

Brown teal/pateke
(Anas chlorotis)
husbandry manual

Brown Teal Recovery Group

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Northland

Cover photograph: Brown teal drake (Brent Stephenson)

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1 Introduction

This husbandry manual is prepared for all holders of brown teal in accordance with the Brown Teal Captive Management Plan (DOC, 2000). The information contained within this manual reflects current best practice for captive management of brown teal, and draws on the experience and expertise of participants in both the New Zealand brown teal and sub-antarctic teal captive programmes.

This manual facilitates the establishment of minimum standards for housing, health care, feeding and breeding management of brown teal, allowing the captive management programme to support the recovery of the species. The establishment of standards for recording information, and notifying and investigating deaths, will assist the Captive Management Co-ordinator to maintain an accurate studbook and provide the feedback necessary to assist the programme to meet its annual production targets. It will also allow the collection of veterinary information to provide both a better understanding of, and improvements in, brown teal health management.

With continuing improvements to current captive management techniques, the information contained in this husbandry manual will require updating and should be reviewed at least every five years.

1.1 OBJECTIVES

This husbandry manual should enable the brown teal captive management programme to achieve the following objectives:

- Establish best practice captive management procedures at all holding facilities;
- Support the brown teal recovery programme by producing quality birds fit for release into the wild;
- Improve advocacy for the conservation of the species.

1.2 TAXONOMY AND CONSERVATION STATUS

Vernacular name: Brown teal, pateke
Species: *Anas chlorotis*
Order: Anseriformes
Family: Anatidae
Subfamily: Anatinae
Class: Aves

Critically Endangered (IUCN Red List Category A 1994).

Nationally Endangered (DOC Threatened Species Classification Ranking).

1.3 CAPTIVE MANAGEMENT CO-ORDINATOR

The Brown Teal Captive Management Plan will outline the involvement of captive brown teal holding and breeding facilities in the recovery programme and will be held by the Captive Management Co-ordinator.

The current Captive Management Co-ordinator is:

Kevin Evans

RD 2, Ruawai, Northland

09 4392561 or 027 4392561

kevin@brown teal.com or kevan@ihug.co.nz

1.4 PERMITS

Permits (issued by the DOC) are required for captive holding of brown teal. The Captive Management Co-ordinator can be consulted regarding the requirements necessary for obtaining these permits.

1.5 NATURAL HISTORY

Brown teal are considered to be a nocturnal species although activity is not uncommon in the day. They are strong fliers, but are generally reluctant to take to the air. They are particularly vulnerable to both terrestrial and aerial predators.

Brown teal are a dabbling duck with an omnivorous diet; they regularly forage in paddocks, estuaries, and freshwater and mud pools.

During the breeding season (most commonly July to November), pairs are highly territorial, both vigorously defending nesting sites—usually close to freshwater in dense vegetation—and broods of offspring. Males are unusually attentive during the rearing phase. They are regarded as one of the more aggressive species of waterfowl, particularly in the captive environment.

Outside the breeding season, following the moult, birds become gregarious and gather at traditional flock sites; currently these are known to be mostly at estuarine locations, although would historically have also occurred on inland freshwater sites. During flocking, pair bonds are formed or re-established; successful breeding pairs show a tendency to be monogamous.

2 Identification Methods

2.1 IDENTIFICATION BANDS

Birds are individually identified with a metal band (open ring) supplied by the DOC Banding Office. The band size 'S' (10 mm internal diameter) is used for all but very large birds, where an 'L' band (11 mm internal diameter) might be necessary to avoid constriction of the tarsus. Males are banded on the right leg and females on the left leg, when fully grown.

It is sometimes necessary to fit plastic colour bands to birds for temporary individual identification (e.g. group holdings). Colour bands play an important role in the identification of individuals during behavioural observation, and provide essential information on social hierarchy, and the interactions and relationships between birds held in a group. They can,

however, be an additional hazard in heavily vegetated pens. Colour bands should be wrap-around type, with internal diameter of 10 mm, and need to be super-glued to prevent them coming off. Bands can be 5 mm wide allowing single or two colour combinations to be worn on a leg; wider bands (up to 10 mm wide) can be used as single colour codes.

All bands should be inspected at every available opportunity and replaced if sharp or worn.

All information relating to captive brown teal in New Zealand is managed by the Captive Management Co-ordinator. Records are kept on SPARKS software (Single Population Animal Record Keeping System).

2.2 SEXING METHODS

Brown teal males are generally larger than the females; captive males usually weigh between 600–700 g, and females 500–600 g. Sexing adult brown teal is more straight forward using plumage characteristics and call. Sexing immature birds, and birds in eclipse plumage is more difficult and is achieved by performing a cloacal examination, a technique also called vent sexing.

2.2.1 Plumage and vocalisation

By about six months of age, young males will have developed a rich chestnut- brown chest coloration, an iridescent green tinge on the head, and a white posterior bar on the speculum. A few males will also develop a white neck-band. Acquisition of this first winter, or nuptial plumage is a result of their first moult from juvenile plumage. At this age they also begin to use there high pitched whistle. Females will retain a plumage very similar to immature birds, but will develop a noisy and raucous quack.

Captive brown teal spend up to eight months of the year in breeding plumage. Both sexes then spend up to five months of the year in various stages of moult; during this period the eclipse plumage, where males resemble females, can last up to two months.

Adult males have a muted bell-like whistling call, which can take the form of a territorial or alarm call; they also have a soft, repetitive hiss-like communication call. At maturity, females develop a raucous growl and a quiet chattering communication call. Male and female calls can be distinguished by about 40 to 50 days of age.

2.2.2 Cloacal Examination

Cloacal examination is essential to accurately determine the sex of teal, particularly juveniles sharing similar plumage. Unlike most birds, males of waterfowl species can be identified by the presence of a penis, however, this is normally retracted inside the bird's vent and considerable manipulation is usually required to reveal it. Mistaking a male for a female because the penis has not been easily found is the most common cause of error in the vent-sexing process. If lacking confidence in correct sexing, it is recommended to practice on some of the more common duck species first with advice from someone who is experienced in the procedure.

Adults and Juveniles

Hold the teal upside down with the tail pointing away from you. Placing the head and upper

body between your legs will secure the bird and calm it down. The three last fingers on each hand support the bird's lower body from underneath, whilst the index fingers, resting behind the vent, are used to gently bend the tail back (down towards the ground). The thumbs are placed on either side of the vent and are used to expose the cloacal chamber by pressing gently downwards and outwards.

Males can be determined by the appearance of a corkscrew type penis of an adult, or the smaller penis of a juvenile. (The opening to the bursa, a lymphoid organ developing from the cloacal region, is apparent in juveniles only although this would be relatively hard to detect in the teal.)

The female cloacal area will reveal the small, dark clitoris on the anterior wall of the cloaca and the start of the oviduct (as a fold in the wall). (Again, the bursa may be more obvious in a juvenile.)

Ducklings

It is possible to vent-sex teal as early as one day of age although it is not necessary to do so at this time. The procedure for ducklings is the same as used with adults although a little more care is required. If vent-sexing downies under three weeks of age, there is obviously no need to use your legs for the purposes of restraint. Holding the duckling firmly in hands, the index and adjacent (third) finger of one hand can sandwich the tail and gently bend it backwards, whilst the thumbs are free to manipulate the vent. The penis of the male and clitoris of the female often appear darker than the surrounding tissue (and therefore more obvious) in such young waterfowl. Older ducklings are best sexed in the same way as the adults.

2.2.3 Sexing by DNA finger printing

A growing feather with good amount of feather pulp/blood at base is removed from the bird with a pair of tweezers; care is taken to avoid contaminating the sample by contact with human skin/fingers. The sample is placed in a sealed plastic zip-lock bag and can be sent to:

Ian Anderson
Equine Blood Typing and Research Centre
Massey University
Private Bag 11 222
PALMERSTON NORTH
Ph: 06 350 5799 ext. 7261

Cost for analysis is approx. \$30/sample (May 2003).

3 Housing/Environment Standards

Brown teal that are part of the captive breeding programme should be housed in a fully enclosed aviary for two important reasons:-

- to deny access to all aerial or terrestrial predators and pests;
- to ensure that the teal have no means of escape.

Holders of this species will require at least one reserve aviary to accommodate offspring, or to

use as additional space in cases of conflict or illness where isolation of individuals is necessary. DOC basic permit requirements regarding housing standards/specifications can be found in the Appendices.

The highly territorial and aggressive nature of this species influences aviary design as birds tend to be held year-round as pairs; some facilities will require the housing necessary for flocking which generally occurs outside the breeding season.

3.1 AVIARY DESIGN AND CONSTRUCTION

3.1.1 Size requirements

Brown teal show obvious signs of stress when held in unsuitable aviaries. Activity in the day becomes extremely restricted, and hyperactivity in the form of pacing perimeters becomes evident at night. Birds will display better in larger aviaries where they probably feel less threatened; however, teal in very large pens (greater than 200m²) will be more difficult to manage in the breeding season and certainly harder to view. The minimum required ground space is 15–20m², but teal aviaries around 40m² are preferable. Such pens maintain aesthetic appeal and all the important roosting and foraging habitats year-round. A recommended display/breeding aviary would be around 20–40m² in area.

Pens with ceilings more than 2m high are harder to service; increased aviary height is wasted space with this species and the birds will gain more benefit from provision of a generous ground area.

There are many advantages to being able to combine two or more adjacent aviaries into one, incorporating a dividing door, thereby extending the total pen area. Situations where this facility is useful include:-

- flocking teal, if necessary, for natural mate selection;
- extending a breeding pair's foraging and nesting habitat leading into the breeding season (thereby offering additional stimulation to breed);
- housing large families/broods/juvenile flocks;
- separating disputing individuals;
- certain introductions.

3.1.2 Construction

Aviary design and construction will be, to a degree, at the discretion of the facility; but could use framework constructed of tanalised timber posts or galvanised piping. Wire mesh or polypropylene, with a maximum diameter of 25 mm, can be used to cover external and dividing walls as well as the roof. Small chain link mesh is the most robust, 10 or 12 mm weld mesh will eliminate large mice, weasels and sparrows. The mesh can be painted with a non-toxic bitumen-based black paint to preserve the wire and improve viewing for the public.

The mesh is strengthened with regular strainer wires to which it is tied. At the base of the walls, the mesh can be attached to a base structure. The base is buried into the ground by at least 300 mm (ideally >400 mm) to exclude burrowing mammals. The first metre of aviary wall above ground level suffers the most hard wear (rusting, mesh damage etc.). It is, therefore, recommended that the predator-excluding wall be increased in height above ground level. If this is not possible, it is advisable to use the chain-link mesh for this lowest section along with some solid reinforcement (e.g. ply). Solid barriers are important to install between

adjacent pens to prevent aggressive interactions between neighbouring birds.

3.1.3 Substrate

Teal will adapt to a range of substrates, but provision of a variety of substrates within the land area of a teal aviary will benefit the birds in several ways. Rock or stone areas will toughen up soft feet and help to naturally wear down lengthy toe-claws. Well draining soil will provide birds with dry areas to roost and nest. Low level marshy areas offer enrichment to dabbling ducks and a damper site for wetland plants to grow.

Landscaping a pen to incorporate raised mounds is important in order to allow the ground-dwelling teal to exercise muscles in a balanced way. In the wild, these birds are used to rugged terrain. Dominant males will broadcast territory ownership from elevated vantage points. This may well be a breeding stimulation between neighbours.

3.2 PONDS AND WATER SYSTEMS

3.2.1 Pond size and design

Pond design is usually dictated by pen location and the logistics of water supply. A pond large and deep enough for the birds to perform all their behaviours, such as upending, swimming, bathing, courtship and copulating, is essential. A pond 1m wide x 2m long x 300mm deep is adequate for a small aviary; while smaller ponds have been used, they can only be recommended when a larger pond is not feasible. The water must be clean and clear. Stagnant water, especially in summer, quickly heats up promoting the rapid growth of bacteria. At worst, botulism could cause fatalities. Brown teal holders often observe bathing immediately after water is changed.

With all ponds it is essential that birds, especially ducklings, have easy access out of the water. The sloping sides on concrete ponds provide plenty of grip for the birds, but on others, especially fibreglass ponds, platforms, branches, roosts and walkways must be added so that ducklings can exit the water.

Brown teal are also incredible dabblers, and will spend hours dabbling in a small area of mud. Therefore, the inclusion of a small dabbling pool which is shallow, muddy, with natural invertebrates is highly recommended as a way to keep the birds stimulated and in good condition.

3.2.2 Pond location

Ponds are best not located toward the front of a display aviary as the teal will be more reluctant to use them and viewing the birds will be more limited. A pond placed centrally, or towards the back of smaller aviaries will be more likely to be visited during the day if the birds feel more secure. Relaxed individuals will then even roost on rocks or logs provided in the water. (Islands and peninsulas are also favourite roost spots.)

3.2.3 'Natural' and artificial ponds

Ponds may be constructed within a natural substrate (e.g. clay or gravel bed) or using artificial materials.

'Natural' ponds support more plant and invertebrate life and are more aesthetically pleasing. However, they rely on a continual water flow to flush the system as regular cleaning/water changes are impractical, and unless anti-erosion structures are built into or around pond edges, ponds will enlarge, claiming land area. Natural ponds silt up quickly and thick blankets of filamentous algae can be hard to remove.

Artificial ponds tend to be smaller yet adequate in size, and are easy to clean/replace water. They offer less enrichment for the birds, and have less aesthetic appeal to viewing public.

3.2.4 Pond construction

Commercially produced plastic and fibre-glass ponds have been used successfully for brown teal. Large, naturally vegetated ponds lined with a heavy duty, yet flexible, PVC sheeting/geomembrane/butyl rubber liner can be used. If slippery materials (such as plastic sheeting or fibre-glass) are used, many access points will have to be created around the perimeter using logs, planks and/or rock platforms.

Concrete ponds tend to be more permanent and durable, eliminating most erosion problems and offering safer, non-slip pond access (especially important for ducklings). They also offer a hard substrate for the teal to toughen up soft feet and wear down lengthy toe-claws, but be aware that birds forced to ascend/descend steep, rough concrete pond rims to access/exit water may develop callouses on the soles of feet/toes.

Natural ponds need to have anti-erosion materials incorporated into the perimeters to preserve the edges. At the same time safe access in and out of the pond should be considered. Avoid using materials that create gaps and holes above or below the water level as these will present death traps to dabbling birds. Surrounding the pond with stone or gravel will keep water cleaner in smaller ponds; the birds will lose some of the mud on the gravel before entering the water.

3.2.5 Water source

Water may be sourced from a natural stream, river, or pond, a rain water storage facility, or a residential/town supply. Diverting water from a natural waterway is probably the most 'risky' of the three; the waterways may be subject to contamination with pollutants, seasonal fluctuations must be accounted for, and risks of predator access via connecting water bodies are increased. Stored rain water (dams/tanks) will be relatively free of pollutants, but again seasonal fluctuation will need to be monitored. Residential supply will be clean and unlimited, but costly. Utilising a combination of two or more of these sources should meet the demands.

Ideally, water supplying teal aviaries should not have been passed through other waterfowl aviaries as this will increase the potential for transferral of contaminants.

3.2.6 Static and moving water systems

Advantages and disadvantages of different water systems are outlined below:-

Static water system	Moving water system
<i>Advantages</i>	<i>Disadvantages</i>
Ponds designed for static water are easily	Natural ponds with moving water are more

cleaned.	difficult to clean.
No flooding; overflow facilities are not required.	Elaborate outflows (and overflows) are required to prevent flooding.
No water pumps required.	Pumps are required for recycling and/or transporting water (unless the supply is unlimited and ponds are gravity fed).
Artificial ponds are less likely to erode.	Moving water can create more erosion, particularly in natural ponds.
<i>Disadvantages</i>	<i>Advantages</i>
Ponds can only be constructed of artificial materials.	Ponds may be constructed of natural or artificial materials.
Ponds tend to be of a smaller size.	Ponds can be relatively large.
Water must be replaced regularly to prevent stagnation (particularly in hot weather).	Water is constantly flushing through, reducing stagnation and increasing aeration.
Still ponds have less aesthetic appeal.	Moving water has more aesthetic appeal.
Ponds will freeze in cold climates.*	Freezing is less likely to occur.*
No natural plant and invertebrate life can establish.	Plant and invertebrate life can establish in slow-flowing 'pockets'.

* In the event that ponds do freeze over, it is often better practice to either let ponds defrost naturally over the day (providing there is some available surface drinking water) or to break the entire iced pond surface. Creating a small hole in an otherwise solid sheet of ice can be a death trap to a duck that is suddenly disturbed and dives under the ice.

3.2.7 Outflow/overflow systems

Outflow pipes, positioned at the deepest point of the pond, should be bunged at the pond end in static systems to prevent heads/bodies getting stuck. A back-up bung or removable grid at the other end of the outlet will prevent entry of predators, particularly in the event that the internal bung is dislodged. Ponds with moving water require carefully designed, predator-proof outflow systems with overflow facilities. If the grid-covered weir system is not being used, some alternative designs for pipe outflows are illustrated in Figures 1 and 2. These designs were developed at the National Wildlife Centre to cater for heavily vegetated ponds with moving water systems. Figure 1 illustrates a design which allows for a gradual rise in water level should blocking occur. This system is used in most of the breeding aviaries where flooding (potentially of nest sites) must be avoided. Figure 2 shows an outflow cover which considerably reduces the incidence of blocking by floating pond vegetation; this system fails if sediment/sinking debris accumulates too rapidly on the floor of the pond and blocks the submerged outlet.

Figure 1a: Cross section of pond to show location of outflow/overflow pipe.

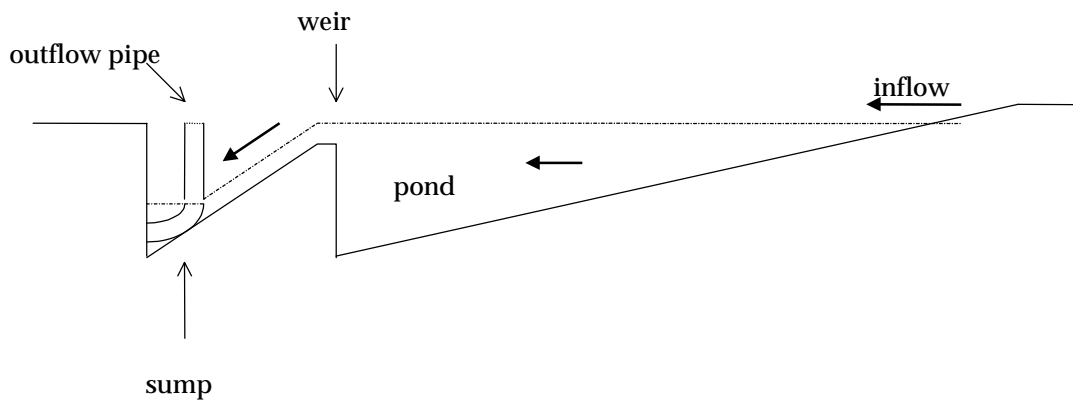


Figure 1b: Pond outflow pipe design with incorporated overflow modifications.

