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## PREVALENCE OF SUBCUTANEOUS EMPHYSEMA IN YOUNG TERNS, SKIMMERS AND GULLS

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**Abstract:** Examination of five coastal species of sea birds on Long Island, New York, revealed 18 cases of subcutaneous emphysema among over 11,000 chicks handled over a 5 year period. The condition may result from a variety of causes, but trauma to young birds from territorial adults is believed to play an important role. The condition is often benign, but when severe may interfere with both cryptic posture and escape. It should be distinguished from generalized edema, a condition which might occur in the same populations. Treatment is simple and usually successful.

The accumulation of pockets of air under the skin is a sometimes dramatic event which, in humans, is most frequently due to soft-tissue infection with anaerobic, gas-forming bacteria (*Clostridium* spp.). It also occurs occasionally following surgery, trauma (such as penetrating injuries), or spontaneous rupture of lung tissue with air escaping under pressure into the mediastinum and later into the subcutaneous tissues.<sup>12</sup> It is apparently a rare event in other mammals. Birds, because of their extensive system of intercommunicating air sacs extending into bones and body cavities<sup>5</sup> may be more subject to subcutaneous emphysema, although damage to these structures would not be the only cause. I and others working in colonies of nesting Common Terns (*Sterna hirundo*) and Black Skimmers (*Rynchops niger*) have found that it may occur occasionally among young chicks, particularly in large dense colonies. We have also found a young Roseate Tern (*S. dougallii*) and a young Herring Gull (*Larus argentatus*) similarly affected.

### METHODS

Periodically since 1964 the breeding biology of several species of seabirds has been studied in colonies on the south

shore of Long Island, New York, in Nassau and Suffolk Counties. We have worked mainly in two colonies, at West End Beach and at Cedar Beach, in each of which about 1000 pair of Common Terns are the dominant element. Our studies involved banding many of the young birds, studying their growth and development, and determining the causes of morbidity and mortality.<sup>7,8,9</sup> In some seasons more than 90% of the young birds fledging from the West End colony were banded, and the total number of young handled exceeds 10,000. This sample allows an estimate of the prevalence of subcutaneous emphysema in the Common Terns and Skimmers. The colonies were visited usually twice a week, but not every colony could be covered thoroughly each time, so undoubtedly many other chicks died, were eaten, or left the colony without being examined. Data on diseases and abnormalities are incomplete for conditions causing death prior to or shortly after hatching.

### RESULTS

The numbers of cases of subcutaneous emphysema found for each species and the numbers of chicks handled each year are listed in table 1. The prevalence for all species was 1.57 cases per 1000

TABLE 1. Prevalence of Subcutaneous Emphysema in Five Species of Seabirds on Long Island, New York, 1969-1973.

Species	1969		1970		1971		1972		1973		Total	
	Cases	N	Cases	N	Cases	N	Cases	N	Cases	N	Cases	N
Common Tern	2	1602	2	2090	1	2942	3	2390	1	866	9	9890
Roseate Tern	0	30	0	26	1	21	0	13	0	26	1	116
Least Tern	0	60	0	140	0	210	0	81	b	b	0	491
Black Skimmer	2	191	4	247	1	163	0	91	0	32	7	724
Herring Gull	0	40	0	44	1	80	0	31	0	26	1	221
Total	4	1923	6	2547	4	3416	3	2606	1	950	18	11,442

a Prevalence = cases/1000 chicks handled

b No young Least Terns found in 1973

N Number of chicks handled

chicks. No cases were found among 388 adult Common Terns and 12 adult Black Skimmers trapped and examined through June 1973. Emphysema was found in chicks as young as 4 days of age, but the peak occurrence was in the second week of life. There was no apparent inter-year variation in the occurrence of subcutaneous emphysema. This is in contrast to the changing incidence of such abnormalities as premature feather loss<sup>8</sup> and defects of the eye, bill and feet,<sup>9,11</sup> which increased markedly in 1970 and 1971. The relative lack of cases of emphysema in 1971 was associated with very high mortality of young, which meant that few chicks over 1 week of age were alive and at risk.

