BIRD-BANDING

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FURTHER CONTRIBUTIONS TO THE KNOWLEDGE OF THE CAPE COD STERNINÆ[1]

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THE nesting of the Terns on Tern Island at Chatham, Massachusetts, has always been remarkable for its earliness. Banders have been amazed to find young birds almost ready to fly early in July, when on all the other near-by rookeries the eggs were still being incubated. Indeed, the Terns lay their eggs here long before they have started courtship proceedings on Muskeget and Penikese, and even prior to the normal season at Cobb Island, Virginia, far to the southward. This phenomenon has yet to be explained satisfactorily. It must be a reaction to local environmental conditions, but the factors responsible for the variance from the normal are not yet evident.

The spring just past was comparatively a late one. The Terns arrived off the Chatham coast, according to the fishermen who make daily trips to the outside cod grounds, on April 20th, and remained off shore as the flocks increased in size, until suddenly, on April 26th, they "came to land" at Tern Island. They flew around the island and rested on the neighboring beaches and sand-bars for two days, and then returned to fish on the outside shoals for another week. They returned to commence their nesting activities on May 3d, but only in about one third the numbers usually present in the rookery at the height of the season.

THE EXPERIMENT ON THE NESTING AT TERN ISLAND

The past four years have witnessed a steady increase in the amount of ground covered by beach-grass on Tern Island and a steady decrease in the patches of open sand. Not only has the grass encroached on the open areas, it has also increased remarkably in height and thickness, no doubt encouraged by the heavy fertilization it receives each summer from guano,

[1]Contribution No. 11 from the Austin Ornithological Research Station.

dead fish, and dead birds. In 1928 there were about five acres in the center of the rookery almost free of vegetation. Today this is reduced to not more than a single acre. All over the island the grass is higher and thicker than ever before. I commented in a previous paper[2] on the fact that the Roseate Terns limit their nesting on Tern Island to the heavily grassed areas, while most of the Common Terns nest either in the open, or else in the sparse grass. The Common Tern chicks hatched in nests in open areas always take cover in the grass a few days after emerging from the shell. A certain amount of vegetation is necessary to the welfare of the terns, to provide the young birds shelter from the hot rays of the sun. But too much grass may be ecologically unsuitable for both species, for not only does it make nest-building difficult, but it affords cover for predatory animals such as rats.

Primarily to determine the relationship between the vegetation and the nesting of the Terns, three sample quadrats were laid out in the rookery on April 22d, before the birds first came to land. Three squares, ten meters on each side, were marked out by pegging down inch-wide strips of canvas on the ground with long wire staples. The first was placed in the heavily grassed section of the rookery, where, when the beach-grass was slightly sparser, the Roseate Terns used to breed so successfully. The next was staked out in the center of the last remaining sandy opening. The third was laid in an area recently covered with a few sparse patches of beach-grass.

A fourth quadrat was also laid out, in territory ecologically similar to the last, partly open sand and partly sparsely grassed, which was used primarily for experimental work and close observation on the individual nesting territorial relationships. The birds in this quadrat were more or less continually disturbed by our activities, with the result that fewer pairs nested in it than on the other ecologically similar plot a hundred yards away.

As the Terns commenced selecting nesting sites, the quadrats were mapped, and from the time the first egg was laid on May 23d, the quadrat nests were checked at regular intervals until the final disappearance of the last egg and chick on July 10th brought the breeding season on Tern Island to a close.

The first, or normal laying of eggs commenced on May 23d, and was completed by May 31st. At this time the totals were

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[2]*Bull. Northeastern Bird-Banding Assoc.*, Vol. V, No. 4, pp. 133.

