Microbial Infection of Avian Eggs: A Threat to All Synchronously Incubating Species? Case Study of New Zealand's Little Blue Penguin (*Eudyptula minor*)

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Abstract

Microbial infection of eggs was originally investigated in terms of human health only. Recently, however, it was found that it can also cause early embryo mortality in birds, mainly through trans-shell infection prior to incubation. Trans-shell infection is highly dependent upon environmental conditions, egg temperature and egg properties such as shell quality and antimicrobial defences. Microbial infection of eggs is more likely to occur in synchronously incubating species as first laid eggs can be exposed for up to several days prior to full incubation. One example of a population that seems at particular risk of egg microbial infection is New Zealand's little blue penguin (*Eudyptula minor*) from Tiritiri Matangi Island. This bird lays two eggs on average three days apart, and is believed to begin full incubation only after the second egg has been laid. Both eggs are laid in particularly humid and soiled nests and contain only low levels of lysozyme, an important antimicrobial protein. The aims of this study were therefore to 1) obtain a first examination of the rates of shell and trans-shell microbial infection of chicken eggs in New Zealand and assess the effects of cleaning on those rates, 2) investigate the role of microbes in hatching failure of little blue penguin eggs and 3) investigate other factors affecting little blue penguin egg viability. This study revealed that shell infection in chicken eggs significantly increased with exposure and significantly decreased with cleaning; however, trans-shell infection was only marginally affected by exposure and cleaning. On Tiritiri Matangi Island, Hauraki Gulf, New Zealand, nest type, egg order and shell cleaning did not affect hatching success, suggesting that nest conditions and microbial infection prior to incubation were not a major cause of egg mortality in this population. Temporary abandonment during incubation, however, was very frequent in the second half of the breeding season and

fatal to most eggs. These temporary abandonments seemed to be caused by resource limitations, an aspect that should be investigated in future studies.

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