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CAUSES OF DEATH IN CAPTIVE WILD WATERFOWL IN THE KORTRIGHT WATERFOWL PARK, 1967-1970

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Abstract: Diseases occurring in captive waterfowl at an Ontario park maintained for research and public education were studied over a three-year period, 1967-1970. Organic diseases, probably causally associated with stresses of captivity, were the most serious mortality factors. These diseases were amyloidosis, myocardial infarction, and gout. With the exception of aspergillosis and one serious outbreak of *Pasteurella anatis* infection, infectious diseases were of secondary importance.

INTRODUCTION

Causes of mortality in captive ducks, geese, and swans were studied over a three-year period at the Kortright Waterfowl Park and Niska Research Center, at Guelph, Ontario. This park is managed for waterfowl research and public education by the Ontario Waterfowl Research Foundation. Waterfowl at the park numbered approximately 1000 at the end of 1967, 1450 in 1968, and almost 2000 in 1969 and 1970. The portion of the park used by the waterfowl comprised about 15 acres.

METHODS

To increase production, the first clutches of most laying ducks and geese were collected and incubated artificially. They were then allowed to incubate the second clutches naturally. Hatchability has averaged about 75%. Mortality of downy young and fledgling birds was about 25%. "Adult" (birds in or beyond the post-juvenile molt) mortality was estimated to be less than 10% each year. Certain research practices in the park, such as frequent handling of birds to determine weights and measurements and blood sampling, raised the mortality rates

above those expected in a waterfowl collection kept only for display purposes; also in some cases, experimental diets were used which may not have been nutritionally adequate.

Most birds which died because of predation, vandalism, or accidents of various kinds in which an obvious cause of death was recognized by the park attendants were not submitted for necropsy. All dead birds in which the cause of death was not apparent were examined by necropsy and histopathology. Tissues for histological examination were fixed in buffered formalin, embedded in paraffin, sectioned, and stained with hematoxylin and eosin. Frequently, special stains were used to demonstrate amyloid and myocardial lesions. These included the Congo red, thioflavin T, allochrome, and periodic acid-Schiff (PAS) methods. Parasitologic, bacteriologic, mycologic, virologic, and toxicologic studies were undertaken when they seemed indicated by the lesions observed at necropsy.

RESULTS AND DISCUSSION

Specific causes of death are listed in Table 1. Cases of no or uncertain diagnosis, predation, and accidental death are omitted. Diseases which may be related

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to the stresses of keeping many birds together in restricted space were prevalent; for example, amyloidosis (fig. 1) was found in 20% of the cases, myocardial infarcts (fig. 2) in 6% and gout (fig. 3) in 4%.

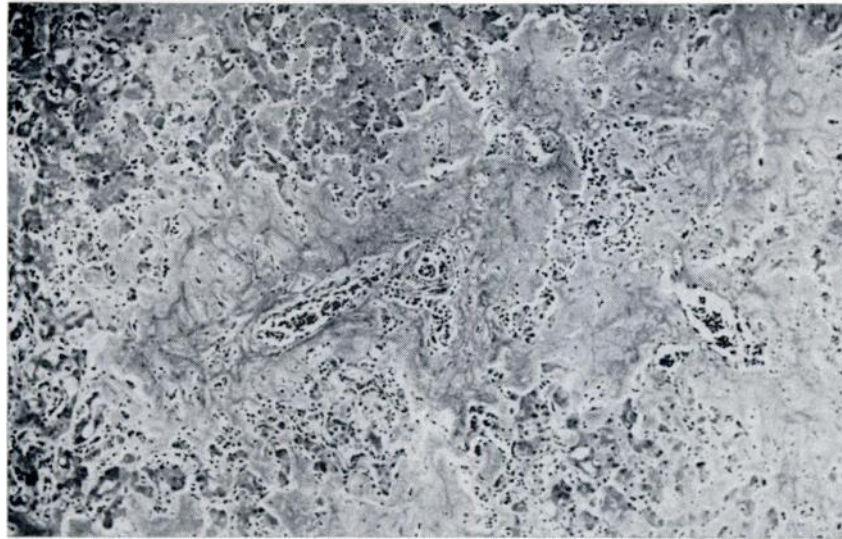


FIGURE 1. Liver, Canada Goose. Most of the hepatic tissue has been destroyed and replaced by pale amorphous or faintly fibrillar amyloid. PAS-hematoxylin stain, 300X.

