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THE STATUS OF THE CAPE COD TERNS IN 1944; A BEHAVIOUR STUDY

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Each added year of work done by the Austin Ornithological Research Station in the Cape Cod group of tern colonies compiles further evidence which sustains previous conclusions concerning major traits in the behaviour of the Common Tern (*Sterna hirundo*). At the same time trends, hitherto unrecognized, become evident. The latter, while of minor importance, function, at least collectively, in maintaining the species' welfare.

Continued observation has shown that deviations from the behaviour pattern as a whole are far less obvious and distracting when the doings of the entire group, a large colony or an aggregate of small colonies are analyzed rather than those of a few individuals, also that adherence to the major rules of conduct increases with each added year of age. The credibility of a determination of the behaviour pattern of the Common Tern and an evaluation of its details is in direct relation to the number of birds from whose actions it has been deduced, since there are wide divergences in both the physical and mental attributes of individuals. For example, in half-grown chicks the alert aggressiveness and robustness of the smaller brown plumaged birds contrasts

¹Contribution No. 40 by the Austin Ornithological Research Station.

sharply with the apathy and low vitality of the larger gray colored young. Also, in small colonies, notably in such matters as reaction to intrusion and the maintenance of territorial rights, behaviour, while fundamentally identical, does not duplicate that observed in terneries having several thousand numbers. Our concept of the pattern has resulted from the study of thirteen usual and what may be considered normal nestings and, in addition, two altered considerably by marked predation. The validity and effectiveness of specific traits, especially those of major importance—as are the alignment of individuals, the selection of nesting sites and reaction to frustration—are demonstrated better by being subjected to tests imposed by a nesting which varies so much from the usual one that it must be considered abnormal. This occurred in 1944 when, subsequent to a most auspicious start, serious mishaps interrupted the breeding routine, disrupted the initial distribution and compelled the extensive readjustments without which necessary reproduction would not have been achieved.

The alignment of the Cape Cod group of tern colonies (which, for fifteen years, has had a stationary aggregate population of thirty thousand birds) has been previously described (Austin, *Some Aspects of Individual Distribution in the Cape Cod Tern Colonies*, *Bird-Banding*, Vol. XI, No. 4, October, 1940). The group is self-sustaining and free from association with other groups during the nesting season. The component colonies occupy an almost rectangular area with its long sides about forty miles, the shorter ones fifteen and twenty in extent. Recently the largest colonies have occupied the four corners, Tern Island one, Plymouth diagonally opposite a second, Billingsgate Island and Jeremeys Point another, Bird and Ram Islands the last. From year to year the smaller flocks have nested on sundry sites along the borders; always a few pairs locate on isolated beaches and sand dunes. Consistently the trend has been toward amalgamation in spite of the existence of several apparently ecologically desirable but unutilized locations. Since, over the last decade, the group's total population has not increased and particularly because a few feet of terrain is the maximum requirement of a breeding pair, there is no necessity for young birds spreading out into adjacent territory as is the exigency of some avian species. For that matter, we are sure Tern Island alone could domicile adequately the entire Common Tern membership of the Cape Cod group. This year, in the initial site selection, the habitual proclivity toward cohesion into one colony attained its maximum at Tern Island.

On May 2nd, 1944, fishermen observed the first returning terns offshore; two days later, May 4th, the terns arrived at Tern Island, a site regularly occupied before the others for its tenanted colony contains a preponderance of older birds which always nest much earlier than do their juniors. On May 19th, 2,500 terns were present; 6,000

on May 24th. The nights of May 24th and 25th, when egg-laying had become extensive, the temperature dropped below freezing. By May 29th the population had grown to 13,000; June 2nd it was estimated conservatively that 18,000 were domiciled on the site, egg laying was approaching its peak and was commensurate with the size of the colony.

On June 6th a complete survey of the island was made. It showed that egg-deposition equalled the maximum ever seen on this ternery, also that there had been no removal or destruction of clutches. No rat holes nor other evidence of the presence of these predators were discovered. However, on the north end of the island, 14 long dead adults were found, presumably decapitated by a single owl. Despoilment by this bird ceased June 23rd with the death of its 39th victim.

The first chick hatched June 8th, three days earlier than in 1943, confirming the impression that nesting had been at least on schedule. June 10th and 11th were very cold, stormy days. On the latter, all other nesting sites in the Cape group's range with the exception of Plymouth, Ram and Bird Islands were visited and found to be absolutely unoccupied, accounting for the unusual concentration at Tern Island. Up to now this colony had fared so well it was believed a record-breaking chick yield would ensue.