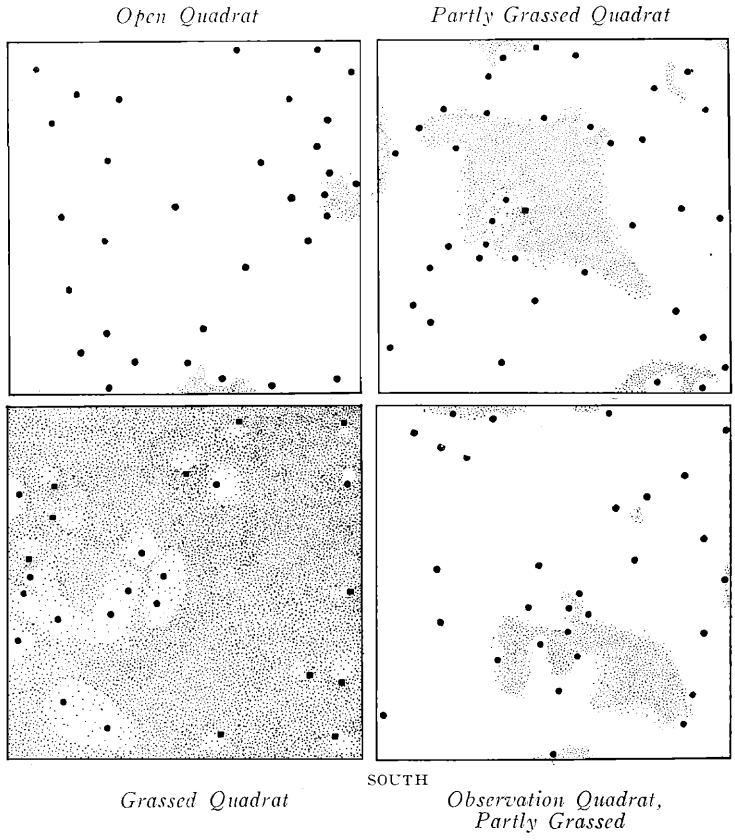

FIGURE 1. SHOWING THE FOUR TEN-METER QUADRATS ON TERN ISLAND.

LEGEND { Nests of Common Terns Represented by Round Dots.
Nests of Roseate Terns Represented by Square Dots.
Stippled Areas Represent Beach Grass.

Grassed quadrat	25 nests	47 eggs	average 1.9 eggs per nest
Open quadrat	32 "	83 "	" 2.6 " " "
Partly grassed quadrat	38 "	106 "	" 2.7 " " "
Partly grassed observation quadrat	30 "	75 "	" 2.5 " " "

In the heart of the largest patch of grass in the center of the partly grassed plot was one nest of a Roseate Tern. In the grassed quadrat fourteen of the nests were of Common Terns, eleven of Roseates. The open plot and the observation plot contained only Common Terns.

It is obvious that the heavily grassed condition is not preferred by the Common Terns, though it is evidently more or less essential to the Roseates (on Tern Island at least; on other rookeries, notably Muskeget, the Roseates as well as the Commons are known to nest in the open). The absolutely grassless condition, while infinitely preferable to the heavy grass, is in turn excelled by the partly grassed sites.

Broken and deserted eggs began to appear on the quadrats shortly after the laying commenced, but not in sufficient numbers at first to cause any alarm. By June 2d, it became apparent that the breakage was abnormal, and from then on the eggs continued mysteriously to disappear. As they disappeared, new nests and eggs appeared, evidently second layings, and they continued to appear throughout June and the first part of July in all except the heavily grassed quadrat, where no second nesting was attempted. Counting all the eggs laid in the quadrats from May 23d until July 10th, the totals were:

Grassed quadrat	25 nests	47 eggs
Open quadrat	50 "	130 "
Partly grassed quadrat	67 "	165 "
Partly grassed (observation) quadrat	71 "	161 "

The only eggs to hatch were those of the first laying. Not a single egg hatched of the many that were laid in June and early July. The percentage of eggs to hatch in each plot varied in inverse proportion to the amount of grass present, thus:

Grassed quadrat	47 eggs laid	15 hatched	32%
Partly grassed quadrat	106 " "	55 "	52%
Partly grassed (observation) quadrat	75 " "	57 "	76%
Open quadrat	83 " "	75 "	90%

This ratio indicates that the grass is a decidedly detrimental factor. The difference in the percentages of hatch in the two partly grassed quadrats may be partly explained by the fact that the destructive agents had less opportunity to act on the observation plot, because it was farther from the heavy grass and slightly more open.

