

Husbandry Manual for  
**Brush-tailed Rock-wallaby**  
*Petrogale penicillata*  
Mammalia: Macropodidae



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## **CLASSIFICATION**

The Brush-tailed Rock-wallaby is classified **Low Risk/Innocuous** - harmless or not likely to cause harm to a person.

See Section 8.4 for more information on zoonotic diseases

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# 1 INTRODUCTION

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## HISTORY IN CAPTIVITY

A captive breeding programme was set up for the BTRW as their numbers were too few remaining in the wild to ensure the species would survive long term. Also, their breeding rate was too slow to maintain positive population growth due to natural and introduced predators and competitors.

Cross fostering is now being used to help the population growth. Cross fostering has 2 main benefits for the species.

- 1) It frees the mother from the burden of carrying the young to term (7-8 months)
- 2) Allows her to cycle again, mate and produce another young which can then be fostered to a surrogate mother.

Cross fostering trials started in 1997 at Tidbinbilla Reserve using Tammar wallabies as surrogate mothers. These trials were completed in 1998. Tammar wallabies were replaced with Yellow footed rock wallabies because their mothering techniques were more suitable and their cycle was year round. Cross fostering trials between BTRW and YFRW commenced in 1998 at Adelaide zoo and were completed in 1999.

Several institutions are involved in the BTRW cross fostering programme. These include five intensive breeding institutions; Adelaide Zoo and the Waite Animal facility in SA, Healesville Sanctuary in Vic, Waterfall Springs Conservation Park in Gosford and Tidbinbilla Nature Reserve and Curumbine Sanctuary in Queensland. (Brush-tailed Rock-wallaby Recovery Team)

## VALUE AS A TOOL FOR EDUCATION CONSERVATION AND RESEARCH

The BTRW is the basis of many research programmes throughout Australia, particularly along the Eastern seaboard. Most recently the NSW DEC has put into action a recovery plan working with organisations throughout NSW to assist in the recovery actions being directed towards the continuation and enhancement of existing predator and introduced herbivore control programs; surveys to enhance our knowledge of the distribution and abundance of the species; the maintenance and enhancement of captive breeding programs both throughout NSW and Victoria for identified regional populations (Southern, Central and Northern) and the continuation and enhancement of community based conservation programs. (Department of environment and conservation, 2005)

## 2 TAXONOMY

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### 2.1 NOMENCLATURE

Kingdom:	Animalia
Phylum:	Chordata
Class:	Mammalia
Order:	Marsupialia
Family:	Macropodidae
Genus:	<i>Petrogale</i>
Species:	<i>penicillata</i>

Common name: Brush-tailed Rock-wallaby

Scientific name: *Petrogale penicillata*

Pen-iss-il-ah-tah: 'brush (-tailed) rock-weasel'

(Muranyi, Monica, 2000)

### 2.2 SUBSPECIES

To date there are no recognised subspecies for the BTRW. There are however three recognised ESU's (Evolutionary Significant Unit's) the Northern, Southern and Central. ESU's are used when it is not yet possible to prove that groups are genetically different and therefore subspecies but it is suspected that they may be. This way each gene pool can remain 'clean' until additional information can be obtained on the gene pools and the ESU's can be managed as though they were subspecies. (Pers. Com. Phipps, Graeme, 2006-07)

Research to date on the genetic typing of BTRW indicates BTRW populations are naturally highly structured and the level of geneflow between colonies is typically limited (Eldridge and Browning unpub.). For example, restrictions in geneflow can occur over distances of approximately 4 km. Recent studies on BTRW dispersal indicates the females demonstrate strong philopatry within colonies, i.e. they are more related to females in close proximity than those further along the same cliff-line, whereas males are more likely to disperse.

Relatively undisturbed populations of BTRW still contain high levels of genetic diversity (as measured by microsatellites). However, in areas where BTRW have declined, the remnant populations have lost considerable amounts of genetic diversity and remaining individuals are often highly related. Demographic, environmental and genetic stochasticity severely threaten the survival of these remnant populations.

The pattern of sequence divergence of BTRW mitochondrial DNA (mtDNA) indicates the presence of three genetically distinct groups or ESU:

- (i) A highly divergent lineage currently consisting of the remnant Victorian populations. Representatives of this lineage may have previously occurred in southern NSW.
- (ii) A well defined central NSW group consisting of closely related populations in the region from the Shoalhaven and Jenolan Caves to Broke and the Warrumbungles.
- (iii) A less well defined group of populations in south-eastern Queensland and northeastern NSW (at least as far south as Woko National Park. The mtDNA of this group appears most closely related to Herbert's Rock-wallaby and may be the result of natural introgression. At the northern most extent, a narrow hybrid zone has formed between BTRW and Herbert's Rock-wallaby (Department of environment and conservation, 2005)

While the exact level of taxonomic difference remains to be established, it is clear that these three groups exhibit important genetic variation that should be maintained. In this regard, as indicated in Section 3.0, they have been determined to be Evolutionary Significant Units (ESU).

The exact boundaries between these ESU are yet to be determined. The boundary between the northern and central ESU lies somewhere between Broke and Woko National Park, and may be centred on the Hunter Valley. Defining the boundary between the central and southern ESU is likely to remain problematic as there are no animals now known from this area. Therefore, these boundaries should be considered as guides only for management and recovery purposes, and have most applicability to the maintenance of genetic integrity of the three taxonomic groups.

Three genetically distinctive groups of Brush-tailed Rock-wallabies have been identified on the basis of mitochondrial DNA analyses. Due to a lack of taxonomic resolution, these groups are referred to as Evolutionary Significant Units (ESUs):

- (i) Central ESU: a well-defined group consisting of closely related populations in the region from central NSW, including Kangaroo Valley, Jenolan Caves, Broke and the Warrumbungles;
- (ii) Northern ESU: a less well-defined group comprising locations in north-east NSW and south-east Queensland, which extends as far south as Armidale. At the northern end, there exists a narrow hybrid zone between *P. penicillata* and *P. herberti*;
- (iii) Southern ESU: a highly divergent lineage from Victoria, and previously south-east NSW (Department of environment and conservation, 2005)

These differences can be explained by the fact that at some point it seems, probably tens of thousands of years ago, the distribution of the BTRW was fragmented and what is now the Victorian populations stayed separated for an extended period of time and their mtDNA (mitochondrial DNA) diverged. The cause of this fragmentation may have been ice sheets spreading down from the Australian Alps (Brush-tailed Rock-wallaby Recovery Team)

### **2.3 RECENT SYNONYMS**

Not Applicable

### **2.4 OTHER COMMON NAMES**

Not applicable

## 3 NATURAL HISTORY

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### 3.1 MORPHOMETRICS

#### 3.1.1 Mass And Basic Body Measurements

The BTRW is a distinctively marked, medium-sized wallaby and one of the larger species of the genus *Petrogale*. Individuals average 510-586 mm in head to tail length and 500-700 mm in tail length. Females are slightly smaller on average than males, with less muscle development on the forelimbs. Body weight for males ranges from 5.5 to 10.9 kg and for females from 4.9 to 8.2 kg. (Department of environment and conservation, 2005)

Males:	529 – 586	(557) mm
Females:	510 – 570	(536) mm

#### Tail length

Males:	510 – 700	(611) mm
Females:	500 – 630	(563) mm

#### Weight

Males:	5.5 – 10.7	(7.9) kg
Females:	5.4 – 8.2	(6.3) kg

(Muranyi, Monica, 2000)

#### 3.1.2 Sexual Dimorphism

N/A

#### 3.1.3 Distinguishing Features

Brush-tailed Rock-wallabies are most commonly dull brown above, tending to reddish brown on the rump and to grey on the neck and shoulders, and lighter underneath. Although little colour variation generally occurs between the sexes, the rufous coloration of the male may be more emphatic. However, there is considerable variation in colouring and patterning between different populations and between individual wallabies within a population, often allowing individual identification.

The head is marked by a light coloured cheek stripe and a black dorsal stripe from the eyes to behind the head. The flanks are more or less distinctly striped pale grey over black, and there may be a white blaze, which varies in size and shape, on the chest. The posterior third of the tail is generally distinctively bushy (hence the species common name) and is generally brown to black but can be paler in some individuals. Colours tend to be lighter and tails less bushy in the north of the range, and juveniles are more brightly marked than adults. The hind feet are comparatively short, the foot pads have rough surfaces and the central toes bend more freely than those of other long-footed wallabies. The toes do not extend as far beyond the toe pad as compared with other wallabies (Department of environment and conservation, 2005).

Rock-wallabies are highly agile animals able to move swiftly and confidently, by means of highly precise bounds, through very rugged and precipitous areas. The rock-wallabies great agility has been attributed to their long flexible tail used for balance, and their short, flexible, well padded, and rough textured feet which give remarkable traction (Department of environment and conservation, 2005).

The Brush-tailed Rock-wallaby is small to medium in size, stands 60-65 cm tall and adults weigh 6-8 kg. Upper body fur is generally brown, with a rufous patch surrounding the hind-quarters. The face has a pale cheek-stripe. Ears are black outside and yellowish on the inside and the tail is long, 500-600 mm, and characteristically bushy at the end (Department of Primary Industries)

Rock wallabies are small agile inhabitants of cliffs and boulder piles. They are distinguished from other members of the family Macropodidae by the following characteristics.

(i) The tail is not thickened at the base as in most other members of the kangaroo family but rather is long, cylindrical and more thickly haired. It is not employed to support the weight as a “fifth leg” but is used to assist in balance.

(ii) The body is compact and the feet comparatively short

(iii) The soles of the hind feet are tuberculated and the nails are very short, not projecting far in front of the toe. The tuberculations give a rough surface to the foot enhancing friction.