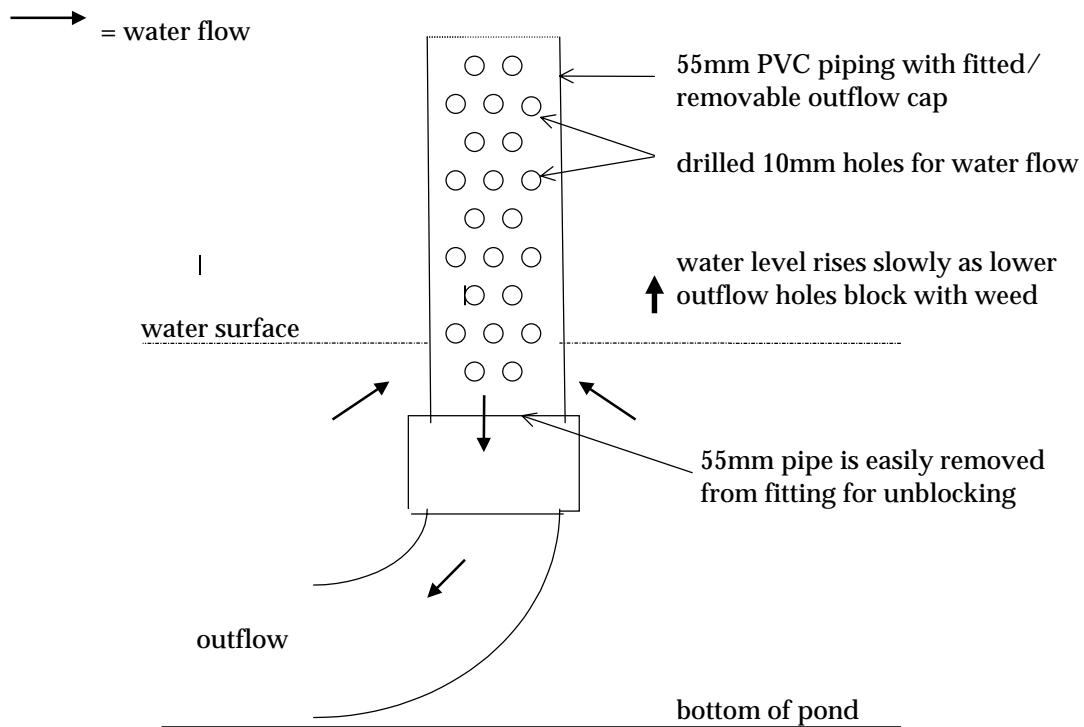
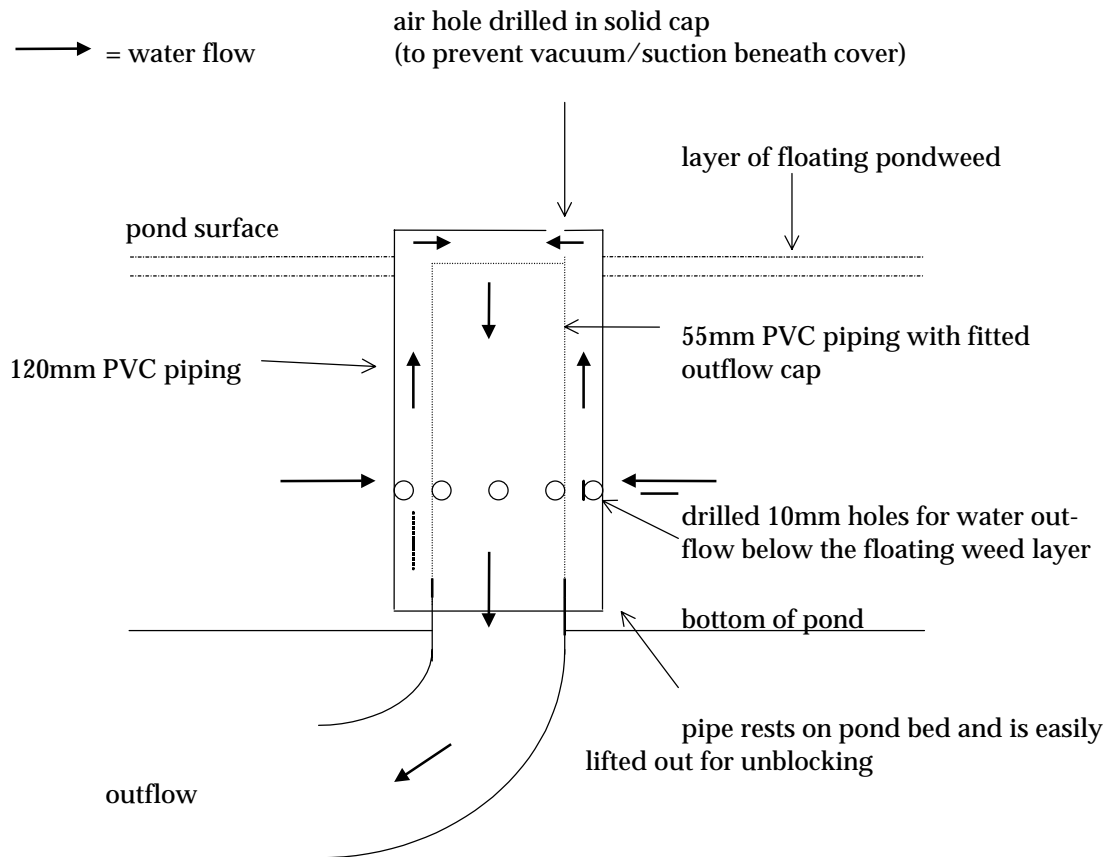


Figure 2: Pond outflow pipe design with surface pondweed excluding modification.



3.3 VEGETATION

3.3.1 Ground cover

Brown teal are very secretive and require plenty of ground cover for security, shelter from sun and adverse weather conditions, and nesting. The aviary can be filled with grasses, sedges and rushes; in this way the birds will use all areas within the confined space, vary their roosting spots, and have a good choice of nesting sites. It seems almost impossible to have too much cover for brown teal, and this also makes the aviary attractive for viewing public. If unplanted spaces are to be included (to improve viewing) it is beneficial to create a 'corridor' of plants within these spaces, and to the pond edge, as cover for birds when moving around the pen and accessing water.

To establish good ground cover before the birds are introduced to an aviary, rapid-growing vegetation should be planted in the early stages of aviary development; excessive growth can always be cut back later. Native species are attractive with good advocacy value. Because the teal can compact pathways between and around individual plants, suitable dense nesting spots may not always be available even though the pen may appear well planted. For this reason, it is helpful to plant in clumps of three or more specimens.

Flax, toetoe and other tall grasses are sometimes used but can become problematic when overgrown and, therefore, high maintenance. Teal, in particular ducklings, may get stuck between the strong bases of flax leaves.

Low-growing, woody/thorny shrubs (e.g. divaricating *Coprosma* spp.) should be avoided in waterfowl enclosures; they offer inappropriate cover as the birds' bands can be easily hooked on protruding branches. Tall shrubs and trees, if present, must be managed to ensure they do not exclude sunlight, or break the aviary mesh.

Plants (other than introduced grasses) which can be successfully used for ground cover:-

Latin Name	Common/Maori name	Family/Growth type	Origin
<i>Anemanthele lessoniana</i>	Wind grass	Grass	Native
<i>Chionochloa flavicans</i>	Lowland tussock/ dwarf toetoe	Grass	Native
<i>Chionochloa rubra</i>	Red tussock	Grass	Native
<i>Cortaderia toetoe</i>	Toetoe	Grass	Native
<i>Poa cita</i>	Silver tussock	Grass	Native
<i>Carex petriei</i>	-	Sedge	Native
<i>Carex secta</i>	Niggerhead/purei/ Makura	Sedge	Native
<i>Carex trifida</i> *	Mutton-bird sedge	Sedge	Native
<i>Cyperus ustulatus</i>	Giant umbrella sedge/ Toetoe upoko-tangata	Sedge	Native
<i>Phormium cookanum</i>	Mountain flax	Flax	Native
<i>Phormium tenax</i>	N.Z. flax	Flax	Native
<i>Blechnum discolor</i>	Crown fern/piupiu	Fern	Native

* A subantarctic and Chatham Islands species.

Protocols for provision of cover in aviaries holding wild-caught birds during transition into the captive environment are described under Translocation. Here, it is specified that aviaries must be densely planted with large *Carex*/tussock/grass so that at least $\frac{3}{4}$ of the aviary surface has dense cover.

3.3.2 Aquatic plants

Whether native or not, establishing aquatic vegetation, for all or even just part of the year, in ponds will hugely benefit captive teal. Plants will support a host of invertebrates that will be relished by adults and ducklings, and greenery (e.g. duckweed) is a valuable nutritional addition to the diet. The only drawback with supplying natural aquatic invertebrates is that many are intermediate hosts to parasites. Vegetated ponds are also visually more interesting.

Ideally, a pond should be composed of a shallow vegetated marginal area (this can be almost 'marshy' in larger pens) and a deeper clear water area (which may have floating vegetation only) for behavioural activity. Because brown teal tend to be held in pairs, vegetated ponds seem to withstand dabbling pressure. Plants will obviously do well in a naturally dug pond (and sediments are usually rich in invertebrates) but it is possible to establish pond vegetation in larger artificial ponds which have a moving water system. Plants such as water plantain and jointed rush (although not native) will form a mat across the bottom of the pond (even on plastic sheeting or concrete), reducing flow, trapping sediment and offering a substrate for other plants to grow in. The mat of roots will be home to many pond bottom dwellers. Seeds will fall into the pond and provide an extra dietary item. The plants can easily be lifted out and removed before they get out of hand.

Ponds that contain prolific quantities of duckweed also generally contain large populations of water snails. Filamentous algae is probably the least desirable weed as it forms a thick, fast-growing blanket in the pond, however it does support worms etc. in the ooze it forms on the

pond bed.

Birds in pens with ponds which contain a prolific supply of natural food have been found to be notably heavier than other birds, and take relatively less pellet food.

Aquatic plants that can be used are listed in the following table:-

Latin Name	Common name	Family/Growth type	Origin
<i>Alisma plantago-aquatica</i>	Water plantain	Emergent aquatic	Exotic
<i>Callitriche sp.</i>	-	Semi-aquatic	Exotic
<i>Eleocharis acuta</i>	Sharp spike-sedge	Leafless sedge	Native
<i>Juncus articulatus</i>	Jointed rush	Rush	Exotic/naturalised
<i>Juncus gregiflorus</i>	Common leafless rush	Rush	Native
<i>Lemna minor</i>	Duckweed	Free-floating aquatic	Exotic
<i>Mimulus guttatus</i>	Monkey musk	Emergent aquatic	Exotic
<i>Potamogeton cheesemanii</i>	Red pondweed	Floating aquatic	Native
<i>Rorippa nasturtium</i>	Watercress	Emergent aquatic	Native

3.4 SHELTER AND FURNISHINGS

If healthy plant cover is limited, cover in the form of branches/brush and shelters can be installed. Every effort must be made to replicate natural habitat conditions. Protocols for the provision of additional cover in aviaries holding wild-caught birds during transition into the captive environment are described under Translocation. Here, it is specified that shelters must be well spaced around the aviary with a minimum of one shelter per bird, ensuring that each bird has refuge in the event of social aggression.

Artificial shelters/roost boxes can be of any basic design but will be more likely to be used if they have double-end access, are low-lying and have low light penetration. Shelters will often be used by brooding females. Nest boxes are described under the section on breeding management.

Placing obstacles such as logs or rocks around the internal aviary perimeter (even under the cover) may help to reduce any incidences of pacing by birds. Furnishings and platforms can also be provided in and around the pond edges. The teal will loaf on these structures, strengthen climbing muscles, and even use them as take-off points for short bursts of flapping/flying.

3.5 FEEDING AREA

Feeding areas need to be relatively clean and dry (to reduce risk of decomposing food becoming a disease source), and free from overgrown vegetation. Feed stations need to be next to the pond, and within close proximity of the aviary door so that roosting/nesting areas are not disturbed. They should also be set at a comfortable distance from viewing public. Concrete ponds can incorporate a flat feeding platform to one side; in this way the feed area can be washed down into the pond when pond water is due to be changed. Alternatively food trays and food shelters can be placed on fine gravel (crusher dust) areas bordered with rocks, adjacent to ponds. By the time birds reach the food tray their feet are less muddy and wet. A feed pad of 1m² will enable extra shelters to be used, particularly if a pair breed and extra security is required for the young. (A large brood of ducklings will also make quite a mess.)

3.6 ADJACENT AVIARIES

There is good evidence that holding more than one pair of brown teal in neighbouring aviaries acts to stimulate all the birds to breed. But these need to be screened off with some kind of visual barrier (e.g. plywood) so that neighbouring pairs do not spend all their time threatening each other through the mesh, or wearing down their bills on netting during combat or pacing sessions. Barriers will also reduce mechanical damage to the lower mesh wall and reduce risks of small ducklings getting heads or feet stuck.

Solid visual barriers may be erected at least 500 mm in height from ground level around all perimeter walls (ideally >700 mm) . Care must be taken to ensure that birds are not able to climb or jump onto the top of a division. Sliding doors can be built into an aviary division, which can be useful.

3.7 AVIARY MAINTENANCE

Winter is a good time to perform rigorous checks of all aviaries to ensure they meet the predator-proof requirements. It is also important to check divisions for gaps that the birds themselves create; feuding neighbours can burrow under shallow, solid divisions and even burst through weak links in mesh divisions to get at each other.

Hand-weeding of enclosures can occur at available opportunities throughout the year to remove unsightly plants. Thistles should not be allowed to grow as they can cause foot injuries which may lead to infection. Feed station and outflow areas will need to be kept free of weeds and overgrowth. Keeping internal and external perimeters of enclosures free of vegetation allows for easy monitoring of interactions between birds of adjacent pens, and makes light work of predator-proof checks. Chemical sprays such as 'Interceptor' (organic – recommended) or 'Round-Up' (not organic – more caution required) can be used on stone areas within large pens. Dead weeds should be removed to avoid any risk of secondary poisoning, and also to prevent build up of *Aspergillus* spores; pens should be left for at least a week following treatment before returning birds. Hot water weed spraying can be effective in eliminating undesirable seed banks if necessary, but this method is only economical for facilities who may use the units on a larger scale.

Prior to the breeding season, enclosures should be carefully checked for hazards for ducklings and shelters/boxes should be cleaned.

3.8 PREDATOR AND PEST CONTROL MEASURES

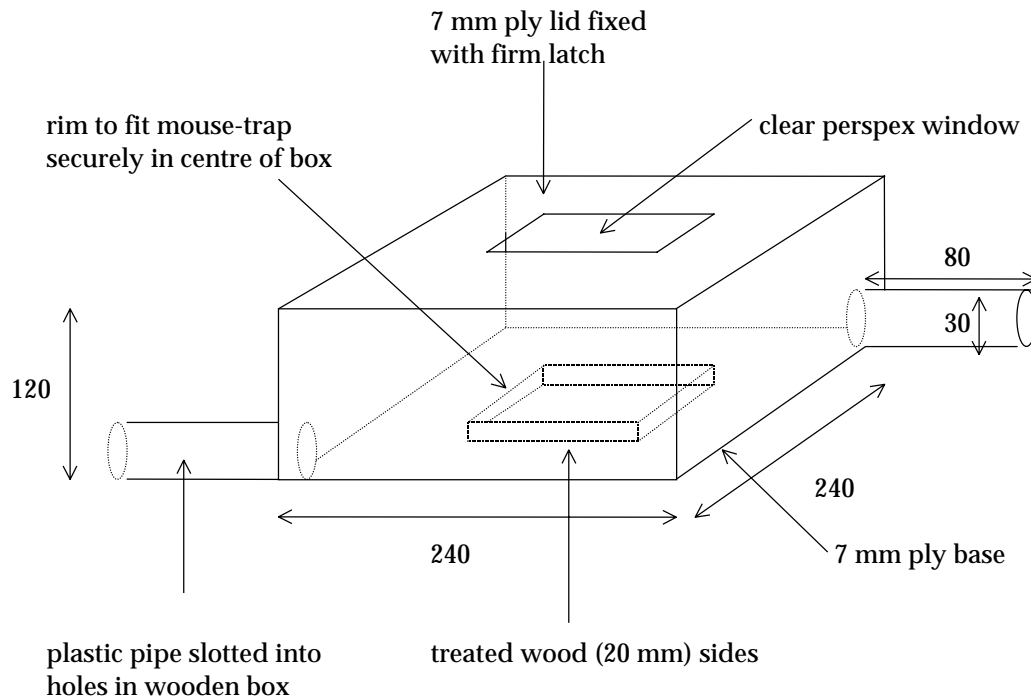
Well designed, constructed and regularly checked aviaries should remain fully predator-proof. Facilities with significant predator problems should install traps external to pens, in the vicinity of brown teal enclosures. Traps should not be placed in an aviary with teal as small females will be able to squeeze into trap boxes designed to catch rats and mustelids. If predator invasion is suspected, the teal should be moved immediately to another aviary.

Mice can be a real problem in large, densely vegetated aviaries. They can squeeze through the smallest of mesh sizes and rapidly take up residence in a teal aviary where places to nest and

food supply are abundant. Figure 3 illustrates a mouse-trap box design consisting of a secured trap in a wooden box, with access for mice via two or three mouse-width plastic pipes longer than the length of an adult teal's bill. The lid is fastened and contains a clear perspex window for viewing the trap to avoid having to open up the lid each day. The whole trap is weighted with a rock. As a precaution, these traps are removed from aviaries containing newly hatched ducklings.

Figure 3: Mouse-trap (teal-proof) box design.

(Measurements in mm.)



3.9 OPEN ENCLOSURES AND RETAINING BIRDS

Exhibiting brown teal on open ponds within well-maintained predator-proof (often with electric wire) open enclosures has been achieved with mixed success by some facilities. The benefits of keeping birds that are not involved in the captive breeding programme in this way are that they tend to display quite well on the open water during their active periods, as well as breeding successfully in a more 'natural' habitat.

However, there are some major drawbacks to consider with this housing method:

- Enclosures require a year-round predator-trapping and regime around the external perimeter of the enclosure for terrestrial predators.
- Aerial predation of teal by harrier-hawks is not controllable.
- The teal must be restricted in some way to prevent them flying out of the enclosure. This can be achieved by wing-clipping, as holders are being directed not to use the long-term option of pinioning with this species in New Zealand, although this is a temporary restriction option (refer Wing-clipping below)
- Restricted birds (through wing-clipping) must receive supplementary food year-round, at least twice per day; they usually have to compete with wild birds for their ration. Ensuring that broods of young receive enough food in these circumstances can be particularly

- tricky; adult duck proofed floating rafts can be used to provide food for just the ducklings.
- Ducklings would need to be captured before primaries are developed if they are to have any future role in captive management.
 - Only one pair of brown teal can be kept on an open pond due to their territorial nature. Other species of waterfowl will be vulnerable to the teal's aggressive behaviour.

3.9.1 Wing-clipping

Wing-clipping involves cutting the primaries on one wing so that birds can not fly until after the moult and new feathers have grown. Wing-clipping is a short-term retaining method only; birds need to be re-captured in a narrow timeframe towards the end of moult and just before the primaries are fully grown if they are to continue to stay in the open enclosure. Primaries cut too early in development can result in considerable blood loss.

3.9.2 Pinioning

Pinioning involves the permanent removal of one wing tip, a procedure usually performed at the duckling stage. Pinioning is not recommended by the Recovery Group for use on brown teal and is not considered best practice for this species due to the nature of the captive management programme. The procedure is, therefore, not covered in this manual.

4 Health Management

4.1 ENVIRONMENTAL HYGIENE

Like most waterfowl, brown teal will tolerate fairly foul and muddy conditions, but every effort should be made to provide a clean and hygienic environment at all times in order to prevent the build up of pathogens.

If pens are an adequate size with good planting, they tend to stay reasonably tidy as brown teal, with their aggressive nature, are generally not housed in flocks of more than two birds (with the exception of young family and juvenile groups, or flock-mating situations). Ideally a pen should be left to fallow between use; the longer the period the better.

Being aware of the different sources of disease is useful in husbandry hygiene regimes. Disinfecting agents can target different organisms e.g. 'Virkon', a good all-rounder, kills bacteria, viruses and fungal growth but remains ineffective to the spores (oocysts) of the protozoan *Coccidia*. The teal should be able to tolerate low levels of *Coccidia* in the environment

4.1.1 Soil and Vegetation

Turning over and periodically removing and replacing the topsoil (at least 50–100 mm depth) may be necessary, as the earth will become sour. This is particularly important in smaller aviaries, and in aviaries utilised during periods of quarantine. Most aviaries tend to have their hotspots where droppings are concentrated; with the teal these are usually roosting spots under shelters or favourite plants, and around the internal perimeters of pens or on top of high vantage points where birds spend much time at night. Removing soil may also help to reduce

loads of direct life-cycle parasites.

Regular relocation of shelters will prevent birds sitting amongst faeces and allow the rain and sunshine to freshen up dry, stale areas of soil, although it is preferable to remove such build-ups from the aviary. Many keepers of waterfowl freshen up the soil with a regular dosing of garden lime when aviaries are empty of birds.

It may be necessary to remove some dying plant material at the end of the summer to prevent a build-up of rotting vegetation on the ground. This will really depend on the choice of plants and the location/conditions of the pen (dampness, light, airflow, climate etc.).

4.1.2 Ponds

Water supplying teal aviaries should be from an uncontaminated source which has not been used in other species aviaries.

Small, artificial ponds, with no established vegetation, need to be scrubbed clean on a regular basis to prevent a build up of algae and faeces in the water. Ideally, water should be replaced at least once per week; during summer months this will need to be more frequent.

Naturally vegetated ponds are not easy to clean out on a regular basis but this is usually compensated by the fact that these ponds tend to have a constant flow of fresh water through them. Some aquatic plants also act as natural filters. However, when sediment layers become too deep on the bottom, the pond should be completely cleaned out. This may only be necessary every few years.

4.1.3 Pest Control

Mice need to be controlled year round or they can pose a threat to the teal by bringing in disease, eating much of their food or storing pellets around the pen in food caches. Trapping efforts should be focused around the feed station area and care must be taken to ensure all mouse-trap boxes are completely teal-proof, even if blown or tipped over. The mouse-trap boxes ideally need regular disinfecting.

4.1.4 Shelters

Wooden roost shelters should be removed from the aviary at least once per year and thoroughly disinfected. Cleaning may need to occur more frequently depending on their use by the birds. A good time to do this is just before the start of the breeding season, or whenever a pen is emptied of birds.