The duration of the period of incubation may be estimated most conveniently and most accurately as extending from the date of laying of the last egg in each nest to the date of hatching of the last young in that nest. In the grassed plot, the amount of incubation received by the eggs in each of the eight nests in which chicks were hatched was as follows:

Days	*No. of Nests*	
21	1	
22	1	
23	3	
24	2	
25	1	Average 23.1 days per nest

In the open plot the thirty-one nests in which chicks were hatched were incubated:

Days	*No. of Nests*	
21	1	
22	1	
23	0	
24	3	
25	12	
26	9	
27	3	
28	1	
29	0	
30	1	Average 25.4 days per nest

In the partly grassed observation quadrat the twenty-seven nests bringing forth chicks hatched in the following times:

Days	*No. of Nests*	
24	3	
25	5	
26	11	
27	5	
28	2	
29	0	
30	1	Average 26 days per nest

The other partly grassed plot had chicks hatched in twenty-nine nests as follows:

Days	*No. of Nests*	
23	2	
24	4	
25	6	
26	12	
27	3	
28	2	Average 26.2 days per nest

Taking into consideration the ninety-five nests in which chicks were hatched (see graph), we find the period to vary from twenty-one to thirty days, with an average of 25.7 days. It is noticeable that the period averages markedly shorter in the

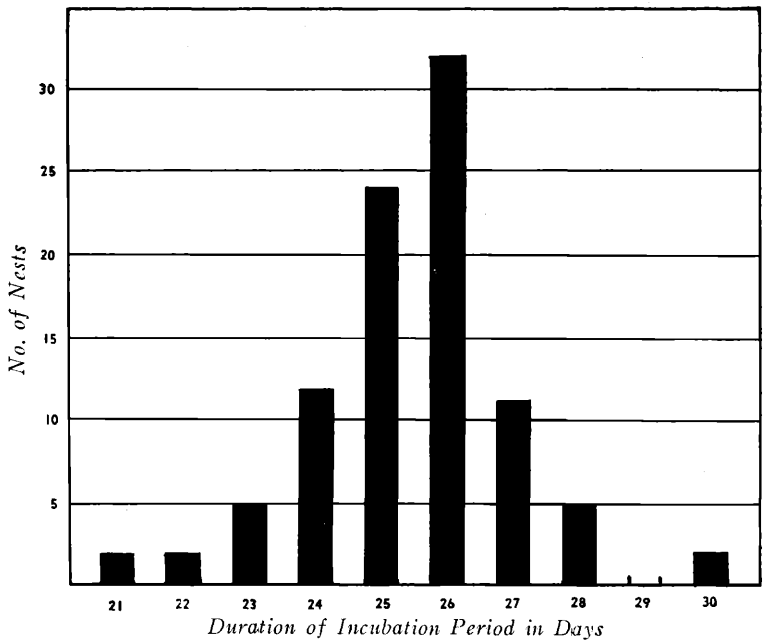

FIGURE 2. HISTOGRAM SHOWING DURATION OF INCUBATION PERIOD IN NINETY-FIVE NESTS.

heavily grassed quadrat than in the other three. This is doubtless because the birds were disturbed there by our activities less than in the more open plots, where more trapping was done and the birds were considerably wilder. Incidentally, these figures likewise refute the hypothesis occasionally advanced that the eggs of Terns may be incubated in part by the sun. The eggs in the open quadrat received much more heat from the sun's rays than those in the grassed plot.

The first young Terns hatched out on June 12th. Between then and June 30th there were banded on the rookery, including the 202 quadrat chicks, 1716 young Common Terns and 38 young Roseate Terns. By June 18th it was obvious that something was destroying the chicks, for the banded birds began to disappear as mysteriously as had the eggs. Very few dead birds were found, and only unbanded, newly hatched chicks were encountered. No young were found more than four days after banding. The grass was combed for them unsuccessfully. One quadrat was surrounded with a fence of

inch-mesh chicken-wire eighteen inches high to keep the chicks from straying, but they disappeared from this as rapidly and as mysteriously as from the rest of the rookery.

House rats were undoubtedly to blame for a large percentage of the damage, but it is probable that they were not entirely responsible. In April a careful combing of the island revealed no signs of rats whatsoever. The first evidences of rat work were found on May 14th,—an adult Tern freshly killed and partly eaten. The following day the whole island was poisoned thoroughly with red squill, but no dead rats were found afterwards. A second broadcasting of poison baits on June 6th had no results. There was such an abundance of food available in the eggs that almost no baits were taken. Then with the burning of the Chatham town garbage dump a half-mile away during the second week in June for the first time in years, the influx of rats was marked. The thickness of the grass gave them such good cover that it was impossible to combat them in any way. On July 6th, when during previous years the island was always literally alive with chicks in every stage of development, and was enveloped in a white cloud of busy adults, this season it was, well, just a grass-covered sandy island. We found a mere handful of eggs, no chicks whatsoever, and we counted but 150 wary adults present! By June 10th these last hardy remnants had gone, and, except for the rustling of the rats in their runways under the grass, the island was quiet.

