

Salmonella sp and Clostridium botulinum in waterfowl and sea-birds

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FOOD poisoning deriving from duck-eggs provides a well known consequence of the infection of wildfowl by Paratyphoid bacteria. At the present time we can distinguish five hundred to a thousand different types and subtypes of the causative organism, *Salmonella*. It is therefore comparatively easy to ascertain the origin of an infection by typing the organisms concerned.

In the last fifteen years it has been increasingly shown that waters polluted by sewage contain salmonellas which are able, under suitable conditions, to multiply exceedingly. The questions are, therefore, may water birds be infected by salmonellas in these conditions and do they spread the infection to clean waters?

In addition to domestic duck eggs, the eggs of gulls have been especially concerned in outbreaks of food poisoning in human populations. Gull droppings from the harbours on the north and east coasts of Schleswig-Holstein were examined between 1947 and 1951. Salmonellas were found in about one in twenty to fifty samples. In several breeding colonies of gulls and terns in Schleswig-Holstein, numerous eggs left at the end of the breeding season were found to contain salmonellas.

It is the rare exception for the eggs to be infected while in the ovary. More usually the eggs are contaminated with infected faeces when being laid. During incubation the salmonellas can usually be detected inside the shell after six days. They increase very rapidly and usually kill the embryo between the eleventh and fourteenth day from the start of incubation. This timing evidently depends solely on the rate of increase of the salmonellas. It is the same whether the bird has a long or short incubation period. If the egg is not incubated the salmonellas do not reach the interior of the eggs until after three or four weeks. It is rare for duck eggs to cause food poisoning as they are usually eaten before the salmonellas pass through the shell. In this respect, a few days incubation is more dangerous than prolonged storage at 68°F.

In Central Europe fluctuations in the frequency of several types of salmonella have been noted equally in man, in polluted waters, in rodents, and elsewhere. In 1945 *Salmonella paratyphi B* was common everywhere. Gulls, and Shelducks also, sickened from it or were proved to be carriers. In 1949 and 1950 *S. panama* appeared as a relatively new form on the North Sea coasts, where it was equally frequent in gulls and ducks, the latter's eggs causing human food-poisoning. In 1952 *S. paratyphi A* became relatively common in sea bird colonies. A subsequent increase in *S. bareilly* caused an epidemic of over 10,000 cases amongst people in Western Germany. This form had seldom appeared in Central Europe before but became very common in seabirds and was clearly spread by their migrations. Thus *S. bareilly* has been detected in migratory gulls, terns, ducks and mergansers from the Spanish Mediterranean coast to the German North Sea and Baltic coasts. In 1956 it was found on Röst Archipelago, the westernmost of the Lofoten Islands, North Norway, and in various kinds of terns on the Upland Archipelago in Sweden. In 1957 it was detected in breeding places on Lake Manyas

near Bandirma in Anatolia, Turkey; in 1958 in ducks wintering in the city of Stockholm and in Sandwich Terns passing down the west coast of Schleswig-Holstein and of Belgium. In 1959 it was found in Sandwich Terns on the west coast of Ireland.

From 1955 to 1957, *S. perisacola* appeared in birds in Western Germany, without any parallel outbreak of human disease. From 1957 to 1959 *S. typhosa*, a form often found on and in gulls' eggs, became increasingly common. In 1958 *S. blockley* turned up rather frequently and in 1959 it was *S. manchester* which caused, for instance, mortality among gulls in the estuary of the Weser and food-poisoning in Bremen.

All these variations in the incidence of the various types of *Salmonella* could be traced not only in the water samples but also in the addled eggs and dead chicks in gull and tern breeding colonies. Certain of the tern colonies on the island of Scharhörn off the mouth of the Elbe and on the North Frisian island of Amrum have produced no offspring since 1956 because of salmonella infections, detectable in the faeces of the adults and on the egg shells. At hatching time the terns abruptly deserted the colony (usually after periods of bad weather between the 18th and 24th of June), so that all the embryos as well as the newly hatched chicks died. The desertion was sometimes extraordinarily sudden, occurring in a few hours. The terns, especially *Sterna hirundo*, founded a new colony about a mile away and laid some eggs. These were however stolen by gulls against which the terns put up little defence.

The month of February, 1956 threw much light on the relation between wildfowl and salmonella infections in severe frosty weather. Numerous Tufted Duck, Scaup, Goosanders and Coots gathered on the coast of Schleswig-Holstein from the open Baltic up to the sea-ports. They stayed wherever warm waste-water flowing into the harbours or bays prevented ice from forming. Here many perished though bird-lovers fed them with stale bread. On post-mortem dry pieces of bread were regularly found stuck fast in the throat above the clavícula. These could have choked the birds, but on the other hand gut-inflammation through salmonella infection was sufficient to have caused death. While the two events may have been only coincidental, it is more probable that ducks already weakened by the enteritis were unable to swallow large pieces of food. The sewage effluent was always found to contain many salmonellas and the food given by bird-lovers was not only unsuitably hard but contaminated by the disease organisms. Great Black-backed Gulls which killed the exhausted and eviscerated the dead themselves succumbed to salmonella infection.