(These distinctive features of the genus are adaptations to living in a rocky environment where manoeuvrability and surefootedness are more important than sprinting ability) (Short, Jeffery Charles, 1980)



*The Brush-tailed Rock-wallabies long bushy tail acts as a “fifth leg”*

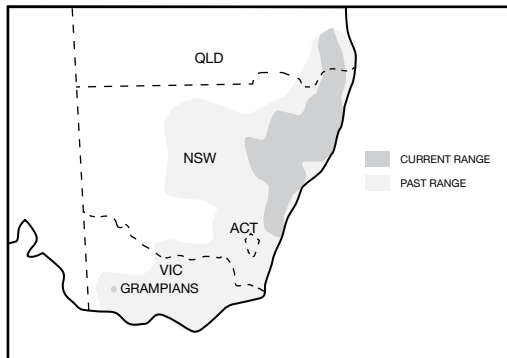
### **3.2 DISTRIBUTION AND HABITAT**

(indicate worldwide distribution, a distribution map if possible, if migratory include details of habitat types it travels to and from

The historical range of the BTRW extended from the Grampians in western Victoria to Nanango in south-eastern Queensland, roughly following the line of the Great Dividing Range. However, there has been a decline in numbers and a reduction in the species range, with the decline being greatest in Victoria, and in western and southern NSW. The species range is now fragmented, particularly in the south where it is now mostly found as small isolated populations dotted across the former range (Department of environment and conservation, 2005).

Until recently, the very small population in the Grampians in Victoria was the most westerly population, some 550 km away from the nearest population in East Gippsland. The population in the Grampians is now thought to be extinct. In NSW, the populations in the Shoalhaven and the Warrumbungle Ranges are the most southerly and westerly known populations, respectively. Although still fragmented, BTRW occurrence in the north is more continuous along a number of the major river system gorges, for example, the Apsley-Macleay and Clarence Rivers.

A major survey of the species distribution was carried out in 1990. They found 37 sites where the species had occurred within the previous 20 years and 30 sites where they were presumed extinct. In 1993, a more comprehensive survey identified 47 colonies existing in 18 localities in central, southern and western NSW and more than 100 colonies in 15 localities in northern NSW. The survey found a further 14 sites where the animals had become extinct. Since 1993 BTRW at five of these localities have disappeared, making a total number of 49 sites known to have become extinct, or vacated, since 1990. A National Parks and Wildlife Service (NPWS) survey in 1995 located 15 colonies of BTRW in Yengo National Park and Parr State Recreation Area and surrounding areas (Department of Environment and Conservation, 2005).



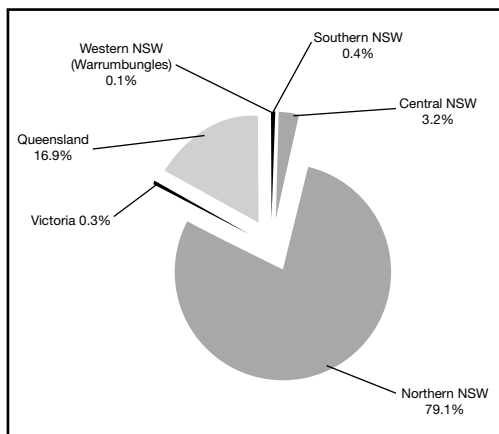
*Past and present range of the Brush-tailed Rock-wallaby*

### **Abundance**

During the late 1880s, BTRW were abundant and widespread across the rocky country of south-eastern Australia from southern Queensland to Victoria. From 1900 until about 1920, hundreds of thousands of BTRW were shot as agricultural pests and hunted for fur. Subsequently, their numbers appear to have continued to fall in most localities and it is now estimated that there are between 15,000 and 30,000 animals left in total. Gaining a more precise estimate of numbers is difficult due to the inaccessibility of the species' habitats, particularly in the north of its range where numbers are known to be greater.

Based on current records, approximately 17 % BTRW occur in south-eastern Queensland, 82 % in NSW (including ACT), and fewer than 1 % in Victoria. In NSW, as many as 98 % BTRW are found north of the Hunter River, and up to 80 % the total number of BTRW in Australia are found in north-eastern NSW alone (see Figure 8). Moreover, the majority of the northern NSW populations are in the Macleay River and Clarence River gorge complexes.

While it is possible that numbers in the north of the species range were always higher than in the south, there is a substantial amount of evidence which indicates the relative numbers in the south have not only been reduced, but drastically so. Accurately estimating abundance remains one of the challenges for recovery planning (Department of Environment and Conservation, 2005).



*Estimated region abundance of the Brush-tailed Rock-wallaby*

## Habitat

Brush-tailed Rock-wallabies are a widely distributed species but populations are isolated even within areas of continuous rocky habitat, particularly in the southern part of their range. A possible explanation for this pattern of dispersal is that this species has specialised habitat requirements that are met only in localised and patchily distributed locations (Department of Environment and Conservation, 2005).

This study classified occupied BTRW habitat into three categories:

- Loose piles of large boulders containing a maze of subterranean holes and passageways.
- Cliffs with many mid-level ledges and with some caves and/or ledges covered by overhangs. Cliff height is usually over 15 m.
- Isolated rock stacks, usually sheer-sided and often girdled with fallen boulders.

Habitat requirements of the BTRW were examined, and 15 refuge/habitat variables were tested as potential discriminators. Short (1982) developed a predictive equation to assess refuge/habitat suitability, which used 5 variables: percentage of sheltered ledges, number of ledges, aspect of cliff, percentage of ledges of restricted accessibility, and length of ledges.

Importantly though, Short (1982) also points out that this present habitat picture may have developed after environmental changes wrought by European man, including fox and other feral introductions, raising the threshold of suitability of rocky habitat.

The species use of rocky habitat, rock-stacks and boulder piles may afford greater protection from predation. Steep rocky slopes and rock-stacks may provide a buffer against environmental stress. These habitats are difficult for most exotic herbivores to penetrate (except goats); they have a patchy distribution of fuel which breaks up fires; they provide effective shelter from most cursorial predators and provide energy cheap, thermally buffered shelter. Vegetation near rock surfaces also receives shading, seepage and run-off that encourages greater plant diversity and extends periods of growth and occasional flushes during drought (Department of Environment and Conservation, 2005).



*A trap used for Brush-tailed Rock-wallabies both in captivity and in the wild - set open*



*A trap used for Brush-tailed Rock-wallabies both in captivity and in the wild - triggered shut*

Since the work of Short (1982), BTRW have been found to use a wider range of rocky habitats. Brush-tailed Rock-wallabies have been found living on much less complex cliffs, using vegetation rather than rocks for shelter, eg. in some areas of the Shoalhaven and the Macleay River Gorges. Large spreading fig trees are a common shelter plant in the New England area. Brush-tailed Rock-wallabies have also been found on aspects other than northerly (Department of Environment and Conservation, 2005).

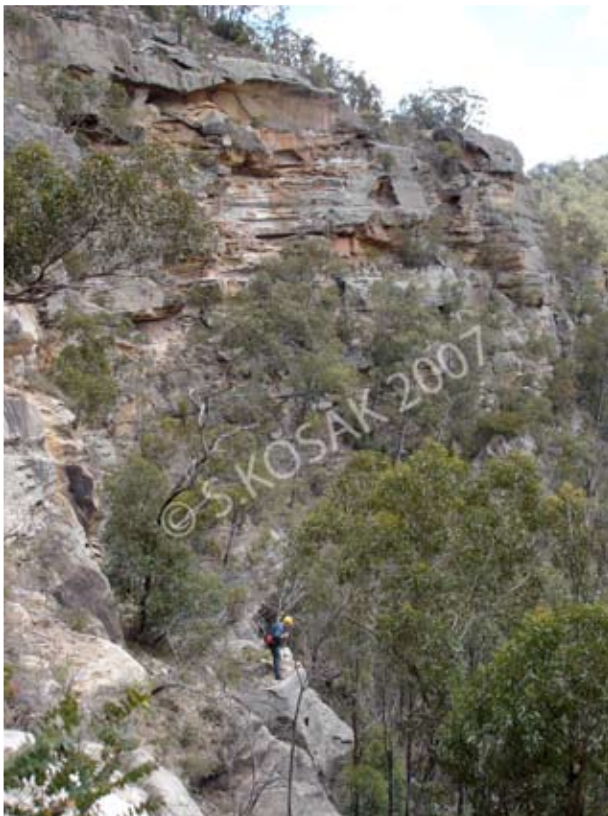
While it appears that most BTRW colonies are on north-facing slopes and cliff lines (Short, 1982), colonies have been found on south-facing cliffs in Kangaroo Valley (Kutzner and Dodd 1996; Wong 1997), in the Macleay River Gorge, at the Warrumbungles and at Mt Kaputar, although usually in lower densities. Although the habitat of these colonies is south-facing, there are still areas which are exposed to the sun, eg. a free standing rock pinnacle or prominent spur. Of 963 recorded sites, Cavanagh found that while approximately 73 % faced in a northerly direction (west through north to east), 24 % sites faced in a southerly direction (WSW through south to ESE) (Department of Environment and Conservation, 2005).

The vegetation on and below the cliff appears to be of equal importance to BTRW. It is a source of food and shelter and in some cases may provide some protection from predation. The proximity of mesic vegetation, vegetation structure and floristics are important habitat factors for BTRW in the Shoalhaven. This follows similar results of studies on other species of rock-wallaby. Bugg (1995) also found that core BTRW habitat in the Shoalhaven occurs where mesic vegetation is associated with complex cliffs, boulder piles and rock outcrops. In Kangaroo Valley, BTRW occur in areas where the rainforest vegetation is associated with topographic complexity (Bugg 1995). The invasion of grassy feeding areas by weed species such as Lantana is thought to reduce habitat quality for BTRW (Department of Environment and Conservation, 2005).

