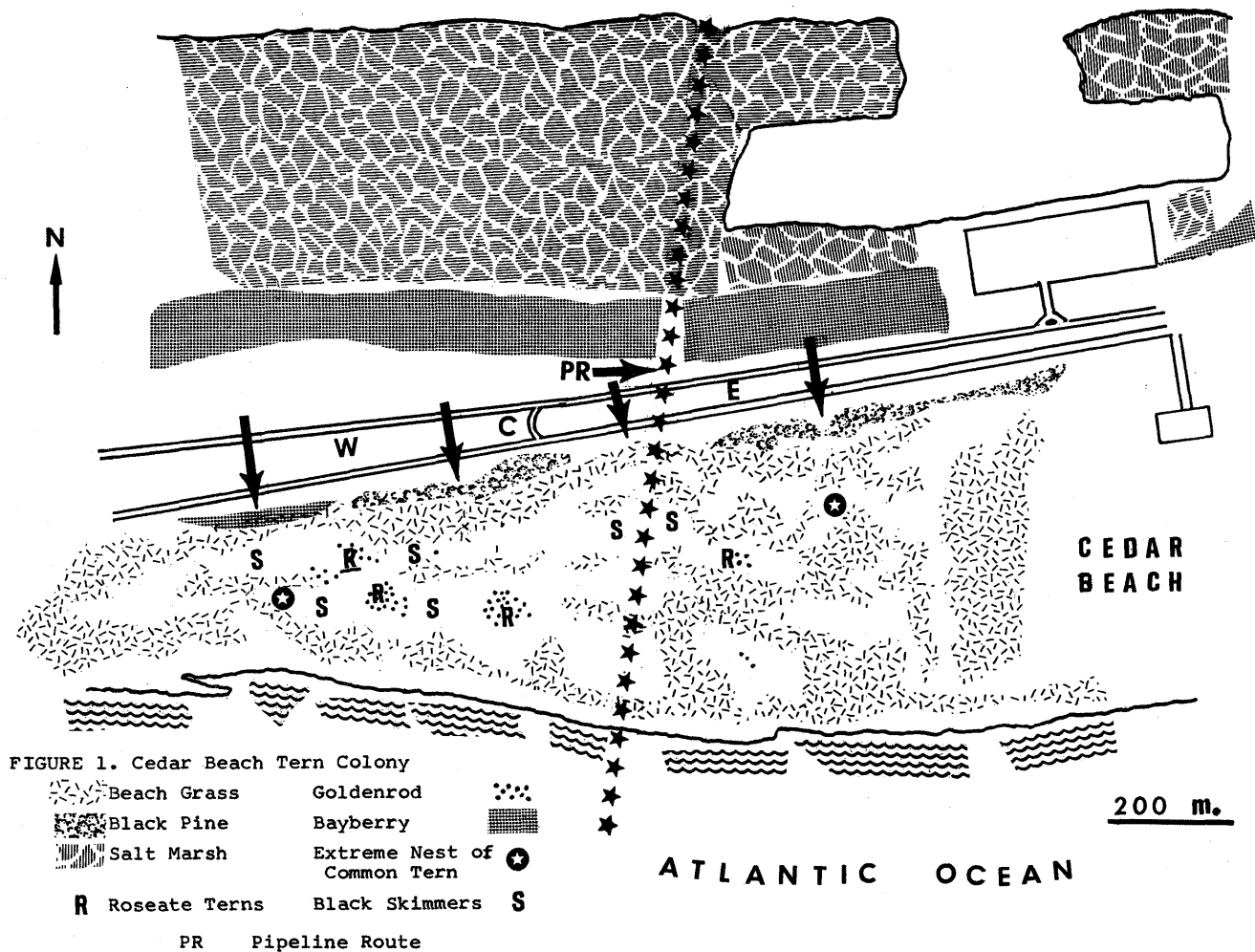




WATERBIRD COLONIES OF LONG ISLAND, NEW YORK

3. CEDAR BEACH TERNERY

MICHAEL GOCHFELD

The tern colony at Cedar Beach, about 6 miles south of Babylon, occupies a wide interdune area on the south shore barrier beach in western Suffolk County, New York (40° 38' N; 73° 22' W). The colony covers an area of about 12 hectares (ca. 32 acres) and extends from 200 to 1400 meters west of the Cedar Beach (Town of Babylon) recreation facilities. A tern colony has existed in this vicinity since at least the mid-1930's (Bull 1964); the present site was first occupied in 1957 and has been in use continuously since 1968. The estimated breeding populations for recent years (always listed as pairs of birds or numbers of nests) of Common, Roseate and Least Terns (*Sterna hirundo*, *S. dougallii*, *S. albifrons*) and Black Skimmers (*Rynchops niger*), are indicated in Table 1.

