

# The artificial incubation of kiwi eggs: a conservation tool

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## Abstract

Kiwi (*Apteryx* spp. Order: Apterygiformes) are the smallest of the ratites and are endemic to New Zealand. There are currently six recognised species, of which the brown kiwi (*A. mantelli*) is the most abundant and widespread. All species are classified as threatened due to a range of factors, including habitat loss and fragmentation and predation by introduced mammals. In this study we present the current conservation actions and issues associated with the active management of kiwi. We present examples from our own experience and one captive rearing centre, and particularly discuss the animal care and ethics issues associated with the captive hatching, rearing and care of kiwi.

## Introduction

Kiwi (*Apteryx* sp) are the smallest and most cryptic of the ratites, a taxonomic group of flightless birds, which includes the world's largest birds—the cassowary, emu, ostrich and rhea, as well as the extinct moas of New Zealand and the elephant bird of Madagascar. There are currently five species and one sub-species of kiwi recognised, and all are endemic to New Zealand (Holzapfel et al. 2008). All species of

kiwi now have restricted distributions primarily due to historical land clearance, with the little spotted kiwi (*Apteryx owenii*) now only found on offshore islands or within predator proof enclosures on the mainland (McLennan et al. 1996; Robertson 2003). By far the most significant threat to current kiwi populations is predation by introduced mammals, particularly stoats (*Mustela erminea*), feral domestic cats (*Felis catus*), dogs (*Canis familiaris*), and pigs (*Sus scrofa*) (Miller & Pierce 1995; McLennan et al. 1996; McLennan 1997; Pierce & Sporle 1997), and unmanaged populations are estimated to be declining at around 6% per year (McLennan et al. 1996). A range of management actions have been initiated in response, some of which have animal care and ethics implications.

Here we outline the plight of kiwi, and introduce the three current conservation management responses, including the captive rearing of wild eggs and chicks—termed Operation Nest Egg (ONE). We will discuss the incubation challenges that we face under this approach (focusing on the captive rearing centre *Kiwi Encounter* as a case study), the ethical and welfare considerations surrounding this type of kiwi management, and future directions for kiwi conservation.

## Kiwi decline

Before Polynesian settlement of New Zealand (approximately 1000 years ago), there were an estimated 70 million kiwi in New Zealand. At the time of European colonisation in the early 19<sup>th</sup> Century, populations are estimated to have declined to around 26 million birds, and only 100 years ago, there were still an estimated 11 million kiwi (P Jansen, pers comm). The most recent estimates put current numbers at

about 70,000 on mainland New Zealand. All five species of kiwi are currently classified as threatened, with the five species surviving on mainland New Zealand all in serious decline (Table 1). Without any conservation management, it is estimated kiwi will be extinct on the North Island of New Zealand within 40–50 years (Basse et al. 1999).

Adult mortality ranges from 5 to 16% per year with 28% of this mortality directly related to predation from dogs, cats and ferrets (*Mustela furo*). 50% eggs fail to hatch (10% due to predators). Chick survival in the wild is only about 5%, and the primary cause of this decline is predation by introduced mustelids, particularly stoats. Nationally, mustelids kill 77% of chicks. However, one saving grace is that this predation rate declines as chicks grow, so that by around 1 kg in weight, which is about 6 months old, chicks are fairly safe.

## Management responses

There are three main responses to these threats. Broad-scale protection of remaining habitats is the main legislative response, either through the conservation estate on public lands, or a range of community trusts and programmes on private lands. To directly increase kiwi survival, intensive predator control is frequently implemented, either through trapping, poisoning or the use of exclusion fencing. And third, the Department of Conservation has initiated a programme called “Operation nest egg” (ONE) in which kiwi eggs are lifted from their nests in the wild and the eggs incubated artificially (Colbourne et al. 2005). The rationale behind Operation Nest Egg is that chicks are most vulnerable when they weigh less than 1 kg, and fairly safe from stoats after that. Consequently, eggs and chicks are removed from the wild

and the eggs hatched in captivity. Chicks are raised in captivity or on predator-free offshore islands for 4–6 months until they reach a stoat resistant size of 800–1200 g, and are then liberated into the wild.

