directions of two permanent departures of birds from the ships were noted. A flock of 15 left around midnight of 12 November, disappearing toward the south. One egret, leaving 26 November, flew toward the west-northwest.

That many species of herons are wanderers is well documented in the literature, which contains incredible reports of sightings of stray herons in unexpected, often remote, places (Pettingill, 1970). For instance, the American Ornithologists' Union Check-list (1957) reported the American Bittern (*Botaurus lentiginosus*) as "casual" in southeastern Alaska (Sitkine Flats), southern Labrador, and St. Croix, Virgin Islands, and "accidental" in Bermuda, Greenland, Iceland, the Faeroes, British Isles, Channel Islands, Azores, and Canary Islands; the Common Egret (*Casmerodius albus*) is casual in the Falkland Islands, and the Gray Heron (*Ardea cinerea*) is casual in Iceland, the Faeroes, Spitsbergen, and Ascension Island, and accidental in Greenland. Some additional reports of various species are included in Table 2.

Reports of first sightings of Cattle Egrets have been particularly numerous and spectacular in recent years, probably because of the tremendous increase in the numbers of these birds beginning around the early 1930s. Many first-sighting reports regarding Cattle Egrets, such as those for Surinam, Mexico, Haiti, Cuba, Florida, and Central America, have been followed within a few years by reports of large numbers of the species in the area and by breeding.

HYPOTHETICAL MODEL FOR THE POSSIBLE GENETIC BASIS TO WANDERING

There are many unanswered questions about the long-distance movements of Cattle Egrets. One of the most important is, "What controls these movements?"

Individual Cattle Egrets vary in both wandering and migratory habits. McLachlan (1966) and Siegfried (1970), after banding several thousand Cattle Egrets in South Africa and documenting numerous recoveries, reported that young birds either stayed within a few miles of their place of hatching or moved long distances up to

TABLE 2. Sightings of herons in unusual places.

Species	Number and date	Place and reference
Casmerodius albus	1 on 29 Mar. 1964	Royal Bay, S. Georgia, Antarctica. Jefferies, 1965.
Nycticorax nycticorax	1 on 30 Oct. 1957	Ponape Is., Micronesia. Brandt, 1961.
Ardea cinera	1	West Indies, Blaker, 1971.
Egretta garzetta	1 on 8 May 1954	Flatrock, Conception Bay, Newfoundland. Tuck, 1968.
Egretta garzetta	1 on 13 Jan. 1957	Trinidad. Downs, 1959.
Bubulcus ibis		Tropical Pacific Ocean, 570 miles west of Central America. Lint, 1962.
Bubulcus ibis	106 in Nov., Dec. 1971	Tropical Pacific Ocean, 1,800 miles west of Mexico, between 6° and 13°N and 115° and 121° W. Williams, F., pers. comm.
Bubulcus ibis	1 in April 1963	St. Paul's Rocks, equatorial Atlantic Ocean. Bowen and Nicholls, 1968.

3,000 miles. As mentioned in the previous section, some Cattle Egrets obviously migrate, whereas others do not. Genetic factors might underlie such behavioral variation, a possibility which needs study.

The wandering mechanism would be especially valuable to a bird population in controlling population numbers and in enabling the colonization of new areas if the mechanism were responsive to population density. A genetic system producing a behavior gradient in the young of each generation might serve such a purpose. The gradient in the young of each generation might serve such a purpose. The gradient might function in the following manner:

Some young birds would have very low thresholds and would wander regardless of the level of stimulus or even when no stimulus was present.

Others might have higher thresholds and wander only when the stimulus was stronger, some responding to weaker stimuli than others.

The exact nature of the stimulus is not known but should be directly related to population density (Wynne-Edwards, 1962) and might be manifest as stress caused by crowding or shortage of food.

This proposed model for the genetic basis to wandering allows that some small per cent (a few individuals) of a population will always be wanderers, but that an increasingly greater per cent will become wanderers as population density levels build.

It is not known that this model has any basis in actuality, but, as a beginning point toward finding out, we might ask whether or not a behavior gradient with a series of increasing threshold levels among different individuals could be established and maintained through genetic mechanisms.

Studies in quantitative inheritance have established that the independent segregation of a group of genes having an additive effect on one character can produce a gradient of types that, in the absence of selective forces, can be expected to have a normal distribution (Strickberger, 1968). Termed "polygenes," these gene groups have been implicated by experimental evidence as the basis of gradients in size, color, and other physical attributes among individuals of the same population. Whether or not a polygenic system could control behavior gradients has never, to my knowledge, been tested. The Cattle Egret might be an appropriate species with which to determine whether or not quantitative inheritance can relate to behavior.

If wandering and migration are two separate phenomena (Pettingill, 1970), possibly they are under the control of two separate polygenic systems. Independent assortment between the two groups might enable one population to produce four different general phenotypes: wanderer-migrator, wanderer- nonmigrator, nonwanderer-migrator, and nonwanderer-nonmigrator; so that a group of wandering birds arriving at a new location would carry the genetic potential to establish two different types of populations, a migrating and a resident one, thus doubling their chances of a successful colonization. In some locations, both types would be adaptive and, as in South Florida, both resident and migrating populations would become established.

These ideas are presented and questions raised in hopes that they will be considered as future studies are designed and further observations of the behavior, movements, and population dynamics of the Cattle Egret are made.

SUMMARY

Flights of Cattle Egrets have been observed entering the Dry Tortugas from the north and departing toward the southwest in the fall. Wintering grounds in Yucatan, Western Cuba, and Central America for populations of Cattle Egrets from North America are implicated. Return flights through the Dry Tortugas occur in the spring. Deaths of large numbers of Cattle Egrets in the Dry Tortugas, especially in the spring, are tentatively ascribed to starvation. The supply of suitable food for these birds seems scanty, particularly when their large size and multitude are considered.

Shifting wind directions in the spring and storms in the fall might necessitate a rest stop in the Dry Tortugas. Cattle Egrets and other herons are able, however, to escape the full effect of head winds by flying low over water where wind speed is greatly reduced.

Cattle Egrets seen in the Dry Tortugas at times other than spring and fall are probably wandering juveniles.

Year-round resident, migratory, and transitory populations of Cattle Egrets probably occur in south Florida. In Africa, resident

populations of Cattle Egrets are found nesting at the equator in areas near the eastern coast, whereas more westerly populations are migratory, nesting between latitude 14-18° N and spending their nonbreeding season south of the equator. Some South African populations of Cattle Egrets probably migrate toward the equator.

Herons are notorious wanderers, particularly in their first year. Both migration and wandering in Cattle Egrets and other members of the family Ardeidae might be under genetic control and programmed to provide mechanisms both for dispersal of the species and for population control.

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