

Brown Kiwi (*Apteryx mantelli*) husbandry manual

Ian Fraser and Tracy Johnson

VERSION 3 (updated and revised by Suzy Barlow and Claire Travers in 2015)



Female captive Brown kiwi in nest burrow at Rainbow Springs Kiwi Wildlife Park

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1. PREFACE

The production of this husbandry manual has been supported by the Kiwi Recovery Group and by the Zoo and Aquarium Association New Zealand, (the regional zoo association). It has been reviewed and endorsed by representatives of all captive holders and the Recovery Group. All of these groups agree that the minimum standards and recommended best practice presented herein reflect current standards and practices in husbandry of Brown Kiwi and that this document meets the needs of the Kiwi Recovery Group in terms of clear standards for captive management.

This document was reviewed, updated and re-endorsed in 2011. It was re-reviewed, updated and re-endorsed in 2015.



Claire Travers
Kiwi Husbandry Advisor to the NZ Fauna TAG



Suzy Barlow
Kiwi Captive Coordinator



Dr Jennifer Germano
Kiwi Recovery Group Leader

2. INTRODUCTION

This husbandry manual has been prepared for all institutions holding Brown Kiwi, *Apteryx mantelli*, in captivity. It reflects the collective experience of many individuals and organisations that have held kiwi in captivity over the past four decades, and seeks to document current best practice in husbandry of captive kiwi.

This manual also establishes clear minimum standards for some aspects of kiwi husbandry. These minimum standards have not been established with the purpose of eliminating all variation on how institutions keep and care for kiwi (and/or present them for display). Rather, they are there to reassure all those with an interest in kiwi, including the captive management community, the Department of Conservation, iwi groups, and the public of New Zealand, that the fundamental requirements of kiwi husbandry are being met by all holders.

Consistent terminology is used throughout the document. Recommendations or guidelines are worded using 'may', 'can', 'should try to' etc, whereas requirements or minimum standards are worded using 'must'.

It is not the intention of this manual to reproduce a lot of material published elsewhere. This manual should not be considered in isolation, but as part of a series of documents that lay out why and how we care for kiwi in captivity. These documents include:

Kiwi Recovery Plan: 2008-2018 (Holzapfel *et al.*, 2008). Describes the current conservation status of kiwi and lays out overall strategy for the recovery of all kiwi taxa in New Zealand over the next ten years. (*In rewrite 2015*)

Kiwi Best Practice Manual (Robertson & Colbourne, 2003 (updated 2014)). Provides information on numerous aspects of practical (mostly *in situ*) kiwi work including handling, marking and transport.

Kiwi First Aid and Veterinary Care (Morgan, 2008). Provides information on the treatment of sick and injured kiwi.

Operation Nest Egg Incubation and Chick Rearing Best Practice Protocols. (Bassett. 2012). Provides detailed information on kiwi egg incubation and chick rearing.

Captive Management Plan for Kiwi 2010-2015 (Barlow, 2011). Sets the strategic direction for the captive kiwi population in New Zealand; outlines the actions required to deliver this strategy.

'Advocacy Messaging for Kiwi in Human Care'. (Du Bern, 2014). Outlines the agreed kiwi advocacy messaging strategy that links captive and community kiwi conservation efforts.

Taxon plans for Northland, Western and Eastern brown kiwi (2011- 2014). Available from the Department of Conservation.

All kiwi holders should be familiar with the documents listed above and should refer to them whenever they are seeking information on kiwi issues not covered in this manual. All of these documents can be downloaded free of charge from the Department of Conservation's website (www.doc.govt.nz). Most of the documents are also available from the ZAA website member's section (www.zooaquarium.org.au). There is also a wealth of resources at the 'Kiwis For Kiwi' website - www.kiwisforkiwi.org.nz where all kiwi holders are encouraged to register themselves as 'kiwi practitioners' to keep up to date with national events and available resources.

People with an interest in the husbandry of kiwi, especially those that care for kiwi on a daily basis, are encouraged to contact the Captive Coordinator (see section 2.3) with suggestions and comments that can contribute to the next review.

2.1 Taxonomy

Class:	Aves
Super order:	Palaeognathae
Order:	Apterygiformes
Family:	Apterygidae
Species:	Brown Kiwi <i>Apteryx mantelli</i>

Previously the species was referred to as 'North Island Brown Kiwi'. Since the formal description of Rowi and Haast tokoeka, (formerly referred to as 'South Island Brown Kiwi'), the species is confined to the North Island, and hence the 'North Island' epithet is now superfluous.

The captive population of Brown Kiwi is managed intensively through ZAA NZ in accordance with the goals and objectives set out in the Kiwi Recovery Plan (Holzapfel *et al.*, 2008) and the Captive Management Plan for Kiwi (Barlow, 2011).

The currently accepted taxonomy of kiwi (see Holzapfel *et al.*, 2008) divides the Brown Kiwi population into four regional populations based on genetic distinctiveness:

- Northland
- Western North Island: King Country – Taranaki – Wanganui
- Eastern North Island: Bay of Plenty – East Coast – Hawkes Bay
- Coromandel

At the time of writing (2009; reviewed 2011; reviewed again 2015), the Brown Kiwi programme manages three regional Brown kiwi (Northland, Western and Eastern), and a small group of mixed-region birds. The mixed-region and Northland Brown Kiwi are scheduled to be ‘phased-out’, i.e. no longer bred in captivity and/or released to the wild over the next few years (Barlow, 2011); with the Westerns following. The long term aim is to develop a sustainable captive population of **Eastern provenance** Brown Kiwi in New Zealand.

Three Great Spotted Kiwi (*Apteryx haastii*), and one Little Spotted Kiwi remain in captivity (at two institutions) these are not managed as part of a full captive programme by ZAA NZ, as the captive population is too small to warrant such management and Brown Kiwi is the agreed priority for the captive programme.

2.2 Conservation Status

Brown Kiwi are classified as ‘nationally vulnerable’ - (Miskelly *et al.*, 2008) and as ‘Endangered’ in the IUCN Red List (Birdlife International 2008).

For more details on the conservation status of other kiwi taxa refer to the Kiwi Recovery Plan (Holzapfel *et al.* 2008).

2.3 Captive Management Co-ordinator

Suzy Barlow

ZAA New Zealand Liaison Officer,
c/o Department of Conservation,
Whangarei Office, PO Box 842,
Whangarei 0140, Northland,
New Zealand

Email: suzy@zooaquarium.org.au

Phone: +64 9 470 3357

<http://www.zooaquarium.org.au>

Note: the European and North American captive populations are managed jointly under the American zoo association’s Species Survival Plan (SSP) Programme. The species co-ordinator is

Kathleen (Kathy) Brader, National Zoo, Washington, D.C., USA. Kathy may be contacted at: braderk@si.edu

2.4 Timeframe of the plan

The Husbandry Manual will be reviewed every 5 years; kiwi holders will be notified when an updated version is available. Those involved with kiwi captive management are encouraged to comment on or submit new information for updates of the husbandry manual at any time to the Captive Coordinator and/or the Kiwi Husbandry Advisor.

3. IDENTIFICATION METHOD

3.1 Individual Identification

Reliable, safe and permanent individual identification of all kiwi involved in the captive management programme is essential for the maintenance of the programme (e.g. to track parentage of new individuals and to enable the identification of genetically appropriate pairings) and to assist with the ongoing husbandry of the kiwi in captivity (e.g. for tracking information such as medical treatment and behavioural data on individuals).

Transponders are preferable to metal leg bands as the identity of a kiwi can be checked with a minimum of disturbance (e.g. no need to handle a kiwi or remove it from its roost box), and metal leg bands have been known to 'open up' and consequently be lost from a kiwi or cause leg injuries. Leg bands can also become tangled with vegetation in an enclosure which can also lead to injuries. The use of leg bands on kiwi held as part of the captive management programme (c.f. injured kiwi or chicks hatched in captivity as part of BNZ Operation Nest Egg™) is being phased out.

Minimum Standard 1. Identification.

All Brown Kiwi held in captivity must be individually identified by the implantation of a recommended brand of microchip/transponder (e.g. Trovan/Allflex) by a suitably qualified operator within three months of hatch, or within three months of being transferred into captivity (for wild caught birds).

Until a transponder has been inserted into a bird, kiwi can be temporarily identified using coloured plastic leg bands or by holding birds in individual enclosures.

Transponders (also known as microchips), can be embedded in kiwi once they have regained their hatch weight by a suitably trained person (see Kiwi Best Practice Manual (Robertson & Colbourne, 2003) for details on what constitutes a suitably trained person).

Internationally, the most widely used transponders and scanners used to identify captive animals are the Trovan brand. However, for captive kiwi in New Zealand, Allflex or Trovan brand transponders are used, with Allflex being used by the majority of holders. Whichever brand is used ensure that the scanners comply with NZISO standard 11785: 2001 as this standard

ensures that the transponders can be read by a range of different scanners (i.e. ensuring that Allflex scanners can read Trovan transponders and vice versa). The cost of transponders is approximately \$10-15 each. As of 2011, confirmation from the ZAA Veterinary Specialist Advisory Group is that the Trovan transponders currently used in the Australasian region are not ISO compliant, and there is no imminent plan to change this.

The transponder should be inserted under the skin below the right wing (as described in Robertson & Colbourne, 2003). Care must be taken to ensure that the transponder is correctly located, for example, that it is not inserted into the body cavity or anywhere near the femoral artery'.



Figure 1. Transponder insertion (photo: P. Graham)

The following people have experience at inserting transponders into kiwi (this is not a complete list of suitably experienced people, but is intended to provide holders with a suitable person in the area if they do not have a current provider for this service) – each facility is responsible for ensuring they have access to people who are properly qualified to insert transponders:

James Chatterton, An Pas, Sarah Alexander, Melanie Leech, Richard Jakob-Hoff, Auckland Zoo..
The Vet Centre, Otorohanga.

Lisa Argilla, Wellington Zoo.

Trevor Kelly, Rotorua Vet Centre.

Linda Hayes, Beak and Claw Veterinary Services, Hastings.

Claire Travers, Emma Bean, Carmel Richardson, Beverly Wilkinson, Helen McCormick, Carole Dean, Rainbow Springs Kiwi Wildlife Park.

Brett Gartrell, Massey University Wildlife Health Centre.

Andrea Wilson (Veterinarian for Nga Manu Nature Reserve)

Alyssa Salton, Orana Wildlife Park.

Kim Bryan-Walker, Catherine Roughton, West Coast Wildlife Centre.

Shaun Horan, Nick Ackroyd, Pauline Howard, Willowbank Wildlife Reserve.

Trovan transponders and scanners are available from:

Advanced Identification Ltd.
PO Box 48087
Blockhouse Bay
Auckland
Phone (09) 820 7543
Or 09 820 0009; 09 8283410
trovan@xtra.co.nz

'Nano' trovans (used at Wellington Zoo) are available from:
Microchips Australia Pty. Ltd.
22 Fiveways Boulevard
Keysborough, Victoria 3173
Tel +61 3 9706 3165
www.microchips.com.au

'Allflex' transponders and scanners are available from:

Allflex New Zealand Limited,
17 El Prado Drive,
Private Bag 11003,
Palmerston North

Phone: (06) 356 7199 Fax: (06) 355 3421

See 'Kiwi Best Practice Manual' (Robertson & Colbourne, 2003; revised 2014) for further information.

