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THE DISPLACEMENT OF TERNS BY HERRING GULLS AT THE WEEPECKET ISLANDS

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For over forty years Common and Roseate Terns (*Sterna hirundo* and *Sterna dougalli*) have nested at the Weepecket Islands. With an adult population of 3500 terns, this colony has been about fourth in size among the tern colonies of southern Massachusetts. Tern Island, Chatham; Ram Island, Mattapoisett; and Penikese Island are the sites of larger colonies. In some seasons the colonies at Muskeget Island, Billingsgate Island, and Egg Island, Hyannis, have been of comparable size.

Since 1940 no terns have nested at the Weepeckets. In their place is a flourishing colony of Herring Gulls (*Larus argentatus*). This report is a description and analysis of the factors responsible for this displacement of terns by gulls.

The Weepecket Islands consist of one large island and two very small ones. Large Weepecket is 1560 feet long; but at its widest only 650 feet. Its area is about 12 acres. Middle Weepecket and Outer Weepecket are much alike. Each is about 100 feet long and half as wide. The soil is the original glacial till, even on the little islands where the highest point is only 10 to 12 feet above high tide mark. In spite of rather severe erosion, accelerated by the hurricanes of 1938 and 1944, the islands retain their shape and total area. In this respect they differ from Tern Island and Muskeget where the action of storms may change conditions greatly from year to year.

Large Weepecket is at lat. 41°30'40" N, long. 70°44'30" W, lying 2000 feet north of Naushon Island in Buzzards Bay. Middle Weepecket

is 1800 feet NNE from Large Weepecket, and Outer Weepecket is 1100 feet farther north.

Large Weepecket is covered by a mixture of many plants. Bayberry, sumac, blackberry, and wild rose cover the central portions. Pokebush, beach grass, and poison ivy cover the edges and ends. In most years there is an extensive beach on the east side, but elsewhere and on the small islands the rocky shore is close to the eroded banks of the glacial till. At present the two small islands are bare of vegetation, though prior to the hurricane of 1938 they were densely covered by grass, blackberry, and poison ivy.

Earlier descriptions of the islands and the tern colony are given by Howe (1897), Jones (1903), and Cahn (1916). In the interval between the visit of Howe and that of Jones the colony increased from 200 to 1500 adult terns. During three of these years Captain Olsen of Naushon served as warden. He tells us that on at least two occasions he apprehended egg collectors. We are indebted to Dr. Stanley Cobb for the figures for July 4, 1905, and for other observations both at Muskeget and Penikese. Cahn estimated that the colony contained 4000 breeding terns in 1915; yet ten years later it was reduced to a few hundred.

Our own observations at Weepecket began in 1925, and have been made regularly since then. For each year an estimate of the adult tern population is shown in Table 1. These vary in accuracy but we believe they are correct within 25%. Both Common and Roseate Terns are included in the estimate. There is about one Roseate Tern to each three Common Terns. This is shown in the totals of young banded: 1479 Roseate, 5905 Common Terns.

An objective determination of colony size might be based on the number of young terns banded. This would show, at least, the minimum size of the colony. The year 1931 may be cited as a favorable example since mortality of chicks was low and banding was thorough. In that year 1803 young Common Terns were banded. If we add one-third or 601 to include the Roseate Terns (the actual figure that year was 570) this would mean 2404 young terns (actually 2373). Even in a good season it is unlikely that there are more than one and a half young per pair of adults. Using that assumption the adult tern population would be 3606. Taking into account the fact that not all of the young are found and banded, our estimate of 3500 adults in that season appears conservative. Unfortunately, in a season when the mortality of young is high there may be no correlation between the number of young banded and the adult population.

TABLE 1
LARGE WEEPECKET ISLAND

Year	Estimated population of adult terns	Number of immature Common Terns banded	% of immature Common Terns recovered	Success of the season
1896	200 (Howe)			
1902	900 (Dutcher)			
1903	1500 (Jones)			
1905	2500 (Cobb)			
1915	4000 (Cahn)			
1925	200	10	0.0	
1926	300	19	0.0	
1927	600	168	0.0	
1928	800	191	0.5	
1929	1500	477	0.6	
1930	2500	751	0.7	fair
1931	3500	1803	2.3	excellent
1932	3500	1	0.0	zero
1933	3500	446	2.2	good
1934	3500	1135	2.3	excellent
1935	1500	89	2.2	fair
1936	2000	198	2.2	fair
1937	1000	123	1.0	poor
1938	1200	0	0.0	zero
1939	2000	586	2.0	good
1940	1000	8	0.0	zero
1941	4			
1942	10			
1943	0	No young terns after 1940		
1944	not over 10			
1945	not over 10			

Table 1 shows the number of young Common Terns banded each season, partly as a check on the minimum adult population, but especially as an indication of the success of the colony in that season.

