POST-MORTEM EXAMINATION OF *CYGNUS CYGNUS CYGNUS* IN JAPAN

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Since 1973, about 70 dead *Cygnus cygnus cygnus* in Hokkaido have been sent to the Hokkaido Institute of Public Health in close co-operation with the Swan Society of Japan, Hokkaido Branch. Dead swans were examined from a hygienic point of view to investigate the cause of their death and also as the indicator of environmental pollution in Hokkaido. Results of chemical analysis of the total mercury in brains and feathers, heavy metal contents in feathers and organic hydrochloride and residues of other chemicals in organs show a lower level in two figures than in examinations of Hokkaido crows, reported in 1974. Nematodes in heart and stomach, trematodes in orbits, intestine and caecum, mites in nasal cavities were found in parasitological examination. Residual pellets of lead shot in muscles were found by x-ray and autopsy. As they were in small numbers per swan, they may not have had a direct effect on the swans. They will, however, be an indirect cause of death by impeding actions and causing clinical infirmity under severe winter conditions.

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MORTALITY FACTORS OF WILD SWANS IN BRITISH COLUMBIA, CANADA

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Introduction

Necropsies were performed on 52 *Cygnus columbianus columbianus* and 114 *Cygnus cygnus buccinator* from British Columbia, Canada. The birds were collected between June 1965 and October 1979 in coastal and interior areas. Although a feral *Cygnus olor* population is present on southern Vancouver Island (McKelvey 1979), none has yet been submitted for necropsy.

A few specific cases of diseased swans have been noted for British Columbia (Cowan 1946; Moynihan and Stovell 1955; Munro 1962; MacNeill 1970 and 1975). The information provided in this report shows only the disease conditions observed and does not necessarily indicate the prime cause of death.

Methods

Swan specimens for necropsy were provided by personnel of the Canadian Wildlife Service and the British Columbia Fish and Wildlife Branch.

Routine necropsy procedures were followed; where appropriate, parasitological, bacteriological, toxicological and other diagnostic techniques were used. Most specimens were received frozen, often showing advanced tissue autolysis, precluding histological examination. Tissue samples were retained from all suspected cases of lead poisoning and from all birds collected since the winter of 1978/79. Analysis for toxic chemicals is in progress.

To provide baseline information on the extent of parasitism in apparently healthy birds, 52 droppings of *C. c. buccinator* were collected from Comox Harbour, British Columbia, during the winters of 1977/78 and 1978/79. Parasite ova and larvae were separated by floatation.

Results and discussion

Necropsy conditions

Although 166 swans were necropsied, not all specimens were analysed for all conditions reported. When the cause of death was externally obvious, a complete necropsy was not performed.

Internal parasitism was the most common condition observed. Of 155 specimens examined, 121 (78%) were parasitized, a higher percentage than reported in other free-flying Anatidae (MacNeill and Barnard 1978). Parasites included nematodes, cestodes, trematodes and *Coccida* sp, found alone or in combination with one another.

Nematodes, including acanthocephalids, occurred in 115 swans (74%). *Amidostomum* sp was the most common, occurring in 98 (63%). Intestinal nematodes rarely appeared in sufficient numbers to have a detrimental effect. However, nematodes found in the heart, trachea, proventriculus and gizzard were often felt to have been deleterious, particularly in juvenile swans. Myocardial pathology was usually associated with heartworm *Sarconema* sp infection, the incidence of which appears to be increasing, from 2.9% for the period 1965 to 1976 to 7.8% for the longer period 1965 to 1979. It was found more frequently in *C. c. buccinator* (12) than in *C. c. columbianus* (1).

Cestodes were found in 31 swans (20%), usually with other parasites. The most commonly observed cestode was *Hymenolepsis* sp. Cestodes *per se* did not appear to be directly associated with death. Swans appear to be less frequently parasitized by cestodes than ducks and geese. MacNeill and Barnard (1978) found cestodiasis to be twice as frequent in all free-flying Anatidae.

Trematodes were observed in 11 swans (7%), always with other parasites. The most common fluke was *Echinostomum revolutum* (Frohlich 1802), a species reported widely distributed in British Columbia (Cowan 1946).

Internal parasitism did not usually appear to have affected the general health of most birds analysed. However, gizzard worm *Amidostomum* sp infection, with typical gizzard erosion, was often associated with oesophageal impaction; it was then thought to be directly responsible for the death of the bird.

External parasitism was noted on six occasions. Lice in five *C. c. buccinator* were identified as *Trinoton anserinum* (Fabricius 1805). A *C. c. columbianus* found comatose in Powell Lake, British Columbia, had a heavy attachment of leeches *Theromyzon rude* (Rathke 1862), affecting the conjunctival surfaces. That swan also suffered a pathogenic infection of *Amidostomum anseris* (Zeder 1800).

