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Black-backed gulls *(Larus dominicanus)* and their role in the spread of *Salmonella* Brandenburg

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ABSTRACT

During the time sheep are aborting from *Salmonella* Brandenburg infection, black-backed gulls have the ability to contaminate stock water and pasture with *S.* Brandenburg. This enables these birds to play a significant role in the local spread of diseases caused by this organism. They also have the ability to spread other diseases, such as sheep abortions due to *Campylobacter*.

Keywords: Black-backed gulls; *Larus domincanus; Salmonella* Brandenburg; sheep; cattle; disease; vectors.

INTRODUCTION

Salmonella Brandenburg has caused widespread abortions and deaths in pregnant ewes in Southland, coastal Otago and south and mid-Canterbury. In cattle, the same strain of organism has also caused diarrhoea and dysentery in calves and adult cattle, abortions and deaths in first calvers, and to a lesser extent in second calvers. The number of farms where the disease has occurred in sheep and cattle since the first isolate in 1996 are detailed in Table 1 (Clark, 2000a). The bacteria have also been isolated from a one-month-old and 10-month-old foal with diarrhoea and dogs with diarrhoea, metritis and an infection in the male reproductive tract. The disease is an important occupational hazard as a number of farmers, their families, including children and farm workers have contracted the disease as well as three veterinary practitioners.

TABLE 1: Farms with *Salmonella* Brandenburg diagnosed by laboratory culture from sheep and cattle

Years	Canterbury		Otago		Southland	
	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle
1996	1	0	0	0	0	0
1997	17	0	0	0	1	1
1998	31	3	55	2	67	0
1999	45	5	71	4	162	10
2000	36	14	62	16	233	40

EPIDEMIOLOGY

The disease spreads during the abortion season from aborted foetuses and placentae (which contain very high numbers of organisms), uterine discharges and faeces. In groups of ewes that have aborted due to *S.* Brandenburg, 36% of ewes have been shown to excrete the organism in their faeces after lambing (Clark *et al.*, 2000). The spread can be to cohort ewes and into water-ways which may infect stock on down stream farms. Environment Southland has monitored the Mataura and Oreti rivers and found that for most of the year *Salmonella* organisms are present in low concentrations (less than 1.2 organism/l of water), however, during August and September the concentrations have increased to over 110 organisms/l of water. An isolate from one sample was serotyped and found to be *S.* Brandenburg (Scott Crawford, *pers. comm.*). It is likely that the increased numbers of *Salmonella* organisms present in these months are the result of contamination of the environment by aborted foetuses and membranes. Another important source of local spread during the abortion season is black-backed gulls and probably other scavenging birds, such as hawks, and animals such as dogs.

Spread of the disease outside the abortion season is probably by carrier sheep. A small study showed that one ewe excreted the organism for 6 months with an excretion rate, in groups of ewes that aborted, of 3% in December and 2% in March (Clark *et al.*, 2000). It is likely that carrier sheep can excrete the organism for longer periods when appropriately stressed. Another source of infection is from contaminated sheep yards, as adult sheep can be infected by *S.* Typhimurium and *S.* Bovis-morbificans following yarding for 24 hours in infected yards (Robinson, 1967). In a study involving 32 farms that had *S.* Brandenburg abortions and 32 control farms with no clinical evidence of the disease, 39% of the affected farms had *S.* Brandenburg contaminated sheep yard dust in late January, 16% in March-April, 12.5% from late May to late July and 42% in October (Clark, 2000b). As it is likely that these sheep yards were contaminated in the late winter-early spring this suggests that sheep yards can be a potential source of spread for at least 12 months.

When the disease enters a new area, the number of ewe abortions and deaths of aborting ewes can be quite high, averaging about 5% abortions (ranging up to 20%) with about 50% (range 10-100%) deaths (Smart, 2000). In subsequent years the number of ewes aborting and dying appears to decrease. However, an observation has been that a farm that experiences abortions may have none or few (generally two-tooths) the following year, but the next year has abortions in all age groups (Roe, *pers. comm.*).