The next column gives the per cent of young Common Terns recaptured after leaving Weepecket. This shows whether the young actually did mature and leave the island to become a part of the general tern population. The exact per cent is not significant because the capture of one bird more or less would alter the figure considerably. In the last column is a statement of the success of the season.

A study of Table 1 makes it clear that the colony grew rapidly after 1925 and attained a maximum in 1931 of not less than 3500. The seasons of 1931, 1933, 1934, and 1939 were successful in terms of reproduction. Some other seasons were partly successful, as indicated

by the percentage of recoveries, but the number produced was small. There has been no successful reproduction at Weepecket since 1939, and only a few terns have even nested at the islands since 1940.

In 1930 a Herring Gull nest was found on Middle Weepecket Island. It is an interesting coincidence that this is the same island where Vinal Edwards discovered one nesting pair of Herring Gulls in 1888 (MacKay, 1892), the only record of their nesting in Massachusetts until 1912 (Forbush). In 1931 a pair of gulls nested on each of the small Weepeckets. By 1934 the terns had disappeared from Middle and Outer Weepecket, and 50 to 100 gulls were in their place. In 1935 two pairs of gulls nested on Large Weepecket, and by 1940 there were 400 there. The details of these events are shown in Table 2.

TABLE 2
POPULATION OF ADULT TERNS AND GULLS

Year	Large Weepecket I.		Middle Weepecket I.		Outer Weepecket I.	
	Terns	Gulls	Terns	Gulls	Terns	Gulls
1930	2500	0	100	2	100	0
1931	3500	0	200	2	200	2
1932	3500	0	100	2	10	20
1933	3500	0	0	50	2	100
1934	3500	0	0	50		
1935	1500	4	0	100		
1936	2000	12*	0	100	0	150
1937	1000	6*	0	100	0	150
1938	1200	0				
1939	2000	100				
1940	1000	400			0	125
1941	4	400	0	125	0	125
1942	10	1000	0	125		
1943	0	1000			0	125
1944	not over 10	500				
1945	not over 10	250	0	60	0	50

*In 1936 agents of the U. S. Fish and Wildlife Service counted and needled 1562 Herring Gull eggs at the Weepecket Islands on June 4. However, when we visited the large island four days later only a few nests were being used and we did not find abandoned eggs nor nests. It is probable that their figures include all three Weepeckets but even so there is an unexplained discrepancy in the data for 1936. In 1937 they found 321 eggs on May 17.

Table 2 shows clearly that the tern colony declined as the gulls increased. We believe this apparent cause of the displacement of terns is the real cause. By what means did the gulls bring about the abandonment of the colony by the terns?

Direct damage of tern eggs and young by gulls is not often observed. In 1932, however, the Herring Gulls evidently did considerable damage at Weepecket. On June 12 of that year we found the tern colony at Large Weepecket in good condition, with as many nests as in the previous year. On June 18 about 40 Herring Gulls were on the beach when we approached Weepecket. They left when we landed and were not seen again that day. On July 4 we found that many tern nests had been washed by a recent storm and that the eggs of these and others had been broken and cleaned out. Herring Gulls were at the island and their tracks were around broken eggs. Only ten young terns were seen and these were all newly hatched. The adult tern population was estimated at 1000, less than one-third of what it had been earlier. Our notes contain the entry: "Adults indifferent." One week later Herring Gulls, broken tern eggs, 50-75 adult terns, and three good nests were all that remained of the promising colony of mid-June. On July 11 we also visited Middle Weepecket where there were 100 adult terns and several Herring Gulls. No young terns were seen. We found one dead young Herring Gull in a nest and beside it the remains of two adult terns. At Outer Weepecket we banded eleven young gulls but were unable to penetrate the dense growth to capture others. About 100 adult gulls were overhead or on the water nearby. There were about ten terns overhead but we found no other evidence of their nesting on the outer island. We believe that the conditions of 1932 were not repeated in an extensive way in subsequent years.