Now began a series of events which terminated in a practically complete frustration of the Tern Island colony in its initial nesting. On June 9th there seemed to be fewer birds on the site than on the two preceding days, but no accurate estimate was made. On June 12th, after an absence of three days, it was certain that the population had shrunk considerably. When a staked out quadrant near the south end of the island was reached, it was seen that a number of marked clutches had disappeared. This suggested rat predation. Immediate search disclosed three rodent burrows in the nearby bank. As usual, this rat invasion was coincident with hatching now well under way. The burrows were gassed thoroughly and their entrances plugged. The following day was spent making a complete and minute inspection of the entire rookery. The rat holes found and gassed the day before remained closed, with no new openings nearby, which indicated the death of their occupants. No other rat holes were found, and the thorough plowing done in the early spring precluded the existence of hidden entrances. No empty nests were seen other than those already mentioned.

The size of the colony dwindled daily to 8,000 June 17th, to 4,000 at most June 26th. Concurrently, the behaviour of the colony changed rapidly and radically from a peaceful concentration on incubation, to the wildness which characterizes smaller or much disconcerted flocks. During this nine-day interval simple nest desertion, as shown by the presence of cold, unturned clutches, increased progressively. The aban-

donment was generalized and even over the entire island. No new rat holes were found on frequent searches.

Coincident with nest desertion there was an enormous chick mortality unprecedented in the Cape's colonies in both character and extent. Most of the young birds died within twenty-four hours after hatching, practically all others by the end of their second day. Since *hirundo* chicks are dry and able to run about eighteen hours after leaving the shell, it was significant that the dead young were found usually in the nests. That the mortality was not due to parental neglect or desertion was shown by adults continuing to incubate unhatched eggs in nests containing one or more dead chicks. June 22nd, when there should have been several thousand, there were at most 500 living chicks, not one seen over two days old. June 26th, following a two-day rain, even fewer chicks were found. That day the disappearance of some unhatched clutches was observed near the place where its first incidence had been noted June 12th. The three nearby rat holes had been reopened; in one of them were the partly eaten carcasses of four adult terns, but no chicks, eggs or shells. These burrows were gassed and closed. Two days later one appeared to be partly opened so it was retreated. These were the only times that repeated and thorough searches of the whole site revealed rat residence.

Population shrinkage continued with a drop to 3,000 June 28th, then to 1,000 July 2nd. The death of chicks in the manner described persisted; no live chick more than a few hours old was found on either of these two days. On July 2nd, it was found that a few of the clutches on the north end of the island had disappeared, but, as has been stated, there were no resident rats in that sector. So complete was the end result of the disruption and thwarting of this colony that only 63 chicks old enough to band were found in the whole season.

It is believed that a frustrated colony of terns always makes along fixed lines a second attempt to reproduce successfully. This had been demonstrated repeatedly preceding seasons following mishaps involving from a few birds to a whole colony. Although it was known that re-nesting birds do not repair to a site unless it is already at least sparsely tenanted by breeding terns, the other terneries on the immediate Cape were revisited even though they had been found to be birdless earlier in the season. Nowhere were the Tern Island *emigres* found, particularly at North Point, a location to which frustrated Tern Island birds had resorted numerous times in former years.

June 24th Plymouth was visited, a site utilized a few years ago by several thousand Tern Island birds dispossessed by extensive predation. Here were found 3,000, possibly even 5,000 birds. They were not concentrated, as in other years, on the dunes at the tip of the peninsula, for this formerly suitable terrain had been eroded and markedly deteri-

orated by the elements the two preceding winters. The terns were scattered for one and a half miles along the over-vegetated distal half of the point. Evidences of a small, earlier occupancy were found; some old scoop-holes, a small number of abandoned nests as well as a few egg shells broken in rat manner. This rodent is always present on the proximal half of Plymouth Point, invariably invading the nesting area some time during the season. That the present tern occupants of the place were recent arrivals was shown by the marked wildness of the colony as a whole, by a large number of newly made scoop-holes and by about 50 single-egged nests in that half of the tenanted area which was examined. A second visit was made to this ternery July 10th. There remained at most 500 individuals of the late June influx, far more of these on the shore lines than in the nesting area, at most 25 clutches of eggs and not one chick. In view of several similar precedents, it is believed that the large flock present June 24th were predominantly birds from Tern Island. For some unknown reason most of them did not renest at Plymouth but moved again to other rookeries.

The next site to be explored was Bird Island, June 27th. For some time this site has been occupied by a colony varying in size from 2,000 to at most 5,000 birds, one-half always being Roseate, *Sterna dougalli*. Although this flock is doubtless a member of the Cape Cod group, it has been self-sufficient and independent, but for the last three years it has been making a gradually increasing interchange of membership with the other Cape colonies. The population was found to be over 8,000, more than double what it was in 1943. Of greater significance was ascertaining that the ratio of Common Terns had risen to three or four to one Roseate. The island is small, not over five acres in extent, most of it heavily grassed leaving for use very little terrain of the type Common Terns prefer. Usually the only birds of this species found breeding on overgrown locations on the Cape, are older individuals which continue the precarious occupancy of sites they have used for a number of years, and that part of a colony which is so large that a sufficient amount of suitable territory is not available. This year nests were not only concentrated in close proximity on all the more open tracts, but they also extended in large numbers onto stretches of shingle made up of large stones and onto the surface of deep, dense mats of grass. The colony was visited again on June 29th, then a number of times later through July. In 1943, of the returns taken here, 18.7 per cent had been banded at Tern Island; this year the percentage rose to 44.1. The first two days of adult trapping here yielded six birds which had been taken earlier in the year at Tern Island including two mated pairs marked with colored celluloid bands. So it is evident that the increase in the ternery's population this year consisted of *emigres* from the Tern Island break-up. This inference is further war-