In Britain and Ireland it is clear that losses from salmonella infections in water birds and waders are radically lower than in the Mediterranean, Central European and Scandinavian areas. This may be a consequence of the extremely hygienic methods of sewage disposal in Britain. Certainly it is always striking, from the Central European point of view, how little interest there is in Britain concerning the importance of salmonellas in the conservation of water birds. Salmonellas likewise seldom occur in human food in Britain. This is in strong contrast to the situation in Central Europe as well as in the United States, where by 1954, no food products that included fish-meal, carcass-meal, bone-meal, etc. were free of salmonellas. The wide spread of salmonellas in the raw materials of fodder began some years earlier in the United States than in Central Europe, corresponding to the greater importation

of these materials. It has been found that fish-meal prepared from fish caught off the coast of Angola contains nearly the same salmonella types as those which were responsible for the failure of breeding by terns on the German islands of Scharhörn and Amrum. As many of these terns winter on the West African coast it is a moot point whether they carry the infection to Angola or acquire it there in the first instance.

In 1959 the author made an excursion across England and Ireland to gather material for comparison with that from the other areas described above. Samples of birds' faeces were collected in widely varying sites, frozen and subsequently examined bacteriologically. The methods used, growth on Selenit broth, followed by plating out on Wilson-Blairs' agar, have proved satisfactory over the past fifteen years. It was expected that in the enclosures of the Wildfowl Trust rare salmonellas would be found, since the birds there come from all over the world. The actual results were surprising. Although the Trust's records showed that salmonellas had, on occasion, appeared in the past, not one of the 2240 faecal samples collected over the course of three days contained a single strain of salmonella! Neither could salmonella be cultured from mud-samples taken from the Severn. The results are the more remarkable in that numbers of gulls frequent the enclosures and also that some of the artificial food contains fish-meal. If you attempted to keep such a concourse of wildfowl in Germany, on the estuary of the Elbe, for example, whether in the open or in aviaries, you would be certain to have heavy losses through salmonella infections. The favourable bacteriological condition of the New Grounds is thus a big factor in the successful keeping and rearing of wildfowl that must not be underrated.

In fact salmonella were not detected in bird faeces in any of the places visited in England. In Wales a solitary exception was among the Herring Gulls in contact with the sewage effluent of the port of Little Haven. On the west coast of Ireland infections were detected at only two points. One was from a flock of gulls near a sewer mouth in south Galway, the other from the droppings of Sandwich Terns nesting on an estuary near Lahinch, Co. Clare. Undoubtedly this happy state of affairs stems from the great care exercised in the hygienic disposal of sewage. The strict control on fish-meal imports may also play a part since food poisoning is seldom traced to duck eggs.

Besides salmonellas, the organism *Clostridium botulinum*, causing botulism, plays a certain role among wildfowl on the North Sea coast area. In the United States botulism is much more widespread in wildfowl. Here sick duck are sometimes saved by treatment with an antitoxic serum. A more general remedy is to raise and lower the water level at the source of an outbreak. This floats away matted vegetation and brings it into contact with oxygen. The infective organism is an anaerobe and develops fastest when its substrate is covered by sand, etc. There were large-scale die-offs of Shelduck in 1947 to 1949 around the island of Scharhörn off the mouth of the Elbe. They coincided with stormy periods which by stirring up buried vegetation could have brought the infective organisms into contact with the ducks' food.

In November 1951 there was heavy mortality among Shelduck along the North Sea coast from Hamburger Hallig to the island of Nordstrand off Schleswig-Holstein's western coast. At least 1,500 Shelduck died there after a period of very stormy weather. The dead birds were driven ashore, their necks bent down in front. This is a typical posture of botulism resulting from

convulsions in the muscular system. The heads and beaks were thus forced deep in the water and death was caused by drowning, the lungs and air sacs being full of water. Although the condition of the birds was good, their viscera were almost empty. *Clostridium botulinum* could be detected therein though this is not absolute proof that the organism caused death for it is widely distributed and may be found in healthy birds.

In August and September, 1954 there was much mortality on the Knechtsand area, five miles south of Scharhörn, and Goethe (1961) has estimated that 12,384 Shelduck died. In this case the deaths were attributed to the bombing by RAF planes on the practice range established there by agreement with the German authorities. However, the mortality again followed a period of stormy weather and observers reported that dead, drowned birds showed no signs of injury. The author was unable to carry out examinations in the Knechtsand area so no definite statement as to the true cause of death can be made. However there are obvious parallels between this catastrophe and the earlier mortalities in this general area in which botulism was probably concerned. It remains possible that the bomb explosions could cause indirect mortality by disturbing and exposing contaminated material.

Reference

GOETHE, F. 1961. A survey of moulting Shelduck on Knechtsand. *Brit. Birds* 54 : 106-15.

TRAVELLER'S TALES

The wanderings of a sailor

Admiral Sir William Tennant

ALTHOUGH it may sound rather contradictory to be a keen shot and a bird lover at the same time, I must plead guilty on both counts. A naval officer abroad can have tremendous fun with a pair of bird glasses and a gun and a fishing rod.

Some years ago in the Gibson's estancia in the Argentine South of Buenos Aires three of us with fishing waders on went into some marshy country with lagoons and got about fifty duck in an hour. There was a great variety, including many of those to be seen in the South American Pen at the Wildfowl Trust, such as Cinnamon Teal, Rosy-bill, Brown Pintail, Red Shoveler, and Chiloe Wigeon. I am talking of 1924 when we took the Prince of Wales to the Argentine—the whole country abounded with game and wheat straw was often 8 foot high.