

PREDATION BY THE COMMON RAT (*Rattus norvegicus*)  
IN THE CAPE COD COLONIES OF NESTING TERNS. <sup>1</sup>.

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Nineteen consecutive years' observation of the Cape Cod, Massachusetts group of colonies of nesting Common, Roseate and Arctic Terns has shown that the aggregate population of the group remains unchanged with only minor variations. This is in spite of mishaps which each season have reduced reproduction by either the group as a whole or by one or more of its component colonies. Predation by the common rat has been overwhelmingly the greatest deterrent to a successful nesting. The group's smallest annual chick yield, 4,378 in 1933, followed extensive rodent infestation of Tern Island, that year the Cape's largest colony. While such a single event is serious enough, that three fourths of all the partial failures were caused by rats is of greater moment. Rats are abundant in the vicinity of all but two of the Cape's terneries and tend to migrate to and take up residence in them sometime during a nesting.

Only once has a failure of reproduction equal to those caused repeatedly by rats been due to a different agent. At Tern Island in 1944 the entire hatch died in the nests (Austin, 1946), an unprecedented and unrepeated occurrence. Although the etiology was not determined, Pullorum disease was suspected.

The Great Horned Owl is the only other predator which does extensive destruction in tern colonies. Skunks appear to limit their plundering to the consumption of eggs in the nests; foxes take only the adult or two they dispose of completely; but a Great Horned Owl will decapitate 15 or 20 adults in a night and eat but part of one bird. At Tern Island between 20 May and 17 July 1936, Great Horned Owls killed 311 adults, roughly two percent of the island's population; during a corresponding period in 1937, 99 adults; in 1938, 123. Fortunately there are many seasons when owl killings do not occur or are of small extent.

Other customary mishaps seldom involve other than small colonies or inconsiderable portions of large ones. The destruction of eggs or young chicks by high winds or severe storms and the washing away of clutches by high course tides result in relatively insignificant losses. Vandalism by humans, which in 1929 destroyed all the eggs in the large colony at Billingsgate Island and similarly broke up a large renesting at Jeremy's Point in 1947, usually reduces the total annual yield of chicks by only a small percentage.

The rat is always a wanton, wasteful predator consuming but a

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small fraction of what it destroys. This trait is responsible for the great havoc the species inflicts on a rookery. If the rodent destruction of adults, eggs and chicks were limited to food requirements, a colony of 200 or 300 terns would mature a satisfactory number of chicks in spite of the continual presence of one rat. But the daily kill by one individual is from three to twenty birds with but a few mouthfuls eaten from one or two of the victims. Egg destruction is similarly wasteful. Since the rat is essentially a nocturnal animal, very rarely is one seen in the day time. Consequently, the actual predation has never been observed and we can judge it only by the remaining evidence. Much of the wastage in a colony results from the rat's habit of gathering and storing large amounts of food. The virility, cunning and especially the adaptability of the rat enable it to prosper in spite of great handicaps, even food shortage. Yet it is exceedingly fastidious when a choice is available for it exacts a fresh kill for each meal even though it will thrive when only garbage or carrion is available. During the winter of 1938 and 1939, the occupants of one burrow at Tern Island survived on a diet of mussels from a nearby bed.

Rat predation in tern colonies follows a well defined pattern from which there is rarely any deviation. When rodents are already established in or near a breeding-site they forsake their former source of food the moment the terns return and begin killing the birds at night by biting them through the neck or upper back, occasionally through the upper chest. The only part ever eaten is a small segment of the back muscles from a single individual of the several killed. As a rule, rat-killed terns are found lying on their chests with wings and legs extended. Feeding on a previously killed bird has not been observed.

As soon as eggs are available, the rats feed on them exclusively and stop killing adults. Seldom is the entire egg eaten. Broken shells are found in nests at random in an area from 20 to 100 feet in diameter. At the same time, rats start collecting eggs and entire clutches disappear rapidly from a gradually widening circle. A few eggs are carried into burrows but most of them are assembled into piles hidden under dense vegetation, frequently some distance away. The number of eggs in a pile is seldom less than 25; often it totals 150. This habit is exceedingly wasteful for these eggs remain uneaten after the rats have deserted the site at the close of the season.