ranted by there having been no decrease in the population of other colonies to account for the Bird Island flock's doubled size. The colony had a most auspicious nesting unmarred by any mishap. It did much to make up for Tern Island's failure by yielding 2,950 chicks as well as from 1,000 to 1,500 due to hatch from the late renesting.

Nearby Ram Island duplicated the above detailed picture. Its normal population of 3,000 to 4,000 was reduced last year, for some unknown reason, to not over 1,000. This season it exceeded 3,000 when it was visited for the first time on July 3rd. Here, as at Bird Island, were found birds which had been taken earlier at Tern Island including two celluloid banded pairs. Prosperity characterized this nesting. Last year its chick yield was 282; this season it was 3,013 not including late hatchings from the extensive, late renesting.

Tern Island's disastrous first effort was not a finality. On July 2nd considerable new nesting was found at its extreme southern end. Little by little this renesting extended over the whole rookery, especially along the edge of the environmentally desirable west shore. On July 26th more than 3,000 birds were present. On July 28th, the date of our last visit, the clutches laid by these prodigals—as retrapping showed many of them to be—were still intact, incubation was being carried on but, of course, not with the intentness which characterizes either an initial nesting or one by a larger, more concentrated flock. It was not determined whether any chicks accrued from this belated effort.

From the sequence of events delineated it is evident that the Tern Island colony, as the break-up of its nesting progressed, divided into four groups. One group repaired to Bird Island and a second to Ram Island, both for eminently successful renestings. A third group went to Plymouth, remained there a short time, then departed without having started a comprehensive renesting. (Probably these are the individuals which returned to Tern Island in July, duplicating an event known to have occurred one former season. Substantiating this return is the recapture on Tern Island, late this July, of many breeding birds trapped there in May and early June.) The fourth group is composed of several thousand *emigres* which were not found in the three preceding groups.

Of the doings of this last group subsequent to the dispersal of the Tern Island colony there is no positive knowledge. It was found that they did not reneest anywhere within the limits of the Cape group's territory; their having joined "foreign" colonies outside its boundaries is too incompatible with their fixed behaviour in matters of this sort to be considered. Even Penikese Island, with which the Cape group has always had a tenuous affiliation, can be ruled out for never before had Penikese and the Cape's colonies made an interchange of

renewing individuals. Without precedent, during the first ten days of July, a considerable number of terns were observed fishing and idling a few miles offshore. It was too late for these birds to be newly arrived from the wintering grounds, too early for the inception of migration southward of either Cape group birds or members of colonies nesting north of the Cape. So, it is believed they were a part of this fourth group which either had been twice frustrated or had failed to reneat.

In preceding contributions by this station it has been shown that, over the years, the Cape Cod group of terns has maintained its population total at a fairly fixed level, annual variations being ironed out by adjacent seasons. The yearly failures or unusual successes of one or more of the component colonies are compensated by the yields of others. In spite of the gross abnormalities of the 1944 nesting, the Tern Island debacle in particular, the group's chick production was 41 more than it was from the relatively normal 1943 season. A comparison of the takes for the two years is shown in the following table:

	Chicks Banded	Adults Banded	Returns	Repeats	Total Takes
1943	5,962	2,573	3,408	623	12,566
1944	6,003	2,563	2,525	445	11,536
	+41	-10	-883	-178	-1,030

This 1944 nesting was characterized by only two occurrences previously unobserved in the Cape's colonies—the death at Tern Island of practically all chicks soon after hatching and the possible inability of a considerable number of frustrated individuals to reneat. All other deviations from a successful normal, even the complete failure at Tern Island, were repetitions of events incident to former summers simply with variations in the magnitude of the several occurrences and in their causes. Nevertheless, the aggregates of the abnormal and of the deleterious incidents were greater than in any former year. This unusual season confirmed the belief that the behaviour pattern of the Common Tern is so advantageously developed and also so adaptable as to insure reproductive success even under grossly disadvantageous conditions.