Birds with subcutaneous emphysema were otherwise healthy and vigorous, except for one Skimmer with a large accumulation of air in the right abdominal wall which dissected down into the right femoral region. This chick tilted severely to the right side and was barely able to walk. In several other cases, however, the swellings distorted the body outline, and for young Skimmers which rely considerably on their cryptic coloration and posture (M. Gochfeld, personal observation) this distortion could render them more susceptible to predation.

Six birds with moderate or severe accumulations of air in the neck, axillary, or abdominal areas, were kept in captivity and were treated by evacuating the air with a syringe and 18 gauge needle. Two birds reaccumulated some air at least once. One of these, with the ventral and right lateral abdominal wall swollen to about one and a half times normal size, reaccumulated air twice. It was finally treated by making a 2 mm incision in the right lateral anterior wall which prevented further air accumulation. The other four birds fared well in captivity and did not require further treatment. The remaining 12 birds with more minor accumulations were handled differently. Four were treated in the field by a syringe and needle, and the others were released without treatment. For all ten of the treated birds, air was evacuated with a single puncture indicating ap-

parently, a unilocular accumulation of air. However, multilocular accumulations could also occur.

Two of the chicks had been banded shortly after hatching at which time there was no evidence of abnormality. None of the affected chicks was recaptured after examination or treatment, but this is not significant since of all chicks banded, only 25-30% are handled a second time.

Although the afflicted chicks appeared vigorous, seven of them showed some signs of other wounds including abrasions of the scalp, face, or back, typical of those inflicted on wandering chicks by territorial adult terns and gulls.<sup>3,14</sup> Five of the six cases of severe air-accumulation were in this category, which included the young Gull and Roseate Tern, three Skimmers, and two of the Common Terns.

#### DISCUSSION

In poultry, subcutaneous emphysema is found infrequently and is apparently not a significant cause of morbidity.<sup>15</sup> Texts on pathology of aviary birds mention subcutaneous emphysema without indicating its prevalence or significance.<sup>1,2</sup> In wild birds, subcutaneous emphysema is a relatively little-known condition. For passerine birds, there is a report<sup>3</sup> of a Tree Sparrow (*Spizella arborea*) which was swollen to twice normal size. This bird required treatment four times before it stopped reaccumulating air, but in other respects it appeared vigorous and healthy.<sup>13</sup> Floyd<sup>6</sup> mentions a young Common Tern with a swollen neck as one of the two abnormalities among nearly 5000 young terns handled, but we have found no other cases in the literature on terns. Since we are looking for abnormalities among these seabirds, we were perhaps more sensitive to minor accumulations of air than were previous field workers who were more concerned with banding young birds or studying their behavior. However, of the 18 cases we found on Long Island, 6 were large enough to be apparent before the affected chick was picked up. The occurrence

of 9 cases among 9890 young Common Terns (prevalence = .91/1000) probably reflects the true rate in that species, at least where it nests in large dense colonies. The much higher frequency among Black Skimmers (7 cases per 724 chicks = 9.67/1000) differs significantly from the rate among Common Terns (Chi Square = 190,  $p < .001$ ). The single cases reported for the other species are based on small samples, and the condition has not yet been found among Least Terns on western Long Island.

The apparent difference in prevalence between the Skimmers and Terns is difficult to explain, since the cause of the emphysema in these birds is not certain. In view of the recovery of the captive birds after evacuation of the air, and in view of their overall vigor, a bacterial origin can be safely ruled out. Possibly the difference reflects anatomical differences in the structure of the air sac system, which might predispose one species to air sac rupture. Such a difference seems unlikely, particularly since Skimmers and Terns are closely related. Several sources report that subcutaneous emphysema may arise after blunt trauma when the glottis is closed,<sup>2</sup> or after a penetrating injury which allows entry of air into the tissues but prevents its escape.<sup>1,2</sup> Air escape from spontaneous rupture of lung parenchyma or from erosive diseases of the lung (and/of air sacs in birds) is apparently less common, as is air accumulation from fractures of hollow bones or defective epiphyses.<sup>1,2,4</sup>