In areas of coastal Otago and Southland, where the disease has been present for 3 years, its incidence appears to have peaked with about 20-25% of sheep farms in these areas having experienced ewe abortions (Smart, *pers. comm.* and Mavor, *pers. comm.*). However, some small studies showed that on 6-20% of farms with no clinical evidence of the disease, the organism is present (Clark *et al.*, 2000, Clark, 2000b).

Of concern now, is the increased number of cases of *S.* Brandenburg in cattle. In 1999, abortions occurred in two first calvers on one farm and one heifer died. In 2000, abortions occurred on seven farms with up to 10% (25/250)

of dairy cows aborting on one farm. These were mostly first calvers and occasionally second calvers. Many of the affected cows were unwell, some died and others failed to milk or had reduced milk production (Clark, 2001). In 1999, in Otago and Southland, *S.* Brandenburg diarrhoea, dysentery and deaths in young calves occurred on 10 farms. In 2000, the number of farms increased to 40. This increase in numbers probably reflects increasing environmental contamination associated with more sheep abortions over a greater area. Purchasing affected calves can spread the disease to new farms and areas.

With the exception of an October 2000 *S.* Brandenburg isolate from a sheep yard dust sample, all isolates associated with the disease in Otago and Southland have been of the same molecular pattern. The October isolate had a different molecular pattern, using pulse-field gel electrophoresis. There was a loss of one band and the addition of three bands of lower molecular weight (Clark, 2000b). There is a need for this organism to be monitored to determine its pathogenicity and epidemiology.

ROLE OF BLACK-BACKED GULLS

Black-backed gulls (*Larus domincanus*) are one of more than 40 species of heavily built, web-footed sea birds of the sub-family Larinae, family Laridae. Gulls are scavengers, feeding on carrion, insects, molluscs and crustaceans on beaches, on worms and grubs in ploughed paddocks, on garbage from ships and refuse tips and on aborted sheep foetuses and membranes.

When the first outbreaks of *S.* Brandenburg occurred, farmers were quick to observe and blame black-backed gulls for the local spread of the disease. A project designed to determine their likely role was designed and funded by MAF. In September 1999, up to 25 million *S.* Brandenburg organisms per gram of intestinal contents were found in the intestinal contents of black-backed gulls on affected and non-affected neighbouring farms (Clark et al., 1999). In related herring gulls (*Larus spp.*), the numbers of *Salmonella* organisms in the intestinal contents are related to the concentration in the ingested material (Fenlon, 1981). A similar finding has been found in black headed gulls (*Larus ribibundus*) in which the infection was probably short lived (Fricker, 1984).

During the abortion season black-backed gulls scavenge aborted foetuses and membranes, which have very high concentrations of *S.* Brandenburg, and this is the reason for the high counts in their intestinal contents. The numbers of black backed gulls sampled and tested positive are detailed in Table 2 and the numbers of *Salmonella* organisms per gram of intestinal contents are detailed in Table 3.

There is no significant difference, in the number of black-backed gulls carrying *S.* Brandenburg in their intestinal contents, between farms that had *S.* Brandenburg abortions and farms that didn't. This finding is understandable as these birds are not selective on what farms they scavenge on.

In December, *S.* Brandenburg could be isolated from black-backed gulls only when selective media were used so the counts were probably below about 10 organisms per gram of intestinal contents. So at this time of the year black-backed gulls are probably not a major cause of spread of the organism. It is possible that the source of the infection at this time of the year is from contaminated nesting areas. However, samples in June from rocks from a nesting area known to have had *S.* Brandenburg positive birds the previous abortion season were negative. No *S.* Brandenburg was isolated from gulls sampled in March and June, although numbers of gulls sampled were small. Twelve faecal samples from a nest of black-backed gulls in the Waimakariri River were cultured in January 2001 and no *S.* Brandenburg bacteriophage was isolated (Grant Bennett, *pers. comm.*). This all suggests that black-backed gulls are unlikely to carry infection from one abortion season to the next.