BEHAVIOR DURING COURTSHIP AND INCUBATION

Although the breeding season for the Terns on Tern Island was unsuccessful, it proceeded more or less normally from the start of courtship through the incubation period. Ten feet from the partly grassed quadrat which was used for territorial studies, an observation blind was built where it would not interfere with the natural course of events on the plot, but would still provide a good vantage point for close observation.

The birds came to land on May 3d. I do not believe that many, if any, were paired off at this time, for the ensuing week was taken up with the selection of mates. There are many angles of the sexual activity which are still hidden from us, and to investigate them is not easy. In the first place there is so much taking place at once that it is difficult to focus attention on the actions of a single pair. Secondly, the lack of sexual dimorphism makes it necessary to judge sexes by actions alone, and inasmuch as the sexes in the terns are very

balanced psychologically, and each shares the work attendant to reproduction, the only infallible clue we have to the sexes of the birds is the act of copulation, during which the male is always dorsad to the female. The copulation is not begun until two weeks after the birds arrive on the nesting grounds. Nevertheless, our knowledge of the habits of other species gives us a few clues as to the probable sexual identity of the individual terns.

It is notable that the adults commence to carry fish to the rookery when they first arrive, and that they continue to do so regularly until after the young are able to fly. Theoretically, until the young are hatched only the male brings in fish, but it has yet to be proved that the female does not. Although food is actually necessary on the rookery only when there are hungry young to be fed, the act of bringing it in is intimately bound up with the courtship and the incubation. It is undoubtedly a secondary sexual impulse most probably impelled and controlled by the gonad hormones.

When the birds arrive, the first duties are the selection of mates, and the choosing of territories. The two are evidently accomplished at the same time, the former very definitely, the latter but vaguely. While the two acts are intimately bound together, it is difficult to say which sex, if either, is the dominant one. There is no selection of a territory by the male, to be occupied by the female later, as occurs in so many Passerines. If one holds the bringing-in of fish to be limited to the males, selection of mates is certainly done as much by one sex as another. Both sexes arrive together, and one observes two females dancing around one male as frequently as two males courting one female. At first the courtship dance is almost as frequently a trio as it is a duo, but it soon narrows to a single pair. The dance is usually performed while one of the pair (presumably the male) holds a fish in its bill, but frequently occurs without it. While uttering a continuous, throaty chuckle, both sexes circle about on stiff legs, head cocked slightly to one side, the feathers of the high-arched neck ruffed into a graceful curve, wings held away from the body at a stiff angle with "elbows akimbo" and ends dragging in the sand, the tail pointing skyward. After about thirty seconds of the dance, in which the female may make several unsuccessful attempts to take the fish, the male gives it to her. They chuckle contentedly, relax to a normal posture, and one, or both, usually flies away.

It is difficult at this early stage to determine the extent to which territories are selected, for it is impossible to trap and mark the birds individually until nesting activities are begun.

However, there were on the quadrat several birds already banded which were observed to alight in approximately the same place again and again. In general each of these tended to stay in a somewhat localized area, roughly twenty feet in diameter. There was very little actual bickering and fighting, and nothing occurred that could be interpreted as the driving-away of intruders.

The colony increased in size daily as more and more birds arrived. On May 9th, six days after the first ones came to land, a new activity commenced. The birds started to hollow out their nests. That this act is primarily a secondary sexual reaction, and is not done purposefully with the future need for a nest in view is quite evident. The digging procedure is intimately connected with the other courtship antics. Many nests are started, hollowed out completely, and abandoned before the eggs are laid. Both sexes share the digging, which starts at a low intensity, and increases in frequency and vigor as the season progresses and the days of egg-laying approach.

A slight, wind-blown depression may be selected as the nucleus of the nest, and not infrequently a footprint in the sand is utilized. Otherwise the bird makes its own depression by squatting on the ground and rotating its body, scooping out sand with its feet. The hole once started, the bird deepens and shapes it. Resting its breast in the middle of the hole, it pushes sand out behind by paddling its feet alternately. Each pair starts several holes, sometimes as many as six, both birds often digging in different places at once. The digging act is frequently prefaced by a short strutting and feeding. Not infrequently one bird of a pair leads the other to a hole, which both inspect. One of them finally enters it to shape and dig. After a moment or so of work, it may rise, walk to another depression, and continue digging, while its mate enters and commences to dig in the hole just vacated.