The major source of non-lethal trauma in the tern colonies are the adult terns themselves. Chicks wandering into occupied territories are repeatedly struck by certain adults and are often killed or seriously injured,<sup>3</sup> and the same is true for the gulls.<sup>14</sup> Although many of these injured chicks soon die from their wounds, we have found others with lacerations of the scalp and back which survived. The presence of recognizable signs of trauma on 7 of the 18 chicks with emphysema, compared with fewer than 50 noted cases of apparent trauma among 11,424 other live chicks handled (Chi Square = 121;  $p < .001$ ) strongly

suggests a casual relation between the trauma and the emphysema in some of the cases. If the adult Common Terns are an important cause of emphysema, the high incidence among the young Black Skimmers suggests that they are less well adapted to avoid such attacks. Our observations on Skimmers indicate that although they nest close together, usually within colonies of Terns, they themselves rarely behave aggressively towards chicks of any species. In addition, we have found that Skimmer chicks are very mobile and wander extensively through the colony, and we have frequently seen them attacked and twice seen them killed by the more aggressive Common Terns.

Since adult aggression is a cause of morbidity and mortality, it can serve as a selective factor promoting escape or avoidance behavior in the young chicks. One would predict that Common Tern chicks would have certain strategies for minimizing such attacks, including diminished mobility (difficult to measure in a colony with frequent disturbance by humans), running away, or hiding. Skimmers may have had less evolutionary experience with such aggression, since they apparently practice it much less themselves. Lack of avoidance behavior and increased mobility of the young, could account for the higher prevalence of subcutaneous emphysema among the young Skimmers. However, whether Tern and Skimmer chicks actually manifest significant behavioral differences with regard to avoidance behavior remains to be determined. The differential incidence of emphysema suggests that such differences might exist, but the above explanation remains speculative. Since the Long Island tern colonies are subject to frequent human disturbance, they may have more wandering by chicks and more frequent adult-chick encounters, hence a higher frequency of injuries and emphysema. This may account for the observed prevalence, and may indicate that our findings are not typical for these species. However, many reported studies of tern colonies indicate that human disturbance occurs regularly.

In contrast to our findings, P. A. and F. G. Buckley (personal communication) have never observed this condition among Royal Terns (*Thalasseus maximus*) during six seasons of field work. Royal Terns nest in dense aggregations, but the young enter a crèche where they are not subject to attacks by the adults. Also D. B. Ford who has handled several thousand Herring Gull chicks on Long Island, New York, has not seen any cases. Harris<sup>10</sup> mentions diseases of Herring and of Lesser and Greater Black-backed Gulls (*L. fuscus*, *L. marinus*) whose breeding he studied, and he apparently did not find any cases of emphysema. Since gull chicks are frequently subject to attacks by adults one might predict a high prevalence of emphysema, unless such attacks are so often fatal<sup>14</sup> that there are few survivors.

Assessing the significance of the emphysema to the affected bird is difficult. With one exception, the birds appeared vigorous and healthy, but in several cases the air accumulations would have rendered flying difficult or impossible, or would have delayed flight-learning. Moreover, distortion of outline would have made chicks more conspicuous to potential predators.

Another condition which could cause swellings in young birds is generalized edema. It is known that this can be caused by polychlorinated biphenyl compounds, and these compounds are found in tissues of Long Island tern chicks<sup>11</sup> at fairly high levels. Subcutaneous emphysema was usually localized to one part or side of the chick, while edema usually involves most of the soft tissues of the body, and tends to accumulate mainly in dependent areas. Differentiation can be made in most cases by pressing the swelling with a finger and then releasing it. Edema will usually show the imprint of the finger for at least several seconds, while in emphysema, where the air is under pressure, the swollen portion immediately regains its shape, and the finger leaves no impression. Subcutaneous emphysema may be a natural outcome of nesting in dense colonies where adult aggression is high, but other causes should be sought as well. Generalized edema should be looked for also, particularly in view of the considerable concern over abnormalities caused by chemical contaminants in the environment.<sup>8,9,11</sup>

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