If required (e.g. if two chicks are required to share a brooder), colour bands may also be used on young kiwi as a temporary alternative identification method until they are old enough to have a transponder inserted. Bands can be fabricated from electrical insulation (plastic) tape, with the tape doubled back on itself enough to ensure that no part of the adhesive side of the tape is in contact with the bird's leg. The band must move over the tarsus easily but should not be large enough to slip over the foot or hock of the kiwi. Such temporary bands should be checked every day and should be removed as soon as the chick has been fitted with a transponder.



Figure 2. Temporary leg band on chick
(photo: *Kiwi Encounter*)

3.2 Sexing Methods

The two most common ways to sex kiwi are by morphological measurements and molecular techniques such as DNA feather sexing. As the sex of captive Brown kiwi determines where they are placed within the captive population, this information is required as soon as possible in a bird's life, and chicks must be DNA feather sexed (and the Coordinator notified of the results) prior to studbook data collection each year (end of February).

Morphological sexing is only possible on adult birds, where the bill length can determine whether the individual is female (e.g. bill length over 120mm for central Northland birds, bill length over 107 mm for Waikaremoana birds (Robertson & Colbourne, 2003)). Kiwi with bill length below these figures may be adult male OR sub-adult females, and consequently molecular techniques must be used to confirm the sex of the individual concerned.

Wild caught kiwi that come into captivity and are incorporated into the captive management programme (e.g. new founders as defined by the 2011 CMP) must be sexed using molecular techniques. Wild caught kiwi that have been injured and are being treated temporarily in captivity (prior to re-release) are not required to be sexed.

Chicks that hatch in captivity as part of BNZ Operation Nest Egg™ are not required to be sexed unless this has been identified by project partners (e.g. release site personnel, research partners) as a requirement.

Minimum Standard 2. Sexing.

All Brown kiwi that hatch in captivity (excluding BNZ Operation Nest Egg birds) must be sexed using molecular techniques (DNA feather sexing) within four months of hatching.

All Brown kiwi that are brought into the captive population from the wild (excluding birds held temporarily for medical treatment (i.e. held under an injured wildlife permit)) must be sexed using molecular techniques (DNA feather sexing) within four months of their transfer into captivity unless they are confirmed as female by morphological measurement.

3.2.1 DNA Feather Sexing:

The sex of kiwi is identified through the presence or absence of female specific DNA isolated from tissue extracted from the base of a sample of feathers. To date, this method has correctly sexed over 95% of samples submitted. Feathers collected from birds as young as three days old and feathers stored for up to seven years have been correctly identified.

The method of collection is straightforward:

1. Pluck approximately six feathers from each bird (the chest is a good site from which to take the sample). 'An excellent area for feather plucking for a DNA sample from a chick is along the edge of the featherless tract under the wing' (C. Travers, *pers. comm.*)
2. To avoid potential contamination of the samples, avoid touching the shaft of the feather where it attaches to the bird's body.
3. Place the feathers in a paper envelope.
4. Label the package with your name, institution name, date, and individual ID of the bird (band number or colour/transponder number).
5. Store at room temperature.
6. Send off the samples in a envelope with a covering letter or email to:

Michelle Fremaux, Acting Director,
 Equine Parentage and Animal Genetics Services Centre,
 Institute of Veterinary and Biomedical Sciences
 Drysdale Road, Massey University, Private Bag 11-222
 Palmerston North, 4442.
 Ph: 06-356 9099 ext 83472 (DDI: 06 350 4920)
 Fax: 06-350 5621
 Email: M.Fremaux@massey.ac.nz
 Website: <http://ivabs.massey.ac.nz>

Results are generally received in less than one week and, at the time of writing, Massey University now charge **\$25.00 per sample** and will invoice the sending institution. Once the results are received, please inform the Captive Coordinator (see section 2.3) so that studbook information can be updated.

4. NATURAL HISTORY

4.1 Adult wild weights and measurements

Adult weights and measurements vary significantly between individuals, and between the different provenance populations of Brown Kiwi. As with other ratite species, females are heavier than males and have significantly larger bills.

From; Heather & Robertson (2005). Figures are given as minimum – **mean** – maximum

	Males	Females
Weight	1720 – 2250 – 3060 g	2090 – 2750 – 4010 g
Bill length	81 – 100 – 120 mm	111 – 130 – 157 mm

Refer to the Kiwi Best Practice Manual (Robertson & Colbourne, 2003) for more morphometric data, including known differences between measurements for different provenance birds.



Figure 3. Bill measurement (*photo: P. Graham*).
Measure from bottom tip of bill to the cere (e.g. not including the cere).

4.2 Distribution and habitat (from Holzapfel *et al.*, 2008)

Brown Kiwi habitat includes native forests, pine forests, swamp, scrub and even rough farmland. Territory size varies from 2 - 100 hectares per pair.

Archaeological and historical evidence show that Brown Kiwi were once found in southern Northland, the Waikato (Mt. Pirongia) and Mt. Hikurangi (East Cape), but have been extinct from these areas since the 1970s. Little is recorded about the historical presence of kiwi on off-shore islands.

Latest estimates report that the overall population of Brown Kiwi is still declining. Although populations of Northland and Coromandel provenances are expected to increase over the next ten years (assuming current management efforts are maintained) population decreases for Western and Eastern provenance Brown Kiwi in unmanaged sites will more than offset those gains.

Kiwi populations in unmanaged sites (i.e. populations without predator control or supplementation with BNZ Operation Nest Egg) are currently estimated to be declining at 2-3% per annum.

The Brown Kiwi population is estimated at 25,000 birds. Although the mainland populations are declining overall, where active predator or breeding management is being undertaken, their numbers are increasing.

Table 2: Population Trend Estimates of Brown Kiwi (from Holzapfel, *et al.*, 2008)

Species	2008 population	2018 population (projected assuming continuation of current management effort)
Northland	8,000	8,500
Coromandel	1,000	2,000
Eastern North Island	8,000	6,500
Western North Island	8,000	6,500
TOTAL	25000	23,500

Two small populations of kiwi of mixed provenance have been established at Pukaha/Mt Bruce (Wairarapa) and in the Rimutaka Forest Park (Wellington) by releasing birds previously held or bred in captivity.

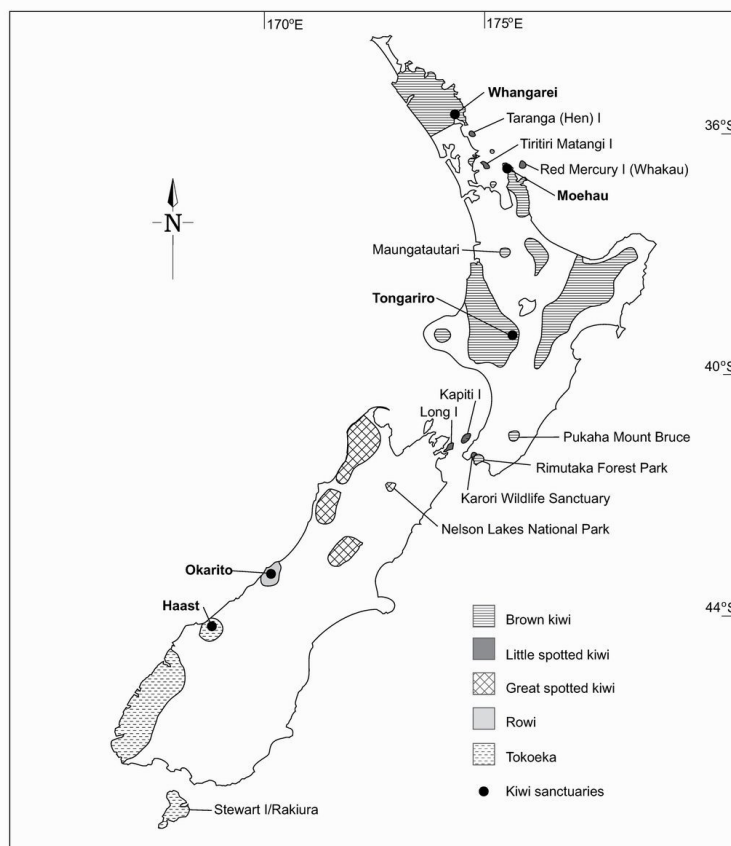


Figure 4. (from Holzapfel *et al.*, 2008). Present distribution of kiwi (*Apteryx* spp.) in New Zealand and location of five DOC kiwi sanctuaries (note: symbol does not reflect the extent of these sanctuaries).

4.3 Habits, social structure

Brown Kiwi are nocturnal, foraging for food at night and resting in underground burrows, rotten logs or thick vegetation during the day. They are monogamous and strongly territorial, especially during the breeding season. Brown Kiwi chicks are precocious, first leaving the nest burrow approximately 5-6 days after hatching. Chicks are not fed by their parents at any stage and disperse from the natal territory at 2 – 5 weeks of age (Heather & Robertson, 2005).

4.4 Feeding behaviour

Gizzard and faecal analysis have shown that Brown Kiwi eat a wide range of animal and vegetable matter including earthworms, beetles (adults and larvae), other invertebrates and the leaves and fruit of several plant species (Reid *et al.*, 1982). Recent research indicates that vegetable matter is a more significant source of nutrition for kiwi than was previously thought (Potter *et al.*, 2006). They use their well-developed senses of smell and hearing to detect invertebrates in the leaf litter or just underneath the soil surface, and obtain them by probing into the ground or leaf litter with their long beaks.

Kiwis are opportunist feeders and on occasions have also been observed fishing for small eels and freshwater crayfish in shallow pools and streams (T. Billing *pers. comm.*).

4.5 Reproduction

Incubation in Brown Kiwi is undertaken exclusively by the male, in contrast to other kiwi species where incubation is shared by both male and female (or by male and female and helpers). Eggs are usually laid in June – December in a burrow, hollow log, or under thick vegetation. Brown Kiwi lay 1- 3 clutches of 1-2 large (124 x 80 mm; 440 g) white eggs each season. Eggs of a single clutch are laid about three weeks apart and are incubated (by the male) for 75-90 days (Heather & Robertson, 2005).

Male Brown Kiwi have been known to breed in the wild in their first season after hatching (i.e. at approximately one year of age) and females have been recorded breeding in their second season (approximately 2 years of age).

Hatch weights of Brown Kiwi in the wild are recorded as approximately 305g for Northland provenance birds (Colbourne *et al.*, 2004) and 320-390g for Eastern provenance birds (McLennan *et al.*, 2004). Hatch weights of 56 Northland provenance Brown Kiwi partly incubated and hatched at Auckland Zoo between 2002 and 2005 as part of BNZ Operation Nest Egg weighed 276g – **357g** – 431g (minimum – **mean** – maximum) (Auckland Zoo, *unpublished data*). The mean hatch weight out of 928 hatches of Brown kiwi at Kiwi Encounter is 340g (Travers, *pers. comm.*)

Growth rates of Eastern Brown Kiwi chicks in the wild range from a high of approximately 6.3g per day at day 30, to 0.9g per day at day 500 (approximately 16 months old) (McLennan *et al.*, 2004).