It is possible that BTRW behaviour and use of habitat has changed in many ways in the last 200 years. The introduction of the fox, along with other human-induced changes, is likely to have raised the suitability

threshold of the wallabies rocky habitat so that fewer sites are now occupied. Behaviour of BTRW reported as typical by Le Souef and Burrell (1926) would seem somewhat unusual in current literature: sheltering in hollow logs, allowing such close approach as to be taken by hand in their caves, and when hotly pursued the rock-wallaby will make for (a leaning) tree at top speed, and without hesitation spring as high as possible up the trunk, then finally gain a fork or large limb (Department of Environment and Conservation, 2005).

Extant BTRW sites were found to be larger than unoccupied sites, face predominantly north to north-east, have a general slope no greater than 45 degrees and a greater number of ledges per 100m of transect. It was also found that BTRW preferred larger refuges with more than one entrance, low exposure to weather and another refuge or ledge within 10m. Preferred ledges were also large, faced predominantly north to east and within 10m of another refuge or ledge (Brush-tailed Rock-wallaby Recovery Team).



*Typical Brush-tail Rock-wallaby territory*



*People placing traps on cliff faces*

A small number of colonies exist in the wild in south-eastern NSW, south-eastern Qld, and at two locations in Victoria, Snowy River National Park in the east, and the Grampians National Park in western Victoria. A captive colony has been established at Tidbinbilla Nature Reserve in the ACT.

Once widespread in areas of eastern Australia, the Brush-tailed Rock-wallaby (*Petrogale penicillata*) now occurs in fragmented populations in southern Queensland, New South Wales, and two locations in Victoria. The only species of rock-wallaby in Victoria, these pretty wallabies were found in large numbers in rocky areas prior to European settlement ((Department of Environment and Conservation, 2005).

Since then, numbers have declined rapidly due to demand for their thick soft fur - over half a million were

killed between 1884 and 1914 - and because they were regarded as a pest in some agricultural areas. Christened the 'shadow' because they are extremely shy creatures which are difficult to see in the wild, the Brush-tailed Rock-wallaby is considered as Critically Endangered by the Victorian Government and Vulnerable by the Australian Government.

These shy creatures inhabit steep rocky terrain. Caves or rock crevices are essential for shelter, from which the wallabies emerge in the evening and early morning, to feed on grass, herbs and shrubs. Little is known about their breeding habits in the wild.

Populations in the southern part of the range of the Brush-tailed Rock-wallaby are small, fragmented and isolated. This reduces the likelihood of successful migration between colonies, making them vulnerable to extinction from inbreeding and catastrophes such as wildfires.

Introduced predators such as the Red Fox, feral Cat and wild Dog also threaten rock-wallabies. Foxes and Cats are adept climbers and it is easy for them to locate the juveniles, which shelter in rock crevices.

Feral Goats and Rabbits are competitors for shelter sites and food (Department of Primary Industries).

### **Reproductive Biology**

A study of BTRW on Mototapu Island, gave an average age to independence of 230 days, and a mean of 1.35 pouch young born per year per female. Breeding seemed to have no particular season and was continuous year-round, probably depending mainly on food availability. Continuous breeding has also been observed in the Shoalhaven Valley where young were seen to vacate the pouch in January, March (twice), April, July, October and November. In contrast, a study in the Macleay River gorges found that April had the highest birth rate, with most juveniles vacating the pouch during August-November and dispersing during March and May. In the same area, Bayne (unpub.) has observed some year round breeding with a peak of large pouch young (when they are most easily seen) in late spring, consistent with an autumn peak in birth rates.

Females give birth to a single pouch young at a time, after a gestation period of approximately 30 days. The young remain in the pouch for 6 months. After they first emerge from the pouch, the joey spends a further 7-20 days in and out of the pouch. As BTRW are crepuscular, young may be left at dawn, dusk or at night in refuges while the mother moves out to feed. Weaning is believed to occur 86 days after leaving the pouch, when the joey is 9 months old (Lee and Ward 1989). Sexual maturation of females occurs at 18 months, males at 20-24 months (Department of Environment and Conservation, 2005).

All sub-adult males and most sub-adult females disperse from their refuges of birth. Life expectancy in the wild is 5-10+ years but can be longer in captivity (Department of Environment and Conservation, 2005).

The minimum time between litters is likely to be 210 days. The number of young born per year is related to dominance. A study by Joblin (1983) found the dominant female of a group produced 1.09 young per year, and the subordinate females produced 0.59 per year. Reproductive success appears to be related to both the dominance rank of breeding females and the habitat the breeding unit occupies (Department of Environment and Conservation, 2005).

Brush-tailed Rock-wallabies are polygynous, and a dominant male will be found with up to four females. They appear to live in family groups of 2-5 adults and usually one or two juvenile and sub-adult individuals, but are also known to occur in male-female pairs (Department of Environment and Conservation, 2005).

### **Reproductive specificity**

Bee and Close (1993) studied the contact zones and the fertility of hybrids produced in captivity of a number of species of the eastern Petrogale. Introgression was identified between BTRW and Herbert's

Rock-wallaby (*Petrogale herberti*) (and also two other *Petrogale* species). Both BTRW and Herbert's Rock-wallaby have discrete distributions and only co-occur at the one site where hybridisation occurs. Bee and Close argue the range of morphologically and chromosomally distinct forms of rock draft NSW Recovery Plan Brush-tailed Rock-wallaby 15 wallabies indicates there is very little to no gene flow between different species of *Petrogale*.

### **Recruitment rate**

The rate of recruitment and the dynamics of dispersal are little known areas of BTRW ecology. However, the species appears to have low migration rates between colonies and low recolonisation rates that may be exacerbated by human induced land use changes and predator pressures.

Recent studies on the microsatellites and mtDNA of BTRW indicate that BTRW populations are naturally highly structured and that the amount of geneflow between colonies is typically limited (Eldridge et al. 2001; Eldridge et al. 2004). However, it is important to note that both techniques also indicate that geneflow between populations is not completely absent. Instead it is this low level of geneflow which has maintained the genetic health and cohesion of the BTRW as a species for millennia.

Recent human induced BTRW population declines, extinctions and fragmentation have almost certainly severely disrupted the natural process of low level geneflow that has been occurring within this species for thousands of years. As colonies are isolated and restricted to rocky habitats, migration is likely to be impeded by cleared or degraded intervening habitat. Without active and on-going management the long-term future of any population that is now completely isolated is questionable (Department of Environment and Conservation, 2005).

## **3.3 CONSERVATION STATUS**

### STATE

Victoria - Critically Endangered (Southern ESU)

NSW - Vulnerable (Central ESU)

Qld - Vulnerable (Northern ESU)

(Brush-tailed Rock-wallaby Recovery Team)

FEDERAL: Endangered

IUCN: Vulnerable

## **3.4 DIET IN THE WILD**

The diet of the BTRW, as determined by microscopic identification of plant epidermis in the faeces consisted primarily of grasses (35-50%) and forbes (28-35%) with a smaller but significant component of shrubs and trees (12-30%). Pterophytes, sedges and orchids were present in the diet but were quantitatively unimportant. Diets were similar in the two areas studied, despite considerable differences in rainfall and vegetation type. There were few marked seasonal changes in diet (Department of Environment and Conservation, 2005).

Ferns and sedges were of minor importance or were absent from the diet. Preferences for particular plant categories (measured as abundance in diet divided by abundance in habitat) were greatest in summer. Parallel-veined shrubs and trees and forbs were most preferred at one site; grasses and shrubs and trees at the other. Ferns were preferred least (CSIRO. Australian Wildlife Research).

### **Major plant species eaten by the Brush-tailed Rock-wallaby as recorded in and around Goulburn and Kangaroo Valley**

**Ridge - Goulburn Valley**

*Melaleuca uncinata*  
*Leptospermum juniperum*  
*Phebalium squamulosum*  
*Lewcopogon muticus*  
*Persoonia linearis*  
*Goodenia rotundifolia*  
*Dimorphochloe rigidea*  
*Eragrostis brownii*  
*Paspalidium albobillosum*

**Cliff - Goulburn Valley**

*Ficus rubiginosus*  
*Ficus superba var henneana*  
*Isotoma axillaris*  
*Rhagodia sp.*  
*Chenopodium carinatum*  
*Parietaria debilis*

**Footslopes - Goulburn Valley**

*Angophora floribunda*  
*Eucalyptus punctata*  
*Eucalyptus fibrosa ssp. Nubila*  
*Alphitonia excelsa*  
*Notelae microcarpa*  
*Abutilon oxycarpum*  
*Sida corrugata*  
*Chenopodium carinatum*  
*Rhagodia sp.*  
*Eragrostis brownii*  
*Microlaena stipoides*

**Valley - Goulburn Valley**

*Acacia linearifolia*  
*Aristida ramosa*  
*Stipa verticillata*  
*Panicum simile*  
*Sporobulus creber*  
*Lomandra sp.*  
*Cheilanthes tenuifolia*  
*Helichrysum apiculatum*

**Ridge - Kangaroo Valley**

*Syncarpia glomulifera*  
*Angophora floribunda*  
*Eucalyptus gummifera*  
*Eucalyptus punctata*  
*Macrozamia commumis*  
*Banksia spinulosa*  
*Pteridium esculenotum*  
*Microlaena stipoides*  
*Imperata cylindricum varmajor*  
*Entolasia marginata*

**Cliff - Kangaroo Valley**

*Ficus rubiginosus*  
*Dendrobium speciosum*  
*Dendrobium striolatum*  
*Liparis reflexa*  
*Davallia pyxidata*  
*Isotoma axillaris*  
*Plectranthus parvifolius*