4.2 HEALTH ASSESSMENT

Birds are often at an acute stage of ill health by the time they are observed to be unwell. Daily observation of each bird during routine chores is the best health control measure. Picking up on abnormal behaviour or appearance in the early stages of sickness provides more time to diagnose and treat a bird. Such treatment will be most effective when the symptoms are less advanced. Weighing birds whenever they are handled will help to build up a picture of normal weight ranges and fluctuations.

Most common visual signs of ill health are:

- Difficulty breathing (open bill)
- Fluffed feathers
- Lethargy
- Poor appetite
- Abnormal faeces
- Drooping tail and wings
- Hiding behaviour
- Abnormal eyes (e.g. shut, sunken, inflamed or weeping).

These symptoms are usually typical of a whole host of ailments.

The following procedures are recommended by Liz Lee of Massey University (Lee 1998) for assessing the health of an individual. A distant inspection should be carried out before an unwell bird is physically examined.

4.2.1 Distant inspection

Locomotive/nervous system

Are there signs of abnormal head movements, wing droops, and altered levels of consciousness? Check for the following:

- fluffed up plumage, eyes closed, low attention level;
- drooping wings, inability to support weight on legs, unbalanced stance, lameness;
- weakness of neck;
- rhythmic movements of the head.

Respiratory system

Problems here may be caused indirectly, e.g. abdominal swellings may reduce air sac space, or low red blood cell counts will affect oxygen uptake. Check the following:

- swelling around the eyes, could indicate problem with sinuses etc.;
- voice change, cough, rattle;
- discharge from nostrils, could be seen as a stain, or wet head from discharge;
- normal sternum movement during breathing, shallow breathing is normal, rapid breathing is not necessarily serious;
- dyspnoea, rapid deep movement, more serious;
- severe dyspnoea involves cloacal movement, serious.

Loss of symmetry

Observe for abnormal swellings, checking sides, front, and back. Check eyes, wings, stance, gait, chest wall mass etc.

Plumage

Observe feathers for ageing, state of wear, damage, state of moult, loss of symmetry, changes in water proofing (bird will sit low in the water). Check the following:

- contour feathers for waterproofing;
- down feathers for insulation;
- feather damage, shaft weakness; retention of feather shafts can indicate severe stress;
- dampness, matting or discoloration due to blood staining;
- stress lines and colour, indicating stress during feather formation; provides retrospective information about nutritional or breeding stress;
- stage of the moult.

Discharges

Regurgitation can cause staining on the head owing to flicking. Check nostrils and droppings for abnormal secretions.

Abnormal noises

Check for change of voice or changed time of vocalising. Coughing and wheezing can be subtle (night time, in the dark, is the best time to listen).

Faecal consistency/colour

Sick birds' droppings change very quickly. Check them for:

- consistency (dependent on diet);
- presence of normal fractions;
- quantity, number per day indicates appetite;
- green discoloration, e.g. anorexic birds;
- undigested food items, e.g. grain.

4.2.2 Physical examination

Body weight

- Weigh bird;
- palpate the keel for prominence.

Assess nutritional condition using scoring system of 1–5 (1 = keel sharp; 5 = keel covered to the point of obesity).

Head

Check head region, including eyes, ears and cere, for:

- bright, clear eye, responsive to movement;
- reflex of third eyelid (birds 'blink' on reflex using this protective membrane – it moves across the eye away from the bill);
- rhythmic movements of head or eyes;
- discharges from ears (these may not be obvious)

Bill

Check bill region, including nostrils and oral cavity (using cloth strip to open mandibles to avoid damage), for:

- damage, abnormal growth or colour, leathery appearance of bill;
- discharge from nostrils;
- signs of regurgitation (vomiting is not common, so look for soiled feathers on head);
- mucus strings in oral cavity (should be dry);
- swellings or blockages on palate slit (access to the respiratory system);
- colour of lining (should be quite pink with papillae noticeable);
- foreign bodies under tongue.

Body general

- palpate neck and crop wall;
- spread wings and examine feathers;
- check under wings for parasites, wounds etc.;
- flex and extend wings assessing passive wing movements, evaluating pull back strength;
- palpate along wing and leg bones;
- assess passive leg movements, looking for strength and contour, swelling over joints;

- check feet for lesions or injury;
- check preen gland and overall plumage condition;
- check colour of ventral skin;
- examine cloaca for blockage, discharge, swelling etc.;
- feel abdomen for unusual swelling.

4.3 DIAGNOSIS AND TREATMENT

If any symptoms or abnormalities are observed the following measures should be taken towards diagnosis (in addition to distant inspection and physical examination) and treatment:

- Inspect the aviary for any signs of physical aggression between birds, e.g. dropped feathers.
- Collect a faecal sample for parasitology tests.
- Collect either a fresh, uncontaminated faecal sample or take a cloacal swab for microbiology examination. (Microbiology test results take several days and can not be relied on for immediate diagnosis, but may be useful to confirm or dispute a diagnosis.)
- If necessary, isolate the individual by removing other aviary companions. It is important, where possible, to leave the sick bird in an environment/aviary it is familiar with. In non-contagious situations, it may be advantageous to leave a companion or mate with the sick bird as the stress of separation can also cause a rapid decline in health. However, in most circumstances it is advisable to isolate the sick individual allowing drug treatment regimes to occur via food and an accurate assessment of food intake to be made. Competition and conflict can be avoided this way.
- Veterinary advice should be sought immediately. (The keeper may feel confident with diagnosis and treatment of a commonly occurring, minor ailment, however, it is still worth informing the regular veterinarian to keep him updated on the health of the stock and give him/her an opportunity to report any recent progress with medical treatments.) Swabs for culturing may be required to assist diagnosis or help identify the most suitable treatment. A variety of treatments may be necessary to cover all bases if diagnosis is unconfirmed. Discussing past treatment procedures with the Captive Management Co-ordinator may also be helpful.
- Consider treating the bird for parasitic worms to eliminate this additional health challenge; the veterinarian should be consulted if using other drugs as well.
- A bird with severe symptoms will require moving to an indoor facility where it can be provided with warmth, quiet and darkness in order to stabilise the condition.

4.4 ISOLATION AND REHABILITATION

Sick or injured teal showing severe symptoms require isolation in a dry, warm, quiet environment where they can be treated and rehabilitated. Dehydration and/or shock may need to be controlled with oral or subcutaneous fluids as directed by the veterinarian.

Ideally the bird needs to be confined in a small area with good ambient warmth throughout. An indoor brooder can be useful for this purpose. Allowing the teal access to water in which to bathe depends a lot on the ailment, but generally a bird that needs confining in this way is probably not fit enough to cope with bathing unless there is an additional warmth source. A bird that can actively bathe and preen will benefit from maintaining an active preen gland and keeping plumage in good condition, particularly during lengthy isolation. This water will need to be changed daily.

Darkness helps to calm the bird and, being a nocturnal species, should not effect their ability to feed. In fact, the teal are more likely to feed in the dark than many other species. Dull emitters, or ceramic bulbs are useful for providing the warmth (up to 30°C for a very debilitated bird). A roost box may serve to further calm the bird but be aware that this can shield out necessary warmth.

A fully recovered bird is ready to return outdoors when it no longer requires additional warmth, and has had access to water to ensure plumage is waterproof. It may be necessary to house the bird in a small rehabilitation pen before returning it to the main enclosure.

4.5 KNOWN HEALTH ISSUES

Brown teal are susceptible to a range of health problems, most are a result of acute stress coupled with disease. Diseases/parasites to be particularly aware of in this species are the following:

- Botulism
- Aspergillosis
- Avian tuberculosis
- Visceral gout
- Tapeworm.

As the captive population expands, the variety and frequency of ailments encountered will almost certainly increase; however, high standards of avicultural practice and provision of a stress-free environment should keep most at bay.

4.5.1 Stress

Stress indirectly accounts for a majority of deaths amongst captive birds. It renders them susceptible to pathogenic levels of common organisms. Stress can be induced by unsuitable environmental conditions, poor nutrition, social conflict or isolation, disturbance, existing health problems or increased physiological demands.

Apart from any obvious symptoms of ill health, signs that may indicate a teal is stressed include untouched daily rations of food, and sometimes either a reluctance to accept live food or a frantic interest in live food whilst pellets remain uneaten. Birds may spend the majority of time in hiding; this is particularly apparent during periods of moult. Erosion of substrate in particular areas in the pen, usually around the perimeters and next to pen divisions, is a result of pacing. The majority of pacing occurs at night when the teal are most active and can be overlooked as a significant behavioural activity in captivity because it is not seen during the working day.

Significant stress factors identified in the captive management of brown teal can be avoided by:

- housing birds in adequate sized pens (see specifications under housing requirements);
- providing plenty of ground cover for security;
- forward planning of bird movements along with consideration of territory ownership and social ranking of birds when choosing pens to house specific individuals;
- considering occupants of adjacent pens. Breaking long-term partner or parental bonds is

easier for both parties if visual and vocal contact is prevented and they are separated by reasonable distance. Highly territorial males held as neighbours may need to be separated by an empty aviary or by a pen of females;

- holding birds in single or mixed sex pairs where possible rather than alone;
- appreciating the demands of egg production on females and limiting the opportunity for more than two clutches to be laid;
- separating early season progeny from parents (if it is likely a second clutch will be produced) before paternal aggression develops;
- breaking up mixed sex juvenile flocks before winter as the hierarchy develops.

4.5.2 Disease

Historically, there has been no disease outbreak amongst captive brown teal and no significant outbreaks amongst captive waterfowl in general in New Zealand (with the exception of botulism). Waterfowl are identified as a significant vector of serious exotic diseases such as avian influenza and Newcastle's disease (velogenic avian paramyxovirus I) through migration. The brown teal recovery program is one of the most active in New Zealand in terms of transfer of ducks from captivity to the wild. Captive brown teal are often housed in close proximity to wild waterfowl.

Recent baseline data has been collected from wild and captive populations of brown teal in 2002 via a MAF surveillance study, providing information on the prevalence of specific pathogens in these populations which can be used to guide DOC in their assessment of disease risks relating to the movement of waterfowl within the country (Jakob-Hoff 2002).

The origin of disease can be bacterial, viral, fungal, protozoan or parasitic and diagnosis of captive birds must be made by a veterinarian in order to prescribe the correct treatment and assess contagiousness.

Respiratory ailments

It is worth focusing on respiratory ailments as these are often associated with symptoms that can (and some have been) observed in the teal, such as laboured breathing (deeper breathing can be a sign of more serious problems rather than the shallow, rapid breathing caused by stress), mucus or fluids appearing from the nasal passages, gaping and head-shaking, inability to vocalise, wheezing or the sound of mucus in the upper and/or lower respiratory tract or other abnormal sounds during in- or exhalation.

On encountering a bird with minor symptoms, such as a mild bout of rales (rattling sound in the airway), and otherwise normal good health and appetite, a course of wormer can be given to eliminate potential gapeworm. During and following the course, the condition can be further assessed and if symptoms are persistent and/or increasing in severity, other treatments must be used. Consult a veterinarian who may take a swab for diagnosis or inspect for lesions or other clinical signs in the oral cavity. Appropriate antibiotics are sometimes used for this condition where considered necessary. Where possible administer drugs in food to avoid repeated capture for lengthy drug courses. Severe cases will require direct oral dosing.

A significant respiratory fungal disease in aviculture is aspergillosis, occurring world wide and typically infecting young, low resistance and stressed birds. Diagnosis is not easy in the live bird but can be made on pathological examination. This is important as, although aspergillosis is not regarded as infectious from bird to bird, it is acquired from the environment and can be an indication that an unsatisfactory level of fungal spores is present in

the teals' captive environment which could be inhaled by other birds. These thrive in humid, warm, unventilated areas particularly in decaying vegetation or waste food material; such sources must be removed. Exposure to large numbers of spores overwhelms the host defences and usually results in chronic, untreatable illness. (Immuno-compromised birds are vulnerable to 'normal' environmental levels.) Aspergillosis of the lower respiratory tract is the most common (and most serious) and although respiratory distress is apparent, it is not necessarily easy to detect any unusual sounds in the airway.

4.5.3 Parasites

Captive brown teal have been known to carry endoparasitic loadings of principally tapeworm (*Cestode*), with round worm (*Ascarid*) and eggs of hair worm (*Capillarid*) and *Strongylid* type detected in very small numbers at laboratory faecal examination. Presence of gapeworm has been suspected but never confirmed. Ingestion of aquatic invertebrates that play intermediate host to some of these parasites is the likely source of infection. Worms that parasitise the teal are unlikely to be host specific within the waterfowl family. Once present in the enclosure habitat/water system, it is virtually impossible to remove them or break the cycle. However, as these parasites are not considered to pose a severe pathological threat to the teal, and generally most wild waterfowl carry such loadings, the benefits of supplying natural food to healthy birds outweigh the risks. However, heavy loadings can compromise the immune system if a bird suffers from another ailment or severe stress. It is therefore advisable to treat any individuals in a poor state of health (this may include birds showing symptoms such as diarrhoea) or birds that are going to be subjected to high stress levels. It is important to note that available treatments do not target all worm species and a combination of drugs may be required. Routine treatment or strategic drenching may be suitable for some holders.

Tapeworms (Cestodes)

Most species of tapeworms penetrate the intestinal walls of their avian host. They may be discovered as either mature tapeworms on visual examination of the cloaca, as segments of mature worms on the substrate (i.e. passed through faeces) or as eggs present in faeces that are detectable by microscopic examination. Mature tapeworms have been found in one month old parent-reared ducklings proving that they can be infected at a very early age, perhaps as soon as feeding. They have been found to be prolific in juveniles with counts of as many as 10 mature tapeworms emerging from a single bird's vent. Severe infestations may result in diarrhoea.

NB Faecal examination will only indicate presence of tapeworms if eggs or segments are shed in those particular faeces (i.e. a mature worm may be present but faeces may show a negative count). Faecal counts are, therefore, not a reliable method of detecting their presence or abundance.

Treatment for tapeworms is effected by the drug Praziquantal which is not present in some of the general wormers such as 'Ivomec'. Praziquantal can be obtained in tablet form under various trade names such as 'Vetcare Tapeworm' and 'Droncit'. The dose rate for teal is 10 mg/kg, although the National Wildlife Centre use a 20 mg/kg dose. It is possible to get 'Vetcare' tablets that contain 50mg Praziquantal. As a guide, a 500g adult teal requires at least 10mg of Praziquantal (20mg is administered as one fifth of a 'Vetcare Tapeworm' tablet). As this is not soluble it has to be given directly and orally to ensure the complete dose is received. Blunt ended tweezers are useful for this procedure. A second follow-up dose can be administered 10–14 days later.

Other worms (Nematodes)

Faecal sampling can be useful to detect presence of other species such as round worms, but again egg numbers are difficult to correlate with the extent of an infestation. Round worms (*Ascarids*) can inhabit the intestine or caeca and hair (or thread) worms (*Capillaria*) live in the intestine; both have a direct life cycle. Proventricular and gizzard worms have an intermediate host stage and have yet to be found in the teal. The intermediate host for gape worm is the earthworm; symptoms here are a sneezing cough, gaping and shaking the head. These can all be effectively treated with Ivermectin which is present in 'Ivomec'. The dose rate for teal is 0.25ml 'Ivomec'/kg. As a guide, a 500g adult teal requires a 0.125ml dose which is directly administered via crop needle. Water can be added to this to help dilute the bitterness. (Be aware of the volume of the crop needle during dosing if diluting the dose.) A second follow-up dose can be administered 10–14 days later.

External parasites

Mites and lice have never been found on brown teal but should be inspected for, particularly during quarantine or if a bird's plumage is looking in particularly poor condition with signs of broken feathers. A generous dusting of either red mite powder for mites or 'Fleatrol' powder (with 1% permethrin) for lice should remove these arthropods.

4.5.4 Injury

Legs and feet

Injuries of adult teal are generally associated with the extremities; most have been of feet or legs as a result of colour band problems. These can be open wounds or even dislocations if a struggling bird's band is hooked by a piece of vegetation. With very young ducklings, misadventures often result in death for obvious reasons. Certain types of woody divaricating shrubs in enclosures have been linked to serious incidences of adult leg injury in the past.

Minor grazes and even broken toe claws can be dusted with 'Aureomycin' powder, but this will wash off fairly quickly when the duck returns to water. So, it pays to be cautious with anything larger or deeper and administer a course of antibiotics.

A severely dislocated leg of another teal species has been successfully corrected at the National Wildlife Centre under veterinary guidance. An X-ray revealed no breaks or fractures. The teal was confined to an indoor brooder (1500 mm x 700 mm) for less than a month with leg bandaged (splinted) to body to return the out-turned leg to a normal position. 'Flexus' cohesive support bandaging is excellent for use on waterfowl as it sticks to itself only and not to feathers, is water repellent and can be replaced easily. Wings were left free for balance. Mobility of the leg was partially restored at 11 days. The foot, curled up and non-functional, was splinted with a flat, light-weight splint and the whole leg re-bandaged to the body. All splints and bandages were removed after a further nine days. Physiotherapy was then required before the bird could be returned to an outdoor enclosure. One hour of swimming in a water bath (the same brooder filled with water and containing only one rock to perch on) forced the teal to exercise the leg and strengthen muscles. This was repeated twice a day for several days. The bird was returned outside, 23 days following the injury.

Head and bill

Wounds to the head can be a result of aggressive encounters between birds. Such injuries usually take the form of an exposed area of raw skin on the nape region of the victim. In extreme cases blood can be drawn. 'Aureomycin' powder can be used to dust on minor

abrasions but severe wounds may require treatment with a course of antibiotics, even as a precautionary measure.

Rough edges at pen boundaries should be removed; active, ground-dwelling teal spend much time patrolling these areas and this can result in the wearing down of certain extremities such as the tip or side of the bill, or injury to the eyes.

4.5.5 Egg-binding

Egg-binding is not common, but is most likely to occur in older birds, birds which have either inadequate nutrition (including calcium deficiency) or by contrast are obese, as well as over-productive females. Breeding birds should have access to additional sources of calcium during the nesting period (e.g. shell grit).

Knowledge of the laying cycle of this species and early detection of the nesting site may help to find females before the condition has got to the peritonitis stage. Birds visually 'heavy' with an egg that show abnormal weakness, or have difficulty in walking and are days late in laying will need attention.

Egg-bound females require warmth and humidity, peace and darkness to pass the egg and, importantly, gentle handling. The veterinarian may administer extra calcium which is required for oviduct contraction. Lubrication of the cloaca may also be necessary.

4.6 DEATH AND POST MORTEM EXAMINATION

4.6.1 Protocols for necropsy of adults/ducklings

Pathological examination of brown teal following death offers the opportunity to :

- determine the cause of death and identify if the cause is contagious;
- identify any sub-clinical conditions or obvious nutrient deficiencies;
- gather previously unrecorded information on the effect of pathogens and parasites on this native species as well as obtaining baseline information.

For these reasons, it is desirable for a full pathological examination to be performed on all dead teal by an experienced pathologist, and all associated data to be entered into the Wildlife Mortality Database (HUIA), currently in development as a partnership between DOC and Massey University, which collates information on native wildlife mortality.

It is recommended that dead specimens be sent to:

The Wildlife Resident/Pathologist
Institute of Veterinary, Animal and Biomedical Sciences (IVABS)
Massey University
Tennant Drive
Palmerston North
Ph: 06 3569099 (ext. 7016) or 06 3504048 (Fx: 06 3505636)

Some facilities will have in-house veterinarians who can perform the necropsy, but these must remember to submit their findings to HUIA and/or the Captive Management Co-ordinator. If there is no such pathologist available to perform the *post mortem* examination within the timeframes stated below, a veterinarian or person experienced in preparation for necropsy should collect relevant samples and preserve the corpse ready for when the pathologist is

available (preparation could occur at Massey if arranged).

In the event of death, certain procedures should be followed:

- Record when, where and how the bird was found
- Check for evidence of predators and on the well-being of other birds in the aviary.
- Weigh bird (noting whether water-logged) and record band identification.
- Refrigerate the dead bird in a plastic, sealed bag. DO NOT FREEZE as this will alter tissue structure and may make diagnosis impossible. If an adult teal is still warm, the cooling process can be speeded up by placing the corpse briefly (around 5 to 10 minutes) in the freezer before placing it in the refrigerator. This helps to slow down the decomposition process as rapidly as possible.
- Complete a Pateke Death Record form (refer Appendices). Note that this form is the universal certificate used for both wild and captive post mortem examinations: some of the prompt boxes (e.g. tx channel) will not apply in some situations. Three copies of the form should be made for:
 - i) the pathologist (to accompany the submitted specimen whether fresh or preserved);
 - ii) the Captive Management Co-ordinator;
 - iii) your in-house records.
- Notify the pathologist by phone or fax to determine if he/she is available to receive the bird and perform an examination WITHIN 24 to 48 hours

If the pathologist is available:

- Pack the body in a chilli-bin along with an ice-pack (several ice-packs may be required for larger specimens in the summer months) taking care that the ice-packs are wrapped in newspaper and not able to freeze the specimen. This is particularly important to remember when sending small ducklings.
- Courier the body, as soon as possible, to the pathologist with all relevant information.