At this stage it is possible to catch the adults by setting drop traps over the partly finished holes. As each bird was captured, it was marked by a combination of colored celluloid bands, which made individual identification not only positive, but comparatively easy and simple. It was then observed that while each pair of birds had established its nesting territory in a general way, territorial rights were not yet strictly enforced. Each pair of birds had its own series of nesting holes, but neighboring pairs frequently dug in the same depressions, and individuals were often observed to alight fifty feet from the holes they were digging, and to walk unmolested past other digging and

courting birds on their way to what eventually they made their "homes."

There is a definite relationship between temperature and sexual activity in the Terns. On cold, cloudy or drizzly days, the birds stand about passively, and the courtship is limited to a little desultory strutting and feeding. Their territorial sense is dulled, and they do not attempt to repel intruders, either human or avian. But when the sun shines hotly and the winds die down, they react violently. They court feverishly, dig happily at their nests, squabble and bicker among themselves about boundary rights—in increasing vigor as the season progresses —and dart ferociously at any human being who ventures near their nests.

After about a week of intense courtship, the male is observed to alight on the back of the female and stand there quietly for a short time. This stimulating procedure occurred commonly all over the quadrat for the first time on May 16th, but not once that day was a female observed to become receptive so that a union could be attempted. Usually the male stood passively for from a few seconds to a full minute, and then flew away. In one case a pair danced about each other, the male with a sand-eel in his bill. After thirty seconds of strutting, the male hopped upon the female's back. Both stood passively for about thirty seconds more, and then the female reached backward with her beak and took the minnow from her mate. Both immediately flew away. When they returned ten minutes later, they turned their attentions to scooping out nest-holes.

On May 17th this pre-copulatory activity increased, and culminated in some cases in successful mating. While the act of copulation is evidently attempted unsuccessfully many times before the union is effected, I did not observe one pair complete the act more than once, nor attempt it again after once completing it.

During the next five days these activities waxed and waned with the varying weather conditions. On May 23d the first eggs were laid. In the observation quadrat five eggs were deposited, one in each of five nests. By the 24th there were twenty-four eggs present in twenty nests, on the 25th thirty-nine eggs in twenty-five nests. The increase was regular until the 31st, when seventy-five eggs had been deposited in thirty nests.

The normal clutch in the Common Tern is three eggs, though frequently but two, and in two cases four, were laid. The rate of deposition varies exceedingly. It is rare that one egg is laid each day until the clutch is completed; usually two, and in

five instances four days elapsed between layings in each nest. Generally the parents do not incubate until the clutch is completed, unless the sun is exceptionally hot or there is danger of the eggs cooking if left uncovered.

Immediately after the laying of the eggs the behavior of the adults changes. There is no more strutting, but one (the male?) continues to feed the other on the rookery. Both sexes share the incubation duties, though to what extent each broods the eggs is still unknown. There seem to be no set times of the day for each bird, but rather a happy, careless spirit of haphazard coöperation. This was brought out forcibly by the trapping. One bird of each pair (presumably the female) is always much more eager to incubate, and overcomes its fear of the traps more quickly. The mate is always more difficult to catch, and presumably incubates only when the other is not around. Numerous times I have set a trap, to have the first owner of the nest to return show fear of it, walk round and round it, hesitatingly poke its head under the wire, and withdraw in fright. But when its mate returned a few minutes later, the newcomer walked right onto the eggs with no fear at all. Time and again the changing of the incubators is observed. The incubating bird is joined by its mate, which stands by quietly until the eggs are vacated for it, upon which it takes up its share of the work. I once saw a bird entreat its mate to incubate. Its actions, as it arose from the nest, waddled to its loafing partner five feet away, and nudged it up to the eggs, said plainer than words: "I've been here long enough and I'm cramped and hungry. Get on there and get to work. It's your turn."

As incubation progresses, territorial relationships become more and more pronounced. Birds alight closer to their nests, or on obviously neutral ground, and brooding individuals leave their nests to drive off intruders. The importance of sex in this regard is again apparent, for the hotter the day, the more finicky are the birds about trespassers, and on cold days, they seemingly do not care who goes where.