When the chicks hatch they become the staple diet. They are killed usually by being bitten through the chest; again, only a small portion is eaten from a single freshly slain victim. The preference is for chicks about three weeks old. Almost all their carcasses are left to decompose where they fall, but occasionally two or three will be dragged into a burrow and allowed to decay there.

When rats infesting only one portion of a large colony nesting on an extensive site have devastated the vicinity of their burrows, they move in a body to a new part of the occupied territory.

Rat invasion of uninfested tern rookeries commonly occurs when egg laying is at its peak. Prompt discovery and elimination of the first comers is not always a lasting antidote for frequently new invaders continue to arrive. As a rule, sites which are rodent free until July remain so until the close of the season but there is an occasional exception. At Plymouth, in 1946, the first evidence of rats was found 8 July when the hatching was almost over; many birds of the year were on the wing and 5,961 chicks had been banded. The rat influx was sudden and heavy. By 1 August, the destruction of chicks had become so excessive the dead were to be found in large numbers everywhere through the nesting territory.

It cannot be solely by chance that rats invade tern colonies during the nesting season. In some unknown manner rodents inhabiting the mainland near terneries on islands and others living several miles from colonies on peninsulas become aware of the presence of food. Perhaps the sight of flying birds or the noise made by a large colony leads them there. Thus the horde of rats which lived in the fish-shacks on the nearby shore may have been attracted to Tern Island. They have been seen both swimming and ferrying on floating objects across the narrow, intervening channel.

If no control measures are instituted, the rat population in a tern colony tends to increase rapidly by both reproduction and accretion. The gestation period for this prolific species is but 21 days and their offspring mature rapidly. A single pair can produce two litters during the terns' nesting season. From the Gorton Pew Laboratory, Gloucester, Mass., comes an opinion that one pair, if given adequate food and shelter, can multiply to 1,500 in one year. Frequently, sudden increases in the amount of predation can be accounted for only by new arrivals of rats especially when its extent continues. At Tern Island in 1933, considerable depredation in hitherto immune parts of the site promptly followed the burning of a near-by town dump.

A ternery's greatest insurance against rat predation is insularity. But rats are good swimmers and an island colony should be separated from the mainland by at least a half mile of water. Rats have never been found on Ram, Bird and Little Sipson Islands, all so protected. On the other hand, Tern Island, at low water only 50 yards from shore has seldom entirely escaped damage. All other nesting-sites, being on mainland, have experienced at least periodic predation. Colonies occupying small sites appear to suffer worse than do others scattered widely over a large area as at Sampson Island.

From the standpoint of end results, the size of a colony and the

number of rats preying on it have a close relationship. So great and rapid is the toll taken by a single rodent that the presence of but one in a small rookery of a few hundred terns usually results in complete frustration. At North Point, in 1937, one lone rat apparently ruined over 200 clutches of eggs and dispersed the entire breeding flock within two days. Large colonies of several thousand pairs of terns are always partially successful if no rats are present when nesting begins. Plymouth matured 2,616 young to banding age in 1940 although rats arrived in mid-season but in small numbers. The rats were more numerous there in 1941 but were confined to only one third of the nesting area and the colony, about the same size it had been the year before yielded 3,070 chicks. From these latter there has never been a return or a recovery. Tern Island, even in the bad year 1933, produced 2,971. Frequently, prompt action in discovering and eliminating the rats on arrival, if the influx is not too heavy, may save the colony. In 1938 and again in 1944, extensive predation in the center of Tern Island ceased after the gassing of a single, well concealed burrow.

The maximum damage which can result from rat predation—the killing of a considerable number of adults and the practically complete failure of a large colony to reproduce—has occurred twice in the Cape's group; at Tern Island in 1932 and at Plymouth in 1947. Both times, rats were domiciled on the sites when the first terns arrived. The Tern Island debacle has been described in detail (Austin, 1932). The 10,000 adults established there in early June were decimated to at most 150 birds by 7 July when a thorough search failed to reveal an unhatched clutch or a living chick. From the early hatching, 1,750 chicks less than one week old had been banded. Of these only 12 were ever heard from later.