DESCRIPTION OF AREA

Figure 1 is a map of the Cedar Beach colony showing major features such as the highway, ocean, and inner and outer dunes. Major vegetation types are shown schematically and the locations of skimmer and Roseate Tern clusters in 1975 are indicated. Dominant vegetation includes Beach Grass (*Ammophila breviligulata*) and Seaside Goldenrod (*Solidago sempervirens*). There is very little other vegetation in the colony. The north edge of the colony bordering the road contains ornamental plantings of Bayberry (*Myrica pensylvanica*) and Japanese Black Pine (*Pinus thunbergi*) among other species.

Plant succession in the interdune area is similar to that discussed by Ranwell (1972), and its progression at Cedar Beach has been studied in sample plots both near and away from nesting areas. During a six-year period, plots subject to fertilization by tern excreta have not had noticeably more rapid plant succession than plots not used by the birds; a detailed study of this will be presented separately.

The berm beyond the outer dune varies in width from month to month and year to year and is believed to be undergoing rapid erosion. The U.S. Army Corps of Engineers periodically constructs a pipeline for its beach nourishment project; sand dredged out of Fire Island Inlet is deposited along the beach from Gilgo to Oak Beach.

This deposition attempts to compensate for the enhanced rate of erosion due in part to construction of the jetty at Democrat Point. The outer beach often undergoes dramatic seasonal changes. In 1975, the distance from high tide line to the base of the outer dune changed from 11 meters on 20 March to 28 meters on 15 May, and to 42 meters on 1 July. Under such unusual circumstances as the high water following Hurricane Agnes in late June, 1972, the outer beach may be completely inundated. Rarely have any terns nested on the outer beach.

The outer dune, in some places rising 3 to 4 meters above the berm and 2 meters above the interdune area, affords a large measure of security to the nesting birds by keeping out high water and beach vehicles. Since I began regular monitoring of the Cedar Beach colony in 1970, none of the main colony area has suffered flooding, and only a small cluster of nests in a depression near the southeast corner of the colony has been lost due to high water. Flooding is a major cause of destruction of tern colonies (Austin 1940) and the security of Cedar Beach with respect to flooding is an important feature.

Although psammophilic (sand-loving) plants such as Sea Rocket (*Cakile edentulata*) and Sandwort (*Arenaria peploides*) are widespread on the outer beach from Fire Island Inlet to Jones Inlet, at Cedar Beach the vegetation of the outer dune consists almost entirely of Beach Grass. Vegetation cover was estimated in 10 one-meter plots on the outer dune and ranged from 5 to 40% (mean 17.5%). Grass is densest near the crest of the outer dune, where it covers about 70% of the ground.

The width of the interdune area varies from about 80 to almost 200 meters. Although it is mostly level, there are several secondary dune systems rising as much as 1.5 meters above the main level. The substrate is sand and shell, generally coarser-grained than on the outer beach. Two large stands of goldenrod occur in the central and western parts of the colony, the western one containing about 71 bushes varying from 20 to 115 cm in height (excluding flowering stalks). These bushes provide the main nest sites for Roseate Terns.

The inner dune rises as much as 4 meters above the interdune area. It is more stable than the outer dune and supports Bayberry and other plants in addition to Beach Grass. No terns nest on the inner dune, but after hatching many young birds seek shelter in the vegetation there.

In Figure 1 the colony is divided into eastern, central and western

thirds by the four parallel arrows. Common Terns nest throughout the ternery, but the center density has shifted from the eastern third (1970-1973) to the western third (1974-1975). Black Skimmers usually form two to four clusters of 20 to 50 nests each in various parts of the colony. In 1975 these clusters were all in the central and western parts of the colony. Roseate Terns (see Figure 1) usually have clusters of 5-25 nests in both the eastern and western thirds, with a few scattered nests in goldenrod in the central portion. Least Terns nested from 1968 to 1974 in the relatively bare area in the southern part of the western and central portions; in 1975 they moved about 1 km to the west, apparently joining with a smaller group of birds from Gilgo Beach.

