Some mortality patterns of Greater Magellan Geese on the Falkland Islands

JOHN HARRADINE

Introduction

Hillgarth & Kear (1979) reported on the incidence of disease in sheldgeese and shelducks (Tadornini) in the Wildfowl Trust's collections. Amongst the South American sheldgeese, Magellan *Chloëphaga picta picta* and *C. p. leucoptera*, Ashy-headed *C. poliocephala* and Ruddy-headed *C. rubidiceps* Geese, tuberculosis, aspergillosis, and amidostomiasis were common. Amidostomiasis (gizzard worm) was found to be especially prevalent amongst juvenile sheldgeese.

It cannot be assumed that diseases of captive birds will occur with the same frequency or severity in their wild counterparts, since the opportunities for disease transmission and development may vary. Wild birds will be subject to different social, nutritive and climatic factors which may alter their susceptibility even to the same pathogen.

For many years Falkland Islanders have reported periodic die-offs of Greater Magellan Geese *C. p. leucoptera*, usually in winter, sometimes in large numbers and normally involving young males. Sometimes 'thin white worms' were found in the intestine of these birds. Such reports generally refer to the smaller off-shore islands where geese tend to live more densely than on the mainland.

Hillgarth & Kear, furthermore, found that male sheldgeese survived less well than the females in the collections, and other workers (Siegfried 1976; Riggert 1978) have recorded female dominance in some shelduck populations. This is contrary to the Anatids as a whole, where males tend to survive better than females and to outnumber females in adult populations.

This paper summarizes observations made on the Greater Magellan Goose in the Falkland Islands from 1974 to 1976 during a study of its impact on the Islands' agriculture.

Methods

Observations were made mainly on Carcass Island, which supported a large population of geese and where periodic die-offs of birds were known. Whenever the opportunity arose the sex ratio of flocks of geese was recorded and the bodies of sick and dead geese were autopsied. The condition of the birds and their tissues was noted and any obvious parasites identified as far as possible. Pathological examination of tissues was not possible. The primary cause of death, therefore, could not be assigned with any confidence despite the presence, on occasion, of considerable parasite loads.

A number of apparently healthy birds was shot and similarly autopsied. In all, 39 adult geese were investigated, comprising 18 sick or dead birds and 21 apparently healthy birds. In addition, 10 downy goslings, which had either died in captivity or been killed by other birds, were autopsied.

Results

Incidence of parasites

The most obvious worms were hymenolepid cestodes, invariably occurring together in the small intestine near Meckel's Diverticulum, and nematode worms in the gizzard (and sometimes proventriculus) and the caecae. The nematodes were *Amidostomum anseris*, the gizzard worm that affects many wildfowl species and, in the caecae, mainly *Heterakis dispar* with *Trichostrongylus tenuis*.

All the overtly sick and dead birds contained gizzard worms and/or tapeworms, whilst about half of the apparently healthy birds also contained one or both of these parasites. Most of the goslings were similarly infected. In the remaining healthy birds, caecal worms were found in two but their occurrence in the other nine birds was not established. Table 1 summarizes the autopsy notes for the 49 birds.

Most of the 'sick' geese (94%) contained gizzard worms whilst only 14% of apparently healthy birds did, a difference significant at the 0·1% level ($\chi^2 = 21{\cdot}8$). About 82% of sick birds had tapeworms and 33% of apparently healthy birds were

Table 1. Occurrence of certain endoparasites in Greater Magellan Geese.

	Gizzard worm						Tapeworms						Caecal worms					
	Sick		Healthy		Gosling		Sick		Healthy		Gosling		Sick		Healthy		Gosling	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
None	0	1	8	10	1	0	1	2	6	8	4	0	0	0	0	0	1	0
Few	5	2	2	1	2	1	5	1	4	1	0	0	1	1	2	5	0	0
Many	7	3	0	0	3	3	6	2	0	2	1	0	3	1	0	1	0	0
Not examined	0	0	0	0	0	0	0	1	0	0	1	4	8	4	8	5	5	4
TOTAL	12	6	10	11	6	4	12	6	10	11	6	4	12	6	10	11	6	4
	18		21		10		18		21		10		18		21		10	

also infected, again a significant difference ($\chi^2 = 7{\cdot}26$). All the 14 geese that were examined for them contained caecal worms. Amongst the goslings 90% contained gizzard worm but of the five examined for tapeworms, only one was positive.

Additional information was collected from farms elsewhere in the Falkland Islands. Twenty-one apparently healthy Magellan Geese from Teal Inlet (East Falkland) showed 48% infection with tapeworms; 10 of 11 geese from Chartres (West Falkland) contained 'few' to 'many' tapeworms, whereas, of 22 geese from Port Howard (West Falkland) only one was clearly infected. Few signs of gizzard worm were apparent in any of these birds. Finally, both a sick and an apparently healthy goose from Speedwell Island and Fox Bay East (West Falkland), respectively, contained many tapeworms.

