Fifty years of animal health at The Wildfowl & Wetlands Trust

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The study of wildfowl disease and mortality was in its infancy when, in 1946, Peter Scott founded the Severn Wildfowl Trust at Slimbridge. The largest collection of captive wildfowl in the world was not to be without significant health problems, since the maintenance of high densities of birds on the same area for 50 years was a sure recipe for a host of infectious and parasitic disease outbreaks. In the United States, studies into large scale mortality of wild migratory waterfowl had been undertaken as early as 1920, and the importance of botulism and avian cholera, with their ability to cause mass mortality, had been recognised. In Europe, however, little was known of the disease status of captive and migratory waterfowl; this was a subject to which WWT would make a significant contribution during the next five decades.

Thankfully, the importance of carrying out detailed *post mortem* examinations of all dead birds, and the recording of subsequent data, had been recognised at an early stage. These records, now on a computer database, have resulted in the publication of numerous papers. The first analysis of mortality of captive birds at Slimbridge (Jennings 1958) gave a valuable insight into the early build up of disease in the collection. Later, an analysis of mortality during the severe winters of 1961-62 and 1962-63 (Beer, 1964) illustrated the problems encountered by exotic wildfowl in cold conditions.

A series of papers by Hillgarth & Kear comparing mortality and susceptibility to disease of the 11 tribes of wildfowl which make up the order *Anseriformes*, gave valuable information on the maintenance of captive seaducks (1979a), shelducks and sheldgeese (1979b), perching ducks (1981), whistling ducks (1982a), stiff-tailed ducks (1982b) and the northern geese (1983). Later, the mortality and disease of captive flamingos were investigated (Brown & Pickering 1992), plus that of captive and wild swans (Brown *et al.* 1992 a, b).

In the early days of WWT, many live birds were sent to Slimbridge from all over the world in order to increase the number of species represented in the collection. Unfortunately, many of these were wild caught and, although some survived the rigours of long journeys, the stress of captivity combined with unsuitable climatic conditions debilitated others which then succumbed to opportunist infections such as aspergillosis, a fungal disease which invades the respiratory system.

The lack of proprietary feeds at this time also resulted in poor nutrition for some species, and many young birds exhibited various problems associated with vitamin and mineral deficiencies. Lack of hygiene and overcrowding in the rearing areas resulted in severe losses from bacterial, fungal and parasitic diseases, and underlined the need for better management of the collection area.

Gradually, with an increase in our knowledge of species' requirements, coupled with better hygiene and advances in veterinary medicine that have provided effective antibiotics and anthelmintic drugs, the picture has improved. Research into

several disease problems has resulted in more effective management of the collection and rearing areas which, combined with better nutrition, has resulted in healthier and more disease resistant birds.

It is fortunate that wildfowl demonstrate great interspecific variation in their susceptibility to most diseases. This has certainly prevented major epidemics. The establishment of six separate collections in different areas of the United Kingdom has always been regarded as an insurance policy against such happenings.

The following accounts cover individual diseases, and catalogues improvements and progress in control and eradication over the past 50 years.

Avian Tuberculosis

Avian tuberculosis is a chronic wasting disease of birds with a slow period of development that enables infected individuals to contaminate the environment by shedding numerous infective bacilli in their droppings.

The first case of avian tuberculosis at Slimbridge was recorded in 1948 but, throughout the following ten years, only a few cases of the disease were diagnosed. Predictably, by the early 1960s TB had become a major problem, accounting for 23% of adult mortality in 1962 compared to only 5% in 1955. Although measures to reduce the incidence of TB were introduced at this time, the disease was well established, and without suitable detection, treatment or vaccination, little progress was made in terms of control. At this time (1960), it was thought that broody hens used for incubation and foster rearing of waterfowl were the likely primary source of infection. A study carried out in the early 1970s, however, disproved this theory as different serotypes were isolated from collection birds and from the hens (Schaefer *et al.* 1973).