Although Black Skimmers are considered birds of open, unvegetated beaches (cf. Bent 1921, Pettingill 1937), on Long Island they frequently nest close to vegetation (see also Stone 1932). The determining factor seems to be the presence of Common Terns. Within tern colonies, skimmers nest in barer areas, but they are apparently more tolerant of vegetation than one would infer from the literature. At Cedar Beach the dispersion of Roseate Terns is most influenced by the presence of goldenrod, under which 45 of the 49 nests (92%) were built in 1975. Other nests were built in clumps of Beach Grass. In other seasons some nests have been built under boxes or pieces of driftwood. The tendency of Roseate Terns to nest under objects is well documented (Austin jr. 1929, Austin 1944, Bent 1921, Cooper *et al.* 1970, Jones 1906).

CEDAR BEACH IN RELATION TO OTHER MAJOR TERNERIES

On Long Island, aggregations of terns and skimmers exceeding 1500 pairs occur at relatively few locations. The large colony at Breezy Point in Brooklyn was eliminated by vandalism. The West End Beach colony, subject to much disturbance, (see Gochfeld and Ford 1974) grew to nearly 2500 pairs of Common Terns and about 150 pairs of Black Skimmers in 1975. On the south shore of eastern Long Island large terneries have existed at Shinnecock Inlet and at Moriches Inlet. The latter has been estimated to have as many as 6000 pairs of Common Terns (1963, Audubon Field Notes) but has repeatedly been devastated by predation and human disturbance. In a helicopter survey (see Buckley 1975) F. G. and P. A. Buckley and I estimated about 600-800 pairs of Common Terns on Laine Island in Shinnecock Inlet and 1300-1600 pairs of Common Terns in Moriches

Inlet, mainly on West Inlet Island. Great Gull Island, the largest ternery on Long Island, had an estimated 2500 pairs of Common and 900 pairs of Roseate Terns in 1975 (H. Hays pers. comm.). Cedar Beach, from an extrapolation of nest counts, had 2500-2600 pairs of Common Terns, and is perhaps the largest aggregation of this species in the state. Fifty pairs of Roseate Terns were present in 1975; this is the westernmost nesting site for this species, which appears to have a tenuous foothold on the Atlantic Coast (Nisbet 1973). About 90% of the Atlantic Coast population breeds on Long Island or in Massachusetts. The 155 pairs of Black Skimmers nesting at Cedar Beach form the largest aggregation of this species on Long Island, comprising about 35% of the island's skimmer population. Not only is Cedar Beach one of the largest terneries on Long Island, but it has grown steadily over the past six years (Table 1). This has not been true for the other large tern colonies mentioned above.

Cedar Beach also is unique in its natural beach habitat. The terns at West End Beach nest in an area consisting partly of landfill and ornamental plantings; most of the plants identified there are not natural members of the beach community (Gochfeld MSA). The Great Gull Island colony (described in detail by Heilbrun 1971) has numerous exotic plant species including various Compositae and shrubs, and much of the colony site is influenced by the stone remains of old Fort Michie. Frequent clearing of vegetation has been necessary to keep the island suitable for terns. Terneries at Shinnecock and Moriches Inlets have usually been on low-lying islands behind the barrier beach. These resemble Cedar Beach in having largely natural vegetation but are much more subject to flooding and erosion.

SEWER OUTFALL LINE

Figure 1 shows the proposed route of the sewage outfall line from the treatment facility of the Suffolk County Southwest Sewer District No. 3. Alternative routes east of the colony have been suggested by some environmentalists but have been discarded by Suffolk County. A route to the west of the colony, involving the least deflection from the present route and probably the least environmental impact on the barrier beach, has not been seriously considered. Under the original plan of Suffolk County most of the colony area to the east of the route would be used as a staging area for assembling the pipe. The U.S. Environmental Protection Agency, while approv-

ing Route No. 1, has forbidden use of the colony site as a staging area and has limited construction to the period of September 15 to April 15. The county officials are currently (as of March 1976) contesting these restrictions. The arguments involved in the pipeline dispute have been summarized elsewhere (Gochfeld 1976). Suffice it to say that since the Cedar Beach ternery is one of the largest, most secure and most productive tern colonies on Long Island and in the eastern United States, its preservation at the present site should be given high priority.

HISTORY OF RECENT OCCUPATION AT THE PRESENT SITE

In July 1968 Dr. Robert O. Paxton discovered a colony of about 50 pairs of Least Terns at Cedar Beach. In June 1969 he estimated about 200-250 pairs of Least Terns there; this colony was augmented by the arrival that July of about 200 pairs of Common Terns, which had presumably been unsuccessful in earlier nesting attempts elsewhere.