**Footslopes - Kangaroo Valley**

*Eucalyptus saligna*  
*Angophora floribunda*  
*Cissus hypoglaucous*  
*Culcita dubia*  
*Urtica incisa*  
*Sarcopetalum harveyanum*  
*Commelina cyanea*  
*Cayratia clematidea*  
*Eupatoria riparium*  
*Rubus parvifolius*

**Valley - Kangaroo Valley**

*Eucalyptus saligna*  
*Eucalyptus urceolaris*  
*Senecio mikanoides*  
*Commelina cyanea*  
*Eupatoria riparium*  
*Culcita dubia*  
*Microlaena stipoides*  
*Pellae falcata*  
 (Short, Jeffery Charles, 1980)

## 3.5 LONGEVITY

### 3.5.1 In the Wild

Not known

### 3.5.2 In Captivity

up to 15 years (Short, 1987)

### 3.5.3 Techniques Used to Determine Age in Adults

#### FEMALES

Pouch - tighter the pouch the younger the animal

Teats - small and sometimes capped the younger the animal

Weight - under 4-5kg for a sub-adult

Crown measurement (A) - head

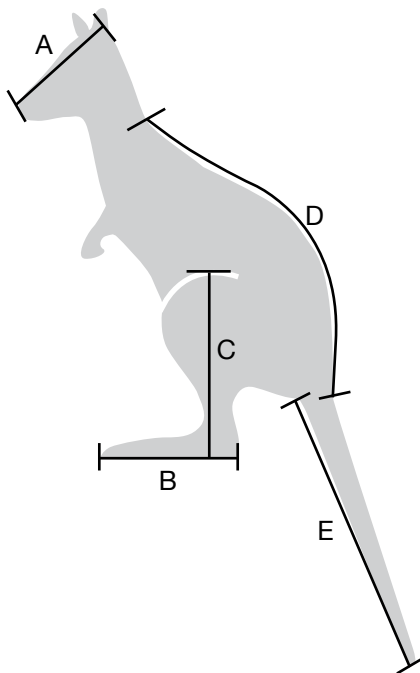
Pes measurement (B) - Back foot

Leg measurement (C) - top of knee to level with the bottom foot  
(foot to be held at right angles to the leg)

Rump measurement (D) - neck to the base of the tail

Tail measurement (E) - taken from the underside of the tail

Teeth - Condition and wearing



#### MALES

Testies - Smaller the younger the animal

Weight - under 6kg for a sub-adult

Crown measurement (A) - head

Pes measurement (B) - Back foot

Leg measurement (C) - top of knee to level with the bottom foot  
(foot to be held at right angles to the leg)

Rump measurement (D) - neck to the base of the tail

Tail measurement (E) - taken from the underside of the tail

Teeth - Condition and wearing

## 4 HOUSING REQUIREMENTS

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### 4.1 EXHIBIT/ENCLOSURE DESIGN

Nocturnal House - As all species of macropod are considered to be predominantly nocturnal and crepuscular, they may be exhibited in a reversed lighting enclosure (AGRIC).

Naturally extant BTRW sites that are preferred face predominantly north to north-east, have a general slope no greater than 45 degrees and a greater number of ledges per 100m of transect. It was also found that BTRW preferred larger refuges with more than one entrance, low exposure to weather and another refuge or ledge within 10m. Preferred ledges were also large, faced predominantly north to east and within 10m of another refuge or ledge (Brush-tailed Rock-wallaby Recovery Team).

#### Construction

- a) Enclosures shall be constructed of such materials and be maintained in sufficiently good repair to ensure that they will contain the animals at all times and are to be safe for the animals, for the staff attending them, and for the public.
- b) The size and shape of enclosures for macropods shall provide freedom horizontally and, where warranted, vertically and should not fall below the minimum requirements set forth under 1.1.6.
- c) All macropod enclosures shall incorporate an adjoining holding yard(s). A number of display enclosures may make use of the same holding yard. The size of holding yards should not fall below one third of the minimum requirements for display enclosures.
- d) The enclosure shall be well drained and the substrate predominantly of compacted inert material which is non-abrasive to macropod feet. Concrete is only acceptable for short term holding/hospital enclosures.
- e) The accumulation of faeces and urine in or on substrate around watering and feeding points shall be prevented by at least one of the following:
  - i) providing readily cleanable substrate around fixed watering/feeding points;
  - ii) providing a readily replaceable substrate around watering/feeding points which are fixed; or
  - iii) providing feeding/watering points which can be readily moved (AGRIC).

#### Fences

- a) Establishments exhibiting macropods shall have a dog and fox-proof perimeter fence. (Min.2m high, 0.5m beneath ground and 0.5m overhang at 45 degrees outward. If not constructed from smooth unclimbable panel - other appropriate alternatives will be considered.)
- b) If unroofed fences are to be used, then the fences shall either be made of a material which is not climbable (min. 2m high for Rock Wallabies) or be rimmed by 45 degree outrigger 0.5m wide facing into the enclosure.
- c) Fences which incorporate obstacles protruding out from the fenceline into the enclosure shall not be used to enclose macropods.
- d) Straining wires for fences shall be on the outside of the enclosure.
- e) Changes in the direction of fence lines should be as smooth as possible. Any fence angle change should be clearly visible to the macropods. Where there is dense planting behind changes in the angle of wire mesh fences, the fence shall be of more visible construction. Bushes may be planted inside the enclosure, or loosely fitted wire mesh may be placed across corners to reduce the impact of a macropod encountering sharply angled corners.
- f) Mesh size of wire fences should be sufficiently small to ensure that the enclosed macropods cannot get their heads caught (AGRIC).

#### Treatment Facilities

Facilities shall be available for the isolation and treatment of sick animals. Reverse cycle lighting shall be available in these facilities for sick animals which are normally housed in a nocturnal house (AGRIC).

## **Feed**

- a) There shall be food available in addition to the vegetation growing in the enclosure.
- c) Food shall be placed above the substrate in suitable food containers. The enclosure shall have facilities for placing the food containers under shelter to ensure the provision of unspoiled food.
- d) The number of feeders and waterers and the available space at feeders and waterers shall be sufficient to ensure easy access to food and water by each individual.
- e) Suitable fibrous material shall be a component of macropod diet.
- f) Dry food containers (pellets) shall be kept clean, dry and free from pellet dust accumulation (AGRIC).

## **Water**

- a) Uncontaminated drinking water should be available to macropods at all times.
- b) A water trough shall be provided which is sufficiently large to allow each macropod to immerse its forelegs for cooling purposes. The trough shall be designed to prevent macropods sitting in the water.
- c) Water troughs shall be in a shaded area away from fence lines (AGRIC).

## **Clause 5 Hygiene**

- a) Substrate of enclosures shall be kept clean. The substrate, any enclosure furniture, food and water containers and other components of the enclosure shall be maintained in a clean and hygienic condition, free from the accumulation of faeces and urine.
- b) Without limiting the generality of (a), particular attention shall be paid to removing faeces from around feeding stations, watering points and resting areas.
- c) Contaminated substrate material shall be removed and replaced as necessary.
- d) Control of potential pests such as wild rodents, birds and insects shall preferably be under professional guidance.
- e) All articles which are likely to be dangerous if ingested shall be removed from the enclosure.
- f) Public feeding of the animals shall be controlled by supervision or appropriate signage (AGRIC).

It is also recommended that once every 6 months there is an overall maintenance audit to ensure all job requests have been completed. Enclosures require a high amount of maintenance and it can be very easy for small repair jobs to be missed. Brush-tail Rock-wallabies are extremely good at escape from the smallest holes and even small joeys are able to clear 3 metre high fences if there are ledges or tree stumps near by.

It is recommended that once every 2 months in addition to your daily husbandry, weeding is done. Some plants can be very toxic to Macropods as well as inedible weeds can take up valuable space in enclosures where edible browse could be growing instead.

Weeds removed should be placed in garbage bags and removed off site if possible.

## **4.2 HOLDING AREA DESIGN**

All macropod enclosures shall incorporate an adjoining holding yard(s). A number of display enclosures may make use of the same holding yard. The size of holding yards should not fall below one third of the minimum requirements for display enclosures (Minimum Floor Area of Enclosure 30 sqm per pair) (AGRIC).

## **4.3 SPATIAL REQUIREMENTS**

Rock Wallabies/Brush-tailed Rock-wallaby *Petrogale penicillata* - Minimum Floor Area of Enclosure 30 m<sup>2</sup> per pair.

- An additional 25% of the area listed shall be added to the enclosure size for each extra adult female.
- An additional 50% of the area listed shall be added to the enclosure size for each extra adult male.
- Where visitors are permitted to go into an enclosure with macropods, there shall be an area, which at least meets the minimum size requirements for holding yards and which is designated off limits to the visitors so the enclosed macropods may escape unwanted visitor attention (AGRIC).

#### **4.4 POSITION OF ENCLOSURES**

Animals kept outside should always have access to shade, especially during warmer parts of the year. Enclosures should preferably be facing north to north-east (Brush-tailed Rock-wallaby Recovery Team).

It is recommended that enclosures be allowed to spell for at least one month, every 12 months. This will also vary depending on the extent of use of the enclosure and the availability of other suitable enclosures. Spelling helps reduce the existence of harmful bacteria in the soil and also allows native browse and feed (grasses) to regenerate. Sun helps kill bacteria in the soil.

#### **4.5 WEATHER PROTECTION**

All animals shall be provided with a means of sheltering from wind, rain and extremes of temperature and sunlight. (This requirement may be fulfilled by providing a combination of ground cover and external plantings.) (AGRIC).

It was also found that BTRW preferred larger refuges with more than one entrance and low exposure to weather (Brush-tailed Rock-wallaby Recovery Team).