With the advances in kiwi egg incubation we have made over the last 10 years, it is possible to achieve and maintain consistently high hatching success—over 90% on average at *Kiwi Encounter*. However, we still have to deal with problems with eggs that come in from the wild cracked or damaged, embryo mortality during incubation and malpositioned chicks.

The ONE programme buys much needed time, and it has been very important in increasing the profile of kiwi conservation around New Zealand. It has also given us an invaluable opportunity to develop captive rearing techniques, needed as part of an essential fall back position, for the conservation of threatened species in captivity. However, it is an expensive short- to medium-term solution for securing kiwi survival

## Management and animal welfare

If we take the three primary management options for kiwi in turn, there are few animal welfare issues associated with land reservation, although there are associated activities that frequently follow on from land reservation that do have impacts on animal welfare.

There are clearly animal welfare issues associated with mammalian predator control operations, revolving in particular around the development, testing and use of lethal control methods such as poisoning and trapping. These issues are not the focus of this paper, although we would note that kiwi predator control operations on the conservation estate fall under control of the Department of Conservation (DOC). The Department’s obligations are covered under Section 5, subsection 3a, b, and c of the Animal Welfare

**Table 1** Current classification of kiwi taxonomy and conservation status in New Zealand (Holzapfel et al. 2008). Estimated numbers are based on projected numbers for known populations with no conservation management.

Common (and Latin) name	Estimated numbers (2008)	Conservation status
Brown kiwi ( <i>Apteryx mantelli</i> ) (4 taxa)	25,000	Serious Decline
Rowi or Okarito brown kiwi ( <i>Apteryx mantelli</i> ‘Okarito’)	300	Nationally Critical
Haast tokoeka ( <i>Apteryx australis</i> ‘Haast’)	300	Nationally Critical
Northern Fiordland tokoeka ( <i>Apteryx australis</i> )	10,000	Gradual Decline
Southern Fiordland tokoeka ( <i>Apteryx australis</i> )	4,500	Gradual Decline
Stewart Island tokoeka ( <i>Apteryx australis</i> )	15,000	Gradual Decline
Great spotted kiwi or Roroa ( <i>Apteryx haastii</i> )	16,000	Gradual Decline
Little spotted kiwi ( <i>Apteryx owenii</i> )	1,500	Range Restricted

Act 1999. Specifically, the Department of Conservation does not require AEC approval for regular and routine mammal control operations carried out under any Act administered by DOC.

The captive rearing of wild laid eggs and chicks through Operation Nest Egg is also considered regular and routine monitoring under the Animal Welfare Act 1999, and so legally, Animal Ethics Committee approval is not required to undertake this programme. Of course, this does not mean that captive rearing centres are absolved of all responsibility, but only that they do not legally require regular monitoring by and reporting to an Animal Ethics Committee.

### **Kiwi Encounter and animal welfare**

In terms of Kiwi Encounter, animal welfare and the interests of ANZCCART, our activities fall into two categories. As mentioned earlier, ONE is considered a regular and routine activity under the Department of Conservation's obligations under the Animal Welfare Act, and does not require ongoing Animal Ethics Committee approval.

However, we still conduct smaller-scale research focused around improving animal welfare for ONE and other kiwi at *Kiwi Encounter*. These studies are often dealing with ways to improve hatching success, chick survival, and welfare of eggs and chicks, such as modifying transport box design, egg and chick transportation protocols, and disease management and quarantine protocols. These activities are regulated by DOC and the kiwi recovery group to ensure animal welfare is paramount at all times.

### **Day-to-day husbandry and animal welfare**

Our day-to-day kiwi husbandry also needs to be mindful of welfare issues. On a routine basis we are dealing with kiwi hygiene and disease management, housing, feeding, and health. In all cases, we strive to develop and refine best practice to ensure the highest degree of care and compliance with the DOC permits allowing us to hold kiwi.

Another area of activity with welfare concerns includes the early detection and removal of retained yolk sacs in young kiwi chicks. This involves invasive surgery to remove the yolk, with protocols to determine if surgery is required. From experience, we

know that chicks with retained yolk that are not operated on will die within 48 hours, so the risks and stress of surgery are warranted. We also care for a number of eggs or chicks abandoned at the nest that come in at very short notice. These desertions may be human induced, as a result of nest monitoring, and we advocate that all such eggs and chicks should come in to a captive rearing centre.