No significant sex differences are apparent in Table 1 within any of the categories of each parasite type. Overall, of the 22 males examined (excluding goslings) 54·5% were 'sick' whereas the proportion for the 17 females was 35·3%, and 82·6% of males were infected with gizzard worms or tapeworms whereas only 56·3% of females were similarly infected. Neither of these proportions is significant: the sample size in each comparison, however, is small.

Condition of birds

On numerous occasions on Carcass Island individual birds were seen to be sick. Invariably parasite loads were present in such geese. An early sign of illness was a progressive drooping of the primaries until, in advanced stages of sickness, the wings trailed along the ground. The bird became listless, slow, less responsive to danger, unsteady and inclined to sit hunched up. Feeding declined and the victim lost weight until muscle wastage was extreme. Flying became impossible and some birds, most uncharacteristically, sought cover, sometimes disappearing under thick vegetation in which they subsequently died. Body weights of 20 sick birds were, on average, 23·6% lower than the average for apparently healthy birds. In particular, estimates of pectoral muscle weight, based on core samples, showed a 41·0% reduction in eight sick geese compared with 17 healthy individuals.

Emaciation of the musculature was usually the dominant feature. Fibrinous peritonitis in the thoracic and abdominal cavities often occurred in the last stages; the intestinal tract frequently was empty and much contracted from the healthy state although in many birds, both sick and apparently healthy, the walls of the small intestine were damaged and suffused with blood. The liver often was enlarged and discoloured and sometimes covered with whitish spots. Little obvious effect of the parasites was visible except in the gizzard, where the koilin lining invariably was ulcerated, often severely, and suffused with blood, with many nematodes throughout the tissue.

Sex ratios

Out of a total of 2,656 geese observed in various parts of the Falkland Islands, mainly during spring, males comprised 43%. The areas and numbers are given in Table 2.

The West Falkland sample contained birds from Pebble Island where male-dominated die-offs are reported, hence that ratio may not wholly reflect that on the mainland. The overall ratio may also be biased by the disproportionate contribution from the islands, where males are less numerous than females.

A total sample of 22 complete nests on Carcass Island in 1974 and 1975 revealed a ratio of 1:1·02 at hatching. Subsequently a

Table 2. Ratio of male to female Greater Magellan Geese in different parts of the Falkland Islands.

Location	Number of Males	Number of Females	Male:Female	χ^2	p
Northern East Falkland	468	449	1:0·96	0·35	NS
North-eastern West Falkland	178	222	1:1·25	4·84	<0·05
Carcass Island	289	589	1:2·04	102·50	<0·001
West Point Island	211	249	1:1·18	3·14	=0·08
Total	1,145	1,511	1:1·32	62·12	<0·001

sample of 644 downy to recently fledged goslings revealed the same proportion of males. Selective losses of males, therefore, appear to begin after fledging.

Discussion

Effects of the parasites

The caecal nematode worms, on their own, appear to have been relatively unimportant to the geese they infected. *Trichostrongylus tenuis* can cause thickening of, and haemorrhaging in, the caecal walls and destruction of the mucosa surface with the result that the host suffers loss of appetite and weight, diarrhoea, anaemia and toxaemia (Cram & Cuvillier 1954; Lapage 1956), although Wobeser (1981) concludes that these worms are not important in wild waterfowl. *Heterakis*, similarly, can cause inflammation and haemorrhaging but usually is not seriously harmful, unless it serves to transmit acute enterohepatitis. In none of the geese examined were the caecae obviously damaged.

The effects of the tapeworms are more difficult to assess, for the adult stages, normally restricted to the lumen of the small intestine, have no gut and live by absorbing the host's digestive products through their surface. Their requirements for carbohydrates and calcium, however, may be detrimental (Crompton & Nesheim 1976) and they can reduce the movement of food through the host's intestine. In one goose intestine a solid tangle of worms filled the lumen. Crompton & Nesheim consider it unlikely that the energy requirements of the relatively small weight of parasite tissue would seriously affect the host's energy budget but the loss of energy to compensate for any tissue damage, haemorrhage and pathogenic effects can be severe. Some physical damage was detected, perhaps related to the attachment of the worms to the intestine wall. Loss of appetite, anaemia, thirst, emaciation and droopiness (Lapage 1956) may predispose the host to other diseases. In general, however, the effects of cestodes are probably not important, particularly where the host is in good health. This is borne out by the widespread occurrence of cestodes in otherwise healthy waterfowl (Wobeser 1981).

The gizzard worms probably contributed most to the ill-health and mortality of the geese. They mature under the epithelial lining of the gizzard and damage the koilin layer, which is essential in the break down of food prior to its digestion. Symptoms include loss of appetite, anaemia and emaciation through loss of blood or toxic effects of the parasite. Digestive disturbance due to the damaged gizzard may cause malnutrition despite an abundance of food: in wintering Canada Geese *Branta canadensis*, Herman *et al.* (1955) found the number of worms to be positively correlated with damage to the gizzard and loss of body-weight and condition.