The initial alignment of the returned birds at the end of May was simply an advance in the recent drift toward consolidation. The greater part of the Cape group's constituency had gathered and become domiciled on Tern Island. One reason for this is that the colony tenanted the site is the trunk of the genealogical tree from which all the other colonies are offshoots. While group adherence, an important behaviour trait described in former contributions, was the underlying cause of the amalgamation, the ecological desirability of this rookery

may have been the determining influence. Although on superficial observation the Common Tern appears to be slow in reacting to changes, it does recognize and utilize improvement in environment. Tern Island, as the achievement of ten years of extensively constructive care, is overwhelmingly more advantageous than any other Cape ternery and has but one major detraction—its proximity to the mainland and to the rats in the fish shacks along that shoreline. The decadence of other nesting sites had progressed without regression; Egg and Billingsgate Islands no longer exist; Nausett Point has not rebuilt since it was washed away. North Point is level sand with no trace of vegetation to afford cover for chicks; Jeremeys Point and Plymouth have lost much of their desirable terrain. Fortunately, however, Ram and Bird Islands were improved by the scourings of two recent hurricanes and possess the advantage of absolute insularity. Both were well tenanted this year.

Twice in the last decade, first at Jeremeys Point, later at Plymouth (sites continuously but sparsely tenanted for a considerable time), the population suddenly mushroomed into a successful colony numbering several thousands. The mishaps in the other colonies immediately preceding and concurrent with the development of the new ones do not account adequately for these apparently unnecessary developments, particularly because there remained at Tern, Ram and Bird Islands sufficient unoccupied terrain to accommodate the members of the new colonies. Inasmuch as the group's population continued stationary, there was no excess of young birds to call for the pioneering of new terneries. So it is inferred that there existed at the usual nesting sites some unrecognized ecological deficiencies which were immediately responsible for the shifts to new locations. Both these colonies (Jeremeys Point and Plymouth) were short-lived—about three years each. The component birds, as shown by trapping data, then consistently followed their usual behaviour trend by returning to the colonies from which they had withdrawn temporarily until the environment had become again satisfactory.

Only once before had Tern Island failed to mature several thousand chicks. In 1932 the invasion of a large number of rats at a time when the site was so much overgrown that they were afforded perfect cover, resulted in a complete destruction of the entire hatch. (Austin, O. L., Jr., *Further Contributions to the Knowledge of the Cape Cod Sterninae, Bird-Banding*, Vol. III, No. 4, October, 1932.) Partial failures had occurred there from time to time but always from obvious causes. Usually they were due to predation, but once to molestation and once to extensive chick mortality during a severe storm. However, other smaller colonies have experienced practically complete failures of undetermined etiology, notably Jeremeys Point where, repeatedly, several thousand nesters raised less than a score of chicks. Similar frus-

trations are reported to have occurred off the Cape at Penikese Island and in colonies in the region of the Great Lakes.

The Tern Island catastrophe was characterized by two major events, first the unprecedented chick mortality, second, desertion of the rookery by almost the entire colony. Although both occurrences were fairly well synchronized, in almost all instances the death of their chicks preceded desertion of the ternery by the adults. However, this sequence of the two events continued only until the daily hatchings and desertions became so great in number that the remainder of the colony grew restless and began, not only an extensive desertion of unhatched clutches, but an abandonment of the few chicks which had survived for a few days.

In the annual breeding of the Common Tern, chick mortality is always large. At Tern Island in 1939, 21.5 per cent of the hatch was buried; in 1943 it was 22.1 per cent. Both figures are a little high by reason of an inability to include in the total yield the small number which escaped banding. Usually, only a few perish during the first two days after hatching; the highest death rate is during the second week. A considerable number of more matured dead chicks continues to be found until all birds of the year have departed from the ternery. The incidence is greater in big than in small colonies, for concentration increases most of its causes. Insularity of a rookery, by eliminating rodent predation, tends to lower mortality. As a general rule, almost all chicks hatched by small numbers of reneesting birds perish, especially late in the season, but paradoxically, when large, compact flocks make a second attempt, as at Bird and Ram Islands this year and at North Point and Billingsgate Island in preceding ones, the percentage of chicks surviving is more than twice what it is from initial nestings. It is believed that, in spite of the high death rate of chicks, the Common Tern will continue to maintain its population level so long as the average size of the clutches laid is not lessened. Nevertheless, it can be of serious moment if, by reason of mishaps, it is not compensated seasonally, or at least over a period of years. Chick mortality is due to a number of known causes, such as predation, violence, molestation, exposure and parental neglect; possibly to some which have not been proved as food shortage, diseases and constitutional weakness; also to others which have not been observed.

In the insular colonies, the common rat is the only predator known to victimize young chicks and its food preference for them is only slightly less than it is for unhatched eggs. Its voracious appetite means the consumption daily of more than one chick by a single resident rodent, for only small portions from the back of each victim are eaten. Its wantonness is even more destructive for always many more are killed, then either scattered around or accumulated in the burrows than

are consumed. Fortunately, owls never prey on birds of the year until the latter are able to fly, but the young of colonies nesting on either a peninsula or the mainland are often killed in considerable numbers by foxes, skunks and weasels. On several occasions the entire hatch of a good sized colony has been destroyed by these large predators.