In 1970 Common Terns arrived at Cedar Beach in late May, and since then have been the dominant species in the colony. Black Skimmers and Roseate Terns also joined the colony in June 1970. Since then a mid-season influx of nesting birds has also been detected each year. Movement of birds from one colony to another after an initial nesting failure has been well documented (cf. Austin jr. 1932, 1933). In addition, young terns nesting for the first time usually join pre-existing colonies and commence nesting about one month later than most adults.

SEASONALITY AND PHENOLOGY

On western Long Island the first Common Tern eggs appear between 13 and 26 May. Warm, clear weather seems to induce early laying or perhaps the converse conditions inhibit early laying. However, in 1975 cold, wet weather prevailed into the first week of May, but laying was earlier than in any of the preceding 12 seasons, perhaps because of persistent fair weather after 8 May. This anomalous early laying indicates that factors underlying the phenology of tern reproduction are still unknown.

In seasons when early breeding success is high there is little re-nesting. In such seasons most chicks have fledged by 10 July (after about 50 days for incubation and pre-flight periods) and the site may be abandoned by the end of that month. In most seasons, however, between 25% and 75% of a colony is likely to re-nest after initial

TABLE 1. Numbers of nests or pairs at Cedar Beach colony (1969-1975).

Year	COMMON TERN	ROSEATE TERN	LEAST TERN	BLACK SKIMMER	PIPING PLOVER
1969	0 (50 late) ^a	—	ca200	—	???
1970	1145±25	90–100	30±3	45–50	6–7
1971	1640±50	60–70	120±5	50–60	????
1972	1175±25	50–60	35–36	100 ^c	5
1973	1450±50	25	24–25	120±10	4
1974	2143–2250	24	61–65	78	4
1975	2500–2600	42–55	(23) ^b	150–155	2

a = about 50 pairs of Common Terns arrived late in season to nest (R. O. Paxton pers. comm.)

b = Least Terns nested about 1 km west of colony in 1975.

c = Bull (1974)

TABLE 2. Comparison of earliest egg-laying dates for Common Terns at West End Beach and Cedar Beach, Long Island. The two colonies are about 12 miles (19 km) apart. [All dates are in May.]

YEAR	WEST END BEACH	CEDAR BEACH	MAXIMUM DIFFERENCE
1970	19–22	18–20	1 day
1971	21–23	16–19	5 days
1972	21–22	18–19	3 days
1973	21–22	17–18	4 days
1974	16–17	15–16	1 day
1975	14	11–12	3 days

failures. In such species as Herring Gull, (*Larus argentatus*), chicks hatching from late nests have a lower probability of survival (Nisbet and Drury 1972). The same is believed true for Common Terns (Austin 1944). Cohorts of tern chicks banded as downy young in August consistently have a higher local mortality, judging from the number of banded birds recovered at or near the colony, than do cohorts banded in June or July (Gochfeld MSb). But some seasons half or more of the total young may come from re-nesting (Austin 1946, Gochfeld and Ford 1974). This estimate, however, is based only on birds surviving to fledging (about four weeks of age), and does not consider subsequent mortality of such fledglings. The chief limitation for terns is that they must learn to obtain food by diving (LeCroy 1972), and it is probably advantageous for them to become proficient at fishing before migration begins. However, in some species, such as the Royal Tern (*Thalasseus maximus*), parental care may continue on the wintering grounds (Ashmole and Tovar 1968).

At Cedar Beach late nesting adults include late arrivals as well as birds known to have failed in earlier nesting attempts there or at other colonies. The results of trapping such late arrivals, a few of which had been banded previously, indicate that both young birds and adults from other colonies are involved. The fact that young birds nest later than established adults has been noted previously (Austin sr. 1946, 1947; Cooper *et al.* 1970). In all seasons from 1970 to 1975, some nesting attempts have been made in August, probably by birds that had already failed twice, and unfledged but apparently normal juvenals are sometimes found in September. Such late nesting is even more frequent in Black Skimmer, and in several seasons unfledged juvenals have been found in September (pers. obs., D. B. Ford, pers. comm.). Ford found a healthy but still flightless young skimmer on 8 October 1971 at Cedar Beach.