Amidostomum eggs pass out of a goose in its droppings, later to hatch into larvae which then re-enter a goose on its food. The density of geese and the prevalence of carriers for the parasite, possibly adult geese or even other bird species (Leiby & Olsen 1965), therefore, are important determinants of the incidence and intensity of the disease. Thus its outbreaks generally are associated with birds congregating alongside water and with overcrowded wintering sites.

In the Falkland Islands, the offshore islands especially support high densities of geese because the pastures preferred by geese are more extensive and productive than on the mainland. In winter the birds congregate on the short *Poa/Agrostis/Juncus scheuzerioides* coastal, settlement and waterside greens; in the summer the nesting grounds frequently overlap with these preferred feeding grounds and the non-breeding birds remain on the latter. The densities of these non-migratory birds throughout the year, therefore, facilitate

the transmission of gizzard worms, but particularly so in winter. Indeed the reported pattern of die-offs, in which these worms appear to predominate, is one of mainly winter mortality on the smaller islands.

Amidostomiasis is normally a disease of young birds, which have a lower resistance to infection and which probably become infected on the breeding grounds where the conditions are optimal for the parasite's development (Wehr & Herman 1954; Leiby & Olsen 1965). Hillgarth & Kear (1979) found that death from severe gizzard worm infection, amongst the Wildfowl Trust's sheldgoose collections, occurred in the autumn and winter.

In the present study most of the sick and young birds were infected and there was clinical evidence for the impairment of digestion, which would explain the loss of appetite and emaciation observed. Other workers report that amidostomiasis rarely causes death directly and usually is associated with other parasites, particularly those found in this study (Herman & Wehr 1954).

In general parasite and host tend to adjust to each other so that both survive. The finding of parasites in apparently healthy birds suggests they can be tolerated under normal conditions. Stressful environmental conditions, however, particularly crowding and food-shortage, can upset the balance (Lack 1954). Prolonged hard weather during the brief winter days prevents the geese from feeding on the short, relatively nutritious pasture vegetation and forces them at best into rank and fibrous herbage. The stress induced under these conditions is likely to exacerbate the effects of crowding by reducing the birds' resistance and furthering the spread of parasite infection (Herman *et al.* 1955; Wobeser 1981).

Unequal sex ratio

Boyson (1924) stated that amongst Greater Magellan Geese 'there is always an excess of ganders', contrary to the present findings. In many Anatids males often outnumber females, the imbalance sometimes starting at or shortly after hatching, although a higher mortality of females is assumed to occur mainly during the nesting season due to physiological stress and vulnerability to predation during incubation (Hochbaum 1944; Kear 1965; Imber 1968). Jordan (1953), however, found the mortality of captive male Mallard *Anas platyrhynchos* greater than for females under artificial food shortage conditions whilst Imber (1968) found higher natural mortality among male Canada Geese, suggesting also that males, being larger and more conspicuous than females, are more susceptible to hunting mortality.

There may be several factors contributing to the biased sex ratio in Greater Magellan Geese. Food shortage in winter can occur during prolonged periods of hard weather. It may be that males requiring relatively more food for their greater size, suffer more quickly than females under such conditions, which then predispose them to parasitic infection and other diseases. Thirdly, many geese are shot each year for control purposes and for food, and it may be that the larger and predominantly white males tend to be shot rather more frequently than the brown females.

The Greater Magellan Goose normally is monogamous but occasionally polygyny was seen on Carcass Island and reported from elsewhere in the Falkland Islands. This condition may be a symptom of the unequal sex-ratio for it has been recorded amongst geese in confined, that is, crowded, conditions and where a male shortage exists (Brakhage 1965; Johnsgard 1968).

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Summary

Intestinal parasites were commonly present in sick or dead and apparently healthy wild Greater Magellan Geese *Chloëphaga picta leucoptera*. The nematode gizzard worm *Amidostomum anseris*, various hymenolepid cestodes in the small intestine and the nematodes *Heterakis dispar* and *Trichostrongylus tenuis* in the caecae, occurred most frequently.

Apart from the gizzard worms they had little

obvious effect on the geese. Degeneration of the goose's gizzard, however, can seriously affect its ability to feed and may, on occasion, be the primary cause of death. Congregation on short pastures, especially in winter when stress from food shortage can occur, facilitates the transmission of gizzard worm and probably contributes to the periodic die-offs.

A 1:1 sex ratio was found at hatching (22 complete clutches) and around fledging (644 birds) but the ratio was 1:1·3 (2,656 birds) amongst sub-adult and adult Greater Magellan Geese. The reasons for the differential mortality of males are not clear but may include their greater susceptibility to food shortage and its enhancement of disease, and hunting mortality.

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Dr J. Harradine, c/o The B.A.S.C., Marford Mill, Rossett, Wrexham, Clwyd LL12 0HL, UK.