Trauma was noted in 66 (40%) of 166 birds, gunshot trauma being the most common condition (24). Most swan shootings appear to be malicious rather than through confusion with *Anser caerulescens caerulescens,* because most returns are from areas where there are no wintering *A. c. caerulescens.* Shooting of swans does not seem to be a widespread problem nor does it appear to be adversely affecting populations.

Non-gunshot trauma was usually the result of birds flying into power or fence lines. As the human population expands near swan wintering areas, this type of destruction may increase. One remedy, apart from removing power lines, is to make them more noticeable. Those at Port Alberni, British Columbia, have been almost eliminated as a source of danger, following the attachment of fish net floats to the wires. The swans now seem able to judge the exact position of the lines, even in foggy conditions, and to fly over them without colliding.

Debilitation was evident in 55 specimens (33%) and was usually associated with nematodiasis, aspergillosis and, to a less extent, lead poisoning.

Gizzards from 155 swans were examined and in nine instances lead pellets were observed. In 57 swans, gross pathology suggestive of lead poisoning was followed by chemical analysis of their livers for the presence of significant levels of lead. Significant levels were found in 14 instances (24%).

Cases of lead poisoning in swans from British Columbia have been reported earlier

(Munro 1962). Some areas (Table 1), such as Nanaimo, appear to contribute lead poisoned swans regularly. There is evidence that waterfowl feeding on unnatural

Table 1. Recovery location of swans found to have significant levels of lead in liver tissues

Location and species	Number recovered
Cygnus cygnus buccinator	
Nanaimo	7
Kelsey Bay	1
Fraser Lake (Vanderhoof area)	1
Stuart River (Vanderhoof area)	2
Duncan	1
Cygnus columbianus columbianus	
Boundary Bay (Vancouver area)	1
Duncan	1

foods such as waste corn and soybean meal are highly susceptible to lead poisoning (Irwin 1977). Waterfowl have also been reported to appear malnourished even though feeding on plentiful cereal grains (N Perret pers comm). Many of the swans found to have significant levels of lead are from areas where feeding occurs on cereal grains, available as waste or as handouts. The number of swans possibly succumbing to lead poisoning in British Columbia does not seem to pose a threat to the population and the problem appears to be of a local nature.

Impaction, digestive tract blockage, was most commonly seen in the oesophageal area and was often associated with gizzard erosion of parasitic origin. Gizzard erosion associated with lead pellet ingestion did not result in a significant occurrence of impaction. Impaction due to food overload, as frequently seen in *Branta canadensis* grazing lush green pasture in spring (MacNeill and Barnard 1978), was not observed in any swans.

Other necropsy conditions observed were myocarditis (7.8%), air sacculitis (6.6%), pericarditis (6.6%), nephritis (6.0%), anaemia (5.4%), aspergillosis (5.4%), enteritis (3.0%), exposure to weather (3.0%), bacteremia (3.0%), hepatitis (1.8%), amyloidisis of the liver (1.2%), bumblefoot (1.2%), ruptured aorta (1.2%), wild horseradish poisoning (1.2%), asphyxia (0.6%), avian tuberculosis (0.6%), peritonitis (0.6%), pneumonia (0.6%), sarcospordia (0.6%) and tracheitis (0.6%).

Virus isolation procedures were performed on 50 swans, using 10-day-old chicken embryos. No chick embryo lethal agents were detected.

Faecal samples

The analysis of swan faeces for the ova and larvae of internal parasites seems to