Two nests in the observation quadrat were but eighteen inches apart; these were the closest together of any I observed. I had caught and marked both adults on the first nest, and one on the other. A trap was set on the second nest to catch the non-banded bird. One of the first pair returned at once to incubate a foot away from one edge of the trap. The unbanded bird evinced fear of the wire cage. Its banded mate was absent. After circling the trap several times, starting to go under and backing hurriedly away, it suddenly attacked the

incubating bird next to it! Both birds flew up, the intruder was vanquished, and the incubating Tern returned to its eggs. This occurred five times in ten minutes. Then, fearing possible injury to the eggs by the sun if I kept the bird away from its nest much longer, I removed the trap. Both birds were back incubating their rightful eggs in perfect amity the moment I retired to the blind.

CONCERNING RETURNS

As much time as possible was spent during the past season in trapping adult terns, mainly in the hope of procuring returns. By means of drop traps set over the nests, 1322 adult Common Terns were taken, of which 83, or 6.3 per cent proved to be returns. Thirty-seven of these birds were banded originally as adults during the past four seasons, while the remaining 46, or 3.5 per cent of the whole, were banded as nestlings.

There have been banded on Tern Island and the other Cape Cod rookeries, in the ten seasons from 1922, when the work was started, up to and including 1931, 30,910 juvenile Common Terns. Adults have been trapped only since 1928. In the four seasons preceding the one just passed 1230 adult Common Terns were banded. Thus there have been banded twenty-five young terns for every adult, and, were the mortality rates equal for each group, it would be logical to expect the ratio to hold in the birds captured as adults. But among the returns there are but 1.4 birds banded as juveniles for each one banded when adult. To express it another way, of the birds banded as adults, 2.8 per cent were retaken this past season, while of the thirty-thousand odd banded as juveniles, but .1 per cent were captured. This is simply another indication of the high rate of mortality in Terns during their first year, and the comparatively low rate after maturity is attained.

From the distributional standpoint this year's returns of Common Terns are very enlightening. Returns in the past have fallen into the following categories:

1. Terns banded as juveniles on Tern Island and recaptured nesting on Tern Island.
2. Terns banded as juveniles on Tern Island and recaptured nesting on other near-by rookeries—Billingsgate Island, Hopkins Island, and Pamet River.
3. Terns banded as adults on Tern Island and recaptured nesting on Tern Island during following years. Likewise Terns banded as adults on the Billingsgate Island,

Hopkins Island, and Pamet River rookeries and retaken breeding in subsequent seasons on the same rookeries where they were banded.

The logical inferences from these returns are:

A. Terns may return to breed on the island on which they were reared.

B. Terns may return to breed in other rookeries in the general vicinity of the one on which they were reared.

C. Terns may return to breed in the same rookery in successive years.

This summer Terns banded as juveniles on Tern Island were recaptured, in addition to the localities named above, on Egg Island in Lewis Bay, on North Point (formerly known as North Beach), Chatham, and in the new colony in Nauset Marsh. One Tern was captured on Tern Island which was banded in July, 1925, as a juvenile bird in the colony at the north end of the Cape Cod Canal in Sandwich, thirty miles away. This rookery is only five miles farther westward from Tern Island than the Pamet River rookery is northward, but the return is of special interest because it is the first and only one of a bird banded elsewhere as a juvenile to be recaptured on Tern Island. Of more importance among this summer's returns are cases falling into the following category:

4. Three Common Terns banded as adults at Billingsgate Island in 1929 were captured breeding on Tern Island. Two birds banded as adults in 1929—one at Tern Island, the other at Hopkins Island—were taken in the Nauset Marsh colony. Seven Terns banded as adults on Tern Island—one in 1928, five in 1929, and one in 1931—were captured on nests at North Point, Chatham.

From these we may make a fourth inference, that:

D. Common Terns do not always return to the same rookery to breed in successive years, but may nest on other rookeries in the general vicinity.

