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Salmonellae and *Edwardsiella tarda* in Gull Feces: a Source of Contamination in Fish Processing Plants¹

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The incidence of *Salmonella* and *Edwardsiella tarda* in gull feces on the Oregon coast was studied to determine the role these birds may have in the contamination of fish products with these organisms. Approximately 2.1 and 0.4% of 521 fecal specimens examined were found to contain *Salmonella* or *E. tarda*, respectively.

Foodborne human salmonellosis is generally associated with foods of animal origin (3). Moreover, reports of salmonellosis in domestic animals have been widespread (A. B. Moran et al., Proc. Nat. Conf. Salmonellosis, Atlanta, p. 33-37, 1964). Many of these outbreaks, in turn, have been attributed to animal feed ingredients contaminated with *Salmonella*.

Fish meal, an important ingredient in animal feeds, has frequently been implicated as a source of *Salmonella* (A. W. Anderson et al., Proc. Tech. Conf. Fish Inspect. Qual. Contr., Halifax, 1969; 1, 8). Fish products prepared for human consumption appear to be less of a problem than animal feeds, but are certainly of more immediate public health concern (reference 5; A. W. Anderson et al., Proc. Tech. Conf. Fish Inspect. Qual. Contr., Halifax, 1969; B. C. Hobbs, Proc. Nat. Conf. Salmonellosis, Atlanta, p. 84-93, 1964). It is quite clear that *Salmonella* contamination is a very real problem in the widely diversified areas of the fish processing industry. Before a solution to the problem can be intelligently approached, however, the source of infection must be determined.

One of the largest reservoirs of *Salmonella* is the class *Aves* (2). Although there are extensive reports in the literature on the occurrence of *Salmonella* in domestic fowl, there is a general lack of documentary evidence on the incidence and distribution of these organisms in the free-flying wild-bird population.

A review of numerous cases of infection with

Edwardsiella tarda reported to date indicates that this organism is capable of producing disease patterns similar to those caused by *Salmonella* (6). Numerous isolations of *E. tarda* from snakes have been made in Japan (10), but there are few reports of its isolation from mammals and, apparently, none from feral birds.

The present study was undertaken to determine the importance of gulls (genus *Larus*) as a reservoir and potential source of infection by *Salmonella* and *E. tarda* in seafood and fish meal processing plants. These birds are frequently observed in large numbers hovering about the premises, grossly contaminating the environment with fecal material. They often find processing plants to be convenient feeding areas as scraps are swept out onto docks and into the water. Gulls are thereby actively encouraged to congregate in these areas. Raw fish are often exposed for indeterminate periods in open boxes on fishing vessels and loading docks, providing ample opportunity for contamination by avian fecal material.

Fecal specimens were obtained from various areas along the Oregon coast at specific points estimated to contain flocks of 50 to 300 birds. Freshly voided droppings were collected with sterile cotton swabs and placed into 10 ml of SP Hajna (Difco).

Two selective enrichment media were used: TT broth (Difco) and the dulcitol selenite enrichment of Raj (9). A 5-ml amount of well-emulsified SP Hajna was placed into 50 ml of each enrichment broth. After incubation at 35 C for 48 hr, samples were streaked on Brilliant Green agar, *Salmonella*-*Shigella* agar, and xy-

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lose lysine deoxycholate agar. Plating media were incubated at 35 C for 48 hr. Two representative colonies of each type appearing on the selective plating media, other than coliforms, were carefully picked to triple sugar iron agar (TSI). Cultures which gave TSI reactions suspect for salmonellae were examined with biochemical media and typed serologically (7, 10).

Of 521 fecal specimens obtained on the Oregon coast, 13, or about 2.5%, were found to contain *Salmonella* or *E. tarda* (Table 1). Although none of the areas were found to have extremely high infection rates, the isolation of these organisms from widely separated areas on the coast indicates the broad distribution of infection in gulls and their possible role in the epidemiology of salmonellosis.

The most frequently isolated serotype was *S. typhimurium*, representing seven of the nine *Salmonella* isolates. This organism continues to be the foremost cause of foodborne human salmonellosis in the United States (12). *Edwardsiella tarda* was isolated from four samples. Although the role of this organism in human intestinal infections is not precisely known, it seems worth recording the isolation of such organisms in a study of this type. This is apparently the first report of its isolation from gulls.

Having demonstrated enteric pathogens in 2.5% of the fecal specimens examined, it is clear that gulls are capable of playing a role in the epidemiology of salmonellosis. This small

percentage of infected birds, when multiplied by the number of gulls in the environment, amounts to a tremendous reservoir of infection.

Salmonella infections in gulls, as well as other wild birds, is probably a consequence of existing in a contaminated environment. Avian species generally have ready access to wastes of civilization which are frequently contaminated with *Salmonella*. Gulls are scavengers, consuming a variety of types of food which may be contaminated with these organisms; marked gulls have been observed to travel 25 miles daily to feed at dumps on the mainland (11).

Eradication of *Salmonella* in gulls would probably not be possible by any measure short of destroying the entire population, particularly if transovarian infections occur, as are common in domestic poultry. Although young birds may exhibit septicemia and enteritis, adult birds usually suffer from a chronic form of *Salmonella* infection with lesions in the ovary, testes, joints, liver, and spleen (5). As such, they may be expected to excrete salmonellae for extended periods of time. The solution to the problem of contaminated fish meal and seafoods must, therefore, lie in protecting these products from this source of contamination.

Although it remains to be determined whether *Salmonella* infections are self-sustaining in wild-bird populations, it is apparent that they are at least occasionally infected and can pose a threat to public health when given access to materials destined for human or animal consumption.

TABLE 1. Incidence of *Salmonella* and *Edwardsiella tarda* in gull feces

Collection point	No. of samples collected	No. positive	% Positive	Organism
Astoria	40	2	5.0	<i>S. typhimurium</i>
Hug Point	30	3	10.0	<i>S. reading</i> <i>E. tarda</i>
Sand Beach	40	0	0	
Lincoln City	40	1	2.5	<i>S. typhimurium</i>
Beverly Beach	22	0	0	
Newport	82	1	1.2	<i>S. enteritidis</i>
Waldport	30	3	10.0	<i>S. typhimurium</i> <i>E. tarda</i>
Big Creek	20	0	0	
Winchester Bay	35	0	0	
Charleston	35	2	5.7	<i>S. typhimurium</i>
Bandon	39	0	0	
Port Orford	35	0	0	
Gold Beach	35	1	2.9	<i>S. typhimurium</i>
Brookings	38	0	0	
(Totals)	521	13	2.5	

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