It is certainly true that gulls and terns may nest successfully on the same island and in close proximity to one another. This was true at both Penikese and Muskeget for nearly twenty years. At Muskeget the terns bred successfully in spite of large numbers of both Herring and Laughing Gulls. At Penikese there is a colony estimated by Griffin (1943) to consist of 600-800 adult Herring Gulls. Our occasional observations there, including one visit this year, support his estimate. At Penikese the gulls use only the northeast corner which has the same area as Large Weepecket. The number of gulls there, and hence the density of population, is not much different from that at Large Weepecket from 1942 to 1944. However, Penikese is seven times as large as Weepecket. This leaves 72 acres free from gulls. Those gulls which have nested in this area have been evicted by the warden. The terns are distributed in groups of various sizes and densities with the largest concentrations near the center and north end of the island. We estimated the adult tern population on July 16, 1945, to be 5000. It has been much more in some seasons. In addition to the gulls at the northeast corner of Penikese there is another colony of several hundred on nearby Gull Island.

The density of gull nests at Large Weepecket and at the northeast corner of Penikese is much less than on the small Weepeckets or on Gull Island. For the former there are 500 square feet per nest while on the small Weepeckets only 60 square feet per nest.

It would be desirable to correlate the increase in Herring Gulls at Weepecket with the history of their invasion of the Massachusetts coast. It would also be desirable to compare the effects observed at Weepecket with those at other islands. The early records of the immigration are given by Forbush (1925): a few nests near Edgartown, on Skiffs Island, and at Muskeget. Cobb found 30 nesting adults on South Beach Bar, Muskeget, in 1922. MacKay (1925) described their nesting there three years later. Mr. Joseph A. Hagar, State Ornithologist, has made a careful study of conditions at Muskeget, where the Herring Gull population of southern Massachusetts is chiefly concentrated, and where terns no longer nest in significant numbers. When his very thorough data are published we shall be much better able to judge the magnitude and effects of the Herring Gull invasion. For the Maine coast, Gross (1945) states that dozens of tern colonies as well as the Laughing Gull colonies mentioned in his paper have been crowded out by the larger Herring and Black-backed Gulls.

In 1939, although there were about 50 gull nests at Large Weepecket, 2000 terns nested and raised young in satisfactory numbers. However, all of the gull nests were localized in one part of the island. Tern nests were not found in the area used by the gulls. This was the last successful season for terns at Weepecket. The following year, 1940, terns nested at only two sites, while gulls were scattered over all other sections of the island. The number of nests was estimated at: Herring Gull 200, tern 300, on June 23. One week later there were many less tern nests and more adult terns overhead than the number of nests would indicate.

Since 1940 a few terns, but not more than ten in any season, may have nested at Weepecket. The Herring Gulls increased to over 1000 but in 1944 had apparently declined somewhat. We were unable to go to the island that year but Nelson Marshall kindly gave us his estimate of 500 gulls on July 27. He also observed a few tern nests on the shore. This year, on July 5, we tried to count all of the gull nests, probably missing not over 10 per cent. There were only 84 nests plus 14 young gulls not in nests. This would indicate a decline in the Herring Gull population to not over 250. A similar decline is evident at the two small Weepeckets.

At Middle Weepecket there were but three nests, and only 17 young gulls were caught. Some young were overlooked and some swam

offshore. The adult population was 50-75, only half that of previous years. Outer Weepecket was observed only from a distance. There appeared to be about the same number of young and adult gulls as on Middle Weepecket.

In reviewing the events at Weepecket we reach these conclusions as to the factors responsible for the displacement of terns by the Herring Gull. 1) Direct destruction of tern nests, eggs, and young by gulls is not sufficiently common to account for abandonment of the colony. Only in the year 1932, before Herring Gulls were nesting on Large Weepecket, was the active destruction by the gulls extensive enough to be significant. 2) It is clear that terns can nest successfully at the same island that is being used by gulls, provided, however, that there is sufficient room so that the terns can nest in an area apart from the gulls. This was the situation at Weepecket in 1939, and was the case at both Penikese and Muskeget for several years. 3) It seems probable that a tern is incapable of proper nesting behavior when its own nest is too close to that of a gull. Even though the gull may ignore the tern, its presence creates a disturbance to the normal activities of the latter. Palmer (1941, p. 27) expresses a similar idea: "I feel that there is a more basic . . . [cause of desertion] . . . namely, the detrimental effect on the terns' breeding cycle of the presence of a species which has a different rhythm of activities." In terms of Weepecket we should say that, as the gulls became dispersed, no area remained where a pair or group of terns could nest without being too close to a gull nest.