There is a strong individual tendency in Terns, however, once they have established their nesting territories, to return to the same rookery to breed year after year. In every case but one of the recaptures enumerated above, the breeding sites where the birds were originally taken were not habitable at the time the birds were recaptured elsewhere. Hopkins Island still affords some surplus available territory, and the nesting there was a success this year, so there is apparently no reason why the bird which nested there in 1929 should have gone to Nauset Marsh, unless, of course, ecological conditions there seemed more suitable to its fancies. But the site of the 1929 rookery

at Billingsgate Island has washed away completely, and on the narrow sand-bar which has made up to the eastward of it there is not space for one tenth of the birds which occupied the old site, and the Tern Island birds were forced to look for a safer place to nest after the wholesale destruction of their first brood.

That the Tern Island birds did go to other rookeries and attempt to rear second broods after their first ones were destroyed is proved by the following eight returns. Each bird was trapped originally on a nest at Tern Island, and each one was captured from twenty-four to forty-two days later incubating eggs on its new site.

Banded at Tern Island	*Recaptured*	
on	*Place*	*Date*
June 6, 1932	Nauset Marsh	July 1, 1932
May 29, 1932	North Point	July 9, 1932
June 4, 1932	" "	"
"	" "	"
"	" "	July 10, 1932
June 5, 1932	" "	"
June 8, 1932	" "	July 8, 1932
June 15, 1932	" "	July 9, 1932

Thus it is evident that existing ecological conditions are of greater importance in determining the distribution of Terns at nesting time than are any latent so-called "homing instincts."

THE AGES OF BREEDING ADULTS

In a previous paper (*idem,* 1929) I attempted to show the average ages of breeding Common Terns from a number of returns taken on the breeding grounds, but the data at hand were insufficient to give more than a general indication of the probable trend. During the seasons of 1928, 1929, 1930, and 1931 fifty-one returns were taken by C. B. Floyd, myself, and other workers from this station, of breeding adults originally banded as nestlings, and forty-six more were captured this past summer. Thus we know the exact ages of ninety-seven breeding Common Terns taken at random in the various Cape Cod rookeries. They fall into the following age groups:

1 year old	1
2 years "	7
3 " "	36
4 " "	22
5 " "	14
6 " "	10
7 " "	5
8 " "	2

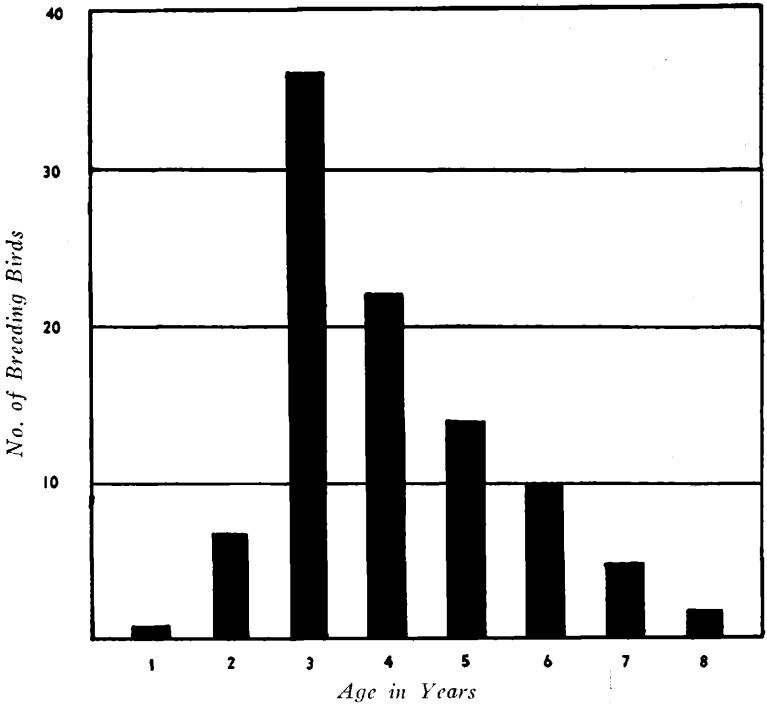

FIGURE 3. HISTOGRAM SHOWING AGES OF BREEDING ADULT COMMON TERNS.

The accompanying histogram (Fig. 3) shows that certain of the fundamental principles indicated by the data of 1929 hold true. Most Common Terns reach sexual maturity and breed for the first time when three years old, though a few breed when two years old. We now know that Common Terns may breed, though they very rarely do so, when only one year old, for a bird banded as a juvenile at Tern Island, July 5, 1931, was captured incubating eggs at North Point, July 7, 1932. We also know that Common Terns may breed when they are eight years old.