4.6 Protected species' role in ecosystem

Kiwi are predators of invertebrates found in the litter and soil of native and exotic forests, and other habitats where they are found.

4.7 Threats in the wild

The main threats to Brown Kiwi populations in the wild are recruitment failure due to predation from introduced mustelids, especially stoats, and predation of adults by dogs and ferrets (Holzapfel *et al.*, 2008). Habitat loss resulting from changing land use is a threat for some populations (IUCN, 2007) and competition for food with introduced pests such as possums and rats may also contribute to kiwi population decline in unprotected areas (Holzapfel *et al.*, 2008).

The small size and fragmented distribution of some Brown Kiwi populations increases their vulnerability to stochastic events such as fire or disease outbreaks, and to genetic effects such as inbreeding depression and genetic drift. It is also possible that some low density Brown Kiwi populations suffer from an Allee effect, whereby potential breeding animals are unable to find mates where the population density is low (Holzapfel *et al.*, 2008).

5. CAPTIVE HUSBANDRY

5.1 Housing/Environment Standards

The 14 captive facilities in New Zealand that currently hold/exhibit kiwi are spread over the length and breadth of the country. They therefore occupy a wide range of different climatic conditions which may influence some husbandry methodology. Consequently not all the information provided here will be suitable for all institutions. However, the Minimum Standards must be met by all kiwi holders.

5.1.1 Size

Except for juvenile kiwi (less than six months old) or kiwi undergoing medical treatment or quarantine, all enclosures, including for display or a nocturnal house, must have a useable surface area of *at least* 30 m² for a single kiwi and at least 50 m² for a pair of kiwi.

Kiwi less than six months old or undergoing medical treatment or quarantine can be held in any enclosure suitable for housing an individual of that life stage and/or medical condition (e.g. brooders, small enclosures, if required to limit movement of injured birds).

Minimum Standard 3.

Enclosures (including nocturnal houses).

- a) Enclosures for a single kiwi (older than six months of age) must have a useable area of at least 30 m².
- b) Enclosures for a pair of kiwi (older than six months of age) must have a useable area of at least 50 m².
- c) Enclosures must not contain more than two adult birds.
- d) All nocturnal display enclosures must contain one permanent roost/nest box. If an artificial roost/nest box is not to be provided during public display times, then dedicated natural areas must be provided within the enclosure where display birds can retreat totally from public display, if they so desire.
- e) Roost/nest boxes must be positioned in free-draining locations and be sheltered from direct sun, and strong winds. They must be constructed of suitably robust material, be large enough to accommodate all birds in the enclosure and be constructed in such a way as to prevent light shining directly into the roost/nest chamber of the box (e.g. by the provision of a tunnel entrance or internal dividers (see figure 2 for examples)).
- f) All enclosures containing kiwi over six months of age must contain at least one fresh water container measuring 250mm long x 200mm wide x 50mm deep.
- g) Kiwi must be able to maintain a distance of at least 2.5m from visitors if they choose to do so (i.e. the minimum distance between visitors and the rear wall of the adjacent part of the enclosure must be at least 2.5m).
- h) In an enclosure containing two kiwi, materials suitable for dividing the enclosure in two parts (to assist with integrating pairs of birds and to control aggression if required) must be held on site.
- i) In enclosures used to display kiwi (including nocturnal houses), where visitors are not completely separated from the birds, (i.e. where walls or glass viewing windows do not completely isolate kiwi from visitors) all reasonable steps must be taken to ensure that the birds are not able to be harmed by visitors.
- j) All off-display kiwi enclosures must be kept secure at all times (except when they are attended by staff) so as to minimise the risk of theft or vandalism.
- k) Enclosures must meet the requirements set out in the Code of Welfare for zoo animals (Code no. 5, 2004).
- l) All enclosures built or substantially renovated after 2008 must be constructed in such a way and, of such materials, as to exclude all mammalian predators and pests except mice.
- m) A pest control system must be in place around kiwi enclosures to minimise the risk of pests entering any kiwi enclosures. All predator traps (or poison bait stations) must be checked and maintained regularly to ensure their effectiveness.

5.1.2 Materials for housing and enclosure location

With the exception of enclosures for juvenile kiwi (less than six months old) or kiwi undergoing medical treatment or quarantine, the substrate for all enclosures should be soil, with a layer of leaf litter above it, to allow kiwi to forage for natural food.

Kiwi less than six months old or undergoing medical treatment or quarantine can be held on any substrate suitable for housing an individual of that life stage and/or medical condition (e.g. artificial grass mat such as 'astroturf', rubber matting etc).

Enclosures should be located as far as possible from areas where loud noises are likely to occur (e.g. busy roads and service roads) so as to minimise disturbance, especially to breeding kiwi.

Enclosures should also be located in areas that are not prone to flooding. The ground slope of the enclosure is not important, although it is recommended that an enclosure on sloping ground is preferred, especially for kiwi that are earmarked for release to the wild, as this may improve their level of fitness.

Internal divisions within enclosures used to separate kiwi should be constructed of a durable solid material, at least 1 m in height. Permeable material such as a soft plastic mesh can be used as a temporary barrier when introducing kiwi to each other, but should not be used to permanently separate birds.

As staff may have to enter an enclosure when kiwi are active (even in outdoor enclosures), entry to enclosures should be via a double door system, though the internal 'door' can simply be a solid gate in a 1 m high internal wall.

Outdoor enclosures must exclude mammalian predators and pests, specifically cats, dogs, mustelids and rats, and therefore must be constructed of materials suitable for that purpose. Commercial predator-proof fences (see Appendix I, page 41 for details of commercial suppliers) are suitable for housing kiwi. The lower 0.5m of the inside perimeter of the enclosure should be a solid material (such as plywood) rather than mesh so as to minimise the risk of kiwi damaging their bills if they run them along the perimeter of the enclosure.

Both the perimeter and internal divisions of outdoor enclosures should be designed to minimise the risk of kiwi burrowing under walls and escaping, or entering an adjacent enclosure. A footing extending either 0.6m down into the ground or horizontally into the enclosure(s) (but covered by soil) is adequate.

Where possible (i.e. where the kiwi on display are completely separated from visitors by solid walls or glass), *Nocturnal houses* should be well sound-proofed. Glass viewing panels should be double-glazed or should use glass designed to reduce noise transmission (e.g. 'Hush' glass panels). The potential to use one-way glass should also be investigated, as anecdotal evidence illustrates that some kiwi respond adversely to seeing movement on the visitor side of the glass. It is also recommended that the visitors' viewing area is fitted with a soft floor covering (e.g. carpet, cork or rubber tiles) to minimise noise levels.

5.1.3 Security/ban on laser pointers/mobile phone torch apps

All off-display kiwi enclosures must be kept secure at all times (except when they are attended by staff) so as to minimise the risk of theft or vandalism. The use of alarm systems, especially monitored alarm systems, is recommended as this can help deter intruders and can also detect and report other problems like power failure and fire. Note that loud alarm sirens should **not** be located where they will disturb kiwi; Rainbow Springs has flashing lights installed in the areas where they hold kiwi instead of 'sound' fire alarms.

All reasonable steps must be taken to ensure that kiwi on display to visitors are secure from theft, physical disturbance and injury.

Reports of visitors using laser pointers in nocturnal houses were received in 2014; note that the use of laser pointers or torches (e.g. in 'smart' phones) is not acceptable in any nocturnal facility

as it compromises welfare and causes distress to the kiwi. It is the responsibility of the operator to ensure that visitors are properly informed and to enforce this condition.

5.1.4 Shelter/screening

Throughout New Zealand there are a wide variety of kiwi nest and roost box designs, each of which has been designed to suit a particular environment. Essentially each nest or roost box should provide the kiwi with a sheltered and secure area which fully accommodates the physiological needs of the bird. As kiwi are nocturnal, the roosting or nesting chamber of these boxes *must be free of direct light* and must comply with the standards identified in Minimum Standard 3 (see page 16).

At least one permanent roost/nest box per bird must be provided in each enclosure. If an artificial roost/nest box is not provided during public display times, then dedicated natural areas must be provided within the enclosure where display birds can retreat **totally** from public display, if they so desire, and kiwi must have access to the roost boxes at all times. It is recommended that a single kiwi has two or more boxes to choose from and that a pair of kiwi are provided with at least three boxes.

Boxes should be constructed of wood (10mm H3 treated plywood is often used), be large enough to easily accommodate two adult birds (approx 400 x 400 mm), and have a tunnel and/or internal dividers to minimise the amount of light reaching the roosting/nesting cavity. All boxes should also have a hinged lid to provide staff with easy access to the bird(s) when required.

Roost boxes should not have a wooden base, and should be dug into the ground (100 – 500 mm). Boxes should be replaced every two-three years because of the increased risk of *Aspergillus* spp spores in the rotting wood causing disease in kiwi.

In cooler environments (i.e. where the ambient temperature falls below freezing in winter) boxes should be insulated in some way: for example by completely burying the box in the ground (up to the level of the lid) or insulating the roosting/nesting cavity using natural domestic insulation material but not fibreglass or plastic based products. In warmer environments it may be beneficial to install an overhead irrigation system which, in addition to the shade and shelter provided from any trees in the enclosure, can cool the surrounding environment and moisten the ground. Care should be taken to ensure that the use of any overhead irrigation system does not compromise the environmental conditions in any nest or roost box by flooding them.

5.1.5 Water

Fresh water must be provided at all times. Water dishes must be large and deep enough (approx 250 mm long x 200 mm wide x 50 mm deep) to allow birds to submerge their entire bill and bathe in. Water features and pools can be used in enclosures but care must be taken to ensure that birds can easily exit the pool should they fall in.

