Diseases of kiwis (Family: *Apterygidae*)

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Introduction

The kiwi is the national icon of New Zealand, featuring prominently in the New Zealand cultural and social consciousness. New Zealanders define themselves as kiwis and the bird is used as a symbol for many sporting teams, businesses and, rather ironically for a flightless bird, the New Zealand airforce. The real kiwis are nocturnal flightless birds that are the smallest ratites (25-55cm tall) and endemic to New Zealand (Marchant and Higgins 1990). The aim of this paper is to provide an overview of the common and emerging diseases and disorders seen in kiwis.

Overview of the Family *Apterygidae*

The Family *Apterygidae* (kiwis) represent the oldest surviving family of birds in New Zealand. The taxonomy of the group has been controversial due to the existence of morphologically cryptic lineages within recognised species (Burbidge et al. 2003). The Family was thought to consist of three species of kiwi, the brown kiwi *Apteryx australis,* the little spotted kiwi *A. owenii,* and the greater spotted kiwi *A. haastii*. However, there is now molecular evidence to support the differentiation of the brown kiwi into at least three suggested separate species. The recommended species are the North Island brown kiwi *A. mantelli*, the Okarito brown kiwi *A. rowii*, and the tokoeka *A. australis,* found in Fiordland and Haast on the South Island (Burbidge et al. 2003). The divergence of these species is estimated to have occurred between 5.8 to 8.2 million years ago (Burbidge et al. 2003).

To further add to this confusion of species it is suggested that there are at least three genotypically distinct populations of the tokoeka (Haast, Fiordland and Stewart Island) and four genotypically distinct populations of the North Island brown kiwi (Burbidge et al. 2003). These genotypes are to be managed as separate conservation units. This has created problems because approximately half of the North Island brown kiwi in captivity have mixed parentage between these conservation units (H. Robertson *pers. comm.*). These "hybrids" do not represent the genotypes that the Department of Conservation wishes to conserve and plans are being made to release these birds in mainland sanctuaries in the southern half of the North Island where no kiwi currently exist (P. Jansen *pers.comm.*). This will enable the species recovery plan to better manage the studbooks to maintain the distinct genotypes present in the wild.

Current Conservation Efforts in New Zealand

The avifauna of New Zealand is unique in having evolved in the absence of mammalian predators. Over the last 200 years the landscape and vertebrate fauna of New Zealand have undergone profound changes resulting in an unprecedented scale of extinctions. For the kiwi the most profound impact has been the introduction of mammalian predators (Boardman 1998). Juvenile kiwi are most susceptible to stoats and ferrets until they reach one kilogram in weight. Mortality rates from predators up to this time are approximately 80% and recruitment into the adult population is less than 5% (Basse et al 1999). A recruitment level of 19% is required for population stability (Basse et al. 1999). After kiwi reach a kilogram in weight, mortality rates fall to between 5-10% (Boardman 1998). An adult kiwi is able to defend itself against these predators using its strong legs as defence. The kiwi are the only flightless bird surviving on the mainland of New Zealand.

The kiwi recovery programme runs Operation Nest Egg, where eggs are removed from wild kiwi nests and hatched in incubators. The chicks are then raised first in brooders and then in predator proof enclosures until they reach one kilogram in bodyweight, when they are returned to the wild (Boardman 1998). This high cost and labour intensive management is only maintaining kiwi populations, not resulting in the increased numbers hoped for. The kiwi recovery programme is supported by a charitable trust, the Bank of New Zealand Kiwi Recovery Trust. http://www.kiwirecovery.org.nz/Kiwi/Home/

Mainland sanctuaries are currently being the developed in many parts of the country with predator proof fencing and/or intense predator reduction by trapping and poisoning (Innes and Barker 1999). Regular poisoning and trapping programmes (using fluoroacetate - 1080 and anticoagulants) to control possums and mustelids (ferrets and stoats) are used as a mainstay for conserving viable mainland populations of native birds such as kiwi, kokako, saddleback and robins (Innes and Barker 1999). Trapping programs regularly remove hundreds of stoats and ferrets per year from mainland sanctuaries that may be as small as fifty hectares (Innes and Barker 1999). It has been estimated that stoat populations have to reduced by about 80% and maintained at low levels to allow sustainable levels of kiwi recruitment from juveniles to adults (Basse et al. 1999).

Reproductive physiology of kiwi

The egg produced by the kiwi is the largest of any bird for its body size weighing approximately 400g and comprising 20% of the mass of the adult bird (Deeming 1991 in Egg Incubation text). In a natural setting, these eggs are incubated in a small burrow and egg turning occurs regularly contrary to early reports (Colbourne 2002). The incubation length is the longest for any bird at ~ 80 days (Vleck and Hoyt 1991). The mean incubation temperature in the wild is 36.5 ˚C at the top of the egg, but the bottom may be up to 10˚C colder (Colbourne 2002). The egg has the highest energy content of any bird with the yolk fraction comprising 65% of egg content and an energy density of 12.4 kJ/g (wet) (Starck and Ricklefs 1998). The yolk also has the lowest water fraction of any bird at 61% of egg content (Starck and Ricklefs 1998) which is suggested to be related to the extremely humid conditions of incubation (Vleck 1991). The kiwi embryo expends only ~17% of the energy stored in the egg during incubation and 48% of the yolk weight is found in the yolk sac of the hatchling (Prinzinger and Dietz 2002). This yolk is used as the chick's sole source of energy and substrate for tissue production for up to 17 days after hatching (Prinzinger and Dietz 2002).

Incubation behaviour of the parents varies for different species of kiwi (Colbourne 2002). For North Island brown kiwi and the little spotted kiwi the male alone incubates the egg, except for the

first week (Colbourne 2002). However in Okarito brown kiwi and the tokoeka incubation is shared by both sexes (Colbourne 2002). Clutch size ranges from 1-3 with eggs being layed from 21 to 66 days apart (Marchant and Higgins 1990). Multiple clutches are possible with some North Island brown kiwi known to lay up to seven eggs a year (Colbourne 2002)

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Chicks are precocial, hatching fully feathered and active with a weight of ~300g for brown kiwi (Marchant and Higgins 1990). No information is available on hatching weights for the greater or lesser spotted kiwis.

Diseases of kiwis

The veterinary management of kiwis is advancing rapidly thanks to increased exposure to clinical cases as a result of Operation Nest Egg, the health screening of translocated animals and post mortem examinations as part of the threatened species diagnostic surveillance programme. Kiwis are ratites (Cooper et al. 2001) and many of their diseases and principles of treatment have been elucidated by the growth of veterinary knowledge in ostrich medicine.

The following are common disorders of kiwi that will be covered in the presentation.

Reproductive problems, Incubation, Paediatrics and Neonatology

- **Egg binding and yolk-related peritonitis**
- **Yolk sac retention**
- **Yolk sac infection (Oomphalitis)**
- **Leg deformities**

- **Infectious diseases**
- **Tuberculosis**
- **Aspergillus**
- **Campylobacteriosis**
- **Other bacterial disease**

Parasitic disease

- **Lice**
- **Nematodes**
- **Cerebral larval migrans**
- **Coccidiosis**
- **Haematazoa**

- **Diseases of captive management**
- **Pneumoconiosis**
- **Iatrogenic toxicity**
- **Foreign body ingestion**
- **Vitamin B responsive dermatitis**

- **Traumatic disorders**
- **Predation**
- **Motor vehicle trauma**