The viability of young of late nestings depends largely on how much experience they can gain prior to separation from the adults. Vermeer (1963) mentions that young gulls from artificially large clutches are more likely to be found on garbage dumps than are young from normal clutches. Presumably the same option is open to late-fledgling gulls, which have only to locate a nearby dump. The relatively new practice of plowing over dumps on Long Island may greatly reduce this option. It would be interesting to determine why Black Skimmers are more likely than Common Terns to re-nest late in the season. I have seen small groups of young skimmers engage in

skimming within four days after fledging. Although still partly dependent on adults, skimmers probably have an easier time mastering their fishing technique than do terns, and therefore fledging late would be less of a disadvantage. This may account in part for the regularity with which skimmers engage in repeated re-nesting. One marked female skimmer is known to have produced three unsuccessful clutches at Cedar Beach by 2 August 1971, and to have initiated yet another nesting attempt. It is also possible that skimmers have a significantly higher failure rate than do the terns, a matter that will be considered separately.

EGG-LAYING SYNCHRONY ON LONG ISLAND

Despite the large amount of field work done on Long Island, there is relatively little comparative information on the onset of laying in different colonies. Wolk and Bull (1967) found a Herring Gull colony on Gardiner's Island to be about two weeks ahead of one at Captree. In 1966 H. Hays (in Cooper *et al.* 1970) compared dates of laying at Great Gull Island, Jones Beach and Jamaica Bay and found that laying had begun within a day or two at all three colonies.

Table 2 shows the estimated date of first layings at Cedar Beach and at West End Beach. The former is generally two to five days earlier than the latter, although the two are only 15 miles apart. In 1975 the ternery at Shinnecock Inlet had Common Tern and Black Skimmer chicks estimated to be four and one days old respectively on 11 June. This indicated that hatching occurred two to four days earlier there than at Cedar Beach. The gradient in onset of nesting varies from year to year and from species to species, but whenever such a gradient has been found, the more eastern colonies have had earlier nesting. How this relates to east-west climatic gradients remains to be studied.

FLOODING

Many species nesting in the littoral zone run the risk of flood damage to nests. Austin (1940) considered this the most important natural cause of nest destruction and colony failure and noted that suitable high nesting area is an important attribute of a secure colony. Numerous cases of colony destruction by flooding have been reported for several species (e.g., Austin jr. 1929, 1933; Mackay 1898; Gochfeld 1974; Bongiorno 1970).

At Cedar Beach the interdune area has been entirely secure from

flooding. A low-lying basin not protected by an outer dune occasionally had a few Common Tern nests, and in late June 1972 about 40 nests in this basin were flooded out. Terns have not nested there subsequently. This represents the only loss of nests due to flooding at Cedar Beach. At Gilgo Beach, only 2 km west of Cedar Beach, where a few Least Terns nest on the berm, high tides and flooding eliminated the whole colony in one season and more than half of it in another, during the five years this colony was in existence.

PREDATION AND OTHER DISTURBANCES

Humans, dogs, feral cats, Norway Rats (*Rattus norvegicus*) and Short-eared Owls (*Asio flammeus*) are known to prey on terns at Cedar Beach. Other potential predators occurring on the barrier beach are Red Foxes (*Vulpes fulva*), Long-tailed Weasels (*Mustela frenata*), Herring Gulls, Great Black-backed Gulls (*Larus marinus*), Black-crowned Night Herons (*Nycticorax nycticorax*) and Fish Crows (*Corvus ossifragus*). The gulls and Fish Crows are fairly common and probably do prey on birds there on rare occasions, but this has never been observed during the hundreds of hours we spent in or near the colony, when disturbance of the terns would have facilitated predation. Both gulls nest at Captree State Park, only five miles to the east, and flocks frequently rest on the outer beach not far from the colony, but actual predation has not been witnessed. Common Grackles (*Quiscalus quiscula*) and Red-winged Blackbirds (*Agelaius phoeniceus*), both potential predators on tern eggs (e.g., Pessino 1968), nest in ornamental pine plantings and natural vegetation on the barrier beach, and are frequently seen near the colony. I have observed Red-winged Blackbirds damaging tern eggs at West End Beach, but not yet at Cedar Beach.

A feral cat was seen once in the colony but the occurrence or extent of damage was not known. However, a cat was largely responsible for eliminating a small colony of Least Terns on western Fire Island in 1973 (D. B. Ford pers. comm.). The Norway Rat is a very important predator on terns (Austin 1948), but its impact at Cedar Beach is negligible. A few rats live in the ornamental vegetation along the parkway, and rat caches of eggs and occasionally of chicks have been found near the northern edge of the colony, but the rat is clearly a much less important predator at Cedar Beach than at West End Beach, where it finds more suitable habitat.