### **Broader husbandry and animal welfare**

A small number of kiwi arrive at *Kiwi Encounter* injured or harmed in some way. Common causes include vehicle collisions, birds caught in incorrectly set mammal traps, and birds injured in dog attacks—either dogs owned by members of the public, or trained kiwi-dogs that may accidentally injure birds during capture. We feel there is still a lack of knowledge about appropriate activities in areas with kiwi, such as regulations on the presence of dogs, or trap setting protocols to prevent kiwi capture or injury. There is also a lack of information available on actions people should take when dealing with injured or harmed kiwi, such as where and when to take kiwi for emergency care.

There have been a number of concerns raised about the welfare of captive and ONE kiwi from sources outside captive rearing centres. For example, it has been suggested that ONE chicks have lower survival than wild chicks, although there is no evidence to support this (Colbourne 2007). Furthermore, Colbourne has shown there is no imprinting in captive animals and similar or better reproductive success to wild birds. Similarly, studies have found no evidence of raised stress levels in captive and ONE kiwi.

### **General conclusions**

The contribution of captive management to kiwi conservation and the role of Operation Nest Egg (ONE) has enabled the plight of kiwi to be recognised. We still have some massive challenges ahead but a huge effort has now been directed towards attempting to find a solution to stoat predation. We need to continue to place emphasis on kiwi in the captive situation, and to improve the husbandry strategies for all species of kiwi. It may become necessary in the future to take a small number of birds from the wild, and put them into an effective captive breeding programme,

in order to recover populations of kiwi species near extinction in the wild.

As a captive rearing facility working with a threatened species, we need to continue to meet and exceed all animal welfare and ethical requirements for kiwi. We also need to work with other captive centres, conservation agencies, vets and the general public to ensure the highest standards of kiwi management and care are always maintained.

## References

- Basse, B.; McLennan, J. A.; Wake, G. C. 1999: Analysis of the impact of stoats, *Mustela erminea*, on northern brown kiwi, *Apteryx mantelli*, in New Zealand. *Wildlife Research* 26: 27–37.
- Colbourne, R. M. 2007: Proceedings of the 2007 Kiwi Hui. 26–27 April 2007, Rotorua. *Department of Conservation*, Wellington, New Zealand.
- Colbourne, R. M.; Bassett, S.; Billing, B.; McCormick, H.; McLennan, J. A.; Nelson, A.; Robertson, H. A. 2005: The development of Operation Nest Egg as a tool in the conservation management of kiwi. *Science for Conservation* 259. *Department of Conservation*, Wellington. 24 p.
- Holzapfel, S.; Robertson, H. A.; McLennan, J. A.; Sporle, W.; Hackwell, K.; Impey, M. 2008: Kiwi (*Apteryx* spp.) recovery plan 2008–2018. Threatened Species Recovery Plan 60, *Department of Conservation*, Wellington, New Zealand. 71 p.
- McLennan, J. A. 1997: Ecology of brown kiwi and cause of population decline in Lake Waikaremoana catchment. *Conservation Advisory Science Notes* 169, *Department of Conservation*, New Zealand.
- McLennan, J. A.; Potter, M. A.; Robertson, H. A.; Wake, G. C.; Colbourne, R.; Dew, L.; Joyce, L.; McCann, A. J.; Miles, J.; Miller, P.; Reid, J. 1996: Role of predation and the decline of kiwi, *Apteryx* spp. in New Zealand. *New Zealand Journal of Ecology* 20: 27–35.
- Miller, P. J.; Pierce, R. J. 1995: Distribution and decline of the North Island brown kiwi (*Apteryx australis mantelli*) in Northland. *Notornis* 42: 203–211.
- Pierce, R. J.; Sporle, W. 1997: Causes of mortality of North Island brown kiwi in Northland. *Conservation Advisory Science Notes* 167, *Department of Conservation*, New Zealand.
- Robertson, H. A. 2003: Kiwi (*Apteryx* spp.) recovery plan 1996–2006. Threatened Species Recovery Plan 50, *Department of Conservation*, Wellington, New Zealand. 26 p.