In the course of a relatively undisturbed nesting a few chicks meet violent ends from being head-pecked by adults whose territory they have invaded repeatedly. While rare instances of it have been noted in small, diversified colonies usually it occurs to an important extent only in such large, closely occupied sites as Tern Island. Although it is the standard punishment used by parents in training their own offspring, numerous autopsies have demonstrated the lethal intracranial injuries a small amount of head pecking can inflict. It is the only violence to which chicks are known to be subjected routinely.

Once from Plymouth and once from Tern Island, setter dogs have been driven off after they had killed 40 or 50 young. In 1942 a party of juvenile vandals destroyed over 200 chicks and as many clutches at Tern Island. However, events of this sort are infrequent and their toll is of minor importance.

Exposure to the elements, excepting when predation is severe, is the most prolific, extrinsic cause of chick mortality. Although in most respects the Common Tern is precocial, its ability to withstand the elements is no greater than that possessed by species bred on more sheltered terrain. In the Cape colonies the chick death rate of the conesting Roseate Tern (*Sterna dougalli*) is more than fifty per cent less than that of Common Terns simply because the clutches of the former routinely are placed well under protecting vegetation and their chicks are given far less to venturing from their nests. It is perhaps for this reason, either as the cause or the result of the behaviour, that Roseate Tern clutches are consistently smaller than are those of Common Terns. During chick banding, when a number are found huddled under a plant or a clump of grass, the Roseates are always at the very bottom of the pile. Heat, cold, high winds and protracted rains alike overtax the physical resistance of young birds depending much on the degree to which counteracting brooding is carried on by the parents. Heat is far more destructive than cold which is why a colony is always more comprehensively grounded when the temperature soars. As a rule the number of dead found after prolonged storms is more than twice that seen during a series of fine days for wet plumage lowers body temperatures and resistance.

It is an important shortcoming in the behaviour of the Common Tern that chicks do not obtain for themselves the maximum possible protection against the elements; usually it is the result of parental neglect. As holds good for most avian species, the care and protection of their

young supersedes all other inclinations of parents, even the enhancement of their own personal safety. Nevertheless, very often sufficient protection is not given to forestall the functioning of some of the immediate causes of mortality. Such inattention is brought about by human intrusion into the nesting territory with resulting interruption of an orderly pursuit of breeding activities. Feeding and brooding are halted while frightened chicks stray too far from their nests to be rescued. No colony escapes intrusion, and some, like Plymouth, are subjected to excessive amounts of it almost daily; even to camps being located and tents erected in the very heart of the nesting area. This station, in order to obviate parental neglect, has found it necessary when working in a colony, to use a blind or to leave the nesting territory frequently and for a sufficient length of time to restore peace and allow adults to give their young adequate attention. Obviously, intrusion does the most harm on very hot days. In July many dead chicks 2½ to 3 weeks old are found, almost always on the edge of the nesting territory or well beyond it, probably victims of parental neglect.

It is desired to discredit the myth of food shortage so frequently asserted to be the cause of mishaps in tern colonies—including chick mortality—when credible findings are lacking. All who have reported food shortages—including the writer—have failed to append credible, substantiating data, for it is not indicated either by the absence of schools of the preferred sand-eels from the immediate vicinity of a ternery, by finding discarded, oversized fish in the nesting area or by the surface feeding on marine invertebrates frequently observed at Tern Island. To the Common Tern, a swift and tireless flier, distance is of small moment and since the feeding and brooding of chicks is done by both parents no harm results from the absence of either one for an hour or more in the acquisition of food, or of both excepting during inclement weather. Planned observation has shown that most of the time, food is obtained between one and four miles away from the terneries. When Egg Island domiciled a large colony, the feeding ground was an inlet one and one-half miles distant. Birds from Tern Island can be seen fishing in the equally distant shallows around North Point. From the vantage point of Chatham light, midway between, lines of terns may be seen flying from the island to the point and returning with fish. The Bird and Ram Island colonies are supplied from the vicinity of the mainland one to four miles distant. Excepting those crippled or obviously sick the 200,000 adult terns we have had in our hands were always plump and well nourished; were they hungry, large numbers of adults would not idle habitually along the shoreline of rookeries. Palmer in his monograph (*A Behaviour Study of the Common Tern*, 1943) gives a comprehensive summary of all that has been published concerning the food of the species, and shows how varied a

selection is made from items not on the preferred list. Additional observations could be recounted to substantiate the opinion that belief in the occurrence of a food shortage is the consequence of either sophistry or conjecture.

Unfortunately, practically nothing is known concerning the occurrence of disease in tern colonies; the question is so much a *terra incognita* that any opinion in the matter is essentially theoretical. The possibility that some acquired malady kills chicks cannot be gainsaid but no incident strongly indicative of this being a fact has been observed.

The offspring of all species vary in size and vitality, siblings are not identical nor do the successive progeny of any bird duplicate each other in these respects. Accordingly, since each individual must possess when hatched a fixed minimum of hardihood in order to survive, it is axiomatic that the chick mortality in any tern colony is determined primarily by the sturdiness of its young. It is equally incontrovertible that the death rate varies both in the several colonies and seasonally in direct relation to the character, potency and number of ecological and other hindrances encountered.