#### **4.6 TEMPERATURE REQUIREMENTS**

Brush-tailed Rock-wallabies do not cope well with temperatures over 30°C. It is important to monitor maximum temperatures. (Anne and Ray Williams, 1999)

Unfurred or just furred joey can not maintain its own body temperature, so it needs an artificial heat source. A constant pouch temperature is important and should be monitored.

A temperature indication is:

For unfurred or just furred joeys: 31°C.

For furred or fully furred joeys: about 28°C.

Overheating is as bad as under heating and can result in long term health problems. Animal heating pads are preferable for a heat source. BTRWs do not cope well with temperatures over 30°C. It is important to monitor maximum temperatures

For more information on joey temperatures see Chapter 11.2

#### **4.7 SUBSTRATE**

Natural substrates are best used in enclosures. In feed stations a fine material that can easily be sifted e.g. sand or fine gravel is good. In enclosures the best substrate for the ground is grass as this also supplies additional feed.

The substrate needs to drain well and preferable not hold moisture. Also consider OH&S risks when using the substrate e.g. when sifting excessive dust can be created.

#### **4.8 NESTBOXES AND/OR BEDDING MATERIAL**

There shall be sufficient soft substrate/bedding to allow all macropods to create a hip-hole for comfortable resting (AGRIC).

#### **4.9 ENCLOSURE FURNISHINGS**

a) Enclosure furniture and fittings shall be of such style and position as to prevent the likelihood of injury and, in particular, shall not be placed so as to provide an obstacle which will injure a macropod running a fence line.

- b) Suitable ground cover and/or other sight barriers shall be provided so that individuals can isolate themselves visually from the viewing public and other macropods sharing the enclosure.
- c) Without limiting the generality includes:
  - i) Rocks, grass tussocks, low plants, bushes, small shade trees, hollow logs, dried grass, leaves.
  - ii) Large rocks forming a rock knoll, rock crevices, caves, overhangs, low growing shrubs/bushes, small shade trees.
  - iv) Shade trees
- e) Ground cover shall be arranged so as to provide numerous pathways and hiding loci which serve to prevent stereotypic behaviour.
- f) Enclosures for rock wallabies shall include trees which they can climb or rough-barked naturalistic climbing structures. There shall be 15 lineal metres of climbing structure/tree for each Tree Kangaroo. Tree Kangaroos should be able to attain height of at least 2.5m.  
Enclosure boundaries shall be sufficiently distant from trees and climbing structures to prevent them from jumping out.  
The requirement for naturalistic climbing structures shall be met by providing a selection of stout, forked branches, low vertical logs and inclined branches to ensure a variety of arboreal pathways.
- g) Shelter: All animals shall be provided with a means of sheltering from wind, rain and extremes of temperature and sunlight. (This requirement may be fulfilled by providing a combination of ground cover and external plantings.)
- h) There shall be sufficient soft substrate/bedding to allow all macropods to create a hip-hole for comfortable resting (AGRIC).



*An example of a hide in an enclosure made out of sticks leaves and sheets of bark*

## 5 GENERAL HUSBANDRY

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### 5.1 HYGIENE AND CLEANING

Enclosures and holding areas that have asphalt or concrete substrates should be thoroughly swept daily and ideally hosed at least every second day. When animals have been moved from exhibits/enclosures with these substrates, the floors should be bleached in preparation for the new arrivals (Muranyi, Monica, 2000).

Outdoor enclosures generally do not need to be spot raked (features such as rock piles make it impracticable to do so). However, feeding areas within these enclosures are to be thoroughly cleaned daily. It is very important to keep the feed area as clean as possible due to the potential of health problems that can result from poor hygiene (Muranyi, Monica, 2000).

During the daily cleaning routines it is also important to investigate the enclosure for other areas that have a build up of faecal contamination that could pose a health threat. Cleaning and feeding times also provide opportunities to examine the animals for any signs of injury or illness (Muranyi, Monica, 2000).

Nesting material need only be changed if soiled or damp. Fresh browse can be supplied daily in addition to what is readily available in the enclosure.

#### DAILY CLEANING ROUTINE

Remove faeces.

Rake sand and substrate - Replace when needed

Supply fresh browse

Remove damp food from troughs

Replace with fresh food

Scatter carrot and sweet potato

Scrub out water bowl and refill with fresh water

Check that hides are still densely covered. Add more browse if there are too many exposed areas.

There are OH&S risks involved when handling or working within close proximity to Brush-tailed Rock-wallabies and the necessary SOP's need to be followed to ensure the health and safety of those working with the animals.

#### SOP's

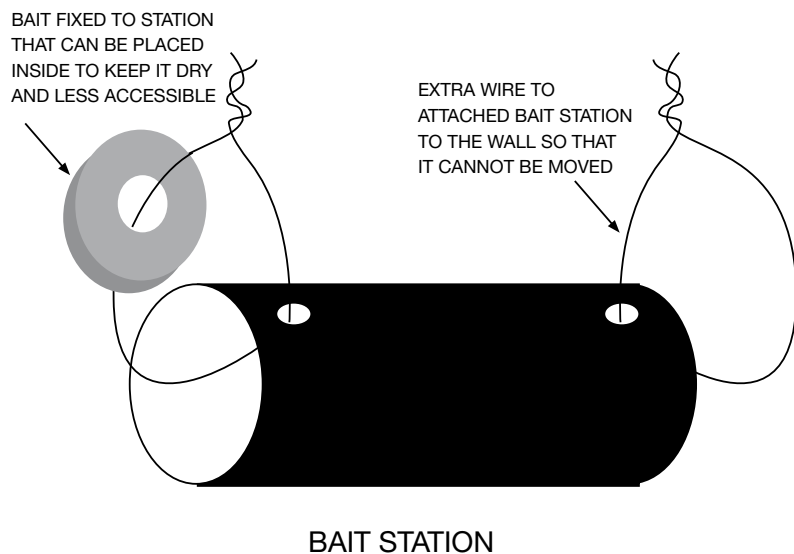
- Regular washing of hands, before and after handling animals and equipment or after coming into contact with scats, being scratched, bitten or nipped by the animal.
- PPE - Protective clothing including boots, long sleeve shirts and trousers, gloves and masks can all help prevent transmitting infection from animal to human and animal to animal. A hat and sunscreen should also be used when working outside to help prevent skin cancer and damage from the sun's rays.
- Correct lifting techniques should be used at all times.

#### BAITING - RATS AND MICE

Rats and mice are common problems when food is regularly available. Ensure food scraps are regularly cleaned up. Food storage should be preferably in metal containers or industrial plastic with sealed lids.

Baiting stations should be laid all year round and checked every 3 months to remove damp or old baits. Bait stations should be inaccessible to other animals and should be fixed to an area so they cannot accidentally be moved/lost.

A simple bait station to construct is a PVC piping about 30cm in length and about 60mm in diameter. Drill a hole in one end and loop fencing wire through, this can also thread through the bait block. This then needs to be attached, also by wires to the wall outside of the exhibit.



## 5.2 RECORD KEEPING

- a) Records for macropods listed in 3.1a) shall be kept on an individual basis in a form which can be quickly and easily examined, analysed and compared with those kept by other establishments:
  - i) The records shall provide at least the following information for each individual:
    - A) The correct scientific name, common name, individual identification, any personal name and any distinctive markings.
    - B) The origin (i.e. details of the wild population or of the parents and their origin, and of any previous location).
    - C) The dates of acquisition and disposal, with details of circumstances and addresses.
    - D) The date or estimated date of birth, stipulating the basis on which the date is estimated.
    - E) Clinical data, including results of physical examination by a qualified veterinarian and details of and date when any form of treatment was given, together with results of routine health examinations.
    - F) Breeding and details of any offspring.
    - G) The date of death and the results of the post mortem examination.
      - ii) Animals moving to new locations must be accompanied by copies of all records relevant to those animals.
      - iii) All documents and other information pertaining to each animal from previous locations must be kept safely.
  - b) The records shall provide at least the following information for each macropod species NOT listed in 3.1(a) above.
    - i) The common name and correct scientific name.
    - ii) The current total number of animals held, the number of males, number of females, and the number of unsexed animals.
    - iii) The dates of acquisition and disposal, with details of circumstances and addresses.
    - iv) The date or estimated date of each birth, stipulating the basis on which the date is estimated.
    - v) The date of each death and the results of the post mortem examination.
  - c) Species identification shall be made by a suitably qualified person and the records shall state who was responsible for species identification for the purposes of this Act.
  - d) The Director-General may direct an establishment to utilise the services of a suitably qualified person to make species identification if there is some doubt as to species identification (AGRIC).

### **5.3 METHODS OF IDENTIFICATION**

- a) It shall be the aim of the exhibitor to individually identify all macropods and each individual of the following species must be individually identified by an Standards for exhibiting captive macropods in New South Wales 9 approved method of identification: Rock Wallaby sp.
- b) Approved methods of ID include eartags, earmarks, tattoos (only where ventral surface of ear or inside of hind leg is relatively hairless).
- c) Establishments exhibiting any of the species listed in (a) as at, or after, 1.7.89 shall ensure each new individual of these species acquired is individually identified. Existing individuals shall be identified as the opportunity arises (AGRIC)

### **5.4 ROUTINE DATA COLLECTION**

Daily diary, update cage cards, Animals personal chart with pouch status

Once every 6 months it is recommended that there is a full animal audit. There will be data recorded throughout the year but these are very discrete animals and quite often only a portion of the animals in an enclosure are viewed at any one time. Joeys and adults can fall victim to snakes and other predators.

## 6 FEEDING REQUIREMENTS

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### 6.1 CAPTIVE DIET

They should be supplied with fresh grass, including the roots and attached soil, Lucerne hay, in moderation, rolled oats, kangaroo pellets, carrots, apples, bark and salt bush. The grasses should be tied into a bundle and hung. Early in the season the grass may not have dried out, so care should be taken when feeding grasses as the high water content can lead to diarrhoea (Marsupial Society).