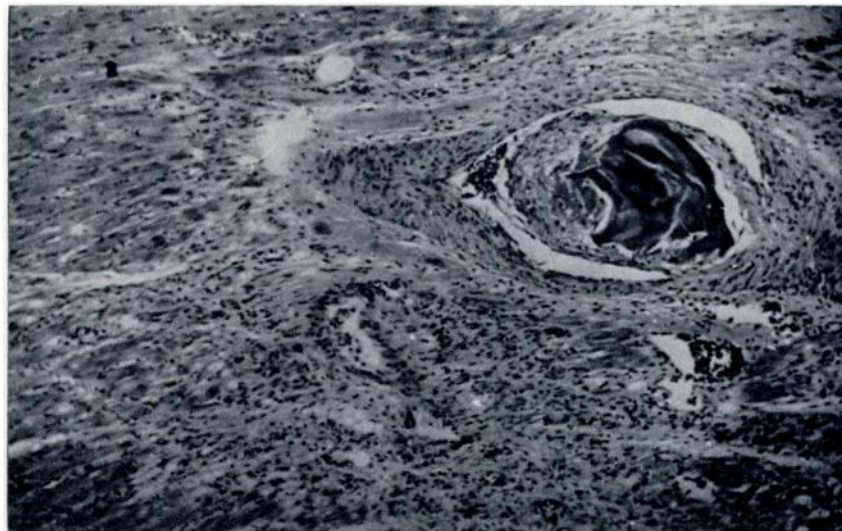


FIGURE 2. Myocardium, Wood Duck. Thrombus in an area of infarction. PAS-hematoxylin, 300X.

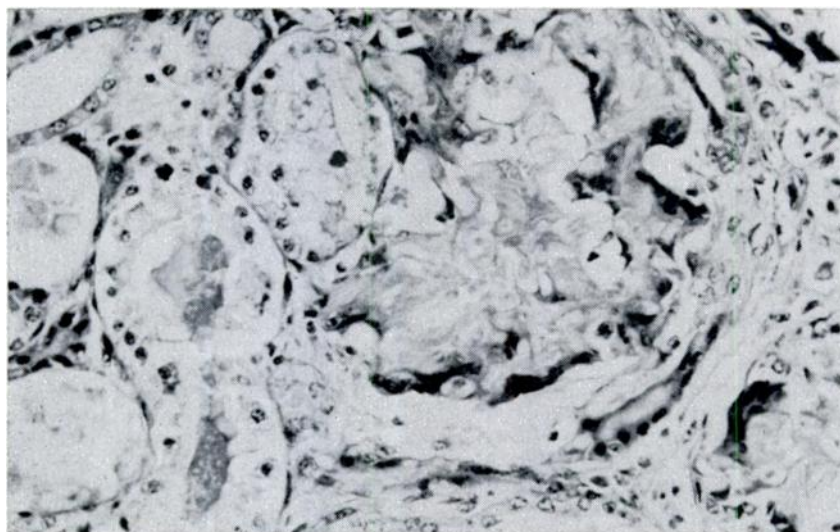


FIGURE 3. Kidney, Wood Duck. A gouty tophus is present, bordered by multinucleate giant cells, atrophic tubules, and fibroblasts. Hematoxylin-eosin, 1000X.