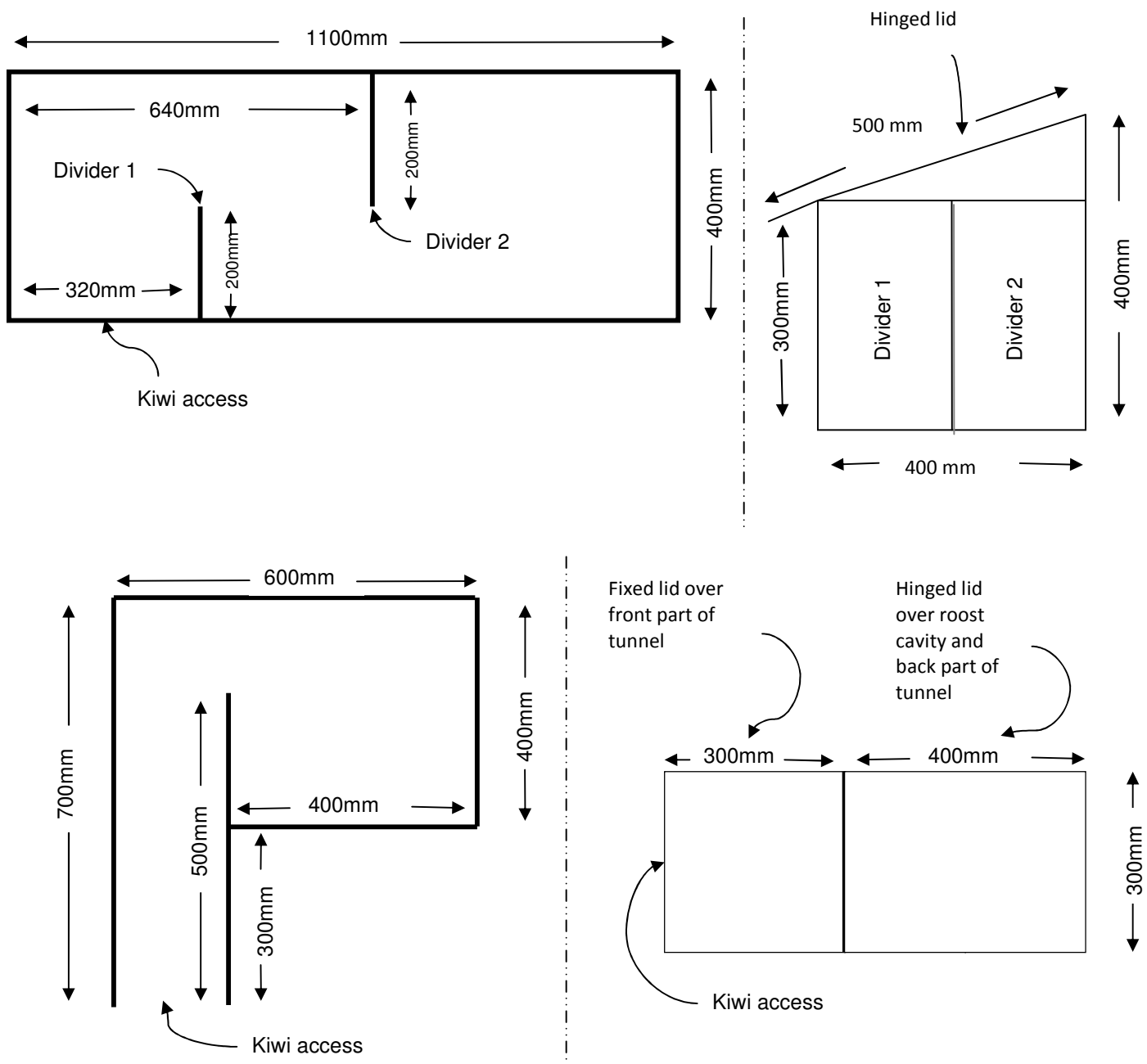


Figure 5. Plans of two types of plywood roost/nest box. Left hand side: top view. Right hand side: side view



Figure 6. Plywood nest/roost box at Auckland Zoo. (photo: M. Whybrow)



Figure 7. Example of kiwi breeding box used at Rainbow Springs Kiwi Birdlife Park (not *in situ*).

5.1.6 Furnishings and vegetation

A thick layer of leaf-litter (20 – 50 mm) should be placed in all kiwi enclosures and added to when it becomes compacted, every two to four weeks. **Care must be taken to ensure, as far as practical, that leaf-litter used in kiwi enclosures is free from harmful material** such as small metal or plastic objects, and/or herbicide/pesticide residue, which may be ingested by kiwi. Leaf-litter and soil should be screened with a metal detector (e.g Fisher 1212X or Garret ACE) before being placed in the enclosure. Holders must also take reasonable steps to ensure that soil used in kiwi enclosures, especially *nocturnal houses*, is free from foreign objects. Rotting logs or tree stumps should be provided for behavioural enrichment of the birds.

Leaf litter should **not** be collected from disturbed habitat (e.g. forest edges), nor should eucalyptus mulch or shredded bark be used, because of the increased *Aspergillus* spore counts in these areas (Joseph, 2000). Eucalyptus trees and mulch are also associated with cryptococcosis, a fungal disease which has caused mortality in several kiwi (Hill *et al.*, 1995; Malik *et al.*, 2003).

Glare, *et al.*, (2014), recommend that ‘leaf litter should be collected from areas of undisturbed forest and **spread immediately after collection without interim storage**’. Additionally they state that ‘Further research is needed to confirm the optimal management of leaf litter to minimize *Aspergillus* spore counts.’

In nocturnal houses, the subsoil and leaf litter should be removed and replaced with fresh material at least once a year to prevent excessive build-up of soil contaminants and faecal material.

Minimum Standard 4. Furnishings and vegetation.

All leaf litter and soil brought into kiwi enclosures must first be screened (either by thorough visual examination of the leaf litter and/or by screening with a metal detector) to minimise the risk of foreign objects (i.e. especially small metal objects) which could be harmful to kiwi if ingested, being introduced to the enclosure. Leaf litter must be collected from areas of undisturbed forest (not forest edges) and spread immediately after collection without interim storage. A minimum of 20 mm of leaf litter should be maintained in all indoor kiwi enclosures.

Enclosures should also contain shrubs/trees. A covering of vegetation in an enclosure will help ensure that the soil remains soft enough for kiwi to probe into and may provide some food (fruit) for the kiwi if appropriate species are planted. Plant cover will also generate leaf litter.

The following species are good for **outdoor enclosures**:

- Pigeonwood – *Hedycarya arborea*
- Kahikatea – *Dacrycarpus dacrydioides*
- Hinau – *Elaeocarpus dentatus*
- Mahoe – *Melicytus ramiflorus*
- Kanuka – *Kunzea ericoides*
- Rewarewa – *Knightia excelsa*

Flax (Harakeke) – *Phormium tenax*
Coprosma – *Coprosma spp.*
Lemonwood (Tarata) – *Pittosporum eugonoides*

The following species have grown well in some **nocturnal houses**:

Brown tree fern (Wheki) - *Dicksonia squarrosa*
Ponga (Wheki) - *Dicksonia fibrosa*
Soft tree fern (Katote) - *Cyathea smithii*
Silver fern (Ponga) - *Cyathea dealbata*
Black Ponga (Mamaku) - *Cyathea medullaris*
Crown fern (Piupiu) - *Blechnum discolor*
Kanuka - *Kunzea ericoides*
Nikau - *Rhopalostylis sapida*
Flax (Harakeke) - *Phormium tenax*
Bush Astelia - *Astelia fragrans* or *Astelia grandis*.
Kohekohe - *Dysoxylum spectabile*
Kawakawa - *Macropiper excelsum*

The following plant species **must not be used in any kiwi enclosures** as they are known, or thought, to have caused illness or death in captive kiwi (see Shaw & Billing 2006):

Onion Weed – *Asphodelus fistulosis*
Black Nightshade- *Solanum nigrum*
Bittersweet Nightshade – *Solanum dulcamara*
Jerusalem Cherry – *Solanum pseudocapsicum*
Karaka – *Corynocarpus laevigatus*

5.1.7 Humidity/temperature/thermoregulation

Although kiwi become lethargic during periods of hot weather, they are relatively robust and can tolerate a wide temperature range. Nevertheless, the temperature in indoor enclosures (nocturnal houses) should remain below 25 C°. Most indoor facilities have indicated that they maintain a temperature range of 14-20 C°.

High humidity promotes the growth of moulds and fungi (including *Aspergillus* spp.) while dry, dusty conditions (i.e. low humidity) predisposes birds to respiratory aspergillosis (Joseph, 2000). Therefore humidity within nocturnal houses should be maintained within a moderate range, 50-60 %, if possible.

The rate of air exchange within nocturnal houses also affects *Aspergillus* spore counts, so kiwi houses should be well ventilated; achieving at least 12% air exchange per hour (Walraven, 2004).

Steps should be taken, e.g. watering, to ensure that the substrate of enclosures remains soft enough (at least in some areas) for kiwi to probe into the soil with their bills.

5.1.8 Lighting

A variety of different lighting regimes and devices are currently used in reverse light cycle displays (i.e. nocturnal houses) in New Zealand. Currently nocturnal displays operate with between six and fourteen hours of 'darkness' in each 24 hour period. A shorter period of 'darkness' (8 – 10 hours) may encourage more activity in kiwi on display. It is recommended that the day/night cycle be changed at least once every three months to mimic changing day lengths in the natural environment (i.e. shorter nights to emulate summer and longer nights to emulate winter).

No ideal levels for brightness (lux) have been developed and establishing an appropriate level of brightness during the night phase is largely a process of trial and error. Nocturnal houses should be bright enough (during the night phase) for visitors to see the kiwi clearly while still being dark enough to encourage the birds to forage in the enclosure.

Ideally, lights used for the day phase of the cycle should provide adequate lighting to support the growth of live plants in the exhibit. See appendix 1 for a list of lighting types currently used in some of the nocturnal houses in New Zealand.

5.2 Health Care Standards

5.2.1 Environmental hygiene and cleaning

Avoid build-up of food debris in enclosures by removing all food scraps around feeding sites daily. Feeding sites should be moved regularly (at least weekly, and preferably daily) to further reduce the risk of a build-up of food scraps.

Nest and roost boxes must be cleaned as required (i.e. if faecal material has accumulated within the box) and should be moved periodically to prevent a large build up or concentration of faecal material in one area. The soil immediately under a roost/nest box should be removed from an enclosure whenever boxes are moved. Boxes should also be cleaned, disinfected by washing with Virkon, Trigen or similar disinfectant, and rinsed thoroughly from time to time. Boxes washed with Virkon or Trigen must be completely dried, then allowed to stand for at least 24 hours before placing back with bird due to the respiratory irritation associated with these disinfectants. Boxes in which kiwi are nesting should not be moved or disinfected during the breeding season.

As far as possible, ensure that *no foreign material* (e.g. tacks, screws, tape, nails, hairclips, and jewellery) is introduced, by any means, to kiwi enclosures. Consider using separate footwear in a nocturnal facility to prevent the accidental introduction of small pieces of metal. Kiwi readily ingest such material and this has caused the death of several kiwi in captivity. Be especially vigilant after extensive enclosure renovations or construction of new enclosures. A metal detector should be used to periodically to search for small metal objects in enclosures. A metal detector should definitely be used following any construction work in or significant renovation of an enclosure.

Feed dishes and/or tubes must be cleaned daily in hot water and detergent. They should also be rinsed thoroughly with water before drying to remove detergents. Feed dishes and/or tubes should also be disinfected regularly with a commercial disinfectant such as Trigene or Virkon (and rinsed thoroughly), especially if swapped between birds.

Food preparation surfaces and areas must be kept clean at all times and should be constructed of impermeable material such as stainless steel or formica.