A pair of Short-eared Owls nests in the salt marsh north of Cedar

Beach (W. Post pers. comm.) and the owls are occasionally seen over the marsh at dawn and at dusk. On one occasion an owl was seen over the colony. On some days "epidemics" of decapitated adult terns indicate the work of an owl (cf. Nisbet 1975), and this is the only owl species known to live on the barrier beach during the breeding season. Great Horned Owls (*Bubo virginianus*), important predators at tern colonies in Massachusetts (Austin 1940, Nisbet 1975), do not occur near Cedar Beach; the nearest known birds are at Heckscher State Park, 10 miles to the northeast.

CHICK DESTRUCTION BY TERNS

Mortality due to attacks on wandering young terns by aggressive territorial adults is often higher than mortality due to predators. This phenomenon has been noted by various authors (e.g., Palmer 1941, Austin jr. 1929, Austin 1946).

Individual terns apparently differ considerably in their aggressiveness toward wandering chicks. In one case at Cedar Beach I observed an adult kill two chicks and severely peck two others that moved through its territory or crouched next to a grass clump. A careful check of this territory revealed 11 dead or dying chicks with characteristic puncture wounds about the head. Such aggression, as well as actual cannibalism, is well known also for the Herring Gull (e.g., Parsons 1971). There is remarkably little quantitative information on the circumstances leading to such mortality. Adult aggression seems likely to be greater in dense colonies, where the likelihood of a chick wandering near such an aggressive adult is also likely to be greater. Although Common Tern chicks normally crouch and hide in vegetation in or near the parental territory, the presence of people walking through a colony, and particularly of banders lifting chicks from hiding places and handling them, can greatly increase the amount and distance of wandering and may increase the mortality due directly to aggressive adults.

HUMAN DISTURBANCE

Ultimately, disturbance by humans is the most frequent and severe factor causing mortality and reduction of productivity among colonial birds (Austin 1940, 1946; Buckley, Buckley and Gochfeld in prep.). Human activities operate on several levels. Humans usurp potential nesting areas for construction of houses or recreation facilities. In 1972, for example, the Long Island State Park Commission built a parking lot on Fire Island right on the site of a large Least

Tern colony. In the early 1950's construction of highways caused a large ternery at Jones Beach to shift about 2 km to the west, and less than a decade later construction of parking lots and bath houses again displaced this colony. The Cedar Beach colony has thus far escaped such disturbance, although it is now threatened with the construction of a pipeline. Like erosion and vegetation overgrowth, which are reversible or cyclic phenomena, construction activity not only eliminates habitat, but in the case of the dredge spoil islands, new habitat is created as well (Buckley and Buckley 1974).

Human disturbance of the environment includes the release of chemical contaminants, the scattering of refuse that may be hazardous to birds (Gochfeld 1973), and the changing of natural population equilibria. The accumulation of edible refuse in large garbage dumps has apparently facilitated the unprecedented population growth of Great Black-backed and Herring Gulls. Gull populations have apparently stabilized in New England (Drury and Kadlec 1974), but on Long Island they are still increasing (Buckley *et al.* 1975). Gulls are potential predators on smaller species such as terns, but their chief effect is to pre-empt tern colonies and prevent terns from reoccupying formerly used sites (e.g., Nisbet 1973). In 1975, a small group of Herring Gulls began nesting on Alder Island, in Jones Inlet, which led to the total failure of the ternery there.

Of greater concern in most cases is direct human disturbance, including vandalism, interruption of incubation and eggging. Although tern eggs are only occasionally (less than once per season) collected for food, the impact of eggging can be great indeed. Interference with nesting activities occurs often when bathers or picnickers settle in a colony and prevent terns from incubating or feeding their young. This is not likely to occur at a large ternery, where aggressive defense by adults keeps out most human intruders, but it is believed to be an important factor in the elimination of smaller terneries on islands in the inland waterway. Vandalism includes shooting of adult birds, destruction of eggs, and the use of beach vehicles in a colony (see Davis 1965). The elimination of the Wantagh colony (Gochfeld 1974) was caused by a combination of flooding, casual interference, and vandalism.

