Leucocytozoon in Yellow-eyed Penguins

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Yellow-eyed penguins

Yellow-eyed penguins, *Megadyptes antipodes*, are endemic to New Zealand and breed only on the southeast coast of the South Island, Stewart Island and the islands of the Subantarctic[1]. Their total breeding population numbers around 6000 pairs, however due to predation and unusual nesting behaviour, they are regionally threatened and vulnerable to environmental change [1,2].

They are the sole species of their genus and exhibit unique breeding characteristics, nesting in sparsely populated colonies up to 1km away from the coast in dense native forest or scrubland[3]. As the landscape has become progressively more industrial, many now nest in heavily grazed paddocks and are predated by introduced mammals[1,4,5].

Background

There is continuing widespread, sporadic mortality of yellow-eyed penguins despite intensive predator control and habitat rehabilitation[1,6]. These unexplained, recurring events represent the largest single retarding factor preventing population growth and stability in yellow-eyed penguin colonies. Major wrecks affecting the unstable population occurred in 1986-87 with the loss of an estimated 400 breeding pairs, and again in 1989-90 where some colonies lost 60% of breeding adults[1,7,8]. Previously, population crashes have been attributed to 'bad seasons', storm action, food availability and avian malaria, yet no thorough scientific investigation has been undertaken to assess the role of infectious disease[1,6,7,9-12].

This project intends to assess the role of haemoparasitism, a worldwide cause of mass-mortality captive and wild penguins[12-14], in the ongoing instability seasonal mortality of the Yellow-eyed penguin population. Specifically, it will focus on the role and prevalence of leucocytozoon, a recently identified pathogen of Yellow-eyed penguins causing recent chick mortality on Stewart Island. It is hoped that our investigation will provide protocols and baseline data for disease monitoring during the recovery project, and to allow risk assessment for translocations of native New Zealand species to offshore Islands frequented by Yellow-eyed penguins.

Methods

Approximately 120 Yellow-eyed penguins will be sampled during routine nest inspection from each of the main 'mainland' colonies of the South Island, namely Otago Peninsula, the Caitlands and Stewart Island. In conjunction with blood testing, traps for the suspected vector, the common Black fly (*Austrosimulium spp.*), will be installed at each of the sampling sites.

Blood sampling will comprise 4 separate investigations:

1. PCR will be used to establish presence of infection, and prevalence at a whole population level. Sequencing to identify Leucocytozoon at a species level will further aid description and allow comparison of Yellow-eyed penguin infections with those of *L. tawaki* found in Fiordland Crested penguins[15].
2. Differentiation and identification will then be furthered by morphological investigation using electron microscopy.
3. Blood smears, which in the past have been used as a poor screening tool in avian malaria, will be assessed to estimate their accuracy as a monitoring tool for *Leucocytozoon*.
4. The findings of clinical exam, haematological and biochemical testing will be used to correlation infection and overt disease, and establish the first reference values for wild Yellow-eyed penguins.

In addition, current and archival necropsy data featuring histologically diagnosed cases will be explored with a focus on understanding and characterising the development and pathology of the disease.

Considerations

Histology was used to confirm the deaths of 7 chicks from Stewart Island during an occurrence of 57 deaths within the 2005-06 period[6]. Therefore we expect to find that *Leucocytozoon* is capable of causing disease, alone or in combination with other factors, in developing yellow-eyed penguins where vectors are in significant supply. The effect of infection on adult penguins will also be of interest for the Stewart Island group, which has experienced remarkably low reproductive success (20.7-33.3%) compared to the mainland (58.7%)[2,16]. Wider investigation will also include the role of *Leucocytozoon* in the seasonal mortality of adult birds.

The low prevalence of predation in some colonies in spite of ongoing losses lends further suspicion toward the presence of infectious disease, and may generate heightened awareness among the managers of other colonies along the south coast of New Zealand[16]. Closer observation will enhance both the ability of managers to recognise disease in penguins and the likelihood that outbreaks will be reported for veterinary investigation

A confounding factor in the epidemiological investigation of this disease will remain the interaction of starvation and disease, which has often rendered historical data difficult to interpret. Even during years of high food availability starvation features as a leading cause of chick mortality, yet it is unclear clear whether this is a primary sign or secondary to disease.

Fortunately, adult yellow-eyed penguins may live for up to 20 years and produce 1-2 chicks each year[2]. With few predators, this renders the bulk of the population quite robust in the absence of disease or predation, and capable of coping with heavy, sporadic losses provided opportunities to breed are available in alternate years. This is not, however, suitable grounds for complacent management as the current reality of a dwindling population and its associated vulnerabilities remains and omnipresent risk.

It is hoped that the results of this study will be published as a series of papers in 2007-2008 and made freely available to assist the management of colonies by the Yellow-eyed penguin recovery team. Any suggestions or requests for information should be directed to the author at a.g.hill@massey.ac.nz

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