The histogram indicates that after the peak is reached at three years, the numbers of birds returning to breed each successive year drop off in a curve suggesting normal probability parameters. When we graph them logarithmically as per cents of an estimated limit, we find that they fall best into line at nine and one half years (Fig. 4). This does not means that

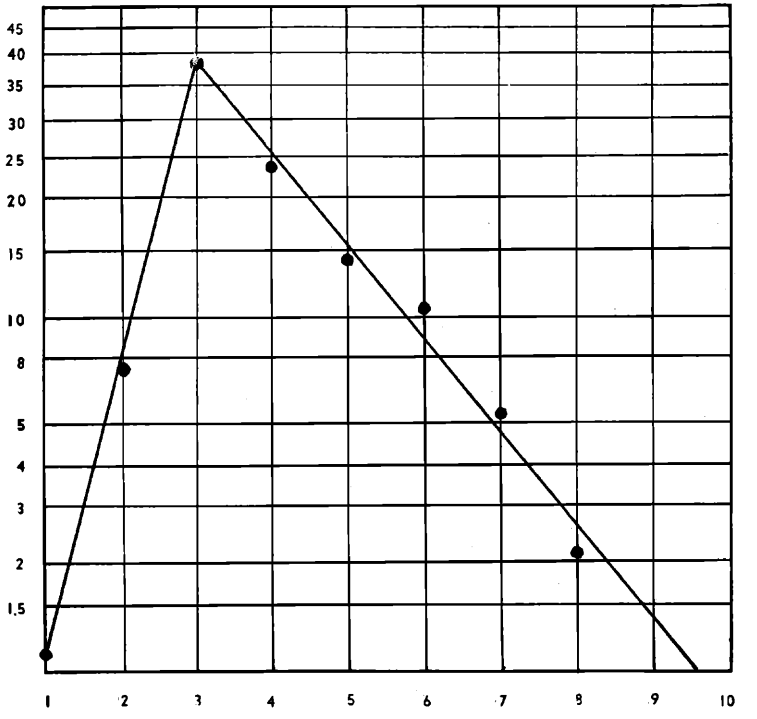

FIGURE 4. DATA IN FIG. 3 PLOTTED ON LOGISTIC GRID AS PERCENTS OF AN ESTIMATED LIMIT, IN THIS CASE NINE AND A HALF YEARS.

we may not find Terns breeding when more than nine or ten years of age, for we probably shall; nor can we postulate therefrom that a Tern has a normal life-expectancy of nine and one half years, for the average length of a Tern's life (though we cannot prove it from these figures) is evidently somewhat less than that. It does mean, however, that breeding Terns, after reaching the age of three years, decrease in numbers annually thereafter according to a definite, fixed ratio up to the age of nine and one half. This ratio is probably identical with the normal death-rate of adult Terns.

It must be borne in mind that these data are still imperfect in many respects, especially where they deal with birds banded previous to 1926. During that year, and in each subsequent breeding season, enough young were banded to permit a

small percentage of returns to be taken as a fair sample, which is, of course, impossible when but a comparatively small number were banded. While the figures in the above histogram fall nicely in a probability curve of parameters definite enough to allow logarithmic plotting, they are nevertheless subject to another factor, which, when taken into consideration, throws the returns for 1923, 1924, and 1925 considerably out of line. This factor is the number of birds banded each year. It is obvious that the number of returns taken in 1932 of birds banded in any previous year will depend directly on the number banded in that year. Hence the truest picture should be that of the percentage of returns for each year, rather than the actual number taken. But in order that the percentage of return may be considered as valid, it must be based on a sufficient number of birds banded to eliminate, or at least minimize, the percentage of error incident to the vagaries of chance. To illustrate: in 1932 ten birds were captured of the 5131 that were banded as juveniles in 1928, and two were taken of the 1000 young Terns banded in 1924. It stands to reason that the percentage of survival will be considerably greater in birds at four years of age than it will at eight, and yet in this case the .19 per cent return of four-year-olds, which is based on a very fair sample, is exceeded by the .20 per cent return of eight-year-olds, which is obviously in error and due to inadequate sampling.

However, the present figures are a vast improvement over those of 1929, and smooth out the age-curve considerably. Future figures should continue in like manner to lead us closer and closer to the truth as more and more young Terns are banded and the percentage of error in returns is lessened.

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