During this period, the value of vaccines as a method of control was investigated and several young birds received the human BCG vaccine which unfortunately failed to give any protection against the disease. Although the vaccine had failed, a whole blood agglutination test to detect TB infected birds in domestic poultry flocks was being used by The Ministry of Agriculture Fisheries and Food (MAFF) giving reliable results. Accordingly, through the co-operation and help of MAFF (Weybridge), all of the Peakirk collection was tested and birds judged to be infected were removed. Deaths from tuberculosis at Peakirk were reduced substantially over the next few years and further testing, especially of rare and endangered species, was introduced. The greatest advantage of this test was the ease with which it could be carried out in the field only requiring a couple of minutes to give a result. Unfortunately, as time went on, there was an increase in the number of false positive and false negative results, and testing was reluctantly abandoned in the mid 1980s.

In early 1986, a joint research project was launched with Dr John Stanford of University College and Middlesex School of Medicine. The project centred on the quest for a reliable avian TB vaccine and resulted in a large-scale vaccine trial which continues at the present time. Dr Ruth Cromie, who received her doctorate for the vaccine work, subsequently developed an Enzyme-linked Immunosorbance Assay (ELISA) which enabled reliable diagnosis of TB in several species of live waterfowl (Cromie *et al.* 1993; Forbes *et al.* 1993). Further development of this test and continued work on vaccines will be essential if we are to conquer this debilitating disease which is the scourge of aviculturalists worldwide.

Other Bacterial Infections

Numerous bacteria cause disease and illness in waterfowl especially in young birds. As previously mentioned, overcrowding and lack of hygiene in the rearing areas is a certain recipe for disaster. As the number of birds reared at Slimbridge each year increased so did the likelihood of an outbreak of bacterial disease, it is no surprise, therefore, that an outbreak of *Salmonella* in the duckery caused severe losses in 1950 and resulted in the preparation of a *Salmonella* vaccine for use during the following year. In the

event, improvements in duckery hygiene prevented any cases in 1951 and the vaccine was not used.

As well as *Salmonella*, many outbreaks of bacterial disease are caused by strains of *E coli, Campylobacter* and *Pseudomonas*. Thankfully we now have a wide range of soluble and injectable antibiotics which can be used to combat such outbreaks. In addition, more effective disinfectants ensure that hygiene in both incubator and rearing areas is of a very high standard.

Other bacterial infections which have been encountered occasionally in adult birds include *Yersinia* which causes tuberculous-like lesions, and *Pasteurella* which is capable of causing sudden and high mortality.

Fungal Diseases

As previously mentioned, aspergillosis caused by *Aspergillus fumigatus* invades the respiratory system of birds causing the formation of spore producing fungal placques in the air sacs, lungs and trachea. Certainly in the first few years of the Slimbridge collection aspergillosis was the major cause of death in all age groups, but particularly young birds. Again this was a result of poor hygiene in the rearing areas as the saprophytic fungus grows on any moist organic debris and failure to remove this results in a build up of infective spores. John Beer, who was WWT's pathologist for 17 years, carried out a great deal of research on the disease and gained his PhD for a study of *Aspergillus*. His findings resulted in a better understanding of the disease and its causes, enabling him to recommend control measures (Beer 1958). Treatment of aspergillosis is extremely difficult, and it is only in recent years that effective drugs such as Itraconazole (Janssen Pharmaceutical) have been available. Successful treatment, however, relies on early diagnosis which is always difficult. Prevention, as always, is the best course of action and the removal of grass cuttings, damp and mouldy food, old straw and other dead vegetation, is the most effective method of control. Good ventilation in rearing areas and stress-free environments are also important, especially for those species which are known to be susceptible to the disease. Today only a few *Aspergillus* cases are seen in collection birds every year and these are usually secondary to other debilitating conditions.

Candidiasis caused by the yeast-like growth of *Candida albicans* is another fungal infection which invades the oesophagus and alimentary system of waterfowl, especially of seaduck. No mention of this disease is made in early reports on mortality, but in the 1960s and 1970s regular problems were experienced with Eider Ducks *Somateria m. mollissima* at both Slimbridge and Peakirk. At this time, the only successful treatment involved spraying the feed of these birds with dilute solutions of formic acid. Later, however, drugs such as Ketaconazole and Itraconazole (Janssen Pharmaceuticals), and Nystatin (Squibb) enabled individual treatment with excellent results.

It is probable that improved diets now used for seaduck through all WWT Centres have contributed greatly to a reduction in the number of cases of *Candidiasis* every year.