**Minimum Standard 5.
Cleaning.**

- a) All water dishes must be cleaned and re-filled with fresh potable water daily.
- b) All food dishes (or tubes) must be cleaned daily.
- c) As far as is practicable, all food scraps and leftover food must be removed from enclosures daily.
- d) Roost/nest boxes should be cleaned if faecal material has accumulated within the box (unless this is likely to interfere with breeding).
- e) All areas used for the preparation of kiwi diet must be kept clean.
- f) Boxes washed with Virkon or Trigene must be completely dried, then allowed to stand for at least 24 hours before placing back with the kiwi.

5.2.2 Known health problems

A range of diseases and trauma may affect kiwi. Common problems include traumatic gastritis caused by ingestion of metallic foreign bodies and egg binding in females. Previous issues that have not been seen recently, but should be closely monitored were obesity and diseases associated with heavy parasite loads.

Refer Morgan (2008), 'Kiwi First Aid and Veterinary Care', for a list of health problems associated with kiwi and their treatment.

Do not hesitate to contact other kiwi holders and experienced kiwi veterinarians for advice on health issues affecting kiwi. If you are unsure who to talk to, please contact the Captive Management Coordinator for advice.

5.2.3 Preventative procedures (health monitoring)

Regular weighing

Adult kiwi should be weighed whenever they are being handled (e.g. for transfer to another enclosure or for treatment) and their weight recorded in their individual specimen record or file. They must be weighed at least twice annually as a minimum standard, however for sound management practices monthly weighing is recommended. Kiwi that are undergoing treatment for injury or illness, or are suspected to have health problems, should be weighed more frequently. Chicks should be weighed daily until they reach 800g (refer to 'Operation Nest Egg Incubation and Chick Rearing Best Practice Protocols') to monitor growth rates.

Kiwi can be weighed by placing them in a box (a modified cardboard 'cat carry' box is sufficient) and using an electronic scale, or placing the kiwi in a bird bag and using a 1, 3 or 5 kg (depending on the size of the bird) spring balance.

Faecal sampling

Faecal sampling of captive kiwi must be undertaken at least every six months to identify common gastrointestinal parasites. If parasites are detected, treatment should be considered and administered as appropriate (refer Morgan, 2008 – Kiwi first aid and veterinary care). Note that kiwi often carry low to moderate parasite loads without showing clinical signs of illness. A veterinarian should be consulted and other factors (such as kiwi weight and appetite) should be considered when deciding whether or not to treat kiwi for parasites.

Kiwi less than 6 months old should have faecal samples analysed for *Coccidia* at least every month, as young kiwi are especially prone to illness due to infection by this parasite (Morgan 2009, pers comm.).

Note that one stool sample is not sufficient as the main parasites are intermittent shedders, thus a minimum of 2 samples per pot, taken from different areas of the pen/holding facility are recommended in any faecal testing regime.

If uncontaminated faecal samples cannot be found in the birds' enclosures then the birds may be held in a clean carry box until they have produced the required sample.

**Minimum Standard 6.
Health Monitoring.**

- a) All adult captive kiwi must be weighed at least twice annually and have their weights recorded in the individual specimen record.
- b) Faecal sampling for parasites must be undertaken on each kiwi held at least once every six months. Samples must be checked for signs of *Ascarid*, *Heterakis*, *Capillaria*, *Strongylate* and *Coccidia* infection by a veterinarian or suitably trained laboratory technician.

Monitoring food consumption

Daily records of the amount of food offered to kiwi and removed from the enclosure each day can provide an early indication of ill health or other developments such as egg laying. Therefore this information should be recorded for each kiwi (or each pair of kiwi) in the animals' individual specimen records or a daily diary. Any sudden loss of appetite should be immediately investigated; as this has often been the first indication of foreign object ingestion and kiwi may require x-raying.

5.2.4 Treatments and Veterinary Procedures

Refer Morgan (2008), 'Kiwi First Aid and Veterinary Care'.

5.2.5 Procedure if kiwi die

It is a Department of Conservation requirement (Wildlife Health Standard Operating Procedure) that all dead kiwi undergo necropsy (post-mortem examination) to attempt to determine the cause of death and to provide other information that might contribute to our understanding of the species.

Any dead kiwi must be submitted to a veterinarian for necropsy. The Captive Coordinator must also be informed of the kiwi's death as soon as possible.

Holders should ensure that the veterinarian undertaking the necropsy provides them with a detailed report on the findings of the necropsy. Once necropsy results have been received from the veterinarian a copy must be forwarded to the Captive Management Coordinator.

**Minimum Standard 7.
Procedures if kiwi die in captivity.**

All kiwi that die in captivity must undergo necropsy by a suitably experienced veterinarian.

The Captive Management Coordinator for kiwi (see section 1.3) must be informed about the kiwi death as soon as possible, and a copy of the necropsy report (prepared by the veterinarian performing the necropsy) must be forwarded to the Captive Management Coordinator by the institution where the kiwi was last held (i.e. the institution that submitted the kiwi for necropsy). The sex of the dead kiwi should be recorded (if unsexed at death).

If the necropsy identifies any causes of injury or death that could be prevented through changes to enclosures or procedures, these changes must be made as soon as possible.

Massey University's Wildlife Health Centre provides a diagnostic service on contract to the Department of Conservation (DOC). Institutions holding kiwi will not be charged for any birds submitted to Massey University for necropsy.

Other veterinarians experienced with kiwi pathology can undertake necropsy of dead kiwi, however the DOC will not pay any charges associated with this service.

For detailed information on how to submit birds to Massey University for necropsy see <http://wildlife.massey.ac.nz>, or Morgan (2008). A summary of this information is provided below:

1. **Do not freeze the carcass.** Wet the carcass thoroughly with clean water to reduce the temperature of the carcass quickly, and refrigerate it as soon as possible. Do not put it in the freezer as this will damage tissues and make a full investigation more difficult. Only freeze the carcass if it is unable to be delivered within 36 hours of discovery.
2. Complete a Wildlife Submission Form. This can be downloaded from <http://wildlife.massey.ac.nz> or copied from Appendix 2. The purpose of the form is to identify

the specimen, list any background information that may help identify the cause of death, state any special information the submitter is seeking about the sample, aside from cause of death, and to record if there are any special instructions regarding the disposal of the carcass following necropsy (e.g. returned to submitter, given to iwi, offered as teaching resource).

3. Place the labelled (tag around leg) carcass in multiple puncture and tear resistant plastic bags or a plastic container with a secure and tight-fitting lid. Put a paper towel or other absorbent material in the bag or container to absorb any fluid that may seep out. Put the bag/container in a robust container (either a small polystyrene chilli bin, or a strong cardboard box) together with a non-leak freezer pack (or frozen, half-filled, soft-drink bottle) and packaging (e.g. screwed-up paper, bubble-wrap) to ensure the contents do not move around too much in transit. Label the package **urgent, perishable** and/or **keep cool, do not freeze** and courier to:

Attention: Maurice Alley/Brett Gartrell/Kerri Morgan/Stuart Hunter
Room 8.28, Vet Tower, IVABS
Massey University, Fitzherbert Road,
Palmerston North

Email (to B.Gartrell@massey.ac.nz) or phone the Wildlife Health Centre on (06) 350 5329 (Weekdays) or (06) 350 5955 (Weekends) to inform them of the carcass being sent. **Do not send carcasses over the weekend** as most courier companies do not deliver on Saturdays or Sundays, nor do they refrigerate packages.

If the necropsy identifies any causes of injury or death that could be prevented through changes to enclosures or procedures, these changes must be made as soon as possible.

5.2.6 Quarantine procedures

Pre- or post-transfer quarantine is undertaken to minimise the risk of transferring diseases between institutions or between an institution and the wild.

A full quarantine period (as set out in minimum standard 7) need only be undertaken by either the receiving OR the sending institution, not both. The two institutions involved in the transfer should discuss quarantine options and decide which facility will undertake to hold the birds in quarantine. Commonly it is the sending institution that will do the quarantine, but this can be reversed if the parties involved agree to it.

Results from faecal analysis should be available from the laboratory providing the analysis 24 hours after they received the sample.

If the receiving institution is doing the quarantine the sending institution must still ensure that the kiwi is fit for travel by getting an experienced veterinarian to examine the kiwi prior to transfer.

A complete copy of a kiwi's individual records must be sent by the holding institution to the receiving institution - including any records from pre-transfer quarantine and vet checks. An information sheet with a summary of the individual's specimen record should accompany the

bird being transferred. Facilities using ZIMS software can use a modified specimen report while institutions not using ZIMS software should use a report such as the one shown in Appendix 3 (courtesy of Westshore Wildlife Reserve).

**Minimum Standard 8.
Kiwi transfer and quarantine.**

All kiwi being sent to or received from another captive facility, or from the wild, must, as a minimum, undergo the following quarantine procedure either immediately before or after the transfer..

- a) Birds should be isolated in quarantine for a minimum of 14 days after arrival or before being transferred (depending on whether the quarantine is being undertaken by the sending or the receiving institution). If birds that have been/are about to be transferred are held in an enclosure with other birds then ALL birds in the enclosure must undergo the quarantine, including all medical checks and faecal and blood sampling and analysis.
- b) Enclosures containing birds undergoing post-transfer quarantine must be serviced **after** other enclosures containing kiwi. Enclosures containing birds undergoing pre-transfer quarantine must be serviced **before** other enclosures containing kiwi.
- c) The bird(s) must undergo a thorough physical examination by a vet at the start and end of the quarantine period.
- d) The birds must be weighed at the start and end of the quarantine period (and the weights recorded).
- e) A faecal sample from each bird undergoing quarantine (or a pooled sample for birds sharing an enclosure) must be collected and analysed by a veterinarian or suitably trained laboratory technician for eggs of endoparasites (*Ascarid*, *Heterakis*, *Capillaria*, *Strongylate* and *Coccidia*) at the start **and again** on day seven-nine of the quarantine period (to allow for analysis to be completed before the quarantine period ends).
- f) A blood sample must be collected from each bird in quarantine at the start of the quarantine period to check for haemoparasites and to check that blood chemistry is within the normal range for kiwi.
- g) Except where birds have been transferred to undergo medical treatment, only birds that have undertaken the quarantine procedure outlined here, and have been found to be healthy, should be released into the general kiwi population at your facility. If medical checks or samples reveal health problems these should be resolved or adequately controlled before the birds are released from quarantine.
- h) A complete copy of the bird's individual record must be sent by the sending institution to the receiving institution.
- i) All kiwi being transferred must undergo a thorough physical examination by a veterinarian prior to transfer (regardless of whether the quarantine is being conducted by the sending or receiving institution).

Where possible, kiwi should undergo the quarantine period in a special quarantine facility, isolated (separate air flow, water system etc) from other kiwi enclosures. Ideally, staff attending to kiwi in quarantine should not be servicing any other kiwi at your facility.

Brown kiwi identified for release to the wild must undergo comprehensive screening; see Appendix 4 on page 48 for pre-release screening protocols.

5.3 Behavioural Notes

5.3.1 Common captive behavioural needs

In association with the shelter, substrate and dietary requirements outlined elsewhere in this manual, the regular provision (probably every two to four weeks in nocturnal houses, less often in outdoor enclosures with good tree cover) of fresh leaf litter and rotting logs/tree trunks will meet the behavioural enrichment needs of kiwi in captivity.