The Plymouth colony breeds in the sand dunes at the tip of a peninsula from 100 to 300 yards wide which extends from the mainland four miles out into Massachusetts Bay. On 5 June, 1947, 5,000 terns were nesting there. The presence of rats was demonstrated by finding in one small sector in the center of the colony 16 recently and characteristically killed adults, broken eggs, empty nests and several rat holes concealed under clumps of beach grass. Predation increased in spite of control measures and extended rapidly toward the outer edge of the rookery where on 16 June, on one dune 75 feet square, were found 66 dead adults, a "feeding shelf" of 75 eggs, many empty nests and two large rat holes. Already despoiled pairs had begun to renest nearby. On 28 June over 25 rat burrows were found and treated with cyanogas but pillage of the originally occupied area was almost complete, one third of the adults had departed and the remainder were relaying in the adjoining tract where renesting had started two weeks previously. During the whole

day one experienced worker found only 148 chicks to band. Believing predation to be beyond control, the site was not revisited until 30 July when the initial site was found to be completely devoid of eggs and chicks and fewer than 50 adults were seen to alight there in four hours of observation. About 3,000 birds had re-nested rather compactly in one 150 yard stretch of dunes. The rats, having cleaned out the original tract moved en masse into this new area where broken eggs, many recently killed chicks and several burrow entrances were found. An exhaustive search through this whole tract yielded only 914 chicks and not over 100 intact clutches. In view of the obvious presence of a large number of rats, it is safe to surmise that very few of these chicks survived even though some were well grown. Usually, during late August and September, several birds of the year banded at Plymouth are found along the nearby New England coast. Up to the present time not one of the 914 has been reported.

From the foregoing, particularly the profligate behaviour of the species, it is evident that the presence of rats in a tern colony is always of serious moment.

Effective methods of preventing and controlling predation by rats have been summarized by Mr. Joseph A. Hagar who worked at Plymouth for seven consecutive years, 1935 through 1941, primarily to preserve the colony of some 350 pairs of Least Terns which nests yearly on the beach near the dunes inhabited by the Common Terns. He was so successful that in 1939 an unprecedented total of 4,945 Common Tern chicks were banded there. His conclusions are as follows (Hagar, 1947);—

(1.) Rats may or may not winter on Plymouth Beach in small numbers, but regardless of whether they do or not, and of what is done to control those who do, the chief damage to terns comes from rats which work out the beach from the mainland after nesting begins. (2.) For control, traps are ineffective at all times; poison is never wholly effective and gives sharply diminishing returns after its first use and after nesting begins; cyanogas applied in the rat burrows with a blower is by far the most effective method of control. (3.) Control with cyanogas is strictly proportional to the persistence with which it is followed up. It depends on (A) systematic search for burrows within an hour after daylight, while the sand retains a tracking surface, and (B) constant repetition—*i.e.*, at least two or three times weekly. With some amplification, the foregoing opinions coincide with those held by this station.

Terns are birds of low intelligence and of even less adaptability, their behaviour being governed more by habit than by reasoned reaction to daily occurrences. Apparently they neither sense the occurrence and import of rat predation nor make the obvious adjustment of re-nesting on a safer site. Young birds, for some time after

they are able to fly well, have a habit of returning to the shelter of cover in the vicinity of their nests. This they continue to do even after most of the hatch has been killed by rodents. For the same reason that some individuals, for several consecutive seasons, nest on land so low that their clutches are washed away by the following high course tide, most terns will return to the identical nesting sites where they had been defeated the preceding years. So doing is the disadvantageous result of a major behaviour trait termed site-tenacity (Austin, 1945; 27). Therefore, every year all occupied breeding sites where rats have ever been found should be searched for signs of predation thoroughly, frequently and until the colony has migrated.

It is of much value to reduce the vegetation of a rookery to an extent which will leave only enough to provide the shelter chicks require. Flotsam deposited by high tides and litter of any sort should be eliminated. This not only reduces to a minimum the shelter rats require, but also facilitates prompt discovery of new burrows. Rodents rarely invade sparsely grassed nesting sites and their residence, under such conditions, is seldom more than temporary. Since the 1932 disaster, Tern Island has been burned over yearly, cleaned thoroughly and enough of it ploughed to eliminate excessive patches of heavy beach grass. As a result there has been no repetition of that mishap.

If, for no reason other than the conservation of wildlife, the welfare of terns should be promoted, it is necessary to safeguard their nesting sites. To this end, the prevention of predation by rates is of primary importance.

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#### COMBINATION WINDOW TRAP AND FEEDING TRAY

BY B. M. SHAUB

During part of the past winter the writer "converted" a window feeding tray into a trap and feeding tray by enclosing the tray and providing a drop door. The combination trap and feeding tray has