At Cedar Beach such incidents have been infrequent. Vehicles have entered the colony on several occasions during a six year period, mainly between 1970 and 1972 when the colony was less dense and well-established than in 1975. R. O. Paxton blocked off beach ve-

hicle access points with wood, effectively eliminating access for a two year period until the barriers were broken down. In 1975 the park commission erected a drift fence across one of the access points. Formerly many people parked cars along the highway adjacent to the colony and crossed it to swim at the beach. As the density and aggressiveness of the terns and the attentiveness of the parkway police force have increased this source of interference has become negligible. In addition, Suffolk County police patrol the beaches in jeeps and helicopters and help reduce vandalism. I have never found evidence of egging at Cedar Beach, but vandalism—shooting or smashing of eggs in some nests—has occurred on at least three occasions. The effectiveness of the police protection afforded the colony is largely an individual matter, but ornithologists visiting the colonies have encouraged the police to take an interest in the birds and their nests, thereby enhancing their protection.

Since there are no parking facilities very close to the Cedar Beach colony, the frequency of human intrusion and vandalism is much lower than at the West End Beach and Captree colonies.

DISTURBANCE BY BIRD WATCHERS AND BANDERS

Cedar Beach, although near nesting areas of the Black Rail (*Laterallus jamaicensis*) and Chuck-will's-widow (*Caprimulgus carolinensis*), does not attract much attention from bird watchers. Photographers find gulls and terns much easier to photograph at nearby Captree and West End Beach, where birds can be observed at close range from a car. The main attraction of Cedar Beach is that it is the westernmost breeding locality for Roseate Terns on Long Island; bird watchers occasionally enter the colony to add this species to one list or another.

Bird study activity, an important potential disturbance, has involved the marking of nests and the monitoring of hatching and survival. Banding of young has been conducted annually but the emphasis on banding has not been great and usually only 300-1000 young are banded there in any season. In most years special attention has been devoted to Roseate and Least Terns and to Black Skimmers so that a greater proportion of the young of these species than of Common Terns have been banded.

To minimize disturbance, work is usually confined to mild days, or to brief periods on hotter, sunnier days, and one moves frequently from one area of a colony to another, so that disturbance in any sub-

unit lasts no more than one hour. The bulk of activities involving prolonged presence in the colony—nest marking, adult trapping, mapping—are conducted during the incubation period, when disturbance has less effect than it does after hatching. These and other less specific precautions minimize but do not eliminate adverse impact on the birds (Buckley, Buckley and Gochfeld in prep.).

OTHER NESTING SPECIES

The Piping Plover (*Charadrius melodus*), characteristic of the outer beaches, has declined markedly in recent years. At Short Beach and West End, where 13 nests were found in 1971, only four pairs were found in 1975. At Cedar Beach and Gilgo Beach, where an additional 10-12 pairs nested in 1972, only four pairs, two of those within the Cedar Beach colony, nested in 1975. Whether this signifies a long term trend is unclear. Increasing use of beaches and of beach vehicles is an important hazard to this species. Wilcox (1959), who conducted a 20-year banding study of Piping Plovers on Long Island, found that they were rare in the late 1920's, increased to about 4 pairs per mile in the 1930's, and declined in the post-World War II period due to housing and human disturbance. On the outer beaches Piping Plovers may nest alone or in association with Least Terns. At Cedar Beach the few pairs present often nest within 3 meters of one or more tern nests. Terns seem to tolerate the plovers.

American Oystercatchers (*Haematopus palliatus*), have increased dramatically on Long Island since 1957, when L. Wilcox found the first nest on Gardiner's Island (Post and Raynor 1964). The 1975 aerial survey estimated over 50 pairs of oystercatchers on Long Island, most of them on marshy islands in Great South Bay. Almost none were found on the barrier beach itself; the only nest I have seen there was one containing three eggs at Cedar Beach in 1972. The entire clutch disappeared without a trace, possibly because of predation or vandalism.

OTHER VERTEBRATES

The Cottontail Rabbit (*Sylvilagus floridanus*) and the Meadow Vole (*Microtus pennsylvanicus*) are very common on the entire barrier beach. The rabbit occupies brushy areas and artificial plantings along the highway and the vole prefers mats formed by dead stems of Beach Grass. Fowler's Toad (*Bufo fowleri*) is abundant on the barrier beach, and while individuals are frequently active in the colony,

most occur in pine groves on sandy soil. The Diamond-back Terrapin (*Malaclemys terrapin*), now rare on Long Island, seems to be increasing in the vicinity of Cedar Beach. The face of the inner dune on the northern margin of the colony is typical of terrapin nesting habitat (Burger and Montevecchi 1975), and two individual terrapins have been seen there in five years. Terrapins live in brackish waters behind the barrier beach and must cross the salt marsh and highway to find habitat suitable for nesting. During 1975, four large terrapins were found dead on the highway between Oak Beach and Gilgo. A 15 cm high cement curb along the median divider provides a barrier that prevents them from crossing the highway along much of the beach. Cedar Beach is one of the places where crossing is possible.