If the pathologist is not available (public holidays etc.), the corpse can be kept for up to four days in refrigeration before being placed in the freezer, with appropriate labelling, for sending as soon as practical. Note that once a specimen is frozen, pathology examination can be inconclusive due to tissue breakdown on defrosting and inability to culture micro-organisms.

Preservation of corpses using Formalin is now discouraged unless facilities are fully equipped to safely deal with this dangerous chemical. Courier companies are also reluctant to transport such packages.

4.6.2 Protocols for Necropsy of Eggs

Necropsy of non-viable eggs provides the opportunity to:

- determine fertility, particularly useful for first-time breeders or new pairings (fertilisation can be detected with experience even if the egg has not been incubated);
- identify age of embryo (stage of incubation) when death occurred;
- identify potential abnormalities in the embryo.

This may be performed 'in-house', or by an experienced pathologist if a more detailed assessment is required.

If decomposition of egg contents is well advanced (i.e. during hot weather), examination for any of the above will be inconclusive, although it can still be worth having a look.

Necropsy of eggs will generally not be able to identify reasons for embryo abnormality or

death.

5 Nutrition and Feeding Standards

5.1 NATURAL DIET

Brown teal are very much opportunistic feeders taking mainly animal matter in the form of terrestrial, freshwater and often marine invertebrates, but also plant material such as clover, or aquatic vegetation. They will obtain their food by probing in damp soil, sand and decaying vegetation, dabbling in water (particularly at water margins or amongst vegetation) and upending, and occasionally diving in shallow water.

5.2 ADULT CAPTIVE DIET AND SUPPLEMENTS

5.2.1 Pellets

Although brown teal can be maintained in captivity on a commercially produced 'Hi-lay' poultry pellet as used with other captive dabbling ducks, it is recommended that the 'Teal Diet' formulated at the Feed Processing Mills, Massey University, Palmerston North (now produced by Unifeeds Ltd.) is used for this species. The pellets contain all the nutrients required to maintain adult birds in good condition throughout the year.

The maintenance pellet contains the following ingredients: vitamins and minerals, barley, maize, malt culms, broil, soybean, meat meal, limestone, salt and s/methionine. A breakdown of the availability of the major nutrient requirements is compared to the breeding and rearing diets under Nutrient Composition of Formulated Diets.

Pellets can come in various sizes. The largest size the teal can cope with is one that is up to 10mm long with a diameter of 3-4 mm. However, a smaller pellet will be much easier for them to manage.

It is recommended that teal are fed no more than a quarter of a cup of pellets (or handful) per bird per day (half a cup per pair per day). If they are fed larger rations than this, and also have access to natural supplementary food, they have a tendency to put on a lot of weight. (Some wild-caught teal can almost double their capture weights.) An empty dish the following morning does not necessarily mean the bird is still hungry (although the bird's behaviour will tell you if this is the case), it may be just the right amount. Ideally, there should be just a scattering of pellets left.

Obviously the amount fed out depends on the condition of the individual, as well as the holding management for each bird. Teal kept in small pens with little or no natural food are reliant on the pelleted rations for daily health. Birds that are stressed, or exhibit frequent pacing behaviour (and much of this happens at night) may require a slightly larger ration. Birds housed in pairs or groups may be taking more or less than their aviary companions; this is where monitoring for compatibility of birds is so important. However, if in any doubt, it is always more prudent to offer more, rather than less food in these situations as well as providing more than one feed station.

Weather conditions can also effect the quantity of pellets taken by the teal. Birds may be hungrier in periods of very cold weather, and less so in mild conditions.

Moulting birds should not require any larger rations than usual; the dietary balance in the pellet should meet their nutritional demands.

It is good practice to weigh birds at all available opportunities, or if there is any concern over amount of pellets being fed. As a rule, adult males should weigh no more than 750g, and females no more than 650g. (There have been breeding birds heavier than this, but these kind of weights far exceed those of any wild birds and are generally considered undesirable). Be aware of fluctuations: experience shows us that a teal can quite easily put on 20–25% of it's body weight in just two weeks, or lose 10% of it's body weight in just 48 hours in stressful circumstances.

5.2.2 Grit

Grit is an essential part of the diet and should be available at all times. Outside the breeding season, a granite grit or a fine river sand can be sprinkled in shallow water or near the feed station on the ground. During the breeding season, it is usual practice to supply a shell grit (similar to that used with poultry) which not only fulfils the function of aiding digestion by breaking up fibrous food, but also provides the females with an additional source of calcium.

5.2.3 Supplementary live food

Offering live food to the teal serves to:

- provide additional natural nutrition;
- provide captive birds with stimulation and environmental enrichment;
- provide the keeper with a reliable opportunity to visually check birds that are normally hiding during the day. (The feeding of a favourite live food item, if carried out on a routine basis, is a valuable 'management tool' and can be used in combination with a call or whistle by the keeper.)

Ideally, natural insects and aquatic invertebrates should be encouraged in aviaries through appropriate aviary design and management. Important to note is that some aquatic invertebrates, deliberately introduced or finding their way into aviaries via the water system, are intermediate hosts of certain parasites that may eventually be passed onto the birds.

If this is not possible, most captive facilities will use commercially produced items; the two most commonly used for brown teal are mealworms (*Tenebrio* larvae) and red earthworms (*Lumbricus rubellus*), both much relished. (NB The tiger worm variety are not favoured by most aviculturists as they exude a non-palatable chemical.)

5.2.4 Supplementary greens

Offering fresh 'greens' to the teal serves to:

- provide additional natural nutrition;
- provide captive birds with stimulation and environmental enrichment;
- natural aquatic vegetation, growing freely in pens, will support invertebrate communities.

Most breeders of brown teal supplement the diet with green, leafy vegetables (e.g. lettuce,

silverbeet), chopped grass and/or duckweed (*Lemna minor*). Providing natural plant material for birds to dabble in is easy, and even untouched food presents no real hygiene issues; it is simply removed when the pond water is changed.

5.3 SEASONAL VARIATION IN FEEDING REQUIREMENTS

The maintenance diet, used for 6–7 months of the year, should have been replaced with a breeder diet by late winter/early spring, which is fed to all birds (breeding and non-breeding) for 5–6 months of the year. As a guide, breeder diet should be offered around 4–6 weeks prior to the first expected laying dates. The timing of the breeding season may vary from north to south throughout New Zealand and between breeders. Brown teal can lay as early as July, so the change to breeder pellet can occur as early as June. Birds can be changed back to the maintenance diet when the last of the breeders are rearing young

The breeder pellet contains substantially more of particular vitamins, additional calcium and phosphorus, and a higher level of protein and fat. It contains the same ingredients as the maintenance pellet with the addition of bloodmeal.

The provision of shell grit throughout the breeding season allows the females to increase calcium reserves by choice.

The availability of a good quality diet is considered a permissive rather than stimulating factor in breeding. However, a nutritional trigger for captive pairs, in particular for first-time breeders, in the form of increased quantities of supplementary live food a few weeks before the first laying dates, could prove beneficial. (Such quantities should not prevent the birds from eating the balanced pellet diet.)

5.4 STORAGE OF FOOD

5.4.1 Storing pellets

Pellet sacks should display a manufacturing date as well as shelf-life. Generally they should not be kept for more than 6–8 weeks. Sacks should be placed in a clean, airy room, free of vermin, preferably on pallets off the ground. A darkened room is better as certain vitamins break down quickly under light conditions. Opened sacks should be emptied into a storage bin with lid.

5.4.2 Invertebrate care

Care must be taken to ensure live food cultures are regularly cleaned and provided with the appropriate fresh food. Healthy insects and worms are nutritionally more beneficial and safer for the birds than those that are neglected. Mealworms require fresh bran changes and regular removal and replacement of vegetable matter. Earthworms kept in a cool, permanently lightened room will stay in an aerated box of moist soil and leaf-litter. If obtaining earthworms from a commercial producer, ensure the medium they are grown in is 'safe' and if in any doubt regarding it's origin, rinse the worms in water before feeding out.

5.5 PRESENTATION OF FOOD

5.5.1 Pellets

The daily ration of pellets should be placed in a strong plastic or rust-proof metal dish preferably of a type that birds will not walk through, so reducing mess and keeping food clean and dry. Placing the dish on a large, strong plastic or rust-proof metal tray will catch the majority of wasted food. Avoid wooden dishes and trays as these are harder to keep hygienic, requiring more frequent disinfecting.

The feed tray should be placed under a heavy, stable shelter to keep out the rain, and the whole feed station (shelter, tray and dish) positioned in close proximity of the pond – the pellets are dry and birds need to drink regularly when feeding – on a flat, clear surface such as a concrete or gravel pad. Feed stations set in muddy areas require more regular cleaning, dense vegetation close to the tray can hide spilt pellets which results in a build up of bacteria and mould, and trays set on uneven ground offer a perfect refuge for mice (should they inhabit the aviaries).

All pellets remaining from the previous day should be removed and replaced. Pellets absorb the atmospheric humidity and soon become a breeding ground for harmful micro-organisms. Ideally, dishes should be replaced each day, or at least twice a week. If rinsing dishes in the aviary, do so near a water outflow, take all traces of wet pellets out of the enclosure, and ensure bowls are dry before adding fresh pellets. Dishes and trays should be routinely disinfected.

5.5.2 Live food

Presenting live food in a routine manner can be an extremely useful management tool to:

- sight each bird with minimal disturbance;
- check on the compatibility of birds held together;
- identify the dominance hierarchy of a pair or group of birds;
- provide a nutritional/psychological breeding trigger in spring;
- check incubating females when they leave the nest;
- check eggs when incubating females are away from the nest site;
- sight all members of a brood;
- lure birds for capture;
- potentially administer some drug treatments in a palatable way;
- 'reward' birds following disturbance or handling.

5.6 REARING DIET

A high protein diet of between 25–30% protein is essential for brown teal ducklings during their first three weeks, regardless of whether they are being raised by their natural parents, foster parents, or hand-reared. Breeder pellet and other Hi-lay products are not used for raising young birds as the calcium balance is not considered suitable for growth. Hi-lay is specifically tailored for high-production laying chickens, and not recommended for brown teal (Thomas, pers. comm.).

The most successful and commonly used diet for brown teal is a combination of chick crumbles and baby food ('Farex'). As the ducklings grow, teal pellets are gradually introduced. When fledglings are fully feathered, they should be readily taking the adult

maintenance diet and have access to grit.

In hand-rearing situations, ducklings can be checked regularly to make sure that dried food or faeces have not blocked the ducklings' vents. If this happens, soften and clean away the obstruction with warm water and cloth.

Several diets used to raise teal ducklings are described below:

Diet 1 : Chicken raiser crumble/ poultry mash or crushed teal pellets/ 'Farex'/ 'Complan'/ 'Fido' dog food

This is a diet that has been used successfully with brown teal for many years. For the first week, 4 parts chicken raiser crumbles, 4 parts poultry mash or crushed teal pellets, 2 parts of 'Farex' baby food, 1 part of 'Complan', and 1 part of finely minced 'Fido' dog food are combined. The crumbles and mash are sieved to remove any large pieces, then all ingredients are mixed to a thin 'soupy' consistency with water. This may be stored in a refrigerator for up to two days, however, it must never be fed straight from the refrigerator. Add a little warm water to take the chill off, but do not make it too runny as the ducklings will become covered in it when feeding. After one week the 'Complan' and 'Fido' are discontinued and the remaining mixture is gradually thickened until at six weeks it is only moist. The ducklings can then be weaned onto poultry pellets.

Poultry rearing diets tend to include a prophylactic coccidiostat. Be warned: some coccidiostats are known to be fatal to some species of ducks. For this reason, it is not considered appropriate to include this in the teal rearing diet unless you know exactly what chemical is used and have proof that there is no toxic effect on the species. (Although the spores of *Coccidia* can be found in most environments, and young birds in general are known to be more susceptible, the teal should develop an immunity in the face of low level challenges and should not require such a prophylactic.)

When using this diet to rear ducklings in a brooder trough, some breeders prefer to withhold drinking water after a day or two, for a few days, to encourage the ducklings to feed. Ideally, ducklings should not be without drinking water. When rearing ducklings with bantams, water must be provided for the bantam, but it may be placed out of reach of the ducklings during their first few days to encourage them to feed.

Diet 2: Chick mash/ hard-boiled egg yolk

This diet is simple and widely used, and consists of a mix of the finely chopped yolk of a hard-boiled egg with an equal amount of fine chick mash. After two weeks the egg yolk can be discontinued. Fresh drinking water must be made available at all times with this diet, however, it is again important to prevent the ducklings getting wet. Finely chopped lettuce, and duckweed, is very popular with ducklings from about three weeks, and at six weeks they may be weaned onto poultry pellets.

Diet 3: Formulated starter crumb/ 'Go-cat' Complete

Another proven diet of high protein crumb is composed of starter crumb mixed with soaked, crumbled 'Go-cat' Complete (chicken, beef, calcium and vegetable flavour) and is fed to ducklings for the first three weeks (see presentation below). When the first feathers appear crushed adult maintenance is gradually introduced and 'Go-cat' reduced. Starter crumb is phased out by roughly the sixth week when whole maintenance pellets are gradually introduced to the crushed pellet rations.

The starter crumb, manufactured at Unifeeds Ltd, contains similar ingredients to the adult maintenance pellet, but malt culms are replaced with wheat, and s/lysine is added. This diet is also fed to blue duck young. A breakdown of the major nutrient requirements available in the starter diet can be compared to those of the adult diets under Nutrient Composition of Formulated Diets.

'Go-cat' Complete must be soaked and put through the blender to create a moist crumble. This can be kept in the refrigerator for 2–3 days. 'Go-cat' tends to be the favourite item but it never dominates the formulated starter crumble and is eliminated from the diet before ducklings are full grown. It has a much higher protein (26%) and fat (8.0%) content than the starter crumb.

5.7 PRESENTATION OF DUCKLING FOOD

Ensuring food stations are visible from the pond and easily accessible for day-old ducklings will get them feeding as early as possible.

Ducklings, at first, should be offered a choice of 'dry' and 'wet' mixes in shallow dishes:-

'Dry' mix consists of the starter crumb/soaked 'Go-cat' blend.

'Wet' mix consists of a soup of starter crumb in fresh water.

Shallow cat-food dishes, with double compartments to hold the 'wet' and 'dry' mixes, have wider bases for stability and tend not to be walked through as much as other dishes. As soon as possible, adult bowls can be used and the 'soup' component removed, so reducing mess.

To summarise, the feeding guide is as follows:

1–2 weeks: 'Wet' and 'dry' mix in shallow dishes. (Feed twice daily.)

2–3 weeks: 'Dry' mix in shallow dish. (Feed twice daily.)

3–6 weeks: 'Dry' mix in deeper bowl with gradual reduction in 'Go-cat', followed by starter crumb, and gradual introduction of crushed maintenance. (Feed twice daily.)

6 weeks: Starter crumb phased out, crushed maintenance only. (Feed once daily.)

6–8 weeks: Crushed maintenance with gradual introduction of whole pellets.

8 weeks on: Whole maintenance pellet.

Fresh drinking water should always be available to ducklings. It is a good idea to place a dish of water at the feed station for a couple of weeks, even if the pond is close by. Ducklings will use this when feeding on the dry mix.

Mealworms are sprinkled into both mixes to encourage feeding; mini-mealworms are suitable for the first few days. Small crickets would also be relished. Mealworms should be fed out in moderation to ducklings; excessive quantities of the fibrous 'skin' of mealworms have been known to cause gizzard impaction in very young waterfowl ducklings. Earthworms and other live foods, and greens such as duckweed are also beneficial to growing ducklings, but in moderation so as not to prevent ducklings eating the formulated diet.

5.8 NUTRIENT COMPOSITION OF FORMULATED DIETS

The three teal diets formulated at Massey University, and available from Unifeeds Ltd., contain the following availability of the major nutrient requirements:

	Maintenance pellet	Breeder pellet	Starter crumb
Available energy kcal/kg	2850	2900	3000
% protein	16	18	20
% calcium	1	1.2	1
% phosphorus	0.37	0.46	0.45
% fat	2.5	3.6	3.13
% fibre	4.6	4.4	2.9

6 Capture, Handling and Transport Requirements

6.1 CAPTURE AND HANDLING

Brown teal are fast and agile on the ground; capturing them in an aviary can be achieved using a soft hand-net. If birds are in quarantine, hand-nets should be disinfected if used previously for other waterfowl.

Care must be taken when handling the birds as it will be a stressful time for them. In most cases, the bird will struggle to free itself from the grip of the handler. Brown teal are unlikely to hurt the handler, but they can inflict injury on themselves. Immobilise the bird by placing both hands around the wings and body. Once you have a firm hold, the bird can be tucked under one arm with the hand of that arm around the bird's lower neck. Remember that any relaxation in your grip may cause the bird to think it is freeing itself, and it will struggle harder.

6.2 TRANSPORT REQUIREMENTS

All transfers of brown teal must be approved by the Captive Management Co-ordinator. The receiving facility must have authority to hold the teal in captivity. The transportation of eggs is dealt with separately under Translocation.

6.2.1 Transfer

The optimum time to implement transfers between facilities is in the autumn, allowing adults and fully grown juveniles to settle with potentially new companions well in advance of the breeding season.

Prior to transfer, a bird should have been checked for identification, screened for disease following the appropriate quarantine and disease-screening protocols, and treated for parasitic worms (see section on parasites under Known Health Issues). The teal should have access to plenty of pellets the night before the transfer as this will be the last time they feed until they arrive at their new destination.

On receiving transferred teal, it is a good idea to weigh the bird(s) before releasing into a 'quarantine' aviary. Do not release transferred birds directly into the established territory of another bird. Releasing birds onto the water allows them to have a quick drink before they inevitably go into hiding.

6.2.2 Transfer boxes

Brown teal should be transported in well-ventilated, clean boxes. The box should be darkened to keep the bird calm. There must be no exposed sharp objects such as nails or netting within the holding compartment, and bird should not be able to get body parts through ventilation gaps. The holding compartment should be large enough for the bird to stand and turn around but not too big that a single bird would be thrown around and damaged during transit. Single birds should not really be transported in compartments larger than the size of a standard cardboard 'pet-carry' box.

Vented cardboard 'pet-carry' boxes (disposable) are suitable for supervised road transport, but more substantial crates are required for lengthy journeys and for travel by air or sea.

The bottom of the compartment should be lined with a disposable, but not excessively dusty substrate such as shredded newspaper, grass or straw, shavings or carpet, which will absorb most of the faeces so the bird does not become too dirty while in transit. Ensure material is fresh to avoid exposing birds to *Aspergillus* spores. Plastic mesh or matting is also effective for grip but should not compromise effective cleaning of the box.

Cushioning the roof of a box with a foam matting (e.g. camp sleeping mat) can be advantageous, but walls should be left unlined to avoid birds overheating and to enable effective cleaning.

Overheating can be a great threat to birds in confined spaces during transit. It is recommended to attach 'spacers' on external walls near to vents to ensure that vents do not get blocked. This can be particularly important when using commercial transport, or if loading can not be supervised.

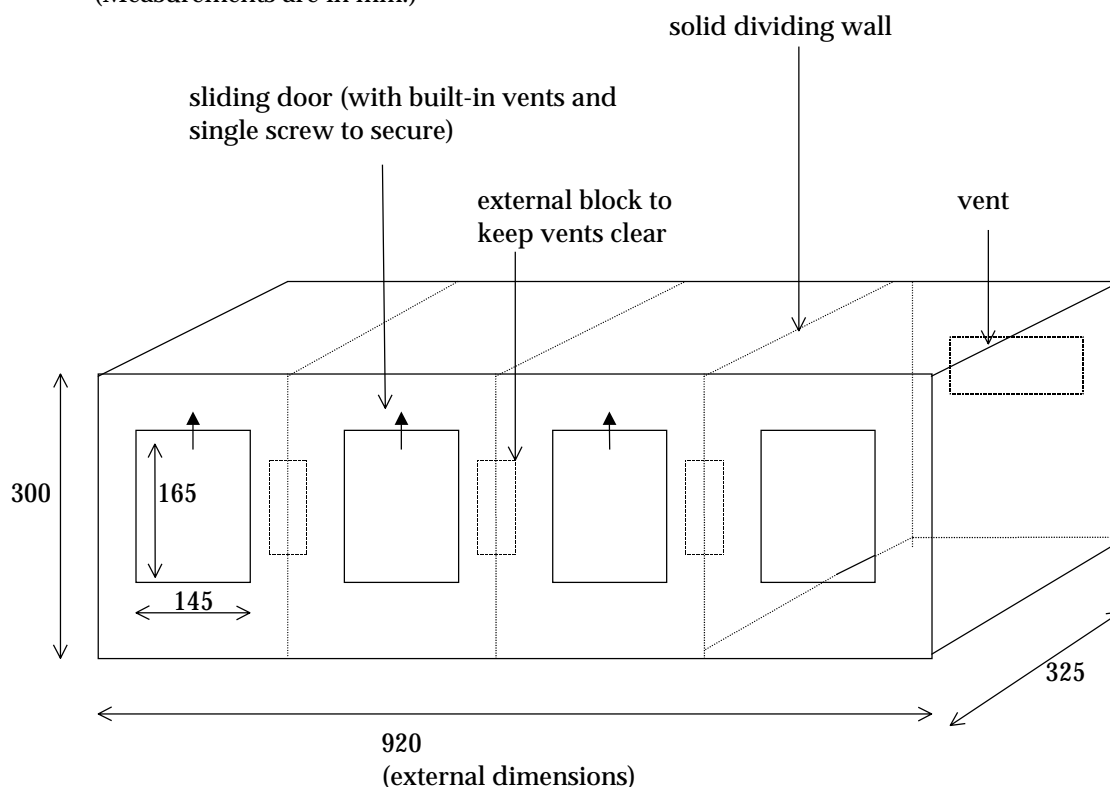
During transportation, the bird(s) should be checked regularly. Food and water is not necessary for trips of short duration (i.e. less than 8 hours). On longer trips, food and water should be provided for a short period and then removed (if left in it will often get upturned during transit/ bird movement). Boxes need to be secure in case of accidental opening, i.e. taped well or locked.