When the several known causes of chick mortality are correlated with the events of this nesting, it appears that neither any one nor any combination of all account satisfactorily for the Tern Island mishap, particularly for the death of chicks in the nests. Rodent predation was trivial and of short duration. After hatching was well started the weather was continuously propitious with no extreme heat. Deaths during the one intercurrent, two day storm were only slightly more numerous than before or subsequently. The only recognized deviation from the normal ecology of the site was a moderate sparcity of vegetation. This, however, was of no moment chiefly because most of the chicks expired before shade and shelter became requisite. Intrusion was reduced to a fraction of what it had been preceding years for this station's activities were centered on special work carried on with quadrats in three small sectors. For the first time in more than a decade adult trapping did not encompass the entire island at least once. When the excessive mortality had become apparent, special observations were made to determine possible parental neglect. It was found that, in spite of the marked wildness of the colony, incubation, feeding and brooding were carried on quite as consistently as usual. Repeatedly adults were seen incubating eggs with the hatched portion of the clutches dead in the nests. July 2nd, a pair of adults were retrapped while incubating eggs in the same nests from which they had been taken May 29th. This being nearly a week more than the maximum known incubation period, the eggs were broken and found to be spoiled. Since premature hatching does not occur in class Aves, emer-

gence this year could not have been before physical development had reached its normal.

With no demonstrable cause having been found, disease comes to mind intuitively as being an apt, explanatory source of the anomalous chick mortality. Nothing substantiating this can be offered excepting its plausibility while there are no cogent arguments against it. Hereditary disease is ruled out for being contrary to present day tenets; there is no known malady to which parents might have failed to transmit to their offspring the usual immunity. Any sickness acquired after hatching must have been endemic on Tern Island for no similar chick mortality occurred in any other ternery. Also it would have affected some of the adults and that was not the fact. Incidentally, the adult death rate at Tern Island this season, 1945, was within normal limits. At times, pathogenic organisms do become temporarily exceedingly more virulent. If tern chicks always experience a mild form of an ailment which, this year, became deadly, in view of the constant interchange of membership by the colonies not only would the incidence have been widespread in the Cape group but also, as is more significant, it would have persisted throughout the renesting.

It is possible, but visionary, that the Tern Island chicks, necessarily as a unit, this year possessed a much reduced physical inheritance. If this were true, the affliction would not have been visited on a single colony. Further, the second seasonal broods of the same parents should have fared at least quite as badly if not even more grievously.

Unless the occurrences incident to this season's nesting were not observed accurately and the various sources of chick mortality correctly evaluated, the real cause of the fatalities must remain unknown. This and other unexplained events have suggested repeatedly that there exist, unrecognized, important ecological desiderata which are the determining factors in some items of behaviour.

The disintegration of the Tern Island colony with dispersal of its component members was so closely correlated in incidence and progress with the chick mortality that both events would appear to have been of common origin. In former contributions it was postulated that mass site desertion results only from one or both of two mishaps—predation and frustration. The former, this year, was too insignificant in amount to have been causative but the latter began with the first hatchings and increased so rapidly that it promptly involved the greater part of the colony. Therefore the correct inference is that chick mortality was the essential cause of the Tern Island rout. Once started, it was patterned by behaviour trends and terminated with the extensive desertion of clutches in which embryonic development was found to be well advanced.

The predominant traits in the behaviour of the Common Tern from

the standpoint of their value in enhancing the welfare of this species are, in the order of their relative effectiveness, colonial nesting, group adherence, site tenacity, reaction to predation or frustration and renesting. Not only do all five work cooperatively but they also modify each other to the degree made necessary by the constantly changing events of a nesting. This is of importance because tern behaviour is far more a matter of habit than one of conscious cerebration. All have been defined in former contributions and their functioning under ordinary and some abnormal conditions have been described.

Group adherence is simply a corollary of colonial nesting, both trends probably having developed concurrently. So closely are they correlated that it cannot be postulated whether or not, and if so which anticipated the other. At present this type of nesting is more essential than is the preservation of the same membership in flocks; so, naturally, it has assumed dominance during the breeding season. However, group adherence continues to be of great importance to the welfare of the species for it has been found that reproductive success, when averaged for a decade with due allowance being made for inevitable variables, increases in proportion to the degree to which the Cape group's total membership is concentrated in the colonies. Likewise, when extensive renesting becomes necessary the better gregariousness is maintained, the more advantageously are the birds relocated on secondary sites. Recently this habit, stimulated by the disappearance or deterioration of several excellent rookeries, has effected a progressive concentration of the Cape group's birds into fewer and larger colonies. It culminated, this year, in the convergence to Tern Island of about two-thirds of the population. Although, as it turned out, this concentration was responsible in the initial nesting for a great elevation of the percentage of chick mortality, ultimately the trend which led to the concentration accomplished a satisfactory seasonal chick yield. In view of the known failure of small colonies to raise chicks in the same ratio to the number of breeding adults present as large ones do, had Tern, Ram and Bird Islands been tenanted in either the first or second nestings by their usual populations and the remainder of the group's components scattered through lesser terneries, the total chick yield would have been much smaller. Group adherence obviated this by amalgamating into a few large flocks the completely frustrated Tern Island birds and relocating each in another big colony. Leadership and flock dominance played a very small, if any, role in the procedure for, other than older birds being first to nest and most consistent in site tenacity, there is nothing to suggest the existence of class distinction in tern colonies.