Each animal of average weight and size consumes approx. 200g (min. 15% of their body weight) each per day of:

Lucerne hay - ad lib

Macropod pellets - ad lib

Cracked corn/Maize - 1/2 cup per day - usually only added to the diet in winter to help bulk up the animal

Sweet corn on the cob - 2 slices (about 2 cm thick but only 2 x per week) mainly used for conditioning

Sweet Potato - 50g per day

Carrot - 100g per day

Any type of native grasses OR Buffalo - 1/2 bucket per wallaby

(Taronga Zoo, 2006)

Native Browse - which includes tea tree, bottle brush, grevillia, Eucalypt

#### **\*\*\*\*\*NOT DO NOT FEED WALLABIES EXOTICS AS BROWSE\*\*\*\*\***

Browse to be given fresh every day (with bark on) in addition to what is readily available in the enclosure. Additional grass and forbs also to be supplied.

#### **\*\*\*\*\*AVOID WHOLE GRAIN AND SHARP SEEDS\*\*\*\*\***

These can cause gum abrasions which can lead to Lumpy Jaw (Marsupial Society).

#### **FEED**

- a) There shall be food available in addition to the vegetation growing in the enclosure.
- b) Omnivorous species (Potoroos, Bettongs, Hipsiprymnodon) shall be provided with the opportunity to obtain animal-based food appropriate to the species in addition to vegetation-based food.
- c) Food shall be placed above the substrate in suitable food containers. The enclosure shall have facilities for placing the food containers under shelter to ensure the provision of unspoiled food.
- d) The number of feeders and waterers and the available space at feeders and waterers shall be sufficient to ensure easy access to food and water by each individual. Food should be available to Tree Kangaroos which are at or above ground level.
- e) Suitable fibrous material shall be a component of macropod diet except for those omnivorous species which do not require it (Potoroos, Bettongs).
- f) Dry food containers (pellets) shall be kept clean, dry and free from pellet dust accumulation (AGRIC)

#### **WATER**

- a) Uncontaminated drinking water should be available to macropods at all times.
- b) A water trough shall be provided which is sufficiently large to allow each macropod to immerse its forelegs for cooling purposes. The trough shall be designed to prevent macropods sitting in the water.
- c) Water troughs shall be in a shaded area away from fence lines (AGRIC).

## 6.2 SUPPLEMENTS

This may include cracked corn during winter months to help bulk the animal.  
(Thomson, Celia, 2006-07)

## 6.3 PRESENTATION OF FOOD

### ENRICHMENT

There are four aims of behavioural enrichment:

- 1 - To preserve and conserve natural behaviour - eg searching for food in a particular manner, digging, climbing, browsing, foraging, caching etc.
- 2 - To eliminate or reduce levels of stress, abnormal or stereotypic behaviour, such as pacing, rocking, over-eating, aggression, hyper-sexuality or over-grooming.
- 3 - To increase the behavioural diversity of the animal by giving it a variety of different things that it can do and choices it can make, each day.
- 4 - To increase the animals' activity levels and thereby increase the overall levels of both mental and physical fitness (Marsupial Society).

Native Browse - which includes tea tree, bottle brush, grevillia, Eucalypt, Mulberry (although not native - do not supply the berries, only leaves and branches)

**NOT DO NOT FEED WALLABIES EXOTICS AS BROWSE**

Browse to be given fresh every other day (with bark on) in addition to what is readily available in the enclosure. Give a generous bouquet of browse with a minimum of 3 species per bunch. Native grasses and forbs also to be supplied.

Browsers, especially wallabies do not mind eating from a shared food container (Phipps, Graeme, 2006-07).

Food should always be placed on feeder tables at a decent height of about 1M above the ground to help prevent vermin from taking any excess food.

Food should be kept dry at all times as mould can cause health problems.

## 7 HANDLING AND TRANSPORT

### 7.1 TIMING OF CAPTURE AND HANDLING

As with all macropods it can be difficult to catch BTRWs and the risk of injury increases when animals become stressed. Captures should be organised in advance and generally undertaken in the coolest time of the day. This is because Macropods can overheat if it is too warm or if chased for too long. Early morning captures are recommended and also have the advantage of the absence of the public (AGRIC).

When catching up BTRW's that have pouch young, when under stress they may throw their joey. If this happens the joey can be returned to the mothers pouch.

The joey must first be checked for injuries and placed in a warm joey bag. The mother then needs to be sedated (insert sedation and quantity as well as Vitamin E Selenium). The joey is then able to be re-inserted into the mothers pouch. Masking tape the pouch closed, but make sure the tape is loose enough that the mother can gradually remove the tape herself. The mother with joey then need to be placed in a dark, quiet room for a minimum of 24 hours.



Step 1



Step 2



Step 3



Step 4



Step 5

*The joey is inserted head first into the pouch while the mother is lightly sedated. Masking tape is then used to hold the pouch closed so that the mother cannot throw the joey.*

### 7.2 CATCHING BAGS

This is the most common form of catching device used for BTRW. They are also commonly used for transporting Macropods as they settle easily when hanging.

- The bag should be made out of thick material (canvas), so that as little light as possible is coming through. Macropods settle down faster in darkness.
- The material should be strong enough to contain the animal and not allow its teeth or claws to puncture the bag.
- The bag should always be used in-side-out to reduce the chance of loose threads entangling the wallaby.
- The bag needs to be a decent size of approx. 1.0 m x 0.6 m. This should allow the wallaby to be quickly and easily placed into it (AGRIC).

### 7.3 CAPTURE AND RESTRAINT TECHNIQUES

- A macropod enclosure should include or have access to a confinement run, or well padded crush gate. Small macropods may be caught in a race made of nets.
- If a macropod licks its forearms after being chased, the person overseeing its capture shall immediately attempt to minimise further disturbance until the following day.

Captive macropods shall be under the supervision of a person capable of:

- safely handling and restraining macropods.
- minimising the likelihood of and danger of attacks on keepers and visitors by macropods.
- minimising the stress experienced by macropods resulting from keepers carrying out routine duties.
- providing adequate maintenance diets for the macropods held.
- demonstrating his/her good record in the maintenance and husbandry of macropods.
- in the case of studbook species, keeping accurate records of studbook species and participating in their management to the satisfaction of the Species Co-ordinator of the Australasian Species Management Scheme (AGRIC).

For regular catch-ups the best method to use for capture is tailing. This involves someone entering a small enclosed area with the wallaby. Grab the wallaby by the base of the tail where it meets the body. Be sure not to grab the tail too far down as this can cause trauma to the tail. The wallaby will quite often try to 'spin' when being held like this. So it is helpful to use two hands when restraining. Once the wallaby is caught it can be placed head first into a catching bag. Once in the bag the wallaby can be scanned for microchip identification.



### 7.4 WEIGHING AND EXAMINATION

**WEIGHING** - Use a hanging scale. Bags are easily hung from these.

For lighter animal hold the scale away from your body with the bag attached to record a weight.

For heavier animals attach the scale to a fixed location

- Weight the bag before use and record the weight (this will later be subtracted from the total weight of the wallaby and the bag to give the exact weight of the animal).
- Record the weight of the BTRW in the bag.

EXAMINATION - Is best done with 2 people. While examining the BTRW try to keep its head covered at all times to help reduce stress. Examination is best done sitting down with the bag on one persons lap. One person should restrain the animal while the other person examines the wallaby (a third person is useful to record data). Person 2 needs to check the animals mouth - inside and out, skin, pads of feet, eyes, ears and quality of fur and the weight of the animal to touch (Muranyi, Monica, 2000).



## 7.5 RELEASE

- Place the bag on the ground and untie the bag opening.
- Ensure the opening is not toward a sudden drop or obstacle when an animal is released from a bag or trap.
- Gently shake the animal out of the bag or trap.

NOTE: Animals that have been sedated should be kept in a holding yard under close supervision before being released to their enclosure (AGRIC)

## 7.6 TRANSPORT REQUIREMENTS

Also refer to attached IATA Transportation Standards (p54-57) in Appendix

### 7.6.1 Box Design

Materials that may be used for the box are: wood, plywood, hardwood, fibreboard.

For transport trips of less than 24 hours duration, macropods should, wherever possible, be transported in suspended bags made of hessian or similar open-weave material. The animals shall be accompanied by a person described in 2.1 who shall monitor their condition.

Where this is not possible, or for transport trips greater than 24 hours duration, the macropods shall be transported in a container constructed from fibreboard, hardboard, wood/plywood, or other appropriate material to the design requirements of 6.2.

### DESIGN

- a) Framework shall be 20mm x 20mm light timber for macropods weighing less than 20kg.  
Framework shall be of 25mm x 25mm light timber for macropods weighing more than 20kg.  
Macropod transport containers shall not have internal framing.

- b) Bottom and fixed sides shall be of 6mm (13mm for macropods weighing more than 20kg) plywood glued and screwed. Macropod transport containers shall not have slatted floors.
- c) The end is to be closed by a sliding door of 6mm (13mm for macropods weighing more than 20kg) plywood which, once in place, shall be secured by screws at each end.
- d) The ceiling shall not be solid. It shall consist of flexible chicken wire mesh, padded on the underside with hessian to protect the animal's head should the animal become agitated and jump.
- e) The container shall be large enough for the animals to turn around, to lie and to stand comfortably. Dimensions shall not exceed these criteria as no room for exercise is needed and animals may hurt themselves if too much room is provided.
- f) A transport container for macropods shall not allow the entry of light, except through ventilation holes. The ventilation holes shall be 5cm below the internal roof height and 5cm above absorbent material used on the floor of the container to prevent spillage. The ventilation holes of 15mm diameter shall be pierced at no greater than 10cm centres at the top and bottom of each side.
- g) Spacing blocks of 2.5cm shall be fixed to the outside of the box on all four sides.