5.3.2 Behavioural enrichment activities

In addition to leaf litter and rotten logs, live earthworms (not tiger worms) or other invertebrates should be regularly spread about in **all** kiwi enclosures to encourage birds to forage naturally for food. Live invertebrates must be provided at least twice weekly to kiwi held in indoor enclosures.

Care must be taken to ensure that this additional source of nutrition does not cause kiwi to become overweight. If this occurs then the amount of artificial diet offered should be reduced (rather than reducing or eliminating the live invertebrates from the diet). If mealworms are used for enrichment/nutrition they should be limited to approximately 10 g per day per kiwi or less (approximately 60 large mealworms per bird) as they have a particularly high fat content. Waxmoth larvae should also be limited because of their high fat content.

**Minimum Standard 9.
Behavioural Enrichment**

- a) Live invertebrates (e.g. earthworms, cricket nymphs, locust nymphs, wax moth larvae, mealworms (in limited numbers) huhu grubs, puriri moth larvae) must be provided at least twice weekly to kiwi held in indoor enclosures.
- b) New rotting logs or fresh leaf litter should be provided to each kiwi enclosure weekly to encourage foraging.

5.3.3 Sharing of enclosures

Kiwi are strongly territorial and the introduction of another kiwi into the territory/enclosure of an existing pair could lead to injury or even death of one or more kiwi. Adult kiwi should be held singly or in breeding pairs. It is possible to hold two adult males together, especially if they have been housed together from an early age. It is also possible, though riskier, to hold two adult females together in a single enclosure. This should not be done without first consulting the Captive Coordinator.

Adult kiwi (especially females) living in pairs have been known to kill their mate (even when they have been paired together for several years without any apparent aggression). Same sex 'pairs' are more likely to show aggression toward one another and must be monitored carefully.

Kiwi can be housed with other native species (note that the DOC Guidelines for holding protected wildlife for advocacy purposes (DOC, 2007) states that exotic and protected native

species cannot be held together). Kiwi have often been held in nocturnal houses with Ruru (morepork) and have occasionally been held in large walk-through aviaries displaying a range of native avifauna.

5.3.4 Handling/physical restraint

From 'Kiwi Best Practice Manual' (Robertson & Colbourne, 2003):

'No one should handle kiwi without first having been trained and supervised by someone experienced with handling the species. Kiwi require special care when being handled because they are easily injured as they have a very brittle sternum, weak pectoral muscles and ribcage, and a long thin bill. They also have an ability to shed feathers easily, especially during wet conditions or if the bird's feathers are even slightly damp. In addition, kiwi are able to seriously injure handlers with their claws'.

Special care must be taken when holding kiwi, both for the safety of the kiwi and for that of the handler. When handling kiwi for the first time, **you should be instructed by an experienced handler in what to do.**

Method for juvenile, sub-adult and adult kiwi (but not chicks less than three weeks old)
(Robertson & Colbourne, 2003):

1. Always hold kiwi firmly by the bare part of their legs, preferably with the body cradled on a forearm or, if you are sitting down, on the upper legs. A firm grip around both legs is needed to prevent a bird lashing out with one leg and twisting around which may damage the upper part of the leg being held, or the sharp claws may inflict serious wounds to the handler. If a bird does get one leg free, allow the bird to rotate in your hand to prevent its upper leg from being damaged.
2. Do not hold the bird by the feathered portion of its legs as kiwi very easily drop their feathers.
3. Never hold a kiwi solely by the bill or around its body, as both bill and ribcage are delicate and the bird could be easily injured.

Method for kiwi chicks (less than three weeks old):

Kiwi chicks are fragile, especially in the first week or so of life when they have a large internal yolk sac. Cradle kiwi chicks in two hands, with hands cupped underneath the bird's feet. The bird can be lightly restrained with the thumbs.

All and any staff handling kiwi MUST go through appropriate training (as outlined in the BP manual) and be registered on the 'Kiwi Handlers Database' held on behalf of the Kiwi Recovery Group by Kiwis for Kiwi advocacy mentor Wendy Sporle (kiwendi@xtra.co.nz).

5.4 Feeding Standards

5.4.1 Diets and supplements

The diets used by the 14 facilities currently holding kiwi in New Zealand are all based on ox-heart and are all *adequate* but definitely not optimal, for the maintenance, and outdoor breeding, of Brown Kiwi.

However, in 2015 diet trials of a diet based on the nutritional breakdown of a wild kiwi diet (work performed by Charlotte Minson, Massey University, as a component of her PhD study) were commenced at two captive facilities under the guidance of Don Thomas (Massey University) and Claire Travers (Rainbow Springs Kiwi Wildlife Park). Following trials this diet will become the standard required diet for the captive programme, as rather than 'maintenance' this diet better meets the nutritional requirements of captive birds. As such it is considered essential to provide the optimum nutritional requirements for the captive kiwi that maximises welfare for the individual kiwi.

Always wash your hands before preparing any kiwi food. Ideally, disposable gloves should be worn during food preparation.

Ensure that the ox-heart used for kiwi is from a reputable source (i.e. an abattoir or butcher producing meat for human consumption) as there have been some issues in the past with contaminated meat causing kiwi fatalities. All fat should be trimmed from the ox-heart before it is used in kiwi diet.

Approximately 200-250g of diet should be offered to each adult kiwi each day. Do not overfeed kiwi as they can become chronically overweight (mean weight of a male kiwi = 2.25 kg; female kiwi = 2.75 kg).

Either 'Kiwi Premix' or 'Wombaroo Insectivore Mix' **must** be added to the artificial diet. One facility found that shortly after switching from the premix to Wombaroo several kiwi they held began to suffer from dermatitis. Although a direct link was never proven, facilities using Wombaroo should monitor their kiwi closely for signs of dermatitis.

The Kiwi Premix was reformulated in 2000 as the previous formulation was essentially a cat premix and was not suitable for kiwi (Billing 2001). This obsolete kiwi premix (as stocked by Carlyle Veterinary Clinic at the time of writing (March 2009)) should no longer be used by institutions holding kiwi.

Live invertebrates (earthworms, crickets, locusts, mealworms, wax moth larvae etc) **must** also be offered to kiwi frequently – preferably daily (see section 4.3.2 – Behavioural enrichment activities). Outdoor enclosures with well established plant cover may naturally provide adequate numbers of live invertebrates. If institutions do not feed live invertebrates to kiwi in outdoor enclosures they should check that suitable prey items are available in the outdoor enclosures throughout the year.

5.4.2 Presentation of food

Recommended Best Practice

To mimic natural feeding methods and to minimise desiccation of the diet and the risk of non-target birds (e.g. feral blackbirds) consuming kiwi diet in un-roofed outdoor enclosures, the artificial diet should be placed in a solid impermeable tubes such as a plastic syringe cover or PVC pipe closed at one end, pushed directly into the enclosure substrate or placed in slightly larger diameter pipes or tubes buried in the ground. The feeding tubes should be surrounded by an area of plastic, polythene, rubber or neoprene sheet (approx 400 mm diameter) from which food scraps can be easily removed and which can easily be cleaned - wiped down while in place and periodically removed and thoroughly washed. Neoprene is often used by roofing contractors, who may be able to provide suitable off-cuts free of charge.



Figure 8. Feeding tubes (syringe cover type) and rubber sheet at Auckland Zoo (*photos: I. Fraser*).

The feeding sites should be moved at least every week (and preferably daily) so as to eliminate the build-up of any food scraps not captured by the plastic sheet. The daily allowance of artificial diet should be divided between multiple feeding sites to encourage the birds to forage throughout their enclosure, thereby helping them maintain a higher level of fitness. In nocturnal houses, dividing the diet into two **or more** feeds each day will encourage kiwi on display to forage for longer. Additionally this provides the opportunity for keeping staff to interact with visitors in the public access area of the nocturnal house while the kiwi are out foraging.

Other methods

The artificial diet can be presented in a standard impermeable feeding dish, although extra precautions to stop food drying out in hot weather or interference from feral birds, or other species in the enclosure, maybe required. To avoid desiccation of the diet in *outdoor enclosures* during periods of hot weather food should be kept refrigerated and not placed in the enclosure until approximately 30 minutes before sunset. Non-target species can be discouraged from interfering with the diet by using either of the following methods:

Placing the dish under a small shelter the sides of which are comprised of strips of relatively heavy, but flexible material (e.g. carpet, thick plastic), OR

Placing a plastic or steel mesh cage over the food dish with a mesh size (approximately 40 mm) large enough to allow kiwi to extract food from the dish but small enough to prevent non-target species getting to the food. The cage must be high enough above the food to prevent non-target species reaching through the cage to the food.

5.4.3 Seasonal/breeding changes in feeding requirements

Although kiwi have been known to breed in captivity without any changes to their usual diet, and eggs have been produced in every month (Johnson, 2004), it is recommended that during the peak breeding season (June - November) the frequency and amount of live invertebrates offered to breeding pairs of kiwi is increased.

Food consumption by the female is likely to decline significantly during the week preceding egg laying, with a sudden resurgence of appetite observed once the female has laid an egg.

5.5 Breeding Requirements

5.5.1 General behavioural notes; forming new pairs

The Brown Kiwi population is intensively managed and kiwi must not be allowed to breed unless they have a breeding recommendation from the Captive Coordinator. Such recommendations are contained in the in the final 'Annual Report and Recommendations' document prepared each year by the Captive Coordinator in consultation with captive kiwi holders.

When establishing a new pair at your facility, never introduce a new kiwi to another kiwi's existing enclosure straightaway. As kiwi are very territorial, especially the females, they will need time to get used to each other via scent and calls, otherwise aggression may occur which can result in death. Pairing birds should always be supervised by an experienced kiwi practitioner. The following steps are provided as a guide to assist holders with successfully pairing two kiwi:

1. Place the two birds in adjoining enclosures, or a single large enclosure with an internal solid barrier dividing the enclosure in two.
2. Each day transfer leaf-litter from their roost burrows, droppings, vegetation etc from each bird's enclosure to their prospective mates. This will allow them to get used to each others scent.
3. After approximately 4-7 days swap the two birds over that they occupy the other's enclosure.
4. After a further 14 days or so open a gate or doorway between the two enclosures to allow the two birds to access to each other's enclosure. An experienced staff member must be present to observe interactions between the two birds on the night (or night cycle in a nocturnal house) they are first given access to each other. The birds must be

able to be separated and isolated in separate enclosures should either kiwi be overtly aggressive toward the other. Some facilities prefer to allow the kiwi to have contact through a plastic mesh barrier for a few days before allowing them full access to each other.

If one kiwi has acted aggressively toward the other during their first night (or night cycle) together then they should be separated and contained within the two separate enclosures again before the observer ceases their observation of the kiwi. Another introduction can be attempted on subsequent days/nights. All direct contact between the two kiwi should be supervised by an experienced observer until they are convinced that the kiwi are no longer aggressive toward one another.

Some facilities also report that placing the two kiwi into a neutral territory also minimises aggression. Regardless of what method is used to integrate kiwi, it is vital that staff make direct observations of the birds' interactions to ensure that one kiwi is not overly aggressive toward the other.