We are able to determine fairly well what has been the fate of the terns which emigrated from Weepecket. Fortunately many of the adults had been banded. For the period 1935 to 1938, 13 per cent of the adults captured were terns previously banded. Trapping operations by Dr. O. L. Austin and others have resulted in the recapture of 18 Common Terns which had previously been taken on nests at Large Weepecket. Of these 18, only ten have been taken since the final abandonment of the Weepecket colony in 1940. Thus it is clear that Weepecket terns had often moved to other sites, even prior to the disruption of the colony. Conversely two terns banded when adults at Tern Island and one from Penikese were taken at Weepecket prior to 1941. If one also considers the interchange of birds banded when immature, the contribution of colonies to one another is far more striking. Of the 5905 Common Terns banded as nestlings at Weepecket, 32 have been taken on nests at other colonies. Eleven born elsewhere have been taken at Weepecket.

TABLE 3
COMMON TERNS BANDED AS ADULTS AT WEEPECKET AND
RECAPTURED AT OTHER COLONIES

Year banded	Year Recaptured	Place of Recapture	
1931	1935	Tern I., Chatham	
1934	1935	" " "	Total to Tern
1934	1935	" " "	Island: 9
1934	1936 & 1943	" " "	
1934	1940	" " "	
1934	1942 & 1943	" " "	
1940	1942	" " "	
1940	1943	" " "	
1940	1943	" " "	
1930	1944	Ram I., Mattapoissett	Total to Ram
1934	1938	" " "	Island: 3
1936	1940	" " "	
1935*	1938	Penikese Island	
1934	1941	" "	Total to
1935	1938	" "	Penikese: 4
1939	1940	" "	
1935	1941	Plymouth Beach	
1934	1936	Egg I., Hyannis	

*Originally banded when immature, in 1931, at Weepecket.

The recoveries of Weepecket terns at other colonies (Table 3) support Austin's (1940) opinion that the fate of an individual colony has little effect on the total population of a larger area. The recovery of more Weepecket terns at Tern Island, Chatham, a distance of 60 miles, than from Penikese, only ten miles away seems to show that Austin is in error in excluding the Weepecket colony from his "Cape Cod Group" and placing it with Muskeget, Penikese, and Ram Island, Mattapoissett, in a "Vineyard Group." Actually the trapping at Tern Island has been so much more intensive than at other colonies that no quantitative appraisal of the distribution can be made on the basis of Table 3. We can only say that the former Weepecket terns have entered into the general population of the area and have joined several different colonies.

Is it likely that terns will recolonize the Weepeckets? This is probable if the Herring Gulls abandon or are forced out of these islands. The reduction in the number of gulls at Weepecket, in the last two years, may indicate a trend which if continued would soon leave the island unoccupied. All of the important Cape Cod tern colonies have been abandoned at one time or another (Austin, 1940). They have been recolonized whenever conditions at the site became favorable.

There always seems to be a small number of terns "trying out" new sites. At Woods Hole, for example, there was a colonization on a tiny spit projecting into Sheep Pen Cove from the mainland of Naushon Island. About forty terns used this site in 1931 and 1932. Young were not successfully raised, probably because of predators, and the location was abandoned. Two other minor colonies have existed at Woods Hole. One of these at Pine Island consisted of as many as forty adults and persisted successfully for several years until the island's destruction by the hurricane of 1938. The other, on an islet less than 150 feet long and 30 wide between Ram and Devil's Foot Islands, has also supported as many as forty terns, and has been occupied for at least the last twelve years. The presence of a few terns at Weepecket during the last five years seems to suggest that the site has not been abandoned completely even though successful reproduction has not been achieved. The reduction in vegetation by storms has created more nesting territory at Weepecket than has been the case at any previous time in our experience. If the Herring Gulls abandon the colony or are driven out it is probable that the colony would soon regain its former importance.

SUMMARY

1. The changes in population at the colony of Common and Roseate Terns at Weepecket Island, Mass., is described for a period of twenty years.
2. During the past ten years this colony of 3500 terns has been replaced by breeding Herring Gulls.
3. In only one season was there evidence that the gulls were seriously predatory on the terns.
4. The terns are probably incapable of successful reproductive activity if gulls are near, even though the latter do no direct injury.
5. The members of the colony have been redistributed to other colonies of southern Massachusetts as shown by recoveries of banded birds.
6. Conditions favor a recolonization by the terns if the gulls are evicted or abandon the islands.

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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.