### **CONSIGNMENT REQUIREMENTS**

A person who consigns a live macropod shall:

- a) affix labels to the container of not less than 20cm in length and 14cm in width on which is clearly, legibly and indelibly printed in capital letters the word "KANGAROO" or "WALLABY", "LIVE ANIMAL" : "HANDLE WITH CARE" : "THIS WAY UP" : "KEEP COOL".
- b) attach to the outside of the container an envelope in which is contained a consignment note showing the consignor's name, address and telephone number; the consignee's name, address and telephone number; the date of dispatch; the number of macropods despatched and the common name, scientific name of the species enclosed.

### **SEDATION**

All macropods shall be sedated with diazepam administered under the supervision of a registered veterinarian before being enclosed in transport containers (AGRIC).

### **CRATES/BOXES**

Macropods must be transferred individually within solid framed crates that meet the IATA standards relevant to that species.

In addition to the relevant IATA standards, the following conditions apply:

- (a) macropod transport containers must not have internal frames.
- (b) macropod transport containers must not have slatted floors.
- (c) substrate and food items to be used during the shipment must meet the approval of the importing and transit countries.
- (d) if Australian native flora, the food to accompany the macropods must be included on the export permit application submitted to DEH.
- (e) sawdust should not to be used as a substrate due to risk of inhalation.
- (f) the padding on the internal ceiling should not be able to be eaten or pulled off. A padded wire ceiling may be used instead of plywood if approved by IATA (Department for Environment and Heritage, 2003).

## **7.6.2 Furnishings**

The floor must be covered with a deep layer of absorbent material, such as wood shavings, for bedding.

A soft plastic water container must be provided, raised off the floor and with outside access.

Wallabies require curtaining over the door and ventilation openings to give reduced light inside the container (IATA Container requirement 82).

Shredded paper or weed free lucerne hay or straw may also be suitable.

### **7.6.3 Water and Food**

Separate food and water receptacles must be provided, either fixed inside the container or attached to it with a means to access into the container so that they can be filled or replenished when required. They must have rounded edges and be made of non-toxic material suitable for the species.

Shippers instructions for feeding and watering must be given in writing at the time of acceptance. Feeding and watering instructions must be fixed to the container and a copy of the instructions must accompany the shipping documents. Any feed or water given must be recorded on the container instructions with the date and time of supply (IATA Container requirement 82).

### **7.6.4 Animals per Box**

Macropods must be transferred individually within solid framed crates that meet the IATA standards relevant to that species (Department for Environment and Heritage, 2003).

### **7.6.5 Timing of Transportation**

Transportation is best to take place in the early morning to help prevent the animal over heating. If this is not possible then a temperature controlled environment (car air conditioning) is recommended.

### **7.6.6 Release from Box**

- a) An enclosure in which macropods are to be released should have its wire fences made more visible by hanging hessian or similar material.
- b) Macropods shall not be disturbed for at least three hours after release into their new enclosure to allow familiarisation with their surroundings.

## 8 HEALTH REQUIREMENTS

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### 8.1 DAILY HEALTH CHECKS

(List the routine observations undertaken daily during cleaning and feeding.)

Animals temperament

Fur condition - if there are any bald areas, thickness and density of the coat

Feet, claws and pads of feet. Damp conditions can cause the pads to become swollen

Front paws can be damaged during fights from biting and scratching

Skin condition

Often wet areas on the coat can indicate excessive licking of possible wounds or sores.

### 8.2 DETAILED PHYSICAL EXAMINATION

#### 8.2.1 Chemical Restraint

SEDATION - All macropods shall be sedated with diazepam administered under the supervision of a registered veterinarian before being enclosed in transport containers (AGRIC).

Appropriate anaesthetic agents include:

- Diazepam (Valium) - a useful sedative for short procedures such as pouch checking and blood collection at a dose rate of 1 mg/kg intravenously;
- Zoletil - a good immobilising drug providing smooth recovery and induction at a dose rate of 20 mg/kg intramuscularly;
- Ketamine / Xylazine mixture - similar effect to Zoletil at dose rate 15 mg/kg Ketamine mixed with 5 mg/kg Xylazine, intramuscularly; and
- Isoflurane or Halothane - both can be administered by mask to reach surgical anaesthesia following immobilisation by any of the above agents.

Euthanasia can be performed by intravenous injection of an overdose of sodium pentobarbitone (Lethobarb) (ANZCCART, 1995).

#### 8.2.2 Physical Examination

Routine mouth inspections for lumpy jaw.

Regular pouch checks.

Weighting and general body condition checks should all be carried out regularly.

The fur condition should be regularly checked to ensure it is thick and consistent condition.

The skin should also be checked regularly as they can be prone to mites. Skin infections can also occur during the breeding season from mating wounds.

In addition to the above a routine examination should be done by a vet once every 12 months

### 8.3 ROUTINE TREATMENTS

Eqimec - roundworm

Injectable Ivomec - for parasites

Baycox (Piglet or chicken) - Coccidia (when found in large amounts in their faeces).

Frontline - If ticks are bad or the animal may be more susceptible to illness from ticks and parasites. (Thomson, Celia, 2006-07)

### 8.4 KNOWN HEALTH PROBLEMS

Little is known about disease in wild populations of BTRW, although it is likely that this species is susceptible to diseases found in other macropods. Owing to the naturally disjunct nature of BTRW colonies, the species may be capable of surviving genetic bottlenecks and recovering from very low

numbers. Inbreeding depression may be present in some colonies, for example, the Jenolan Caves colony, resulting in suppressed reproduction.

A study which found massive infestations of hydatid cysts in the thoracic cavities of BTRW suggests a relationship between hydatidosis in BTRW and sheep (Close 1984 in Lobert 1988). Lobert (1988) also raised the possibility that BTRW are susceptible to toxoplasmosis infection, carried by cats. A BTRW in Kangaroo Valley was reported to have died from toxoplasmosis in addition to liver fluke infestation.

Lumpy jaw was apparently present in the captive colony at Jenolan Caves prior to the large scale release in 1988 (Buchan 1995). This disease is more prevalent in populations of macropods which are exposed to human contact and, specifically, fed soft (processed) foods (Department of Environment and Conservation, 2005).

Macropods may be affected by a number of different diseases (Spielman, 1995). Many diseases are avoidable if good husbandry techniques are employed. Provided that stocking rates are low, there is an adequate number of feeding stations, water troughs are cleaned regularly, faeces are removed from concrete enclosures and animals that do become ill are isolated, disease incidence can be minimal in captive macropod colonies.

Necrobacillosis, or lumpy jaw, is one of the most well described and characterised diseases affecting macropods and although there is more to learn about its aetiology and inciting agents, it is relatively well understood. It is associated with overcrowding, poor hygiene or poor diet, although it can occur in situations where none of these factors is apparent. The first signs are swellings around the jaw associated with necrotic, foetid and erosive lesions. Internal organs may also be involved.

Once the disease is detectable, antibiotic therapy is probably universally unsuccessful without surgery. However, precursor conditions (such as gum disease) may be effectively treated with antibiotics. Animals suffering will usually show some improvement with treatment, but the disease is only slowed, not cured. Unless the circumstances are exceptional, the animal should be euthanased.

Toxoplasmosis can occur in marsupials, which act as an intermediate host for the coccidian parasite, *Toxoplasma gondii*. Transmission is usually via ingestion of oocysts excreted in the faeces of domestic cats. Slight to severe neurological signs are manifested, including head tilt, ataxia, difficult respiration and sometimes sudden death. Treatment is only effective if given early and should include a combination of vitamin E / selenium, corticosteroids, diazepam (to reduce anxiety and produce sedation), sodium bicarbonate and intravenous fluids. Helminths are common in macropods and do not produce problems, except in times of stress. Good husbandry procedures provide the best means of protection (Spielman, 1995) (ANZCCART, 1995).

There are a few known diseases which can be transmitted from macropods to humans. There is a high carrier rate of salmonella species in young macropodids and even normal adults and these bacteria can cause sudden death, diarrhoea, lethargy, poor appetite and pneumonia in affected animals. Ringworm can be severe and is highly contagious to humans. It can cause oval to round areas of redness, scaliness or itchiness. However, most cases are mild and self-limited. Larger macropods can harbour the cystic stage of the tapeworm (*Echinococcus granulosus*), and are a possible source for spread to domestic animals and humans. Uninspected carcasses should not be fed to dogs. Macropods can be infected by encephalomyocarditis virus, which is spread by rats and perhaps mice. It can cause death in animals and is potentially a serious zoonosis (Spielman, 1995) (ANZCCART, 1995).