Internal compartments of transfer boxes should be thoroughly scrubbed with hot, soapy water, followed by 'Virkon' disinfectant to sterilise them, immediately after use.

Figure 4 illustrates a crate, containing up to four single compartments (internal dimensions of 299 mm length x 214 mm width x 270 mm height), used to transport brown teal over long distances. The transfer box is constructed out of 13 mm ply wood (internal roof fitted with closed cell foam lining). Fine gauze is sandwiched between all vent covers (two vents per compartment) which are screwed onto the box externally. (The box is quite heavy and as a consequence incurs a greater freight cost, however its strength reduces risks of crushing if loads shift and become unstable during commercial transportation; a more light weight yet robust plastic option could be ideal.)

Figure 4: Brown teal transfer box (for up to four birds).

(Measurements are in mm.)



Boxes 400 x 400 x 400 mm have been used to transport up to four brown teal together with no problems; however, single compartments are considered the safest option for the birds.

7 Behaviour and Holding Management

Brown teal are a highly territorial and aggressive species of duck and are not suitable to be held with other waterfowl species. They are also likely to pose a serious threat to other cage-bird species, in particular ground-dwellers and species of a similar or smaller size than the teal. Mixed species holding is less desirable for birds participating in the captive breeding/release programme (disease risk etc).

7.1 GENERAL BEHAVIOUR IN CAPTIVITY

7.1.1 Seasonal activity

Captive brown teal maintain the lowest profile during the moult. They are quite active during the winter months, particularly on overcast and wet days. In the summer, birds exhibit little activity on hot, fine days, becoming very elusive if nesting. Although hierarchies can be formed, reinforced, or on rare occasions even reversed at any time of the year, spring and early summer is predictably when aggressive activity peaks.

7.1.2 Day and night activity

Although regarded as nocturnal, the teal, adapt to a daytime husbandry routine and can be active at intervals through the day. Vocalisations and activities such as feeding, preening, copulating, patrolling territories and interactions with other birds are less intensive in the day than they are at night. Important to note, therefore, is that any threatening behaviour occurring in the day will certainly be more determined and vigorous at night. (Deaths caused by physical attack from other birds have happened during day and night time.) Concern over incompatibility can be alleviated by separating birds at night (if facilities permit) and reintroducing in the day until sure that one bird is not posing a serious threat to the other. Their secretive nature during the day can make these birds difficult to display.

7.1.3 Territorial behaviour

Territorial behaviour is displayed year-round by male brown teal; territory ownership is most likely a prerequisite to successful reproduction in this species.

Territorial aggression in breeding males peaks as the incubation period advances. In large communal aviaries where the flock-mating strategy is used, a dominant male also increases his patrolling area, forcing the subordinate birds to the furthest perimeters. For these reasons, pairs must be isolated from all other birds as soon as pair formation has occurred, before the nesting period.

Territorial displays include standing on elevated vantage points, repetitive calling, pacing fence-lines, and 'charging' at or engaging in direct combat with other teal.

7.2 COMPATIBILITY

Although brown teal will flock at traditional sites in the wild outside the breeding season, flocking of adults is not a suitable holding option for this species in a captive environment. Ideally brown teal should be held as established pairs year round following, where possible, a process of natural mate selection through flock-mating. Flock-mating is only possible if suitable facilities are available and monitoring time planned.

Single teal should not be held for prolonged periods of time alone (i.e. for more than several months). The Captive Management Co-ordinator should be consulted regarding companionship/pairing options for such birds.

In any grouping situation, birds must be sighted daily and have access to plenty of food at many stations around the aviary, as well as plenty of cover.

7.2.1 Mixed groups

Mixed groupings are a short-term holding management option only formed for the purposes of mate selection and flocking prior to release (usually juveniles); they must be reviewed as soon as any dominance hierarchy develops. Birds that are not destined for release or are not required for breeding should not be included in a flocking situation. Mixed groups are sometimes formed during a quarantine period but are extremely closely observed in these cases (refer Translocation). In a mixed juvenile flock, social aggression can begin prior to, or as soon as the birds have gained full breeding plumage at around 4–5 months of age, when male siblings begin competing with each other over their female siblings. In a mixed adult flock

competition for mates and prime aviary space develops almost immediately following introduction of birds and must, therefore, be very closely observed.

Brown teal are not housed as trios as the dominant pair will usually displace (and in all probability kill) the subordinate bird. Very occasionally a trio (male serving two sibling females reared together) will co-habit and even breed, but this is an unusual scenario, and may not necessarily remain stable.

7.2.2 Single sex groups/pairings

If birds have to be held as a group in situations other than flock-mating, then it is preferable to separate sexes, e.g. post-transfer quarantine birds. Single sex groups can still be volatile if held for prolonged periods, so close monitoring is always required.

Single sex pairings can be comfortably held in a single aviary through all seasons but it pays to regularly check on compatibility, especially with a male-male pairing.

7.2.1 Hierarchies

Hierarchies are established in all groupings/pairings of teal within a short period of time following introduction. They become most problematic in mixed sex flocks and also during the breeding season when careful monitoring is required, even between non-breeding same-sex groups/pairs. Established pairs with strong bonds show mutual regard for one another; during the breeding season the degree of dominance that a male holds over his mate can vary considerably between pairs. Once established, rankings usually remain unchanged unless circumstances change. It generally follows that a larger (heavier) bird is the dominant teal in an aviary, but this does not mean that they will remain dominant with other aviary companions. There are, however, a few generally smaller teal that are consistently submissive in the presence of other birds. Every effort should be made to find these birds suitable companionship; introducing them to a juvenile is a useful option if all else fails.

7.2.2 Conflict

Aggressive behaviour in teal is triggered by the following instincts:

- territoriality (including competition over food source);
- competition during mate selection;
- mate defence;
- nest and brood protection;
- mate rejection in forced pairings.

A dominant bird that becomes intolerant of the presence of other birds can claim and defend the feed station area, and tends to keep the subordinates off the pond, sometimes actively searching for and flushing them out of hiding. Confrontation results in a 'charge' and chase of varied intensity. Chases of a relatively mild nature do not usually end in physical contact. The aggressor displaces the subordinate who will, in many cases, continue to boldly provoke the intimidator. During more serious conflict, the aggressor can run the victim down with constant and lengthy pursuits across water and land which terminate in an aggressive mounting where the dominant bird grasps the nape or back feathers of the victim whilst battering the body with wing-flicks. Such feather wear may not be obvious unless the teal's neck is stretched out. Females are occasionally seen to aggressively mount other females, usually if competing for a male.

It is strongly advisable to place several feed stations around an aviary to ensure all birds have access to food if conflict is suspected (refer Post-transfer Management).

7.3 INTRODUCTION TECHNIQUES

The optimum time of year for making adult introductions is outside the breeding season between around March and August. (Some males can still be quite 'hormonal' even if the breeding season is well advanced.) Introducing birds when they are in moult can work well if they are at similar stages (i.e. with equal disadvantage) as aggressive territorial behaviour is then at its lowest level.

When introducing teal to each other for the first time, it pays to be cautious about the compatibility of the birds. Weigh all the birds involved before the introduction. Allow plenty of observation time. Two or more feed stations and several shelters should be spaced around the enclosure to ensure all birds have access to food and places to roost. Using live food as a 'management tool' is extremely useful in these circumstances. If there are any doubts about the welfare of the birds as hierarchies become evident, weighing birds a couple of weeks into the introduction can either confirm that there is a problem, or ease concern if there is not. Birds should be a similar weight at this point to when they were introduced, having lost a little initially through moving stress, but regained after settling. Drastic weight differences between two same sex teal should raise alarm bells.

Avoid making new introductions in the near vicinity of teal who may have an influential relationship with the birds involved, e.g. previous companions or mates.

7.3.1 Introductions in neutral territories

In most cases, birds are best introduced to each other in neutral territories. This involves moving all birds concerned to a new aviary that none of the birds have recently occupied or held as territories on a long-term basis in the past. This way, all birds start off on an even footing. This technique requires a bit of advanced planning and is most suitable for same sex pairings/groupings, or mixing broods of ducklings/fledglings.

7.3.2 Introductions in two adjacent, existing territories

Sometimes an introduction will involve housing the teal involved in adjacent aviaries for a period of time prior to introduction, and then opening a division between the pens/territories, effectively extending (overlapping) each territory into that of the other birds. This can work well providing that the birds have not held their originally exclusive territories long-term prior to the introduction. It is, however, more suitable for forced male-female pairings/trios as opposed to same sex pairings/groupings.

7.3.3 Introductions in one existing territory

There are instances where introducing birds to a neutral territory may not be appropriate. Such cases where the introduction may take place in the existing territory of another bird could include:

- introducing a known (and consistently) dominant bird to a known subordinate bird;
- introducing a considerably heavier bird to a lighter bird;

- introducing a healthy bird to one that has recently rehabilitated from sickness or injury or that has recently suffered the stress of transfer to a new facility;
- introducing a new male to a female who has a good breeding history in a particular aviary;
- introducing more advanced (older) fledglings of one brood to a younger brood;
- introducing a larger brood of fledglings/juveniles to a smaller brood;
- introducing two compatible adults of the same sex to a third same sex bird.

This introduction method is employed to maximise the chances of disadvantaged bird(s) settling into companionship with others. The success of these introductions can depend on the length of time the resident has spent occupying the territory to which the new birds are introduced.

Pair formation is dealt with in more detail under breeding management.

8 Breeding Management

Breeding can be encouraged in brown teal by:-

- allowing birds to naturally select their mates where possible;
- providing optimum nesting habitat;
- offering a nutritional (psychological) trigger leading into the breeding season; (Supplementary live food can be offered twice a day to stimulate first-time breeders.)
- stimulating pairs by extending an existing territory to include extra nesting and foraging habitat;
- stimulating pairs by housing territorial males or pairs in adjacent pens, although in some cases, particularly forced pairings, this may be a distraction especially if a neighbouring bird is a potentially more attractive mate.

Some pairs may require only one of the above to induce a breeding attempt, other more reluctant pairs may require all.

Females found to be incubating non-viable eggs should be carefully considered as potential foster-parents, as a more preferable option to artificial incubation and rearing, before their clutches are removed.

8.1 BREEDING SEASON AND REPRODUCTIVE CYCLE

In captivity, brown teal usually begin breeding in July/August; breeding can occur as late as December/January. It is not unusual for the female to use the same nest site as the previous year. Brown teal will develop strong, long-term pair bonds in captivity. Such successful pairings are capable of being productive on an annual basis if conditions suit. Breaking long-term bonds and repairing, if necessary, for the subsequent season can occur successfully during the winter

Both male and female brown teal are capable of breeding in their first year. The fertility rate, and hatchability and survival rate of naturally incubated eggs and parent-reared young has so far been quite high for this species in captivity.

Often, copulatory behaviour can indicate the success of a pairing; normal copulations usually

occur on water and tend to be followed by some form of brief mutual comfort movements such as swimming or wing-flapping (although this behaviour is unpredictable in brown teal). Females struggle to escape prolonged forced mountings; excessive forced copulation can lead to injury of a female (wounds on back of head). If copulations are observed, a good pair bond is present but no breeding attempt is made, the problem is likely to lie with the female; she may not be producing eggs, or may not be comfortable with the habitat, or may no longer see her partner as a desirable mate.

Brown teal are very attentive parents and, given the correct food and facilities, they will frequently rear 100% of the young that hatch from each clutch. Under optimum conditions, it is not uncommon for a female brown teal to produce several successful clutches in a breeding season. Throughout, the male brown teal takes a keen and active interest in rearing his offspring, and while he does not brood the young, he will expose the ducklings to all activities and will ferociously defend his progeny against intruders.

8.2 PAIR FORMATION

Brown teal pairs can be formed by either natural mate selection in a mixed flock (also known as flock-mating) or trio, or by forced pairing. Pairs can be considered 'established' once a breeding attempt has been made.

8.2.1 Natural mate selection/flock-mating

Natural mate selection has been identified as the ideal method of pair establishment for brown teal, offering a choice of mates and a level of stimulation leading into the season. Naturally selected pairings tend to be reproductively successful in their first season.

Flock-mating must take place in a large, well designed aviary. As soon as a male and female pair up, territorial behaviour is inevitable and at this stage the pair must be isolated. This can involve moving the pair out to a breeding aviary well in advance of the nesting period (e.g. by late winter), but probably more successful in terms of breeding results is to leave the dominant pair in their already claimed pen/territory and separate other birds off. Members of the flock should be introduced together into a neutral territory in the winter months. An ideal time to flock birds is either shortly before or as soon as the birds have gained breeding plumage.

Natural mate selection has also been successfully achieved through variations on the above method. Males and females can be held in adjacent aviaries with visual contact through the dividing mesh. When the division is eventually removed, the pairings occur relatively quickly as birds have already had time to become familiar with each other. This method works well for those who have less monitoring time available. Alternatively, one male can be introduced to a group of females, with males rotated every few days in an effort to stimulate them. Advice can be sought from the Captive Management Co-ordinator as to the most appropriate technique to use.

8.2.2 Forced pairings

Forced pairings are only sometimes successful in their first season, and if not they are unpredictable in terms of future success. They should be set up well in advance of the season (this can be as early as the preceding autumn); forced pairings require plenty of time to develop bonds before they will even contemplate nesting. Forced pairings tend not to be

successful between wild-origin teal but have proved invaluable between some wild-caught teal and captive-bred birds to obtain progeny with new genetic contributions. Wild-origin birds showing consistently subordinate behaviour from year to year in all flock situations may only be able to gain confidence, build up a companionship and breed when force-paired to young birds.

8.3 NESTING REQUIREMENTS

Captive brown teal will readily nest in ground and elevated artificial nest boxes; there should be at least one of each type in each aviary. However, the female may prefer to nest in ground cover if there is plenty present in the aviary. Nesting boxes should be positioned as far away from the aviary entrance as possible, and be behind cover. A shelter on top of the boxes will ensure they are weatherproof; in addition brown teal like to have the option of a high perch. While the elevated brown teal nest box design is not elaborate, there have been over 50 fertile eggs laid in this type over five seasons.

An alternative design of elevated nest box is similar to those used by grey teal. These are about 300 x 300 x 450 mm deep, with a 100 mm entrance hole, and a wire netting covered internal ramp leading up to the entrance. The ramp is essential with this design as, unlike grey teal ducklings, brown teal ducklings cannot climb up the vertical face to the exit hole. A platform outside the entrance hole allows the female to perch, before entering the box; the platform should be about one metre above ground level.

Ground level nest boxes should sit directly on the earth, while a layer of fresh soil should also be spread across the bottom of any elevated boxes. This helps to increase the relative humidity around the nest as brown teal eggs require high humidity in order to hatch successfully. Straw should be placed on top of the earth; hay should not be used as hay dust can hold *Aspergillus* spores.

Most nests are constructed amongst or under dense clumps of vegetation (grass, sedge or rush), and some have been located underneath thick mats of grass. Some can be raised up to 300–400 mm off the ground, well hidden in the centre of a *Carex* plant. Nest sites have a main access point and sometimes a second entrance.

Location of nest sites in an enclosure vary; they can be right at the pond edge or on top of a mound. Managing pond levels is extremely important around the nesting period in order to prevent flooding of ground level nest sites. To avoid the risk of flooding, it may be necessary to reduce water flow into ponds, or even turn off inflows, especially at night. Specific designs for pond outflows can be installed to reduce these risks.

Nests tend not to be constructed in favourite roost spots or in existing run networks. The same sites can be used from year to year by the resident female if availability of sites is limited; she will choose new sites for each clutch, particularly within the same season. To summarise, it is important to have a range of well hidden spots and areas of dense vegetation around the pen, particularly in points of least disturbance. Captive-bred birds can be encouraged to nest in ground boxes or under low shelters if vegetation is in close proximity to form the nest.

Females will line the nest with soft material such as grass. A varying amount of down is added to the nest once incubation commences and advances. Some females add very little down to their nests, particularly in final clutches.

8.4 CLUTCH SIZE AND LAYING

Clutch size varies from 1–13 eggs but 4–6 eggs is normal. Eggs are laid every 1½ days (or two eggs over roughly 3 days). The laying period is the most important time to restrict disturbance. Random nest hunting and disturbance to vegetation during this time can cause a female to abandon a site. If a female is found to be incubating a very small first clutch (one or two eggs), it is quite likely she has abandoned the first eggs of the clutch at another nest site. Unless a nest site is obvious and the female is known to be tolerant of nest inspections (when she is absent), the timing of egg laying has to be determined with careful behavioural observation and by daily monitoring of the female's posterior abdominal profile (around the vent region) for 'heaviness'. The latter can be difficult if females are overweight and large-bellied. Females will become particularly elusive in the mornings, often failing to come out to collect live food on laying days. At this stage, males will rarely give any clues as to the location of the nest site. Females that do emerge on an egg-laying day can be quite obviously 'lighter' in profile than the day before. During the day, the pair will tend to roost away from the site.

8.5 EGG WEIGHTS AND MEASUREMENTS

Egg length range: 50–60 mm

Egg width range: 35–45 mm

Egg weight range: 45–70 grams

8.6 NATURAL INCUBATION

Incubation commences on the same day that the final egg of the clutch is laid. The incubation period is recorded as being around 27–30 days with the hatching period commonly taking up to two days following external pip.

Locating nests is easier once incubation has commenced. The male usually guards the nest, but the site is not always obvious as he will frequently abandon his post to undertake territorial patrols and to threaten intruders. When offered live food, the male may accept some but will often eventually return to the nest site, using a discrete route, to collect the female so that she can feed. It will take her several minutes to cover the eggs with soft material before leaving the nest; she may only leave if the weather is favourable. This is an effective and low-level disturbance method of locating nests in large, densely vegetated pens. As incubation progresses, the guarding male becomes more obvious, and wisps of down and even a 'latrine' can be noted in the near vicinity of the nest.

A female will leave her nest for varying periods of time depending on the weather and the stage of incubation. Commonly, a female will return to the nest within 10 minutes.

Non-viable nests are usually abandoned within a week following the supposed hatching date. It is not a bad idea to break up a known unsuccessful nest around the 35 day mark as the nest can get quite unhygienic by this stage.

8.6.1 Intervention

Naturally incubated nests would require intervention if:

- incubation start date is unknown and eggs require candling to determine hatch date (to ensure the rearing diet is provided at the right time);
- productivity is to be boosted by removing clutches for artificial rearing (best achieved by allowing female to sit for about half the incubation period before removal).

Note that boosting productivity (whilst maintaining quality of young) can be effectively achieved by removing the parent-reared ducklings at several weeks old; established pairs tend to re-nest, and females have had a chance to regain condition in between clutches.

Whilst candling is optional during natural incubation, it can be beneficial:

- to remove infected eggs preventing transmission of infection from a non-viable egg to others;
- to remove non-viable eggs from particularly large clutches to improve incubation conditions for remaining eggs, i.e. greater coverage by female. (However, brown teal have been known to incubate most or all eggs successfully in a 13 egg clutch.)
- to assess fertility (whilst infertile pairs may be encouraged to lay a second clutch, there should ideally be a gap of a few weeks to allow the female to regain condition).

NB Reducing a clutch by more than two eggs at a time can cause a female to abandon. Single eggs should not be left alone in a nest; infertile eggs showing no sign of infection, of dummy eggs can be used to pad out a clutch.

The National Wildlife Centre candle naturally incubated Campbell Island teal eggs at around third term and two-thirds term of incubation, during routine feeding time and when the female leaves the nest of her own accord. Females are never forced off the nest; they can defaecate on eggs if taken by surprise. A portable torch is used; index finger and thumb bridge the gap between torch and egg. Occasionally at hatching time, a staggered hatch is identified where a viable 'unpipped' egg remains in the nest where all other ducklings are hatched and dry and ready to leave the nest. Such eggs have been artificially hatched and the duckling successfully reintroduced to the brood as soon as dry (providing only up to 2 or 3 days younger than the rest of the brood) during a 'confusion' period where adults are distracted.