Another unusual fungal infection that affects the plumage of the Chilean Flamingo *Phoenicopterus chilensis* flock at Slimbridge, appeared in the 1960s. *Cladosporum herbarum*, a sooty mould, which grows on osiers (a type of willow *Salix*) produces myriads of tiny fungal spores. It was discovered that when these spores settled on the plumage of flamingos, the warm and often damp feathers were an ideal medium for propagation of the mould. The resulting fungal hyphae invaded the plumage and destroyed feather structure causing loss of waterproofing and a condition commonly known as 'wet feather' (Beer & Kear 1973). Several birds were treated with anti-fungal preparations, but it was found that removal of osiers from the pen was the best long-term answer to the problem.

Parasitic Disease

It was inevitable that, with the increasing population of captive birds and the large

number of visiting wild waterfowl to Slimbridge, parasitic infections would occur.

Even as early as 1948 Gizzard Worm *Amidostomum anseris* infection in geese was considered a major problem and in 1952 there was alarming mortality in the outdoor duckery when 63 young birds were lost to the nematode parasite *Acuaria uncinata. Acuaria* burrow deeply into the tissues of the proventriculus and gizzard, forming tumour-like nodules. These lesions seriously impair the passage of food through the digestive tract and restrict proper digestion. The only treatment available at this time was highly toxic carbon tetrachloride capsules which, although effective against the parasites, often had serious effects on the birds.

In the case of *Acuaria*, it was found that an increase in water flow through the ponds discouraged the intermediate host *Daphnia pulex*, the Water Flea, and thus the installation of pumps to circulate water was effective in reducing the problem. Other parasitic problems were caused by numerous tapeworm species, Thorny-headed Worms in the intestine, and by coccidiosis, a protozoan parasite which can infect both the alimentary tract and kidneys of birds. Gapeworms *Cyathostoma*, a nematode which infests the trachea, also gave rise to problems in young geese, especially the endangered Hawaiian Goose *Branta sandvicensis*.

With advances in veterinary medicine and the availability of better anthelmintic drugs, the control of parasitic infections gradually became more effective. At the present time, Flubendazole (Flubenvet, Janssen Pharmaceuticals) compounded into the feed twice a year and the use of Ivermectin (Ivomec Merck Sharp & Dohme Ltd) by injection has reduced parasitic infections to a very low level. Fenbendazole (Panacur, Hoechst Animal Health) is also used routinely as an oral drench to control parasites in young birds.

Duck Virus Enteritis

Duck virus enteritis (DVE), often known as duck plague, is an acute, contagious herpesvirus infection of *Anseriformes*. The first outbreak of DVE within WWT's Centres occurred at Slimbridge in April 1978, when over 20 birds were lost in a short space of time. The following spring saw a more severe outbreak and several valuable and endangered species were lost. After negotiation with the MAFF, WWT was permitted to use a DVE vaccine which had been imported from Holland several years earlier but never used. This vaccine successfully controlled outbreaks of DVE at Slimbridge, Martin Mere and Arundel over the following years. Eventually, due to age and the lack of fresh stocks, the vaccine became less viable and dosage rates needed to be increased to achieve immunity.

In 1992, MAFF (Weybridge) produced a new DVE vaccine (Anserivac) which has been employed with excellent results at WWT Centres since this time on an experimental basis. It is hoped that Anserivac will attain full product licence status within the next few years, so that the increasing number of DVE outbreaks within the UK can be controlled more effectively.

Lead Poisoning

The ingestion of spent lead shotgun pellets and discarded fishing weights has long been a serious problem in wildfowl. Birds normally ingest particles of grit when feeding to aid the mechanical digestion of food in the gizzard. Lead pellets may be present in the mud where shooting and fishing activities take place or have done previously. When waterfowl ingest pellets, they are ground down in the gizzard forming soluble lead salts that enter the bloodstream. The resulting toxaemia causes severe central nervous system symptoms, paralysis and often death.

Since 1987 the sale and use of lead fishing weights of less than 28 g have been banned in the UK. This has resulted in a marked decrease in the incidence of lead poisoned Mute Swans *Cygnus Olor* which had previously suffered high mortality from this cause (Owen 1992). Pressure is now growing to restrict the use of lead shotgun loads in wetland areas so that the vast numbers of wild waterfowl which die

from lead poisoning each year may be reduced.