Holders should also note that while most kiwi will adjust to nocturnal facilities (a kiwi may take 3-5 months to adjust to a changed photoperiod) not all kiwi cope with a nocturnal house situation. If kiwi continue to show signs of stress in an enclosure, such as excessive pacing, lack of appetite, loss of condition etc, all efforts must be made to ensure that they are receiving appropriate enrichment (multiple feeds; invertebrate feeds) and that there are not conditions in the nocturnal facility causing the additional stress (e.g. refuges/nestboxes are being kept fully darkened; noise or additional disturbance from visitors is being kept to a minimum, etc). If these do not make a difference it is possible a bird may need to be transferred temporarily to an outdoor enclosure. The Captive Coordinator should be kept informed of any issues as they arise, and will endeavour to ensure that display needs can be met, however the competing objectives of the captive programme (e.g. advocacy versus captive breeding) may affect the availability of new display birds and as a general rule kiwi are only available following the previous breeding season. Thus requests should be made in advance of the 'Annual Report and Recommendations' being generated by the Captive Coordinator each February/March.

Similarly, while some kiwi appear to be very well suited to display in a nocturnal house, the requirements of the captive programme are such that all kiwi capable of breeding will probably need to be held with their mates in off-display breeding enclosures for the majority of their lives. Most nocturnal display spaces will be filled by juvenile/sub-adult kiwi (six months – three years old).

5.5.2 Nesting/breeding requirements

At the beginning of May each year, in preparation for breeding, nesting material (e.g. dry grass, broken fern fronds) should be made available to breeding pairs near the entrance of roost/nest boxes.

During the nesting season disturbance of the kiwi (e.g. enclosure maintenance etc) should be kept to a minimum.

Some female kiwi have been observed sitting in water dishes for extended periods when they are heavily gravid. Holders should offer deeper water dishes up to 75mm deep to breeding pairs, especially if the female has shown a tendency to bath in the water dish when gravid.

5.5.3 Requirements of young

Kiwi chicks are precocious, that is they hatch fully feathered and are not fed by their parents. Consequently their requirements are similar to those for adult kiwi. They are usually reared for the first few weeks of their lives in wooden or plastic brooder boxes designed for this purpose.

The 'Operation Nest Egg Incubation and Chick Rearing Best Practice Protocols' (Bassett, 2012), contains comprehensive information on hand-rearing chicks.

5.5.4 Methods of hatching/rearing/manipulation

Kiwi hatching success in captivity has been increased where eggs have been removed from the male several weeks after laying and artificially incubated from that point, with the resulting chicks hand-reared in purpose built brooder boxes. Research indicates that the best time to remove eggs for incubation is when the oldest egg of a clutch is 41 – 57 days old (Robertson *et al.*, 2006). All institutions seeking to breed kiwi should have at least one incubator and brooder for each pair of kiwi they hold for breeding OR have plans in place to transfer eggs to an appropriately experienced facility.

Eggs may be left for longer under males that have high hatching success rates (i.e. males that don't break or crack eggs). Consult the Captive Coordinator **before** leaving the male to incubate the eggs to full term naturally.

5.5.5 Methods of controlling breeding

If no chicks are required from kiwi already paired together then any eggs laid should be replaced by artificial eggs, and the real eggs removed from the nest. Unless directed to do so by the Captive Coordinator for kiwi, eggs should not be removed without an artificial egg replacing them as an empty nest will encourage the female to keep laying. Repeated egg laying may negatively impact on the health of the female.

If the male is still sitting on the artificial egg(s) after approximately 85 days the artificial egg(s) should be removed.

5.6 Incubation/rearing young

Facilities seeking information on artificial incubation of kiwi eggs and hand-rearing chicks should refer to the 'Operation Nest Egg Incubation and Chick Rearing Best Practice Protocols' (Bassett, 2012).

Facilities holding, or planning to hold, breeding pairs of kiwi are strongly encouraged to send their kiwi husbandry staff to attend one of the kiwi incubation and egg candling workshops hosted by Rainbow Springs Kiwi Wildlife Park and Kiwi Encounter (in association with 'Kiwis for Kiwi' - register as a kiwi practitioner on this site (www.kiwisforkiwi.org) to be kept informed of upcoming workshops.

5.7 Transport Requirements

Over short distances (i.e. from one enclosure to another within a single institution) kiwi can be transferred in modified cardboard or corflute 'cat carry' boxes (available from any vet practice) with the ventilation holes taped over so that the kiwi cannot poke its bill through the holes and thereby risk injuring it. Boxes should be lined with newspaper and absorbent, unscented paper towels. Transport boxes should be wiped down with disinfectant (e.g. Trigen or Virkon S) after each use. Corflute boxes are preferable to cardboard ones as they are more durable.

Over longer distances (i.e. between institutions or transferring a kiwi to a wild release site) kiwi should be transported in sturdy, purpose-built, wooden boxes with ample ventilation, internal padding, and no holes or gaps through which a bird could poke its bill. For air transport, containers must comply with the principles specified for the relevant International Air Transport Association (IATA) container requirement (Container Requirement 21, IATA 2008).



Figure 9. Domestic use kiwi transport boxes (DOC)

These examples are 'double' crates (divided into two compartments); that have a clear Perspex additional internal lid; designed to allow viewing of the kiwi before the wooden lid is undone. These boxes are used for kiwi transfers within Northland and for transfer to wild release sites.



Figures 10 and 11. International IATA standard kiwi transport boxes (Photos; Michelle Whybrow, Auckland Zoo)

These crates were purpose built to transfer Brown kiwi to the United States and meet IATA international air travel requirements. (This transfer occurred to supplement the genetics of the SSP/EEP Brown kiwi captive programme in 2010).

An incident during 2009, where a shipment of domestic chickens infected a captive bred Brown kiwi with mites, during transport, has led to the following revised condition (2011) for airline transport of kiwi. Although this was a simple transfer between two captive institutions, it is clear that this could have occurred to a kiwi being flown to release at a wild location. The associated risk of the transfer of any type of avian mite from domestic stock to a kiwi in flight and onto a wild site, are unacceptable. If kiwi are to be flown on a commercial aircraft, as part of routine domestic transfer, they must not be booked on the same flights as any other exotic bird species wherever possible. Whenever practical the sending institution **should** ensure (with the relevant airlines) that no domestic fowl (or other avian species) are to be shipped on the same flight.

A DOC transfer permit should not be required to move kiwi identified for transfer in the endorsed 'Annual Report and Recommendations' between existing kiwi holding facilities. However, it is the responsibility of each individual facility to check their DOC 'permits to hold' kiwi (as these remain variable across the country) and apply for a 'non-commercial' transfer permit should transfers not be covered in their existing permit to hold absolutely protected wildlife. If a permit is required, a copy should accompany the kiwi in transit.

Refer to the Kiwi Best Practice Manual (Robertson & Colbourne, 2003; revised 2014) for details on transport box construction and methods.

6. RECORD KEEPING

Record keeping is a crucial element of managing all species in captivity. Specific care should be taken to ensure that all records are accurate and up to date.

6.1 Individual records

Animal records should be maintained electronically to make it easier to maintain a backup copy of all records and to facilitate their transfer to other holders and the Captive Coordinator. Ideally the software provided by the International Species Information System (ISIS) should be used. This is currently the Zoological Information Management System (ZIMS).

An example of a manual animal inventory system is available to ZAA NZ members in the members' resources section of the ZAA website (www.zooaquarium.org.au) or from the Captive Coordinator.

Minimum Standard 10. Record Keeping.

An individual record must be maintained for every kiwi ever held at your institution. This record must include the following information:

- Individual identifiers (e.g. band numbers, transponder numbers)
- Sex (if known)
- Sexing method (if known)
- Identity of Parents (if known)
- Origin (if wild caught; e.g. exact location)
- Hatch date (if known)
- Arrival date at your institution
- Departure date from your institution (if applicable).
- Death date (if applicable)
- Cause of death (if applicable and known)
- Weights
- Notes on when faecal (or other) samples were taken and the results.
- Notes on health problems and treatments offered (if applicable).
- Important behavioural notes

6.2 End of breeding season/studbook data reports

The extent to which the Brown Kiwi captive management programme contributes to the overall recovery of kiwi depends to a large extent on effective communication among holders and between holders and the Captive Coordinator. Holders must inform the Captive Coordinator as soon as practicable about any significant developments in the kiwi programme at their institution (e.g. deaths, hatches, plans to increase or decrease the number of kiwi enclosures etc).

At the end of the breeding season a summary of information collected by the holder during the season is submitted to the Captive Coordinator in the form of an end of breeding season/studbook data report (a template is sent out to all kiwi holders by email by the Captive Coordinator). For those holders using ZIMS a ZIMS taxon report for the requested timespan covers this requirement. Additionally a template to cover all egg records is circulated each year to all holders so that the fate of every egg laid maybe reported in the ARR.

**Minimum Standard 11.
End of breeding season report.**

An end of breeding season report must be submitted to the Captive Coordinator for kiwi by 1st March each year, detailing developments for the period 1st March – 1st March. A template will be provided for all holders. Information required includes:

- Records of kiwi hatches, deaths and transfers at each institution.
- Numbers of eggs produced by each breeding pair and the fate of those eggs.
- Confirmation that transfers, releases and breeding recommendations made in the previous year's Annual Report and Recommendations (ARR) were achieved (or at least attempted).
- Information on planned holdings and requests for more (or less) kiwi.

7. ACKNOWLEDGEMENTS

We would like to thank and acknowledge the staff at captive management facilities throughout New Zealand who have provided much of the information presented here and who continue to develop kiwi husbandry techniques through their ongoing participation in the captive programme.

Special thanks are also owed to Suzy Barlow (ZAA) and Tony Billing (Westshore Wildlife Reserve) for their roles in overseeing the 2009 husbandry manual project. Several kiwi experts not attached to any captive facility, including John McLennan, Kerri Morgan, Clea Gardiner and Avi Holzapfel, also provided information for this manual.

Finally, we would like to extend our thanks to the Department of Conservation and the ZAA NZ committee for providing the funds required to complete the production of this manual in 2009. The manual was reviewed by ZAA kiwi holders in 2011 and again in 2015; and edits made by Suzy Barlow (ZAA) and Claire Travers (Rainbow Springs Kiwi Birdlife Park) prior to re-endorsement by kiwi captive holders in New Zealand.

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Appendix 1 Specialised Products and Suppliers mentioned in the text

Transponders and scanners

Trovan transponders and scanners are available from:

Advanced Identification Ltd.
PO Box 48087
Blockhouse Bay
Auckland
Phone (09) 820 7543
Or 09 820 0009; 09 8283410
trovan@xtra.co.nz

'Nano' trovans (used at Wellington Zoo) are available from:
Microchips Australia Pty. Ltd.
22 Fiveways Boulevard
Keysborough, Victoria 3173
Tel +61 3 9706 3165
www.microchips.com.au

Allflex transponders and scanners are available from:

Allflex New Zealand Limited
17 El Prado Drive
Private Bag 11003
Palmerston North

Phone (06) 356 7199
Fax (06) 355 3421

Transponders and scanners can also often be purchased through your local veterinary practice.