It must not be inferred that all members of the Tern Island colony were clearly orientated concerning misfortune which either had happened or threatened. When a sufficient portion of the colony had been

frustrated to make concerted readjustment necessary, most behaviour trends, even loyalty to clutches suffered unreasoned subjugation to an urge to maintain the colonies alignment when renesting followed in other terneries. It might be argued that concerted action is a simpler and equally credible explanation. In rebuttal is the fact that this is of rare occurrence in tern behaviour (Austin, *Bird-Banding*, Vol. XVI, No. 1, January, 1945, p. 25) and takes place only in a ternery itself or the immediate vicinity. Preseasonal and postseasonal migration as well as intraseasonal membership changes in the colonies are carried on by small flocks of a few individuals. The Tern Island expatriates were reunited at Bird and Ram Islands by the same mental processes which reunite returning birds in the Cape's colonies each May. The above, together with no other unnarrated interpretations of the season's events appear to suggest that group adherence is too firmly established a habit to be deviated from even under unusual circumstances.

Perhaps the most convincing evidence of the existence and potency of group adherence is an analysis of the captures of what this station designates "foreign birds"—individuals banded outside the Cape group's territory. Unfortunately, very little adult trapping is done elsewhere to indicate the number of Cape banded birds nesting in foreign colonies. The Fish and Wildlife Service files show that only eighteen Cape banded birds ever have been taken elsewhere in the United States during the breeding season; only five of these in nesting colonies. One was found dead at Brant Beach, New Jersey, July 13th, 1936, four were taken at Weepeket Island, Gosnold, Mass. Between 1938 and 1944 inclusive a total of only 55 birds banded elsewhere have been taken on the Cape, the average being 7.1 for a year; 9 of the 55 came from the Great Lakes region. Not included is the average annual capture of 24 birds banded at Penikese Island, almost all of them being trapped at Ram Island, Bird Island and Plymouth which are close to Penikese Island. That colony, definitely, is not a member of the Cape Cod group, also the number from that ternery taken yearly is too large to suggest their having become affiliated in the manner usual for foreign birds—mating on the wintering grounds. The 55 birds constitute a mere 0.0023 per cent of the total returns and recoveries in the seven-year period. From 0.0011 per cent in 1938 it increased gradually to 0.0059 in 1943 but dropped to 0.0023 this year with the capture of the average seven individuals.

A first, casual opinion might be that the trait termed site adherence exerted small influence on this season's events; quite to the contrary, if its essential characteristic rather than its minor details is considered, it is seen to have contributed more than it usually does toward fashioning a nesting. Its essence is not the return of a bird to the exact spot of its former tenure but rather an individual's utilization of nesting sites

in exact relation to the degree of its former associations with them. Subservient to more powerful trends and especially sensitive to ecological changes, it functions far better in governing the action of flocks than of a single bird. A large majority of the Cape's Common Terns were hatched at Tern Island and subsequently have nested there. Also, as their records show, a considerable percentage of the terns hatched elsewhere have located or renested at Tern Island at least once in their lifetime. This is one of the reasons for the unusually large congregation at this rookery in early May. That the majority of the Tern Island birds chose Ram and Bird Islands for renesting does not indicate an overestimation of the influence of this trend. North Point and Plymouth, from the standpoint of previous attachment, were the logical first choice for many times large aggregations from Tern Island had resorted to these sites. Several thousand did go to Plymouth at once even though they did not stay there. Obviously environmental conditions at Plymouth and North Point were too unfavorable to warrant their occupancy.

There is seldom a year when, from one cause or another, the chick mortality incident to the first nesting of one or several of the colonies does not exceed greatly its normal rate. Were this not offset there would result, necessarily, a progressive shrinkage in the group's total population. The simple expedient of renesting precludes this adequately. Fostered by repeated frustrations, renesting has developed into a fixed habit free from known inhibitions. While it is impossible to determine the doings of every breeding adult throughout a season, the consistent repetition of many suggestive incidents have led to the opinion that practically all thwarted Common Terns make a second seasonal attempt to raise chicks. Newly laid clutches are found even late in July when the chance of chick survival is negligible. That second clutches usually are laid within a week after failure shows that this trend is anything but a dormant trait. This year, the Tern Island failure would have resulted in a serious minimization of the Cape group's chick yield had not a prompt, extensive and advantageously fashioned renesting obviated it most successfully. In a preceding paragraph a suspicion was expressed that several thousand members of the dispersed Tern Island colony failed to renest. If this is a fact, it is believed that the occurrence was due to a transient physical incapacity and not to any lessening of the urge to renest. Never before had a similar event been observed in the Cape's colonies.