8.7 PARENTAL CARE

Unless the nest has been checked during the hatching period, the rearing diet should be provided several days before the predicted hatching date. The ducklings will tend to wait for the female to leave the nest before venturing away from the site. They will happily enter water on their first day and may be seen diving when only a few days old. The female may brood her young at the nest site but often she finds a different well hidden spot.

Male brown teal will escort and protect the family, guarding them when feeding, but have never been seen to brood ducklings. Males are frequently seen pursuing the female for copulation attempts and small ducklings can get easily displaced during this behaviour. If it persists and threatens the survival of the young it may be advisable to remove the male from the pen. In these circumstances, it is not wise to return the male to the female until the ducklings are independent and separated from the mother.

Paternal aggression toward ducklings has been suspected on a few occasions; they can often be seen 'nibbling' the downy young, but should not begin threatening the young until the female is ready to begin her second clutch. In this case, the male generally will attempt to

drive the first brood out of the territory and in some cases kill the young fledglings. For this reason, it is safer to remove the first brood from the parents before they are 30 days of age. (Three week old parent-reared ducklings will be quite able to fend for themselves in a separate pen, well away from the parents to prevent stress and pacing, but younger ducklings would require a bit of warmth at night and may not feed quite as well.) Pairs that rear a single brood and show no intention of double-clutching can keep their young until fledged and the first signs of aggression begin.

9 Artificial Incubation

Artificial incubation should only be carried out by waterfowl breeders with considerable experience in this specialist area, and who have access to good quality equipment. This is particularly important considering the importance of all fertile eggs to the brown teal programme.

Artificial incubation should only be considered when eggs are abandoned by the laying female and there is no foster bird available. The benefits of natural incubation and parent-rearing, for adults and their offspring, far outweigh artificial techniques. Productivity is no longer the primary objective in the brown teal captive management programme. Even facilities directly involved in the release programme are placing emphasis on quality (parent-reared birds) rather than quantity.

Bantams and certain species of waterfowl may be employed as foster-parents/incubators (as is common in waterfowl aviculture), but ideally birds reared in this way would not be used for release (refer section on Foster Rearing).

Incubation parameters are similar to those used with many other duck species. This section offers some general guidelines; holders of this species will already have a basic knowledge in this area.

9.1 INCUBATION FACILITIES

The incubation room should have the following features:

- a constant ambient temperature throughout the day and night (around 20°C) where fluctuations do not exceed 5°C;
- adequate ventilation without compromising the even temperature;
- a simple hygiene regime (hand-washing etc.);
- the ability to easily darken the room for candling purposes;
- record keeping equipment (diary etc.).

Incubators need to be fumigated or disinfected, set up for the appropriate egg size, and run for one to two months in advance of the season to allow for a reliable back-up option to be ready in place.

9.2 EGG COLLECTION, CLEANING AND STORAGE

Should artificial incubation be necessary, it is recommended that eggs are collected as late as possible prior to moving to an incubator for several reasons:

- Artificial incubation is generally more successful when eggs have been naturally incubated for part of the term. (If a clutch has to be removed early, better results will be achieved if the eggs are still 'set' under the female for at least a few days, but preferably for half the incubation term before moving to an incubator.)
- It is healthier for the females (especially those that lay very large clutches) to have a reasonable period of rest between production of clutches. The eggs, of course, can be dummied to prevent immediate re-nesting or access to the nest box temporarily blockaded. Females should ideally be allowed to rear their final brood.
- Extra management time is considerably reduced when birds are left to naturally incubate.

Marking eggs on removal from the nest will not only help identification but indicate which way up the eggs were lying in the nest so that excessive turning is not made during collection and cleaning. Later, this mark will help during the turning regime. It is often convenient to mark the eggs with the collection date, or the incubation start date if known.

Eggs removed for artificial incubation should be individually weighed and measured as soon as collected. Egg weight should be recorded in grams; measurements are taken in millimetres using Vernier callipers.

Dry dirt can be gently scraped/rubbed off the eggs. Alternatively, the eggs can be washed in a special commercial anti-bacterial solution such as 'Chickguard'. It is important that the instructions that come with these solutions are strictly followed. The cleansing solution should always be just slightly warmer than the egg temperature (e.g. 38–40°C) so that the convection of cold to warm moves out from the egg, thereby avoiding the risk of sucking potentially harmful bacteria into the egg through the shell pores. Eggs should be patted dry with a clean paper towel and re-weighed. The decision to clean eggs tends to be a matter of personal preference.

Eggs that are cracked can be salvaged. Such eggs should not be immersed in cleansing solution. Cracks can be sealed using nail varnish, candle wax or surgical tape. Large cracks can be mended with sterilised shell pieces from other eggs. If bacteria have already entered the egg, or the egg has lost too much moisture, the embryo will die. Bad eggs must be removed from the clutch as soon as possible.

9.2.1 'Warm' eggs

Warm eggs tend to be collected as a completed clutch. It is sometimes necessary to replace the clutch with dummy eggs to prevent the female re-nesting. (Warming dummy eggs improves the chances of acceptance by the female.) The eggs should be placed in an incubator within half an hour of removal from the nest. Artificial incubator temperatures will need to be checked carefully and possibly adjusted once eggs are added, to ensure that a clutch of developing eggs does not raise the general incubator temperature.

9.2.2 'Cold' eggs

Eggs may, on rare occasions, need to be collected and stored as 'colds'. This can prevent the eggs 'spoil' in extremely hot weather and reduce risks of bacterial infection.

Stored eggs should be held in a consistently cool room (around 12–16°C) for 7–14 days; any

warmer than this and the eggs may begin to slowly develop. Eggs can be laid on their sides, as they would in a nest, or kept air cell up, and need to be turned daily (a minimum of twice per day, opposing directions on each turn). Viability of stored fertile eggs will obviously decrease over time.

Cold eggs should be allowed to sit at incubation room temperature for just an hour or two before being placed in the warm incubator to prevent sudden temperature shock.

9.3 INCUBATION PARAMETERS

Eggs can be incubated in a forced draft incubator or a still air incubator. In order to successfully hatch, they should lose approximately 12% to 16% of their fresh weight by internal pip.

9.3.1 Incubation temperature and humidity

The temperature should be maintained at a minimum of 36.8°C and the humidity at 52–55%, although a less precise artificial incubation temperature of between a constant 37–38°C has hatched this species successfully. Waterfowl eggs of a similar size to the brown teal will incubate in a still-air incubator with a temperature reading of 38°C at the top of the egg. Eggs should only be moved to a higher humidity, static hatching incubator when a definite internal pip is seen (refer Hatching) and not before this event.

9.3.2 Turning

The eggs will need to be turned (or rolled) either automatically or manually at least four times a day (preferably at even intervals) until the stage of internal pip. Automatic turners should be set to suit the teal egg size; this is essential in still-air incubators to ensure all parts of the egg receive exposure to the warmth source. Manual turning of eggs should be made through a 180° horizontal plane, alternating directions at each turn. Manually turned eggs may benefit from being turned an uneven number of times through the day so that the egg is not resting in the same position every night during long overnight periods between rolling.

Records pertaining to each individual egg within a clutch should be maintained on a record sheet. Good records can help pinpoint when and where a problem began. It is important to record daily incubator temperatures, incubator humidity, egg weight loss, density loss and any other relevant observations on the condition of the eggs.

9.4 MONITORING EMBRYO DEVELOPMENT

Candling eggs during artificial incubation is essential to:-

- identify and remove all non-viable eggs as soon as possible in order to prevent contamination of the incubator/remaining clutch;
- monitor progress in development;
- provide comparable development between eggs of a clutch;
- identify key events such as internal or external pip to prompt a change in incubation parameters (e.g. stop turning eggs, raise humidity).

When using a candling torch, it is important not to leave the light source in direct contact with the egg for too long as the heat may harm or even kill the embryo.

Recording egg weight loss is the most useful 'tool' for monitoring progress as modifications to the incubation regime (specifically humidity control by increasing or decreasing the water surface area) can be made as incubation advances, to compensate for excessive weight gain or loss. Egg weight can be plotted on a regular basis to chart the weight loss pattern and identify necessary changes to incubation parameters (i.e. humidity).

9.5 HATCHING

'Brinsea' table-top hatchmakers are ideal to use as both hatchers (with water) and driers (run dry) for small clutches/broods. A soft matting, that allows water to evaporate through from the troughs below, should be placed on the mesh floor of the hatcher; this prevents the eggs rolling around the hatcher, provides comfort for the ducklings once hatched (metal floors can be quite rough on soft exposed regions such as the navel) and reduces the risk of legs splaying. 'Miracle Grip' matting, supplied by Underdown Supplies, is ideal for this purpose.

Turning is not necessary following internal pip into the air space. Automatic turning modes in hatchers must be switched off to prevent chicks being crushed.

Hatching eggs, from the same clutch, can be placed together (touching) to encourage chicks to hatch simultaneously.

Iodine solution (or other recommended sterilising agent such as 'Betadine') can be applied to the navel when removing ducklings from the drier to reduce the risk of infection during the final stages of yolk sac absorption/naval constriction following hatching.

9.5.1 Hatching temperature

Hatching needs to take place in a separate incubator which may be set $\frac{1}{2}^{\circ}\text{C}$ lower than the incubator temperature as the hatching chicks will be developing their own heat. This is to ensure the hatching temperature does not exceed the incubating temperature.

9.5.2 Hatching humidity

As soon as the first external pip appears, eggs should be transferred to a high humidity (+70%) incubator for hatching. Leaving an externally starring egg in a low humidity incubator may cause the membranes to dry out, resulting in the hatching chick unable to break through them.

A safer option is to transfer eggs to the hatcher when a definite internal pip has been made; moving an egg to a high humidity before this event can be detrimental as a chick may find it difficult to penetrate the membranes into the air cell if they are too wet and elastic.

If all water trays are full and a higher humidity still required in a hatcher, this can be safely achieved by adding a soaked sponge (with large wet surface area) to the hatching compartment or regularly spraying with warm (pre-boiled) water. This is a preferable option to blocking up air vents which ought to be kept open to permit airflow.

9.5.3 Drying

Newly hatched ducklings are more settled if they are in close proximity of other members of

the brood. Ducklings can be left in the hatcher to dry alongside other hatching eggs, but generally they need to be moved to a less humid environment; this also leaves a more hygienic environment for the remaining eggs to hatch out in.

Placing a ring of plastic (e.g. a 2 litre ice-cream tub with bottom cut out) inside a 'Brinsea' hatcher/drier will contain ducklings and reduce the risk of them jumping out when the lid is lifted, or squashed when the lid is lowered following an inspection.

Ducklings can be moved to a hatcher/drier that is run dry (low humidity), set at 36°C, until fluffed up. Leaving them in this environment for too long may cause the ducklings to dehydrate, so they can be moved to the 35°C brooder as soon as dry. They may also be quite active following a resting period after the hatching ordeal; moving the birds together to a brooder before this active stage reduces the risk of them jumping up and burning on the heat element at the top of a still-air machine.

10 Hand-rearing

10.1 'WET' AND 'DRY' TECHNIQUES

Ducks can be artificially reared using two different methods, each requiring a slightly different facility and approach.

- 1) 'Dry' method: ducklings are reared in a dry indoor brooder (i.e. with no access to water to bathe in) until feathering is well underway, at which point birds are moved outdoors and introduced to water (ponds) for the first time.
- 2) 'Wet' method: ducklings are gradually introduced to water in the indoor brooder at a relatively early age (when still downy) and as a consequence are fully water-proofed when moved outdoors – a more natural approach.

Bathing is required to activate the preen gland; delaying access to water causes a delay in water-proofing and can cause plumage problems when ducklings are older. The 'wet' method has some associated risks, but these can be overcome with careful brooder design and techniques. The table below offers a comparison of the two methods.

'Wet' rearing	'Dry' rearing
<i>Advantages</i>	<i>Disadvantages</i>
Ducklings are water-proofed <u>before</u> being moved outdoors, with good feather condition.	Ducklings are not water-proofed until <u>after</u> being moved outdoors, with good feather condition taking longer to achieve.
Ducklings can be moved from the confined indoor brooder to an outdoor pen at an <u>earlier</u> age (3 weeks old).	Ducklings are moved from the confined indoor brooder to an outdoor pen at a <u>later</u> age (up to 5 weeks old).
Ducklings, once water-proofed, are active preeners, staying clean and in good condition.	Ducklings can get quite dirty (down matted with faeces) and have no water available for preening.
Ducklings usually have clean feet and a more natural foot/leg muscle development.	Ducklings can get dry (sometimes cracked) Feet which can get caked in dried faeces and food.

Ducklings can come off heat at an earlier age outdoors as the risk of chilling is less.	Ducklings require a heat source outdoors until fully water-proofed.
Water-proofed ducklings are less vulnerable to bad weather conditions during rearing.	Late water-proofing birds are more vulnerable to bad weather conditions.
Ducklings require less monitoring, when moved outdoors, for symptoms of chilling.	Ducklings require more initial monitoring when introduced outdoors.
Behaviour is enriched both in- and outdoors (preening activity is increased and supplementary food can be presented in water).	Less behavioural enrichment in the indoor brooder facility.
<i>Disadvantages</i>	<i>Advantages</i>
Ducklings require more initial observation when first introduced to water as downies.	Ducklings are not as vulnerable to chilling in the early stages unless very dirty, or to drowning.
Indoor brooder design must accommodate certain important modifications.	Indoor brooder design is of a relatively simpler design.

Large scale 'wet' rearing units tend to have a constant flow of water for hygiene and efficiency. This requires an elaborate and carefully designed set-up with overflow systems etc. Holders of brown teal will find a 'fixed' water set-up perfectly adequate. Brooders will need to be cleaned out daily and water changed up to twice a day as the birds get older and messier.

10.2 INDOOR BROODER FACILITIES

The brooder room does not require a constant ambient temperature like the incubator room, although there should be facilities to warm the room if necessary. Individual heat sources are supplied to each brooder, and when the birds are at a stage when heat is no longer required, they can experience the day and night temperature fluctuations that they will encounter outdoors. If the ambient temperature is too warm, ducklings may overheat, with no cool places in the brooder to retreat to.

A most important feature of a brooder room is adequate ventilation as waterfowl rearing conditions are unavoidably warm and damp.

10.2.1 Brooder size

A brooder needs to be large enough to comfortably accommodate a single brood of up to six ducklings for at least the first three weeks of life, but longer if using the 'dry' rearing method, or if bad weather delays movement of ducklings to outdoor pens. (Exceptionally large broods may have to be split between brooders to reduce crowding.) If the brooder is too large, there may be excessive temperature differences between the warmer and cooler parts of the brooder. A recommended size for both 'wet' and 'dry' rearing methods is around 1500 mm x 700 mm. (A depth of more than 600 mm can make cleaning difficult.) This allows most feeding and watering to occur at one end away from the direct heat source, and a cleaner, drier area under the heat at the other end for resting (particularly important in the 'wet' rearing process). It must be noted, however, that new ducklings moved from the hatcher to the brooder for the first time need to be encouraged to stay under the heat, so food and water should be supplied very close to the loafing area.

10.2.2 Construction

Brooders can be constructed of a light-weight material that will withstand daily cleaning and disinfecting (there are many commercially available plastics). Wood is not recommended nowadays as it is hard to clean effectively and slow-drying.

A trough can be incorporated into one end of the brooder, with a gentle (non-slippery) slope. An outflow pipe (with a good sealing bung) can be located at the lowest point of the trough. The trough can be either filled with water if rearing 'wet', or adapted for the 'dry' method by adding a well-fitting false floor to the trough area to extend the flat area of the brooder and provide a feeding/drinking area.

Adding a light-weight mesh top to the brooder unit will prevent jumpy ducklings escaping from a shallow brooder design. Unless a large heat lamp and reflector are used, a 'roof' on a deeper brooder needs to accommodate the changing height of the heat source.

A good design used at the National Wildlife Centre, which can be used for both 'wet' and 'dry' methods, is shown in Figure 5. Consider the installation of an overflow outlet to ensure that the trough never floods the rest of the occupied brooder if a hose is left running, or if the entire brood are in the water at the same time.

10.2.3 Heat source

Ceramic bulbs (dull-emitters) offer the best heat source as they allow the ducklings a more natural day/night light cycle. They will tolerate splashes of water and have a long life expectancy, but they need to be checked through the day to ensure they are functioning as there is no light emitted which would otherwise indicate that they are on. Shatter-proof 250 watt infra-red lamps are also commonly used, and are beneficial in providing light through the night for feeding etc. Large reflectors will increase warmth coverage. Install surge protectors to prevent bulbs blowing.

Heat lamps need to be suspended from the ceiling with the facility to adjust the height. The bulb may have to be screened to prevent contact by active ducklings.

Brooder temperature should begin around 35°C an inch off the brooder floor (or a resting duckling's back height) for the first day or two, after which temperature can be gradually lowered until the birds are at ambient room temperature during the day, with perhaps a little extra warmth at night (around 2–3 weeks of age). At the time birds are moved outdoors, they should not be requiring additional heat indoors.

Figure 5a: Brooder design for 'wet' rearing waterfowl (static water system).

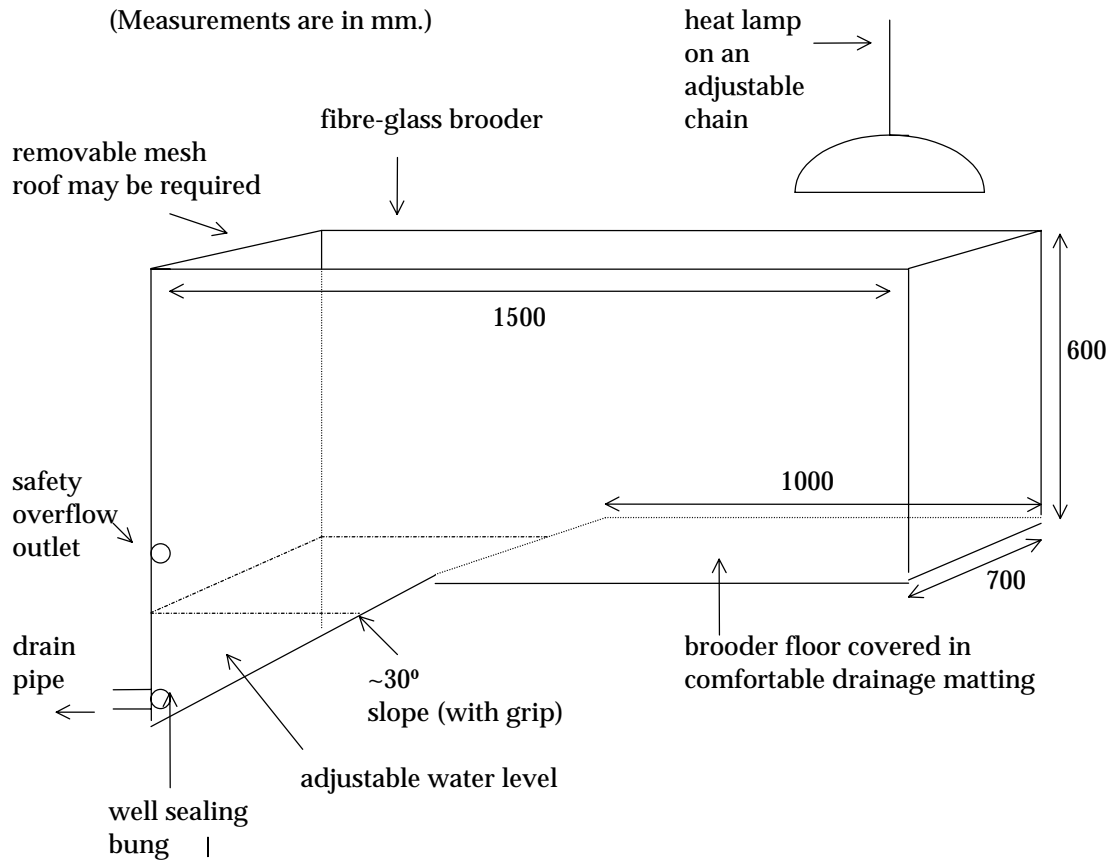
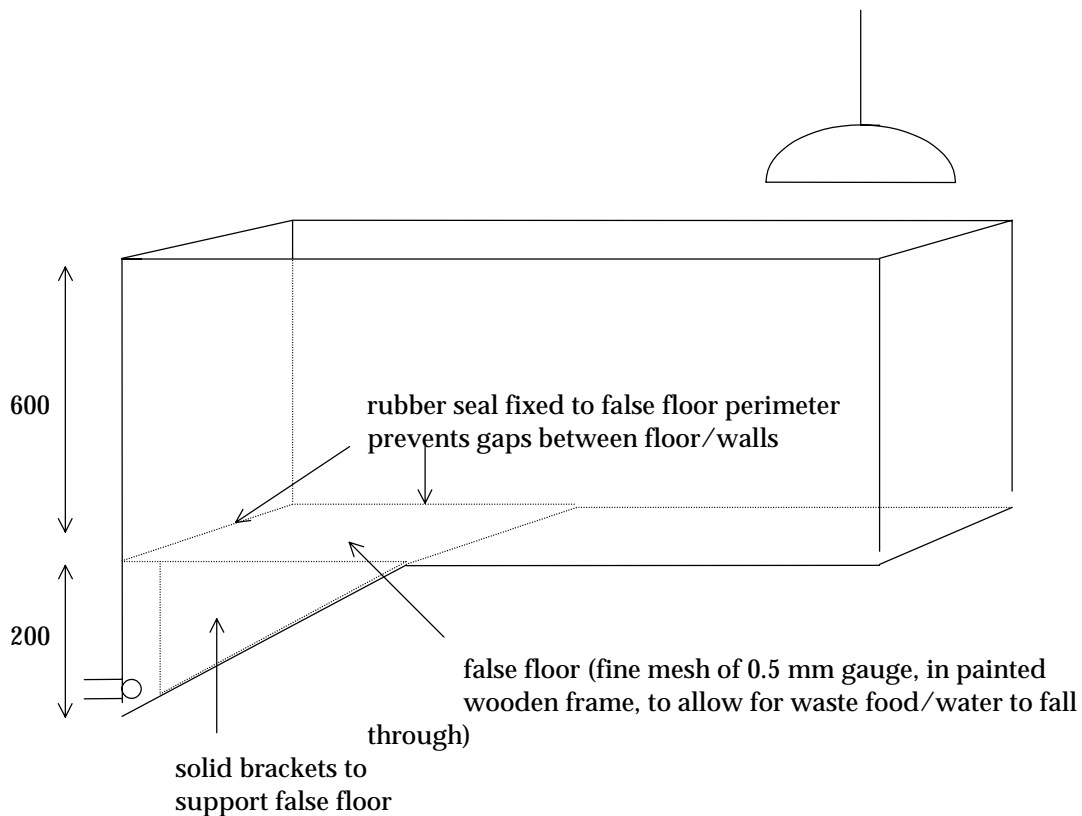


Figure 5b: Brooder design for 'dry' rearing waterfowl.