Seasonal Prevalence

Some diseases had marked seasonal prevalence. Most of the cases of gout and amyloidosis occurred in the winter months. Deaths due to myocardial infarcts also occurred mainly in severe winter weather. With the exception of one case in July, all of the others occurred during the months of October to March, with a preponderance of cases in January. In sharp contrast, most of the aspergillosis cases occurred during the warm months, June to October. Since aspergillosis usually is a subacute respiratory disease, it seems that the time of onset of most of the infection was during warm weather when temperatures would be favorable for mold growth in the external environment.

It was apparent that some species suffered high mortality, while others experienced very few losses. One of the groups of waterfowl with high mortality rates was the small cold-sensitive ducks, such as the tree ducks. Most of the birds in the park were not housed during cold weather. Species which were confined in an indoor pond in an attempt to reduce the losses due to cold exposure, were the

fulvous tree duck, black-bellied tree duck, bufflehead, ruddy duck, shoveller and blue-winged teal.

Amyloidosis

Amyloidosis was the disease diagnosed most frequently, in 20% of 285 necropsies. The rate varied somewhat from species to species, being particularly high in black-bellied tree ducks which died during winter months. Five of these had terminal staphylococcal septicemia. Three of the black-bellied tree ducks died with visceral gout, but two of these also had amyloidosis. Three of these tree ducks had myocardial infarcts as terminal causes of death but they also had amyloidosis.

Approximately 25% of 58 cases of amyloidosis occurred without other recognized disease. Of the other 75%, nine had myocardial infarction as a terminal complication; seven had terminal bacterial septicemia; five had concurrent visceral gout; six birds with amyloidosis had helminth infections; and two ducks had amyloidosis and aspergillosis.

TABLE 1. Summary of diseases diagnosed in Waterfowl at Kortright Park, 1967-1970*

Bacterial Infections	72
<i>Erysipelothrix insidiosa</i> septicemia	6
<i>Escherichia coli</i> septicemia	8
<i>Mycobacterium tuberculosis</i>	1
<i>Pasteurella anatipestifer</i>	36
<i>Pasteurella hemolytica</i> septicemia	1
Staphylococcal arthritis	2
Staphylococcal peritonitis	1
Staphylococcal septicemia	9
Streptococcal abscess—brain	1
Streptococcal abscess—foot	1
Streptococcal septicemia	6
Mycotic Infections	52
Aspergillosis	52
Helminth Infections	20
Microfilariasis (species not determined)	2
Nematodiasis, gastric (<i>Acuaria</i>)	2
Nematodiasis, gastric (<i>Amidostomum</i> sp.)	1
Nematodiasis, gastric (<i>Tetrameres</i>)	1
Verminous bronchitis (<i>Cyathostoma</i>)	10
Verminous esophagitis (<i>Capillaria</i>)	1
Verminous hepatitis (worm not identified)	2
Verminous enteritis (<i>Acanthocephala</i>)	1
Protozoan Infections	4
Coccidiosis, intestinal	3
Coccidiosis, renal	1
Diseases of the Cardio-Vascular System	83
Amyloidosis	58
Arteriosclerosis	1
Endocarditis	1
Infarction, cerebral	1
Infarction, myocardial	18
Infarction, splenic	1
Hemorrhage, adrenal	1
Pericarditis	1
Thrombosis, pulmonary	1
Diseases of the Urinary System	18
Glomerulosclerosis	1
Gout, articular	1
Gout, visceral	11
Nephritis	1
Nephrosis	4

TABLE 1. continued

Diseases of the Respiratory System	4
Pneumonitis	3
Sinusitis	1
Diseases of the Digestive System	23
Enteritis, necrotic	2
Enteritis, unspecified	1
Foreign body, gastro-intestinal	6
Granuloma, cecal	1
Hyperkeratosis, esophagus	1
Impaction	4
Infarction, liver	1
Necrosis, liver	3
Perforated intestine	2
Ulcer, cecal	1
Ulcer, intestinal	1
Miscellaneous	9
Anemia	1
Dermatitis, foot pad	1
Encephalopathy	1
Exposure	3
Peritonitis	1
Salpingitis	2

* Excluded are cases of no or uncertain diagnosis, predation, and accidental death.