Kiwi premix

Contact: Tony Billing
Westshore Wildlife Reserve,
1 Watchman Rd,
Westshore,
Napier 4110
Phone (06) 834 4136
Email: tonyb@napier.gov.nz

OR

Bomac Laboratories Ltd
Cnr Wiri Station Road & Hobill Ave
P.O Box 76-369
Manukau City
Auckland
Phone: 09 262 3169
Fax: 09 262 3008
Email: bomac@bomac.co.nz

Wombaroo insectivore mix

Contact: Karen Wiley
Native Bird Rescue Trust, Wellington
Phone/fax (04) 479 2936
Email: Karin@nbrwt.org.nz

Live invertebrates

Biosuppliers
Birkenhead
Auckland
Phone/Fax 09 418 2352

Email: bugs@bio.pl.net

<http://www.ak.planet.gen.nz/~bio/>

Feeding tubes (syringe cases)

External cases, (i.e. disposable packaging from 20ml syringes); available from veterinary centres and veterinary supply companies nationwide.

PVC piping; available from hardware stores and plumbing supply stores nationwide.

Pest-proof fences

Pestproof Fences
P.O. Box 11019,
Hastings

Email: paul@pestproofences.co.nz
ph: 07 349 4505
www.pestproofences.co.nz

Xcluder Pest-Proof Fence,
99 Sala Street,
(PO Box 7135), Te Ngae 3042
Rotorua

www.xcluder.co.nz

Lights

Night Cycle: red 40W incandescent bulbs, 60W General Electric mini-tubes, various standard spotlights with red filters

Day cycle: Sylvania Gro-lux tubes, 37W NEC tri-phosphor lights

All are available from lighting and electrical suppliers nationwide

Metal detectors

Fisher 1212x and Garret ACE metal detectors are available from \$495 from Detection Solutions:
www.detectionsolutions.co.nz

Phone 0800 800 618

Cat carry boxes are available from veterinary practices and pet shops nationwide.

ZIMS animal records software is available from the International Species Information System (ISIS). Visit their website www.isis.org for details.

Pesola balances

Contact: Graeme Taylor

Senior Technical Support Officer (Banding and Wildlife Health)
Research and Development Group
Department of Conservation
PO Box 108
Wellington 6140
New Zealand

Ph (04) 4713294 Fax: (04) 3813057 Email: gtaylor@doc.govt.nz

Disinfectant

Virkon™ is often available from your local vet. Can also be purchased from NRM (phone 0800 800 380 to order or for local agents).

Trigene™ is also available often available from your local vet or from:

Animates Botany Downs
371 Ti Rakau Drive
Botany Downs
Auckland
Phone: 09 272 7510

Artificial kiwi eggs

Can be obtained for US\$38 + postage from:
Boneclones – Osteological Reproductions
21416 Chase Street #1
Canoga Park
California 91304
USA

www.boneclones.com

Appendix 2 Massey University (Huia) Wildlife Submission Form

WILDLIFE SUBMISSION FORM

Forwarding Instructions	
This animal is the property of the Department of Conservation. Please send a copy of test results to: Wildlife Mortality Database Manager, c/- Pathobiology, IVABS, Massey University, Private Bag 11-222, PALMERSTON NORTH	
Submitter Details	Submission Details
Surname: _____	Date submitted: ____/____/____ Submitter ref: _____
First name: _____	Date found: ____/____/____ Number dead: _____
Organisation: _____	Number at risk: _____ Numbers sick: _____
Address/Box: _____	(In-contacts)
Suburb: _____	
City/Town: _____	
Phone (bus.): _____	
Phone (home): _____	
Mobile: _____	
Fax: _____	
Email: _____	
	Mortality
	Date animal died: ____/____/____
	Death circumstances:
	Found dead <input type="checkbox"/> Infertile <input type="checkbox"/>
	Found alive and died <input type="checkbox"/> Euthanased <input type="checkbox"/>
	Treated and died <input type="checkbox"/> By-catch <input type="checkbox"/>
	Capture or release <input type="checkbox"/>
Specimen Details	Location Type
Animal Details (Please use separate page for additional animals)	Wild
Species/common name: _____	Mainland National Park <input type="checkbox"/>
Animal ID: _____	Mainland Reserve <input type="checkbox"/>
Identification type: _____ <small>(Leg band, microchip, implant, tag, etc.)</small>	Mainland Private Land <input type="checkbox"/>
Individual name: _____	Maritime Park <input type="checkbox"/>
Sex: Male <input type="checkbox"/> Female <input type="checkbox"/> Unknown <input type="checkbox"/>	Island <input type="checkbox"/>
Age Classification: Adult <input type="checkbox"/> Subadult <input type="checkbox"/> Juvenile <input type="checkbox"/>	Coastline <input type="checkbox"/>
Necate <input type="checkbox"/> Foetus <input type="checkbox"/> Embryo <input type="checkbox"/> Egg <input type="checkbox"/>	Sea <input type="checkbox"/>
Date of birth/mating: ____/____/____	River <input type="checkbox"/>
Age/incubation/gestation: _____	Other: _____ <input type="checkbox"/>
period / period Years Months Weeks Days	Location name: _____
Where born/hatched: Wild <input type="checkbox"/> Captivity <input type="checkbox"/>	Conservancy: _____
Weight: _____ gm/kg	Description: _____
	<input type="checkbox"/> Poisons are being used in the area. Please include details of the toxin.
	<input type="checkbox"/> Special requirements for disposal of body parts, e.g. return to submitter for DNA requirements, genetics, or forward to Te Papa etc. Please state details of which body parts required and invoice submitter for carrier costs.
History	Include any information which you think may be relevant to this case.
Previous health history: Clinical signs; external examination; individual treatments; abnormal behaviours (feeding, reproductive, agnostic); breeding history; diet with any changes; exposure to toxins; translocation details; previous clinical pathology (attach relevant reports).	
_____ _____ _____	
Environmental Conditions (including climate) Enclosure substrate/size/type; group treatments; in-contacts; clutch details if relevant - sire ID/name, dam ID/name, number of eggs, egg lay interval, season number, season clutch number, incubation temperature and humidity.	
_____ _____ _____	
<small>Continue over leaf</small>	
Invoice Instructions	
Invoice: Submitter <input type="checkbox"/> National Wildlife Surveillance Fund <input type="checkbox"/>	(Refer to 'Guidelines for the use of the National Wildlife Surveillance Fund' for eligibility on the WILDLIFE HEALTH PAGE - WGNCR-37176)

Appendix 3 Westshore Wildlife Reserve Kiwi Transfer Document



WESTSHORE WILDLIFE RESERVE KIWI TRANSFER DOCUMENT



To: Willowbank Wildlife Reserve. Address: 60 Hussey Road, Harewood, Christchurch.

From: Westshore Wildlife Reserve. Address: Watchman Road, Westshore, Napier.

Transfer Date: 14/09/2003 Previous Transfers: N/A.

Transfer Method: Air New Zealand Link, Flight 8475, Napier/Christchurch direct, (depart 1335, arrive 1510).

Common Name: Brown Kiwi. Scientific Name: Apteryx australis mantelli.

Given Name: Tane. Provenance: Bay of Plenty.

Band Number: R-88235. Studbook Number # 326

Transponder Number and Location: 982 00910 222770 under right wing

Date of Birth: 21/5/1999. Sire: Tarawera (R30234) Dam: Fern. (R30232)

Captive Bred: Yes No Natural or Captive reared: Captive reared.

Place of Birth/Origin: Westshore Wildlife Reserve. Sex: Female. Age: 4 yrs. 5 mths.

Paired/Unpaired: Unpaired. Name of Mate: N/A. Band No. of Mate: N/A.


Enclosure Number: A2. Enclosure: Indoor Outdoor

Breeding success/history: N/A.

Diet:	<i>Beef heart, (cut into thin strips), new formula Kiwi Premix and Rolled Oats. Natural food available in outdoor enclosures, (depending on season and weather).</i>					
Health Status (include previous health problems)	<i>No health problems ever experienced.</i>					
Full veterinary health check prior to transfer:	<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No	Weight	<i>1800 g.</i>
Copies of all laboratory test results attached (faecal/blood)	<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No		
Copy of veterinary physical examination sheet attached	<input checked="" type="checkbox"/>	Yes	<input type="checkbox"/>	No		
Purpose of Transfer:	<input checked="" type="checkbox"/>	CMP Breeding Recommendation			Display	
	<input type="checkbox"/>	Other (state) :				

DOC transfer permit number: 12/133

Studbook holder/captive coordinator notified of transfer: Yes No

Special Habits or Problems:	<i>No bad habits or problems ever noted.</i>
Comments:	<i>Good looking bird with a quiet nature.</i>
Signed: 	Name: <i>Tony Billing</i> Date: <i>13/10/03.</i>

Appendix 4 - Pre-release disease screening

Disease Screening and Treatment Recommendations for Kiwi to be released from captivity (captive bred kiwi rather than Operation Nest Egg) (Kate McInnes and Kerri Morgan) (from 'Operation Nest Egg Incubation and Chick Rearing Best Practice Protocols', Bassett, 2012 *modified by Kate McInnes 2012*) With input from Richard Jakob-Hoff.

Diagnostic faecal for parasitology	Treatment for coccidia:	Husbandry recommendations for coccidia	Treatment for helminths:	Cloacal swab for microbiology (Salmonella and Yersinia only)	Procedure if positive Salmonella or Yersinia	Blood smear for white blood cell count and haemoparasitology	Physical examination and body condition weight check
✓	>++ Baycox to avoid stress related disease issues upon release	Avoid build up of faeces	Tapeworms (cestodes) no treatment* Treat all other positives, recheck those with +++ and ++++ in 5 days after treatment before release	✓	Do not move bird or birds in contact. Isolate individual. Observe strict quarantine principles. Seek experienced veterinary advice	Complete blood count (including blood parasite exam) and serum biochemistry. If blood parasites found seek veterinary advice	Physical exam (including body weight). Ensure birds are in good body condition and show no signs of injury or disease.

Coccidia treatment indications:

- No treatment of birds with low burdens (+) of coccidia ensures natural vaccination without interfering in acquisition of immunity to coccidia.
- Moderate burdens (++) should be treated to reduce environmental contamination
- High burdens (+++ and ++++) should be treated to reduce morbidity/mortality of individual birds, as well as reducing environmental contamination
- Faecal sampling – pool samples from individuals, ensure at least three stools (passed on consecutive days) are collected from each individual.

NZVP scoring chart for coccidia (oocysts per gram): + 0-2,000; ++ 2,000-50,000; +++ 50,000-250,000; ++++ >250,000.

Therapeutics – check calculated dose rates with veterinarian if unsure. These are the recommended formulations for kiwi – there are others also which may be used (See Morgan 2008 p. 100).

*Cestodes may be treated if high numbers are found and birds are clinically ill.