10.2.4 Flooring

Various floorings/mattings can be used to line the brooder floor in an effort to keep ducklings clean, dry and comfortable, and to reduce risks of leg splaying. Materials need to be either absorbent, or perforated to allow faeces/spilt food to sink through; fibrous matting, which ducklings will pick at, should be avoided.

In addition to matting, a soft piece of towel is often used in the first week and can be a useful comfort aid if a brood is small as ducklings tend to prop themselves up on each other when resting.

It is essential to use a suitable matting with good drainage properties when 'wet' rearing. A recommended non-skid liner, which is ideal for both 'wet' and 'dry' methods, is 'Miracle Grip' which can be obtained from Underdown Suppliers. This is a soft, PVC matting containing holes for air circulation and drainage, and is easily cleaned and disinfected. (It can even be put through a washing machine cycle although this may reduce its life span.) It can be doubled up to increase drainage by raising ducklings higher off the floor, or used to cover a wire mesh false floor. Food dishes will not slip around on this matting. Ensure, however, that ducklings can not 'burrow' underneath it where they could get wet and cold.

If you have to put matting down the slope into the water to improve grip, 'Miracle Grip' is not ideal as it floats. It has to be weighted down sufficiently to prevent any diving duckling getting trapped underneath and drowning. This is a major consideration when 'wet' rearing. Ideally, the brooder design should incorporate a rough surface on the slope.

The Wildfowl and Wetlands Trust (UK) use black rubber mats, as used in car foot wells, for 'wet' rearing large numbers of ducks. These need to be carefully chosen; the surface of the deep pile must be comfortable for small feet. The rims need to be trimmed off to allow drainage. The mats can be placed in the loafing area under the heat lamp; water dripping off ducklings is drained off and waste food and faeces sink to the bottom of the pile allowing birds a clean, dry surface to sit on. The black mats also have good heat absorbing properties so the ducklings receive all round warmth. These mats are also ideal to use outdoors on cold concrete and withstand high-pressure hosing.

10.2.5 Brooder furnishings

Shelters are not such a good idea in brooders as they shield the ducklings from warmth and concentrate faeces in one area. It may be possible to add a potted tussock or grass for a little bit of cover; a rock may allow ducklings to strengthen developing muscles used for climbing.

10.3 FOOD AND WATER

The ducklings may not feed for up to 24 hours following the hatch. Food and water should be placed near the heat source to begin with to avoid ducklings straying to the cooler end of the brooder, but never next to the wall of the brooder as they can get trapped and wet. Food can be presented as outlined in section on Rearing Diet. Some crumb and mini-mealworms can be sprinkled on the towelling or in the water dish to encourage the first feeding response. Water can initially be placed in a shallow dish or a small commercial drinker, but in both cases the water holders should be filled with marbles or small stones to prevent the ducklings getting

into the water. Food and water dishes can then be gradually moved away from the resting area towards the opposite end of the brooder.

If rearing 'dry', the dishes can, at this point, be placed on the false, wire-mesh floor to allow waste to fall through to the trough below.

If rearing 'wet', there is no longer a requirement for a drinker. The ducklings can be introduced to the water in the trough very gradually at around one week of age (or earlier if experienced with this method), and the drinker removed only when all birds are confident in the water. This can be achieved by gradually increasing the water level each day, beginning with enough to paddle in, and by allowing the ducklings a limited period of access each day which is gradually lengthened. Ducklings should be carefully observed when exposed to swimming water for the first time. They should be allowed to get wet only once on the first day, and then 'forced' to dry off under the heat lamp (where they will preen). Thereafter, they may be allowed longer bathing sessions (still closely monitored), but should only be allowed access to bathing water at night when sure they are water-proofed (a week or more later).

Supplementary greens can be introduced to the water trough at a stage when the ducklings are capable of spending more time in the water.

10.4 BEHAVIOURAL CONSIDERATIONS

Teal behaviours and responses are generally innate. It is beneficial, however, for hand-reared teal to be socialised with other teal as soon as possible in the rearing process (as soon as hatched or at the next available opportunity during the growth phase) and to avoid rearing single birds without companionship.

Behaviour is clearly influenced by whether or not ducklings are reared alone or as a group. Waterfowl are known to imprint on the first living thing they encounter following the hatch; single birds reared alone will develop additional, undesirable behaviours different to those of a socialised bird. When mature, a bird reared in the absence of company will follow the keeper and/or develop a tendency to physically attack because it has learnt that there will be no retaliation. Use of mirrors can, in fact, cause additional behavioural problems. In these circumstances it is acceptable to provide companionship in the form of another duck species of the same age, providing it has also been artificially hatched and raised (i.e. is free of possible disease) and the birds are separated before or around fledging time. A different waterfowl species is not considered an appropriate long-term companion.

10.5 OUTDOOR PEN FACILITIES

Hand-reared birds can be 'grown-on' in small outdoor pens (e.g. 1 m x 3 m) following the first few weeks indoors and before being introduced to the adult aviaries. The age at which they can be moved outside depends on whether they are 'wet' or 'dry' reared. Pens must be fully enclosed and predator-proof. Some basic requirements in an outdoor rearing pen are:- solid fencing (to prevent pacing and provide additional shade), a shallow pond (easy to clean), at least two weather-proof shelters (feeding and resting), a facility to provide additional heat at night under one shelter, furnishings to provide interest and challenge in exercise. If the rearing pens contain a grassy area, this must be kept short to begin with; young birds can get wet and chilled running through long, dewy grass.

Juvenile waterfowl are susceptible to worm infestations. They can be treated for round and tapeworms when full grown before moving to an adult enclosure if suspected infestations are compromising general health.

11 Foster Rearing

Both bantams and other species of waterfowl offer an excellent natural alternative to incubation and hatching of brown teal eggs if parent-rearing is not possible. However, it must be noted that teal destined for release into the wild should, in preference, not be reared by foster species. Survival and establishment of birds in the wild following release is likely to be improved with birds naturally reared by parents or same species foster parents because the teals' natural behavioural and socialisation traits are encouraged. The potentially negative imprinting influences are avoided, as well as potential disease risks (although birds destined for release would always be tested during the quarantine period).

A bantam house, complete with nest box is needed; eggs can be set in a straw nest on earth, and sprayed with warm water if losing weight too rapidly. Bantams should have access to food and water at least ½ an hour daily. After hatching, a coup is required to raise the ducklings to maturity. A good area of grass is required as the coup must be moved to a fresh patch each day. Ducklings raised in this 'dry' way will have to be gradually introduced to water when they are removed from the bantam when feathering is underway.

Other species of waterfowl (e.g. mallards and grey duck) have been used to incubate and rear brown teal, with good success, although the nesting of brown teal and of potential foster parent species does not always coincide. Such foster-parents would have to rear the brown teal brood in an enclosed aviary that meets the general housing standards for this species, or a coup, although birds reared in this way would not be desirable for release due to the reasons given for bantam foster rearing above.

12 Quarantine Procedures

12.1 BACKGROUND

Diagram 1 below outlines the rationale behind the quarantine protocols for translocation of brown teal. The protocols, developed in July 2003, are designed to mitigate the risk of disease transfer to wild brown teal populations and reintroduction sites. Brown teal are a nationally endangered species so it is important to treat disease as a threat to the species, alongside other threats such as predation and habitat destruction.

Transfers between captive breeding/holding facilities are seen as low risk, as the captive population is treated as a 'whole population'. Transfers between captive breeding/holding facilities and Isaac Wildlife Trust/Peacock Springs are seen as medium risk, as Peacock Springs represents the 'filter' between captivity and the wild, where brown teal are conditioned for release (e.g. exposed to diet and feeders used at the release site). Transfers from Isaacs Wildlife Trust/Peacock Springs to the wild offer the final opportunity to check the

health and fitness of release birds and potential diseases of concern, ('double-check'), to reduce the risk of disease transfer to the wild. Transfers into the wild are seen as high-risk.

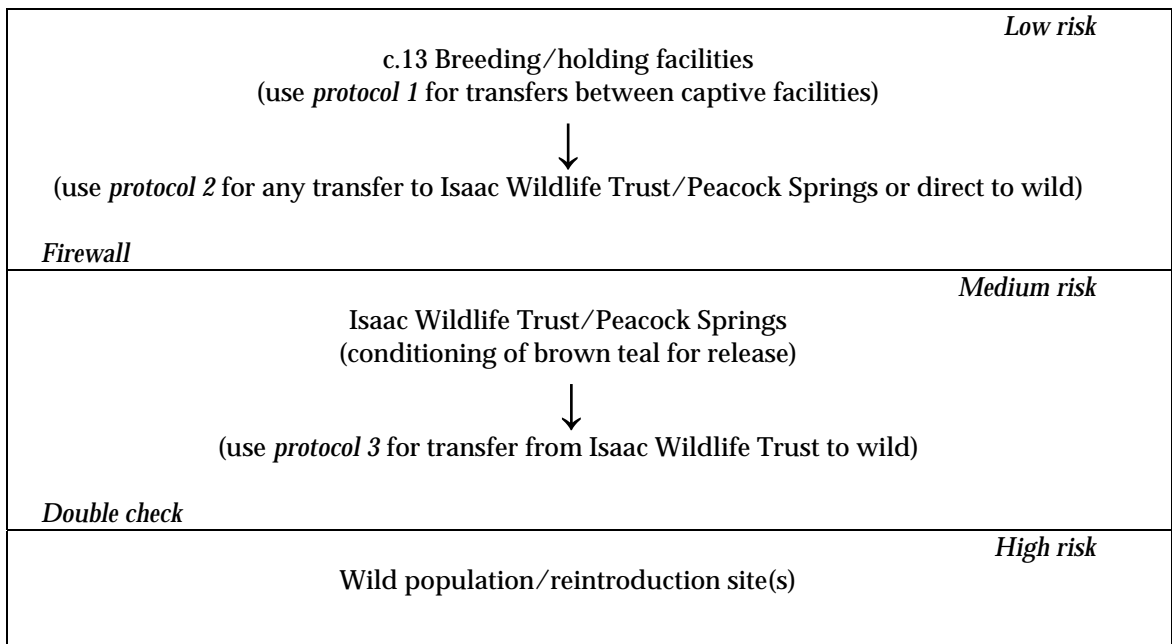
Three protocols have been developed to suit the different types of transfer:

- Protocol 1: captive to captive transfer (excluding Isaacs Wildlife Trust/Peacock Springs).
- Protocol 2: captive to Isaac Wildlife Trust/Peacock Springs.
- Protocol 2: captive (excluding Isaacs Wildlife Trust/Peacock Springs) to wild.
- Protocol 3: Isaac Wildlife Trust/Peacock Springs to wild.

Protocol 2 also applies to transfer from a captive breeding/holding facility direct to the wild. Protocol 2 is the most intensive, dubbed the 'firewall', reflecting the need to reduce the risk to wild brown teal populations/reintroduction sites.

Protocols are currently in development for the transfer of wild birds into captivity; these would also be applied to any captive birds introduced to the wild birds (for 'calming'/training purposes) during the immediate post transfer management phase.

Diagram 1: Rationale for brown teal quarantine protocols



12.2 PROTOCOL 1: CAPTIVE – CAPTIVE TRANSFER (BASIC REQUIREMENTS)

Quarantine Protocol 1 explanation:

- The basic requirement for a standard transfer of brown teal between holding/breeding facilities.
- Excluded is any extra test that a particular facility (or MAF) requires as part of their own health/disease management plans
- Excluded is the transfer from any brown teal holding/breeding facility to Isaac Wildlife Trust/Peacock Springs in Christchurch (see protocol 2 for this type of transfer).
- In general, the costs of protocol 1 will be covered by the participating donor facility unless prior arrangements have been agreed by participating parties.

Protocol 1: Quarantine holding period

Minimum 7 days, unless positive results returned/treatment/further testing/further holding required and/or additional requirements (facility specific/MAF). Note this minimum period recognises that the birds have a known history at the donor facility and have been continuously monitored (with records kept) by the breeder. If there have been any illnesses in the waterfowl collection during the previous 30 days veterinary advice should be sought on the appropriate length of quarantine.

Protocol 1: Tests/treatments prior to transfer

Physical examination should be performed by a trained operator (experienced staff or vet). Record weight, assess condition, look for pox type lesions (if identified – take biopsy); listen to airways, check for external parasites (fleas, nasal mites, ticks). Check birds are eating and behaving normally, and are passing normal droppings.

Parasites should be treated for as follows:

- Treat for internal parasites (intestinal nematodes, cestodes/tapeworms and trematodes/flukes) with a parasiticide effective against internal parasites (e.g. sheep oral 'Ivomec' at 200mcg/kg or 'Fenbendazole' at 50mg/kg plus Praziquantel at 10mg/kg orally) at commencement of quarantine. Screen before departure via faecal direct smear and flotation counts from each bird. Treatments to be repeated within 3 days of departure if any positive findings in the parasite screens.
- Treat for external parasites (ectoparasites) with a suitable parasiticide (e.g. fipronil 'Frontline' spray) once before departure.
- Samples to be sent to: Gribbles Veterinary Pathology, 35 O'Rorke Rd, Penrose, Auckland Tel 09-526-4560 or Alpha Scientific, 57 Sunshine Ave, Hamilton, Tel 07 850 0777. Call at least 3 days in advance to advise shipment of samples.

Protocol 1: Quarantine requirements

- Isolate transfer birds from all other brown teal and other species;
- Sign on door: "Quarantine - No Unauthorized Entry";
- Insect/rodent traps/screens/baits;
- Bags for waste disposal;
- Feeding, watering and cleaning utensils;
- Animal capture and restraint equipment;
- Lock for facility;
- Boot changes;
- Protective clothing e.g. overalls plus disposable gloves if handling birds;
- Aviary habitat/ furniture as appropriate for species;
- Animal record forms;
- Send results to Captive Management Co-ordinator.

A Protocol 1 record sheet features in the Appendices.

12.3 PROTOCOL 2: CAPTIVE – WILD AND CAPTIVE – ISAAC WILDLIFE TRUST TRANSFERS

Quarantine Protocol 2 explanation:

- The requirement for any transfer of brown teal from a captive holding/breeding facility to the wild or to the Isaac Wildlife Trust/Peacock Springs.

- This protocol is more intensive and relates to the Isaac Wildlife Trust facilities as these facilities provide pre-release conditioning of birds immediately prior to release. The Isaac Wildlife Trust facilities act as a 'firewall' between captivity and the wild, in terms of minimising the risk of disease transfer.
- Excludes is any extra test that a particular facility (or MAF) requires as part of their own health/disease management plans.
- In general, the costs of protocol 2 will be covered by the release programme budget (approved DOC or joint venture programme with stakeholder) or recovery group budget, as agreed between the participating parties.

Protocol 2: Quarantine holding period

Approximately 10-14 days unless positive results returned/treatment/further testing and further holding required. Note, as for Protocol 1, this minimum period recognises that the birds have a known history at the donor facility and have been continuously monitored (with records kept) by the breeder. If there have been any illnesses in the waterfowl collection during the previous 30 days veterinary advice should be sought on the appropriate length of quarantine.

Test day 1; transfer when all returned results are negative.

Protocol 2: Tests/treatments prior to transfer

As for Protocol 1 (physical examination and treatment for parasites), plus the following:

- Chlamydia – ELISA Antigen test on conjunctival/choanal/cloacal swab from each bird (use Chlamydial swab).
- Avian TB – minimum take a blood smear for differential white blood cell (WBC) count; ideally blood smear AND whole blood sample (heparin-coated capillary tube sealed at both ends) for haemtocrit and total protein; check previous history of avian TB in source bird collections.
- Salmonella – from cloacal swab direct from cloaca, or from fresh faecal, in transport medium.
- Samples to be sent to: Gribbles Veterinary Pathology, 35 O'Rorke Rd, Penrose, Auckland Tel 09-526-4560 or Alpha Scientific, 57 Sunshine Ave, Hamilton, Tel 07 850 0777. Call at least 3 days in advance to advise shipment of samples.

Protocol 2: Quarantine requirements

As for Protocol 1, plus the following:

- Quarantine register to track movement of people in and out of quarantine.

A Protocol 2 record sheet features in the Appendices.

12.4 PROTOCOL 3: ISAAC WILDLIFE TRUST – WILD TRANSFER (DOUBLE CHECK)

Quarantine Protocol 3 explanation:

- The final double check requirement for any transfer of brown teal from the Isaac Wildlife Trust/Peacock Springs to the wild.
- All birds for transfer originating from other facilities will have already completed quarantine under protocol 2.

Protocol 3: Quarantine holding period

Minimum 30 days unless positive results returned/treatment/further testing/further holding required.

Protocol 3: Tests/treatments prior to transfer

Physical examination should be performed by a trained operator (experienced staff or vet). Record weight, assess condition, look for pox type lesions (if identified – take biopsy); listen to airways, check for external parasites (fleas, nasal mites, ticks). Check birds are eating and behaving normally, and are passing normal droppings.

Monitor body weight by re-weighing birds 2 weeks after arrival and if not less than 90% of arrival weight reweigh at departure; if less than 90% arrival weight follow veterinary advice.

Parasites should be screened for 2 weeks after arrival via faecal direct smear and flotation counts from each bird. Treat if positive and re-screen within 3 days of departure. Transfer if negative on screen.

Protocol 3: Quarantine requirements

As for Protocol 2.

12.5 COMMUNICATION PLAN FOR DELIVERING QUARANTINE PROTOCOLS

Activity	Communication Requirement
<ul style="list-style-type: none"> Notification of transfer 	Captive Co-ordinator → holder/breeder
<ul style="list-style-type: none"> Implement appropriate quarantine protocol (1/2/3) and communicate results pre transfer 	Holder/breeder → Captive Co-ordinator
<ul style="list-style-type: none"> Notification of positive results from protocol (1/2/3) quarantine 	Holder → Captive Co-ordinator Captive Co-ordinator → Veterinary Advisor to brown teal captive programme Captive Co-ordinator → Recovery Group Leader (protocol 2/3 only)
<ul style="list-style-type: none"> Seek advice and agree on treatment/further testing/additions to holding period associated with positive results returned from any quarantine. Recommended actions relayed to holder/breeder 	Captive Co-ordinator → Veterinary Advisor to brown teal captive programme Captive Co-ordinator → holder/breeder
<ul style="list-style-type: none"> Final recommendation on unresolved issues between parties 	Recovery Group Leader → all involved parties

NB: see Appendix 1 for current people in these positions @ July 2003

The Captive Management Co-ordinator will be the point contact with all holders/breeders (and their facility veterinary advisors). Individual holders/breeders or their veterinary advisors should not contact the Veterinary Advisor to the brown teal captive programme directly – they should work through the Captive Co-ordinator.