The causes of spontaneous amyloidosis are unproven. It is difficult to classify any of these as "primary amyloidosis", since it is possible that they represent cases of secondary amyloidosis in which the primary cause was not found. Brassard¹ and Cowan^{2,3} have described amyloidosis in many species of ducks in the Philadelphia Zoo. As in their cases, amyloidosis in the Kortright waterfowl was most common in the liver and spleen. In man, primary amyloidosis often involves the heart and intestines. Myocardial amyloidosis with terminal infarcts occurred in one common eider from Kortright Park. Brassard did not find that the heart was involved in any of his cases. He was unable to state the cause of amyloidosis in the Philadelphia Zoo, however increased incidence of amyloidosis was found to correlate with keeping

increasing numbers of waterfowl on the same acreage. Cowan^{2,3} reviewed the cases of avian amyloidosis which occurred in the Philadelphia Zoo over a 30 year period, 1936-1965. The Anseriformes (family Anatidae) had the highest frequency of amyloidosis in the 13 orders of birds in which amyloidosis occurred. Amyloidosis was recognized in 45% of 578 ducks, geese and swans examined. Highest rates were found in exotic species and in poorly adapted or excessively aggressive birds. He recognized that amyloidosis seemed to be a response to environmental stressors. Rigdon⁶ found a high rate of spontaneous amyloidosis in domestic Pekin ducks, without recognizable causes.

In experiments with Pekins, Cowan⁴ found a positive correlation between amyloidosis and crowding.

Myocardial Infarcts

Eighteen cases of myocardial infarction were diagnosed. In none of these was there recognizable arteriosclerosis, atherosclerosis, or other primary damage to coronary vessels. Five birds had infarcts of the myocardium as the only disease condition recognized. In the 13 other cases, myocardial infarction was accompanied by some other condition: amyloidosis in nine, bacteremia in three, and peritonitis in one, resulting from internal rupture of egg yolk.

Gout

As in amyloidosis, the causes of gout are unknown. High intake of foods rich in purines is considered a contributing cause of gout in man. Diet seemed unrelated to occurrence of gout in the Kortright waterfowl. The standard diet fed to all species was a commercial pelleted duck feed. The diet of fish-eating ducks was supplemented with pelleted trout food and in some cases with frozen fish.

Infectious Diseases

It was considered that staphylococcal septicemia and the other sporadic infections diagnosed posed no serious hazard to the waterfowl in the park. Staphylococcal septicemia seemed to be a common terminal cause of death in birds in which

resistance to infection was reduced by amyloidosis. Other infections such as *Erysipelothrix* septicemia, were sporadic, involving only six birds. *Pasteurella multocida*, the causative agent of fowl cholera, which has caused extensive mortality in wild waterfowl, did not appear at all. This is fortunate in an area such as Kortright, where many ducks, geese, and swans are kept on limited acreage and where there is water flowing through a series of ponds inhabited by different groups of waterfowl and where some waterfowl, some of the geese and pintail, black and mallard ducks are free-flying, entering and leaving the park at will.

Pasteurella anatipestifer infection, so-called "new duck disease", was the cause of an extensive outbreak in young blue and snow geese, with losses approaching 50% of a group of 200 incubator-hatched goslings. Thirty-six birds were diagnosed at necropsy as cases of *P. anatipestifer* infection. This outbreak and the clinical and pathological signs have been described in a separate publication.⁵

Viral infections were not found.

The single case of tuberculosis was a fulvous tree-duck recently acquired from another park.

Coccidiosis and helminth infections other than *Cyathostoma*, did not pose serious problems. Tracheal worms of the genus *Cyathostoma* appeared to be a potentially important cause of mortality of young geese.

Acknowledgement

Mr. William Carrick, manager of the Kortright Waterfowl Park and Mr. René Jones, Research Biologist, Niska Waterfowl Research Center, cooperated in every way possible to make this study worthwhile.

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