TABLE 2: *Salmonella* Brandenburg isolations from black-backed gull intestinal contents on farms where *S.* Brandenburg occurred and farms where it was not diagnosed

	Numbers of birds with *S.* Brandenburg in gut contents					
	Farms where *S.* Brandenburg abortions were diagnosed		Farms which had no evidence of S. Brandenburg		Total	
September	11/26	42%	13/25	52%	24/51	47%
December	2/7	29%	1/10	10%	2/17	18%
March	0/2	0%			0/2	0%
June	0/10	0%			0/10	0%
July			1/3	33%	1/3	33%

TABLE 3: *Salmonella* counts from black-backed gull intestinal contents sampled from the endemic area in September 1998

Black-backed gull	District	*Salmonella* count per gram of intestinal contents
1	Ashburton	5×10^3
2	Winton	1×10^4
3	Ashburton	2×10^5
4	Winton/ Invercargill	3.1×10^5
5	Winton	4×10^6
6	Winton	5×10^6
7	Ashburton	6×10^6
8	Winton	9.5×10^6
9	Darfield	2.5×10^7

Salmonella organisms do not affect the gulls clinically, however, infected faeces can contaminate pasture and sources of stock water (Williams *et al*., 1977; Johnston *et al*., 1979; Fenlon, 1981). In search of food, black-backed gulls can cover a radius of up to 50 kilometres from their nesting areas. So especially during the abortion season, they have the ability to spread the disease over a wide area. There are occasional recorded cases of a banded bird flying from Auckland to Otago and from Southland to Northland (R.O. Cossee, NZ National banding Scheme, Department of Conservation, *pers. comm.*). These longer flights are rare and probably more likely to occur at times of the year when gulls have not got a plentiful source of food. Over the abortion season and lambing period, when carrying high numbers of *S.* Brandenburg, there is a plentiful supply of food and so they are probably less likely to go on long inter-island flights.

In Scotland, *S.* Montevideo has been reported to be spread to sheep and cattle by the herring gull (*Larus argentatus*) (Coulson *et al*., 1983). There are also other reports of the involvement of sea gulls (*Larus spp.*) in the transmission of other *Salmonella* species to cattle in the United Kingdom by ingestion of sewage (Johnston *et al*., 1979; Fenlon, 1981). Because concentrations of organisms

are generally low in sewage it is thought that stress or starvation of sheep and cattle must play an important role if infection is to take place (Fenlon, 1981). Infective doses of *S.* Typhimurium in sheep are reported to be 4,000 organisms by the nasal route and about 20,000 by the oral route (Tannock & Smith, 1971). With intestinal total counts of up to 25 million organisms per gram in black-backed gulls in the prelambing-lambing period there is clearly the potential for infection to be picked up by stock from contaminated pasture and water.

In addition, there are reports of gulls of the *Larus spp.* being infected with *Campylobacter spp*. and *Listeria* monocytogenes. In one Canadian survey 8.7%, 15.9% and 9.5% respectively were infected with *Salmonella spp.*, *Campylobacter spp.* and *Listeria* monocytogenes with 30% of gulls overall harbouring one or more of the bacteria (Quessy & Messier, 1992). Therefore, these birds have the potential to spread these bacterial diseases to livestock, although Quessy & Messier (1992) considered that gulls play only a minor role in the epizootiology of these diseases.

CONTROL MEASURES

Measures used to control numbers of black-backed gulls have been poisoning using alphachloralose (Brown & Keedwell, 1998), destroying eggs at nesting time and shooting. The last is not very successful, as the birds tend to fly away if approached. The hanging of a dead black-backed gull on a fence during the prelambing/abortion period has been reported by farmers to keep other gulls away.

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