The Veterinary Advisor to the brown teal captive programme will be the point contact for veterinary advice on positive results returned from disease screening and recommended treatment/ further holding requirements. Any further consultation required with disease experts regarding treatments/further testing will be led by the Veterinary Advisor to the brown teal captive programme

13 Translocation

The translocation of brown teal between wild and captive environments, and vice versa, would be directed by the Recovery Group. The Captive Management Co-ordinator would oversee quarantine and holding of the birds post (or pre-) transfer, and manage the birds within the captive population under the Brown Teal Captive Management Plan (2000) in liaison with the affected facilities.

All transfers of brown teal between captive facilities must be approved by the Captive Management Co-ordinator, and the necessary permits obtained. Transfer techniques for juvenile and adult birds, and eggs, are described below; transfer of ducklings is rare as abandoned ducklings in the wild tend to be hand-reared by locals and then transferred as juveniles to formal captive facilities.

13.1 WILD TO CAPTIVE POST-TRANSFER MANAGEMENT OF JUVENILES/ADULTS

Captive facilities receiving brown teal from the wild should have considerable skills and experience in the captive management of this species. The quality of the facilities, skills base and husbandry techniques must be consistent with current best practice. The availability of key, experienced personnel at these facilities should not be compromised during the important post transfer transition phase.

Appropriate aviary capacity, plenty of cover for shelter, security and hiding, and easy access to suitable nutrition are considered basic principals in captive management when managing the transition of any wild animal to a captive environment. Together with the experience and competency of the holder, these factors should provide a smooth transition for wild teal, under considerable stress during capture and handling, brought into an unfamiliar environment.

It is essential that communication lines are maintained throughout the transition phase:

- A copy of the most recent quarantine protocol and the translocation proposal should be forwarded to the relevant veterinarian resident or local to the facility well in advance of the transfer.
- Regular contact between the holding facility and the Captive Management Co-ordinator should be maintained, with the Co-ordinator closely advising on post transfer management.
- The Co-ordinator should be informed by the facility of any unexpected events (absence of key staff, capacity issues, etc).
- As soon as the slightest problem is encountered, it is vital that the Co-ordinator, the veterinarian, and any of the relevant members of the Recovery Group are notified immediately. Providing problems are discovered and reported in the early stages, there is time to inform decision-makers and take extra measures to improve the situation, and the

health of all birds involved.

13.1.1 Housing

Birds need to be housed in single-sex groupings where possible, or if in mixed sex groups there must be extremely close observation and immediate separation if problems arise. The number of birds held per aviary is entirely dependent on the facilities available and would be advised by the Captive Management Co-ordinator.

Approved aviaries must meet all of the following standards:

- Aviary formally approved by the Captive Management Co-ordinator based on a site visit to assess the most up-to-date facilities.
- Adequate size. Birds should be divided as advised between aviaries to reduce crowding and the associated impacts of competition for food and social stress.
- Quiet, stress-free environment. Ensure aviaries are not subject to too many disturbances close to people, internal vehicle traffic and general noise.
- Plenty of ground cover. At least $\frac{3}{4}$ of the surface area of each aviary must have good cover. Lack of cover in an aviary is likely to be the single largest stress-inducing factor (birds would already have undergone capture, handling, disease screening and transportation), particularly during daylight hours when wild teal favour roosting in safe, familiar conditions in close proximity to, or under good cover. Feeding is likely to be a secondary consideration for such stressed birds; lack of cover can, therefore, lead to starvation. Trimmed brush from leafy trees can be used to boost existing plantings. It is suggested that lengths of leafy brush should be approx. 2–3 m long and stacked at right angles around the internal aviary perimeter. Brush should be several layers thick so that adequate cover—a dark secluded space with low light penetrating through the cover—is provided. A few ‘tepees’ of brush evenly spaced through the centre of each aviary, or 2–3 leafy branches cut down and laid out on the grass, provide cover opportunities through the middle of each aviary. If brush is used, it will need to be replaced regularly as leaves wilt and fall from the branches.
- Additional shelter. Providing a shelter tunnel per bird and spacing these widely within each aviary ensures that each bird has refuge in the (likely) event of social aggression between birds.
- Prevent pacing. Placing obstacles such as logs, rocks etc. at regular intervals around the internal aviary perimeter (under the cover) may help to reduce the incidence of birds pacing and of possible bill wear.

In cases where a well-used, existing aviary is being modified to accommodate the new arrivals, it is recommended to replace topsoil by removing 50–100 mm of spoilt soil and adding a similar depth of fresh clean topsoil to each aviary prior to planting. Aviaries must be densely planted with large *Carex*/tussock/grass so that at least $\frac{3}{4}$ of the aviary surface has dense cover. *Carex secta* is the best species if it can be sourced readily. If new plants are purchased they will need to be at least PB5 size, preferably bigger (PB10 plus). Brush/foliage is then used to compliment this planting if the volumes of large *Carex* etc. are difficult to obtain.

13.1.2 Food and water

Past experience has shown that transferred brown teal can lose a large proportion of body weight in the days immediately following capture, particularly if housing conditions are not suitable. Following one transfer deemed as unsuccessful, birds lost an average of 122 g in the

first six days post capture (range 82–184 g). Birds that subsequently died had lost 24–35% of their body weight in that six day period, whilst all the survivors had lost 12–20% in the same period. Necropsy results confirmed starvation (severe protein loss and dehydration) as the cause of death, likely to be caused by severe stress – highly likely to be a direct result of lack of cover.

Brown teal are omnivorous; invertebrates are likely to be key components of their wild diet. Presentation of commercially available live foods (e.g. earthworms, mealworms) greatly assists the transition to a largely artificial diet.

The feeding regime outlined below may seem somewhat overkill, however it is seen as necessary to ensure that all birds have at least an equal opportunity to access high quality foods and put on weight. Maximising feeding opportunities will help to carry birds through the period when social aggression between birds develops; hierarchies will inevitably form and dominant birds will defend feeding opportunities against subordinate birds.

Birds must have access to food and water at any location within the aviary. Each food station should contain the following foods presented in liberal (more than necessary) quantities.

- One feed station per bird in each aviary.
- Wet, sloppy mash mix.
- Dry pellets.
- Diced ‘Go- cat’ Complete (chicken, beef, calcium and vegetable flavour), soaked overnight and put in the blender the following morning to create moist crumble. With its high protein (26%) and fat (8.0%) content, ‘Go-cat’ is a good boost.
- Thinly sliced lettuce and silverbeet in a shallow tray of water.
- Live invertebrates: red earthworms (*Lumbricus rubellus*), large mealworms, waxmoth larvae, crickets and locusts sprinkled over a shallow tray of water at each station. Large crickets/locusts will need to be “de-limbed”. Live food can also be worked into all of the above artificial diet to aid transition to the artificial diet. The supply of earthworms will be the hardest to guarantee and should be fed out on an “as much as possible basis” between orders, as they are likely to be the most preferred prey. Mealworms are the easiest to obtain in large volume so will be the bulk live food to feed out; feed out at least a film canister full of mealworms per feed station twice daily. Feed out the waxmoth larvae, crickets and locusts ad lib, aiming for 10–20 of each per station twice daily as a benchmark.
- Feed live diet twice per day (early morning and late afternoon) and artificial diet once per day unless particular items of the artificial diet are disappearing fast (e.g. ‘Go-cat’ is likely) in which case the volume of those items can be increased and provided twice daily.
- Monitor food intake daily.

Repeat the prescribed feeding regime outlined above until such time as the weights of all birds have stabilised at optimum weights as determined by consultation between the Captive Management Co-ordinator, the veterinarian, and any of the relevant members of the Recovery Group. This can be judged by targeted observation of each bird initially, but if there is no sign of feeding, or a bird is always in hiding then brief capture for weighing is necessary at around the 4–5 day mark following transfer. Remote electronic scales set under the feed station are useful in conjunction with observation, but are not always available. Be aware that some individuals can exhibit a fluctuation between weight gain and loss.

If there is particular concern about the welfare of any individuals, the following measures can be taken:

- Provide a crop tubing regime of food and electrolytes for very light at-risk birds.

- Consider the need to isolate the most at-risk birds from other birds, in the same sort of conditions (cover and feeding regime) in another secluded aviary. Consultation between the Captive Management Co-ordinator, the veterinarian, and any of the relevant members of the Recovery Group would be made before this decision is taken.
- The introduction of young captive reared teal to the aviary is useful for settling birds and to encourage feeding behaviour by 'training' the wild teal to take the artificial diet. Again, facilities would be advised if this action, which may prove more beneficial if initiated immediately post transfer, is to be followed.

13.2 CAPTIVE TO WILD PRE-TRANSFER MANAGEMENT

Details specific to a translocation of brown teal for release into the wild are usually contained in a translocation proposal. In addition to the quarantine and disease-screening procedures, some points to consider regarding the condition of birds, but more specifically to the fitting of back-pack style radio-transmitters (if occurring), prior to release are as follows:

- It is beneficial to fit radio-transmitters (with harnesses) after weights have stabilised in pre-release quarantine to ensure harnesses do not become too tight when birds are still gaining weight following transfer to the pre-release facilities.
- Whilst pre-release birds should receive good food quantities in the time leading up to release, it is worth noting that harnesses fitted to particularly overweight birds may become quite loose following release when the bird inevitably loses weight. Loose harnesses are prone to being caught up in vegetation. Overfeeding should be avoided in these instances, or harnesses not fitted to birds at extreme weights.
- An option is to fit dummy transmitters to birds for several weeks prior to the attachment of the real transmitter, to familiarise birds with carrying the device, and to enable keepers to monitor any changes in harness fit in relation to body weight. (This method has been used in the Campbell Island teal release programme.)

13.3 EGG TRANSFERS

The transfer of brown teal eggs from the wild into captivity would be directed by the Recovery Group. All transfers of brown teal eggs between captive facilities must also be approved by the Captive Management Co-ordinator and the necessary permits obtained. Eggs can be either artificially incubated or naturally incubated by a foster parent on arrival at the destination facility, depending on the fate of the young following rearing i.e. following consultation with the Captive Co-ordinator.

Transportation of incubated eggs implemented under the brown teal captive management programme are likely to utilise the AB Newlife 75 portable incubator which can be powered by portable batteries, or via a car cigarette lighter connection. Eggs that are well underway in the incubation period will be less affected by the negative impacts of travel; eggs in very early stages of incubation will be more prone to embryonic damage due to jarring etc.

Key mechanisms to be familiar with (location and operation) when operating this model are the fan, heater and control screw, thermostat, and thermometers. Also to remember are battery leads with appropriate connections and a temperature adjustment screwdriver.

13.3.1 Portable Incubator

Power source

Use the car cigarette lighter connection as much as possible to save on portable battery life. Portable batteries have the following features:

- 12v s.l.a., 6.5ah or 7ah.
- Voltage draw of c. 0.18v when thermostat on.
- The 6.5ah will last about 3 hours and the 7ah about 3.5 hours (3 batteries gives about 10 hours contingency).
- When the battery is running low (from about 7v downwards) the temperature will start tapering off; the battery must be changed when it starts dropping below about 35.5°C (after about 3–3.5 hours).

Temperature

Important points to remember regarding temperature settings:

- For brown teal, aim for temperature average of about 37°C (with flexibility)..a (An acceptable range for the smaller eggs of a wader species often transferred in this machine has been 35.5–38.0°C.)
- Incubator takes about 1–1.5 hours to come up to temperature so turn on as soon as eggs are set. Alternatively pre-heat incubator to around 35°C with dummy eggs; the temperature will increase a little when the real warm eggs are put in.
- Thermostat light starts flicking on/off when it hits the pre-set temperature setting and the draw on the battery becomes intermittent.

Thermometer information:

- The taped on thermometer is very accurate and fluctuates continuously; fluctuation is expected/acceptable as there is temperature gradients vertically and horizontally in the incubator (due to location of heater and fan and the high frequency of thermostat switching on/off).
- The taped on thermometer should be used as the key temperature guide/monitoring tool. The end of the yellow probe should be placed next to the middle of one of the eggs (about 3rd way along tray) for an accurate measure of temperature at this point. If the alarm (continuous bleeping) sounds, the battery sign must be checked and if on, the 9v battery in back of thermometer needs to be replaced (using a Phillips screwdriver).
- Use record function to record max/min temperature, to work out average temperature during sealed (lid closed) periods, and the need to tune or not.
- If the average temperature is consistently too high/ low then the screwdriver is used to slightly tweak temperature control screw up (clockwise) or down as appropriate (no more than ¼ turn).
- The built-in thermometer is less reliable as the built-in probe is at the top of the incubator.

Placement of eggs

- Mark eggs (or at least record their location within egg tray) with relevant information.
- Place eggs sharp end down and work close-cell foam strips around them carefully with a pencil to 'bed' them in (not too much pressure).
- Add cotton wool if need extra protection, but air-cell can be kept clear for gas exchange.
- Add a small piece of wet (but squeezed out) sterile cotton wool for humidity.
- Ensure thermometer will not be touching eggs once lid is closed.

During transit

- Ideally the incubator should be held by a person or set in a cushioned box to absorb shocks,

- especially over rough terrain.
- Avoid any jarring movements.
 - The lid can be opened briefly (up to 10 seconds) about every 2 hours to allow fresh oxygen for gas exchange (not too long because of temperature loss).

14 Record Keeping Standards

14.1 INDIVIDUAL RECORDS

In-house records should be kept for every brown teal held. The official Brown Teal Online Database should be updated on a regular basis to help ensure correct information is collected for the Stud Book. The Captive Management Co-ordinator can be contacted to obtain a login and password, or regarding any queries or problems encountered. In-house records should be kept safe; these may be in the form of cards, ARKS system, etc. Records should always include identification (band no.), sex, age, parentage, health treatment, change of enclosure, identification of aviary companion or mate and any breeding details even if unsuccessful. Behavioural notes can also be included in these records.

14.2 ANNUAL REPORTS/ NOTIFICATION

Breeding Performance

All holders of brown teal are required to complete an annual breeding performance report to be forwarded to the Captive Management Co-ordinator by the end of March every year. The report should include a summary of breeding performance, with all new band combinations, sex and parentage of new recruits. This form is also included as part of the online database, where the information can be submitted instantly.

Delays in receiving the reports will result in an inability to efficiently co-ordinate the programme and failure to pair birds well in advance of a breeding season.

Health Management, Deaths and Pathology Results

Any significant health management issues, and all adult deaths (with pathology results) should be reported to the Captive Management Co-ordinator as they occur as these will effect the overall management of the captive population, including the ability to provide replacements.

Transfers

All transfers in or out of a facility will have been authorised by the Captive Management Co-ordinator; he/she will need to be informed should transfers not be implemented as planned.

15 Acknowledgements

We would like to acknowledge and thank Neil Hayes and the Brown Teal Conservation Trust for providing much information on the captive management of brown teal. Many thanks are owed to all the brown teal holders/breeders who have provided feedback and up-to-date information, and for their on-going commitment to the programme. Shaun O'Connor reviewed the final draft as well as contributing specific protocols; he also developed the quarantine protocols with both Richard Jakob-Hoff and Kevin Evans. Mike Goold, Anne Richardson and Andrew Nelson also contributed to development of the quarantine protocols. Glen Holland, Jerry Pauli and Christine Reed provided valuable feedback on many sections common to both this manual and the Campbell Island teal husbandry manual.

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Appendix 1: Useful Addresses/Contacts

Brown teal Captive Management Co-ordinator
Kevin Evans
Ph: 09 439 2561, 027 439 2561
mailto: kevan@ihug.co.nz

Brown teal Recovery Group Leader
Shaun O'Connor
Biodiversity Recovery Unit
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Veterinary Advisor to the brown teal captive programme
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Auckland Zoo
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mailto: richard.jakob-hoff@aucklandcity.govt.nz

Unifeeds Ltd. (Professional animal nutrition)
Fitzherbert Science Centre
Tennant Drive
PO Box 4247, Palmerston North
Ph: 06 355 5444
Fx: 06 355 5443
mailto: diets@unifeeds.co.nz

Underdown Suppliers (Avian incubation and rearing equipment)
153 Eriksen Road, Napier
Ph/Fx: 06 835 5460

Don Thomas
Technical Officer
Institute of Food, Nutrition and Human Health
Private Bag 11 222, Palmerston North
Ph: 06 350 5253, 025 285 6083
mailto: d.v.thomas@massey.ac.nz

Brett Gartrell or Maurice Alley
Institute of Veterinary, Animal and Biomedical Sciences (IVABS)
Massey University
Tennant Drive, Palmerston North.
Ph: 06 356 9099 (ext. 7016) or 06 350 4048 (Fx: 06 350 5636)
mailto: m.r.alley@massey.ac.nz
mailto: b.gartrell@massey.ac.nz.

Appendix 2: DOC Permit Requirements

Brown teal housing requirements must be approved by the Captive Management Coordinator.

Captive breeding facilities:

Predator-proof aviary

Minimum ground space 15–20 m² (ideally 40 m²) per aviary

Predator-proof base structure a minimum of 300 mm into ground (ideally 500 mm)

Aviary mesh 10 or 12 mm to exclude mice, weasels, sparrows (maximum 25 mm, less desirable as some predators can squeeze through this mesh size)

Aviary pond minimum 1 m² x 300 mm deep (ideally 1 m x 2 m x 300 mm)

Visual/physical barrier between adjacent brown teal aviaries a minimum of 500 mm high (ideally >700 mm)

Plant ground cover (*Carex*, sedge, tussock, etc)

Nest box/s (ideally 2).

Display-only facilities (including “wing-clipped” birds)

Fenced enclosure

Predator minimised area (good predator control)

Escape areas/good cover from aerial predators.

Appendix 3: Drug List

Drugs and their dose rates, that have been previously used for teal without deleterious side effects, are listed as follows:

Drug name	Active ingredient	Drug function	Dose rate for teal	Treatment regime
Baytril	Enrofloxacin	Antibiotic	15mg/kg	Twice daily/ 5 days
Trichozone 200	Metronidazole	Antibiotic	50mg/kg	Once daily/ 10 days
Stomorgyl-2	Metronidazole Spiramycin	Antibiotic	50mg/kg	Once daily/ 5 days
Vibravet 100 (paste)	Doxycycline	Antibiotic	50mg/kg	Once daily/ 5 days
Ivomec	Ivermectin	Wormer	0.25ml/kg	2 doses (10-14 days apart)
Tapewormer	Praziquantal	Wormer (tapeworm only)	20mg/kg	2 doses (10-14 days apart)

Appendix 4: Pateke Death Record

DATE	TIME	OBSERVER	
BANDS	METAL #	TR4 CHANNEL	SEX
LOCATION			
EASTING	NORTHING	WPT	
HABITAT (incl. ground cover, and nearby features such as road or fence)			
STATUS OF BODY (which way up?, how left, was it stashed?, is it plucked?, sign on carcass etc)			
SIGN IN TWO SQUARE METRES AROUND BODY			
RECORDS MADE (specimen, samples, photos)			
COMMENTS (incl. last tx location and date)			
PROCEDURES REQUIRED FROM MASSEY UNIVERSITY (IVABS)			
DISPOSAL OF SPECIMEN - INDICATE HOW THIS IS TO BE DONE. IF RETURNING TO DOC OFFICE, WRITE PROCESS FOR COURIER PAYMENT			
IN OFFICE			
SUSPECTED CAUSE OF DEATH (primary?)			COD BY:
DATE & TIME OF DEATH (record TSD function)		AGE/FIRST BANDED	
AGE OF BIRD AT DEATH		# DAYS TX ON BIRD	
DISTANCE FROM NATAL/TX ATTACHMENT SITE TO DEATH LOCATION			
NECROPSY REPORT NUMBER		WHERE BODY STORED	

NB This is the universal certificate used for both wild and captive *post mortem* examinations: some of the prompt boxes (e.g. tx channel) will not apply in some situations.

Specimens can be couriered to pathologists Brett Gartrell or Maurice Alley at:

Institute of Veterinary, Animal and Biomedical Sciences (IVABS), Massey University, Tennant Drive, Palmerston North. Ph: 06 3569099 (ext. 7016) or 06 3504048 (Fx: 06 3505636)

Appendix 7: Brown Teal Annual Breeding Report Form

Captive facility:							
Date:							
Name:							
Parents	Clutch No.	Egg No.	Method of Incubation	Fertile (Y/N)	Hatch Date	Sex of Progeny	New Band Nos.
Sire S88888	1	1	Parent	Y	15/11/98	Male	S11111
		2	Parent	Y	15/11/98	Male	S22222
		3	Parent	Y	15/11/98	Female	S33333
Dam S99999	1	4	Parent	Y	-	-	-
		5	Parent	N	-	-	-
Comments:							
Comments:							
Comments:							

Please forward to:- Brown teal Captive Management Co-ordinator, RD 2, Ruawai, Northland, or email: kevin@brownteal.com

Appendix 8: Photographs