Unfortunately, lead is very stable and may persist virtually unaltered in mud and soil for many years. Cases of lead poisoning still occur in the Slimbridge collection each year even though no shotgun shooting has taken place in the grounds for 50 years. Lead poisoning was a major problem in the early years of the Martin Mere collection, but the provision of large quantities of suitable grit in feeding areas combined with anti-erosion protection of pond edges has resolved the problem.

The provision of X-ray apparatus at Slimbridge in 1970 enabled better diagnosis of lead poisoning, as lead pellets retained in the gizzard are easily visible on X-ray photographs. Treatment of affected birds using Sodium calciumedetate has been efficacious in many cases.

Radiography has also enabled the study of wild Whooper *Cygnus cygnus* and Bewick's *C. columbianus bewickii* Swans visiting WWT Centres during the winter months. Many of these internationally protected species are fired at each year by indiscriminate shooters, and although many must be killed, others carry shot in their tissues for the rest of their lives. In one study, no less than 34% of wild Bewick's Swans caught at Slimbridge for ringing were found to be carrying lead shot in their tissues (Evans *et al.* 1973). Studies of Whooper Swans, Barnacle *Branta leucopsis* Geese and Brant Geese *Branta bernicla* have shown lower but still worrying numbers carrying shot.

Avian Botulism

Botulism is a disease caused by ingestion of neurotoxins which are produced by the bacterium *Clostridium botulinum*. Although common in the United States, outbreaks in the UK have been sporadic, almost certainly due to the lower temperatures experienced in this country. *Clostriduium botulinum* persists in wetland areas and requires anaerobic conditions, dead organic material and water temperatures of 25°C in order to grow and produce toxin. Other factors affecting botulism outbreaks include water quality, depth and fluctuations in water levels.

Waterfowl affected by botulism sustain muscular paralysis preventing flight and walking, followed by paralysis of the neck muscles which prevent the bird from holding its head erect. Many birds in this last stage die from drowning, others die from respiratory failure caused by the toxin.

That WWT escaped an outbreak of botulism for so many years is probably due to lack of suitable temperatures and the maintenance of fairly constant water levels within the collection areas. An outbreak did occur however on the wild 'mere' area at Martin Mere in the 1980s. During the long hot summer of 1995 a further outbreak occurred at Martin Mere in both wild and collection areas, with the loss of over 400 birds. Many birds were saved due to the efforts of staff who provided shaded recovery pens and oral fluid therapy. With the current trend towards higher summer temperatures due to global warming, botulism may become an important problem in years to come.

Nutritional Diseases

As mentioned previously, the lack of proprietary feeds in the early days of WWT resulted in many young birds suffering from nutritional disorders. These included perosis, rickets and vitamin E deficiency, the latter resulting in degeneration of muscle tissue.

When the first proprietary feeds became available they were specifically designed for domestic poultry and did not always meet the needs of the different species of captive waterfowl. Problems were experienced with many young birds suffering from renal failure due to elevated protein levels in the turkey starter crumb used at this time. Many of the seaduck particularly Eiders *Somateria* sp., also died from renal disease during the first two or three years of life, almost certainly due to high protein levels in the trout pellet with which they were fed.

During the past 20 years we have been fortunate in obtaining diets specially designed for the different types of waterfowl and nutritional disease is now a

rare occurrence. There is, however, still a need for improvement in the diets of many species if we are to maintain healthy self-sustaining breeding populations.

Conclusions

With hindsight it is very easy to see where improvements could have been made in earlier years but it should be remembered how little was known of the etiology of most diseases. The lack of effective antibiotics, anti-fungal drugs, anthelmintics and disinfectants were a serious setback as was the lack of reliable artificial incubators. Nutrition, at best in the early years, was a hit and miss affair and must have increased susceptibility to disease in many species.

Looking to the future, continued research into avian tuberculosis must be the highest priority if we are to continue to maintain captive birds at high densities within our collection areas. Advances in avian medicine have been great during the last 15 years and more veterinarians are specialising in avian work than ever before. With this upsurge in interest, and great advances in the field of veterinary medicine, the future looks promising for WWT and its birds.

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