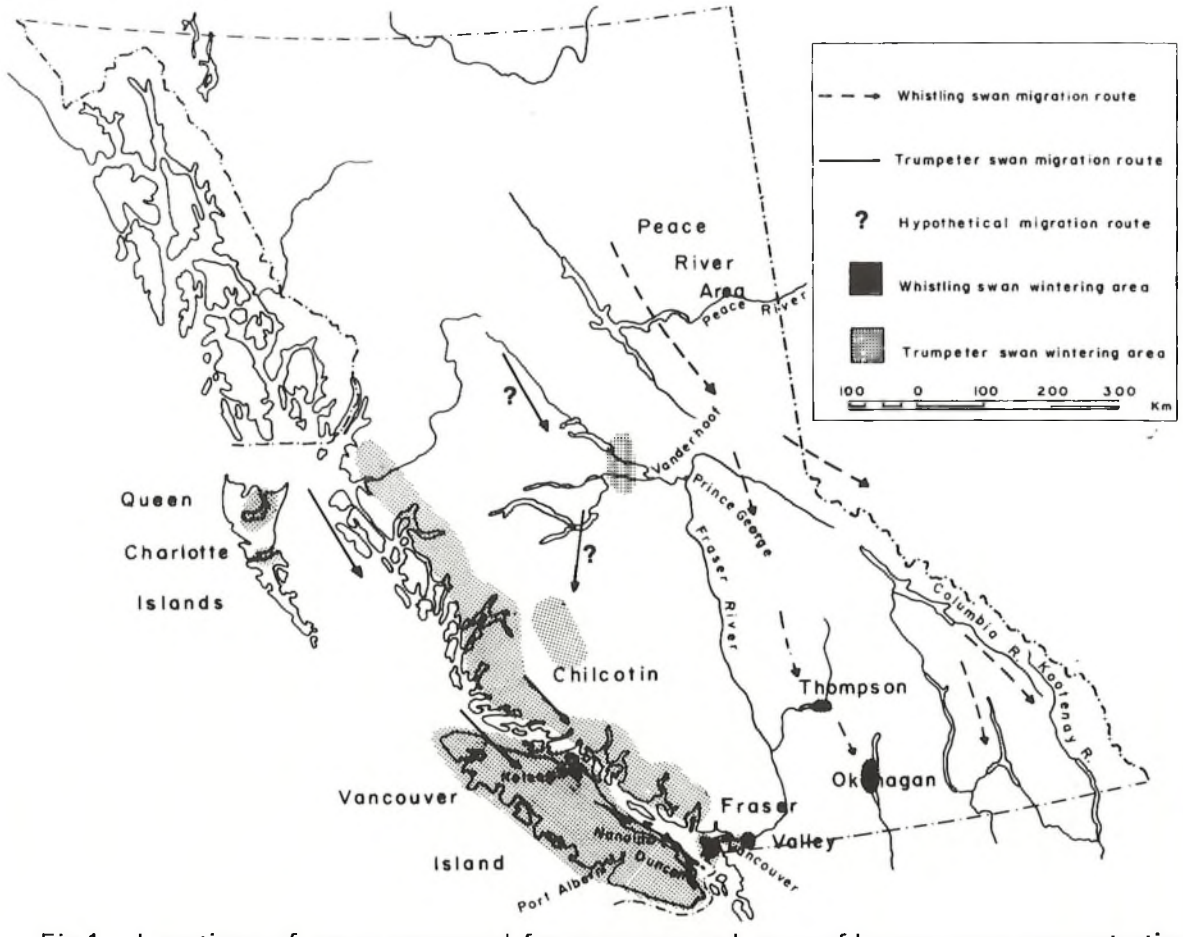

Fig 1. Locations of swans recovered for necropsy and areas of known swan concentrations.
Data from this study, Canadian Wildlife Service files (Delta) and personal observations.

indicate that normal wild swans may not carry many parasites. Of the 52 droppings analysed, 10 contained ova or larvae or both. No attempt was made to identify the species of parasites present.

Distribution of returns

Fig 1 shows the geographic region from which the swans were collected. The distribution of the return of dead swans complements the known population distribution and concentrating areas of both species. Although no systematic searching has ever been possible because of inaccessibility of much of the winter range, the collection of dead birds does not seem to have been too badly biased by proximity to concentrations of human population.

C. c. columbianus is generally less abundant in British Columbia than *C. c. buccinator.* The former migrates through eastern British Columbia and the Peace River district, though few compared with those passing through Alberta. Fewer than 250 winter in the Thompson–Okanagan area and fewer than 150 along the southern coast.

C. c. buccinator winters mainly along the coast of British Columbia, with smaller groups found in north-central areas and in the Fraser Valley (McKelvey in press and 1979). The largest numbers of necropsied swans have come Vancouver Island, an area thought to support about 1000 swans. Lesser numbers have come from interior and north coastal areas, where small populations occur.

The disease conditions reported in this study are thought to be typical, though only a very small part of what is presumed to be the normal winter kill is ever found. The productivity of *C. c. buccinator* wintering on Vancouver Island averages about 25% (McKelvey 1979) but the annual population increment in Alaska is only about 3%.

Some causes of death are obviously related to the presence of men, such as lead poisoning, shooting and collisions with structures. The complete analysis of tissues on hand for pesticide and other toxic chemical residues will eventually give a more complete picture of man's influence. Until then, it seems permissible to conclude that man is not having too great an effect on swans in British Columbia.

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Summary

114 *Cygnus cygnus buccinator* and 52 *Cygnus c. columbianus* were necropsied. The sample reported on is representative. The most frequent parasites were gizzard worms. Only when associated with oesophageal impaction did parasitism seem to be responsible for death. Faecal samples collected from apparently healthy wild *C. c. buccinator* indicate that the normal internal parasite load is relatively low. Trauma was caused mainly by gunshot and collision with power lines. Debilitation was associated with nematodiasis, aspergillosis and, to a lesser extent, suspected lead poisoning, which does not appear to be a major problem.

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DISEASE PROBLEMS IN NORTH AMERICAN SWANS

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Infectious, parasitic and toxic disease processes kill many free-living swans in the United States annually. The two most serious diseases affecting *Cygnus*