Realization of thwarting is prerequisite to any subsequent readjustment to it. Luckily, frustration is one of the few occurrences which terns appear to recognize and evaluate promptly. Mental keenness is not characteristic of this species, and memory appears too frequently to be short lived. For example, the same birds continue to lay eggs year after year where always they are washed away by the first spring

tide which follows. How prompt and comprehensive reaction is to failure, depends on the number of birds involved, for reaction grows geometrically as the number of birds involved increases. Rat predation is the particular mishap to which a colony takes prompt and extensive counteraction, probably because it so rapidly defeats the purpose of most of the membership. It is reasoned that this year's almost complete emigration from Tern Island was due to the speedy frustration of almost the entire population.

The assumption of territory and the protection of its tenure occurs to a varying degree in all colonies of nesting Common Terns but it is a far less dominating trait than ornithologists have found it to be for many other species. In the organization of a ternery, the older as well as the more consistently returned birds first choose nest sites, usually in the immediate vicinity of their preceding holdings. No fixed amount of terrain is required by individuals and those nesting later are permitted to locate between the preempted sites. The degree of concentration and the proximity of nests are determined by the number of individuals present, the amount of land available and especially by the ecological desirability of its sectors. During this formative period there appears to be little if any resentment of intrusion, but once the colony is well domiciled, and especially after complete clutches have been laid, trespass is not tolerated. Further, this behaviour increases markedly when chicks have replaced the eggs. This applies far more to large, compactly nested colonies than to others where the nests are scattered widely. No credible reason for this assumption of territorial rights has been discovered. Food supply is no factor. Contrary to Pettingill's experience with Arctic Terns (*History of One Hundred Nests of Arctic Tern, The Auk*, Vol. 56, October, 1939) the destruction or stealing of eggs by Common Terns has not been observed in the Cape's colonies. The only times when three adults have been taken from one nest have been when an adjoining nest was so close the trap could have fallen easily on occupants of both. The welfare of chicks plays no part, for so persistently do they leave the parental domain that, evidently, they are unaware of the existence of its boundaries. Accordingly it is probable that the assumption and protection of territory is simply an unnecessary continuation of a habit of untraced origin. The correctness of this concept is further suggested by the readiness with which this behaviour trait is abrogated. At the time when the disruption of the Tern Island colony was well started, Bird Island was thoroughly occupied by its usual tenants, all the desirable tracts were closely nested and extensive egg laying had been done elsewhere. Hatching had begun there even before the emigration from Tern Island had reached its peak. In spite of this, over a period of about ten days, the colony doubled its size by giving sanctuary to several thousand renesting birds from Tern Island. Certainly even a

moderate functioning of the behaviour trait under discussion would have prevented this unusual invasion.

The foregoing appears to indicate that the Common Tern is not over-specialized, not even highly specialized and that its advantageously developed behaviour pattern although characterized by several strong traits, remains sufficiently pliable to successfully cope with unusual adversities of dangerous magnitude. Assuredly the evaluation of any behaviour pattern should be from the standpoint of its ability to maintain a species' population at a safe level regardless of any depletions which may occur. This, the Cape Cod group was able to do in its 1944 nesting by resorting to one potent behaviour trend and modifying all others in ways best suited to assist in its consummation. North Eastham, Cape Cod, Massachusetts.

NAMES OF AGE GROUPS OF YOUNG BIRDS

By HAROLD B. WOOD

A uniformity in the terminology of age groups of young birds has always been desirable. Several terms have long been used to denote the approximate ages of young birds, and have been so confusing and overlapping that some have been adopted where they clearly do not belong. These terms are nestling, fledgling, juvenile, immature and young. The word nestling dates back to 1399, juvenile was used by Bacon in 1625, and the fledgling bird was sung by Tennyson in 1830. These different age groups vary in length, respectively, from a few days, to some weeks, to several months, and to from one to three or more years, depending upon the species. This nomenclature of age groups has long concerned ornithologists, who can and should coordinate their ideas into the adoption of systematized definitions. These are essential but for two entirely different purposes, for ageing banded birds and for museum specimens. Whereas the bird bander must judge by the single specimen in hand, the preparator of bird skins has cranial or other anatomic characteristics and comparable plumage specimens to aid in his identifications. The appearance of the plumage, its stage of development and coloration are the principal factors upon which the judgment for classification must depend for banders. Other developmental characters include such items as the color of the iris or markings about the bill, but the bander may have difficulty in determining the condition of the fontanel. While for the collected specimen it may be desirable to note the stage of molting in transition, with banded birds it is only necessary to make a record as of a completed molt. The