INSECTS AND TERNS

Austin (1929), Jones (1906) and others mention that newly hatched and hatching tern chicks are frequently eaten by small ants that infest tern colonies. On Long Island I have several times found that ants enter pipping eggs and attack the live chicks within, but since ants readily enter eggs in which chicks have died during hatching, the extent to which ant predation is a significant factor during hatching is unknown. Once hatched, healthy chicks can usually move if their nest becomes infested by ants, as is likely to happen if there is a dead sibling within it.

At Cedar Beach, a black ant (*Lasius neoniger*) is abundant and feeds on dead chicks; several weak but living chicks were bitten by this ant, thus perhaps hastening their demise. The Pavement Ant (*Tetramorium caespitum*) was an important scavenger of dead birds at West End Beach but was not found at Cedar Beach.

At Cedar Beach and elsewhere goldenrod plants are frequently attacked by the chrysomelid beetle (*Trirhabda canadensis*). This insect lays its eggs in masses that overwinter on the ground. The larvae hatch in early June and eat goldenrod leaves. In 1975, several patches of goldenrod at Cedar Beach were entirely defoliated, and Roseate Terns nesting beneath them either abandoned clutches or attempted to lead chicks off to areas with protective cover. A similar event occurred in Massachusetts in the same year (Nisbet pers. comm.).

THE FUTURE

Large tern colonies have proportionately better survival and pro-

ductivity in most circumstances than small ones (Austin 1946, Gochfeld and Ford 1974). Such a colony as Cedar Beach is not only a secure breeding location to which terns can repair from less suitable sites, but also serves as a nucleus for additional breeding colonies which may become established elsewhere on Long Island. The Cedar Beach colony plays a particularly important role in maintaining Black Skimmer populations on Long Island. As more and more areas have become unsuitable for various reasons, terns have been forced to nest in marginal habitats where human disturbance, rats, and flooding prevent adequate reproduction. Many Common Terns have recently begun breeding in salt marshes on Long Island, and available evidence indicates that such colonies usually fail entirely. The history of tern colonies in Europe and North America indicates that the Common and Roseate Terns are not marsh-nesting species, and the fact that they now seek salt marshes for nesting is alarming. It suggests that they simply have nowhere else to go.

Cedar Beach is therefore an important refuge for nesting terns. Nesting density is still low in much of the colony, and some of the available area is not in use at all. Compared with many other Long Island colonies the vegetational succession is at a very early stage, indicating that it can continue to be a productive colony until at least the end of the current millenium.

If a major disturbance at Cedar Beach causes the birds to abandon the site, one can predict that the birds will attempt to either join one of the other large colonies or to settle on salt marsh or spoil bank islands, where their future will be in jeopardy. The large colonies at West End and Moriches offer some hope, but the West End colony is almost entirely saturated and it is not likely that it could hold even 500 additional pairs. The Moriches colony has lately had very low productivity because of predation. Interchange of birds between Cedar Beach and Great Gull Island is, for unknown reasons, a rare event, so it seems unlikely that birds forced to leave Cedar Beach would settle at Gull Island.

ACKNOWLEDGEMENTS

Dr. Robert O. Paxton kindly provided useful information on the initiation of the present Cedar Beach ternery in 1968 and 1969, as well as useful comments on the manuscript. He also undertook single-handedly to erect barriers preventing the intrusion of beach buggies.

Numerous friends and students have participated in field work at

Cedar Beach. Robert Gochfeld, Joy Grafton and Danielle Ponsolle were the most frequent participants. I thank also David Ewert, Michel, Suzanne and Georges Kleinbaum, Linda and Deborah Gochfeld, and Myrna Jacobson for assistance. Darrel B. Ford carried on a large part of the project of monitoring the colony and marking birds. Small quantities of funds were obtained from the Society of Sigma Xi, the Frank M. Chapman Fund, and an NIH Biomedical Grant to Queens College. I thank Max K. Hecht for the loan of equipment which greatly facilitated studies in the colony.

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