## Zoonotic diseases associated with the Brush-tailed Rock-wallaby

Common Name	Scientific Name	Pathogen	Transmission	Symptoms	Cure/Prevention
<b>Fleas, mites, ticks and other parasites</b>	<i>Varying</i>	Varying	Exposure to the Macropods	May cause itching, irritation and/or bites.	Using insect repellent and regular washing of hands, equipment and bedding
<b>Ross River Fever</b>	<i>epidemic polyarthrits</i>	Arboviral	Transmitted by mosquitos. The virus is maintained in a primary mosquito - mammal cycle involving macropods	Symptoms 3 to 21 days after being bitten. Wide range of symptoms. Pain and tenderness in muscles and joints. Joints most commonly affected - wrists, knees and ankles. Flu like symptoms are also common and include fever, chills, sweating, headache and tiredness. A rash may also occur on the trunk and limbs for a short time. Diagnosed by a special blood test.	<ul style="list-style-type: none"> <li>• Mosquito control measures.</li> <li>• Personal protection measures (long sleeves and pants, mosquito repellents and mosquito coils).</li> <li>• Avoidance of mosquito-prone areas. Vectors usually bite between dusk and dawn.</li> </ul>
<b>Lyme Disease</b>	<i>Ixodes</i>	Bacteria	Transmitted when bitten by ticks.	Lyme disease symptoms appear 3 to 32 days after a tick bite. Most people get a rash that resembles a bulls-eye. Other symptoms include fever, headache, tiredness, stiff neck, joint pain and swollen lymph nodes. Without treatment, the heart, nervous system and joints may be affected for years to come.	Treated with antibiotics. Avoid bush and grassy areas. Use tick repellent and wear protective clothing - long-sleeve shirts and pant legs tucked into socks. Inspect for ticks after being outdoors. Remove ticks with tweezers, wash the site and hands. Mark calendar to show tick removal. Use tick control products on animals.
<b>Coccidiosis</b>	<i>Coccidioidomycosis</i>	-	Infection is caused by inhalation of the spores of the fungus, <i>Coccidioides immitis</i> .	In its severe form it is characterized by diarrhea (sometimes alternating with constipation), fever, abdominal pain, nausea, headache, loss of appetite, and loss of weight.	Coccidiosis may be controlled by sanitary conditions. Chronic pulmonary coccidioidomycosis can develop 20 or more years after initial infection which may not have been recognized, diagnosed, or treated at the time. Infections (lung abscesses) can form and rupture releasing pus (empyema) between the lungs and ribs (pleural space). This disorder is even less common than the acute form, however.

Common Name	Scientific Name	Pathogen	Transmission	Symptoms	Cure/Prevention
<b>Q fever</b>	<i>Coxiella burnetii</i> (the rickettsial organism which causes the zoonotic disease known as Q fever)	Virus	Can be carried and shed by macropods. Contract through working in close proximity with macropods. Infected animals shed this bacteria in urine, faeces, birth products and milk.	Can cause pneumonia and hepatitis (liver inflammation) in its early stages, and infection of the heart valves (endocarditis) if the condition becomes chronic (persisting over time).	Effective hygiene.  Consult a doctor if you suspect you are infected.
<b>Salmonella species</b>	<i>Salmonella typhimurium</i>	Bacteria	Transmitted through rodents.	in young macropodids and even normal adults and these bacteria can cause sudden death, cramps, vomiting, diarrhea, fever, lethargy, poor appetite and pneumonia in affected animals.	Hands should be thoroughly washed with soap and water each time a rodent or its cage, equipment, or bedding is handled. Work place areas should be disinfected with a bleach solution (1/4 cup liquid chlorine bleach to 1 gallon of water).
<b>Ringworm</b>	<i>Tinea Corporis</i>  <i>When it affects the body - Tinea corporis</i> <i>scalp - Tinea capitis</i> <i>feet - Tinea pedis</i> <i>groin - Tinea cruris</i>	Fungus	Transmitted from a direct contact with an infected animal's skin or hair.  It's caused by a mold-like fungus that grows on the outer layer of the skin.	Can be severe and is highly contagious to humans. It can cause oval to round areas of redness, scaliness or itchiness. However, most cases are mild and self-limited.	The best treatment is to keep the skin clear and dry and use of anti-fungal medications if prescribed by a doctor. Avoid touching animals bald spots.
<b>Tapeworm</b>	<i>Echinococcus granulosus</i>	Parasite	Larger macropods can harbour the cystic stage of the tapeworm ( <i>Echinococcus granulosus</i> ), and are a possible source for spread to domestic animals and humans.	anemia, abdominal cramping, diarrhea, even passing of worms. Worms can burrow into a human's digestive organs.	Observe hygiene standards and wash hands thoroughly after contact with animals and carrion. Uninspected carcasses should not be fed to dogs.
<b>Encephalomyocarditis virus</b>	<i>Encephalomyocarditis</i>	-	spread by rats and perhaps mice to Macropods.	It can cause death in animals and is potentially a serious zoonosis	Bait regularly for vermin and keep areas clear of food scraps and food bins securely sealed.

Common Name	Scientific Name	Pathogen	Transmission	Symptoms	Cure/Prevention
Tetnus (Lock jaw)	<i>Clostridium tetani</i>	Bacterium	Found in soil and faeces. The bacteria can enter the body through a tiny pinprick or scratch, even from splinters, although deep puncture wounds or cuts made by nails or knives are especially susceptible to tetanus infection. Animal bites can also cause infection.	The most common form of tetanus causes paralysis, usually starting at the top of the body and working its way down. Lockjaw is often the first symptom, followed by stiffness in the neck and difficulty swallowing; muscle spasms may occur frequently, last for several minutes, and persist for up to a month. Symptoms of tetanus can appear anywhere from three days to three weeks after exposure to the bacteria, and may be accompanied by fever, sweating, elevated blood pressure, and rapid heartbeat.	The tetanus vaccine can prevent infection. Check with your doctor. You need booster shots every 10 years to be protected.  People with tetanus may have to spend several weeks in the hospital under intensive care.
Toxoplasmosis	<i>toxoplasma gondii</i>	obligate intracellular	Commonly known to be transmitted by cats. Present in large numbers in blood, excreta and secretions in acute disseminated infections	May present with fever, general malaise, enlarged glands, splenomegaly, headaches and a macropapular rash. Rarely, severe cases include myocarditis (inflammation of the heart muscle) and retinochoroiditis (eye problems)	Human treatment of symptomatic acute infections is pyrimethamine, trisulfapyrimidines, and folic acid for one month. Recently trimethoprim has been found effective. Steroids may also be used. Blood tests should be done weekly. Congenital toxoplasmosis should be treated whether symptomatic or asymptomatic. Pregnant women should have their serum examined for the toxoplasmosis antibody.

## 8.5 QUARANTINE REQUIREMENTS

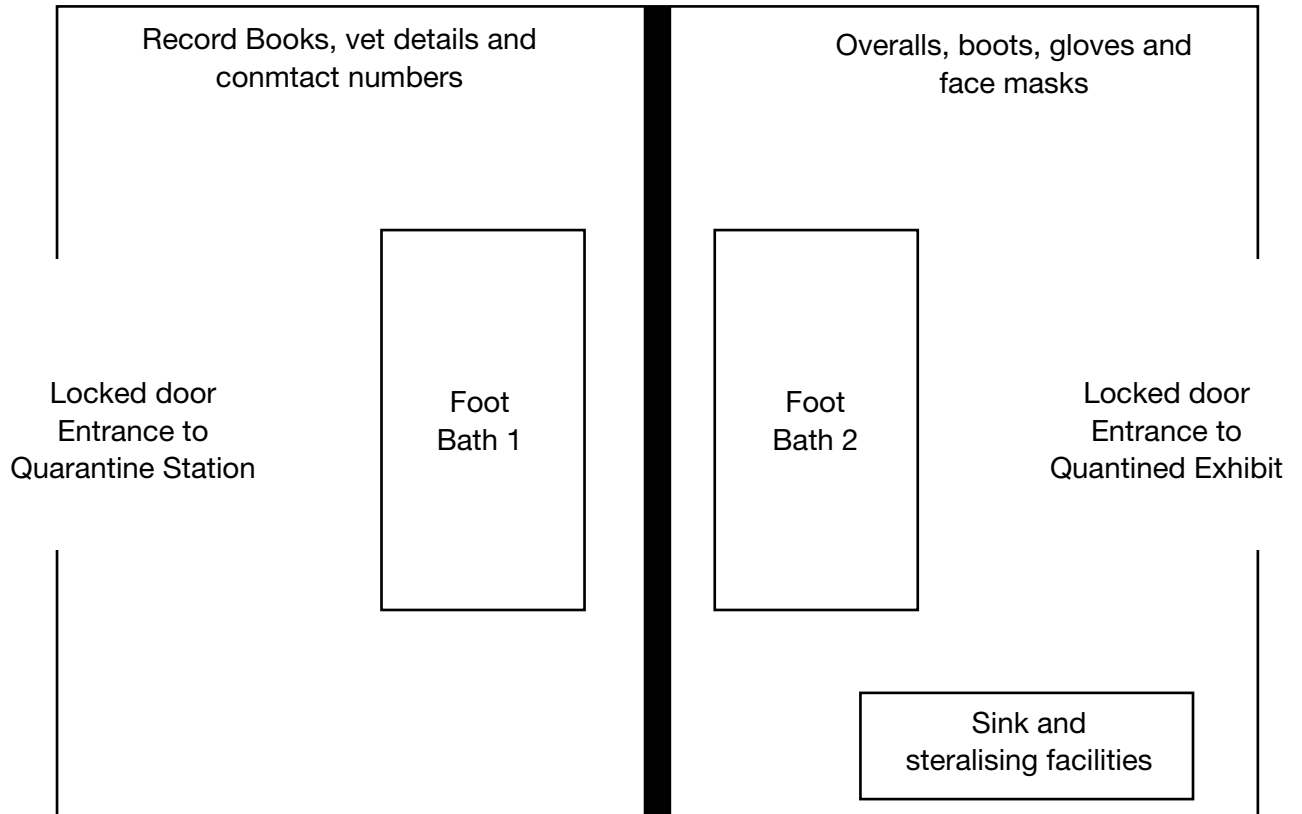
A minimum of 6 weeks quarantine when being transferred interstate or from overseas.

Quarantine set up should include a quarantine station

- foot baths
- overalls
- boots
- steralising facilities
- evaporation tanks
- sink and running water
- quarantine steps clearly listed in station

- lock on doors
- record books kept on location and off location
- designated vet
- vet nurse on site

### Example of a Quarantine Station lay out



## 9 BEHAVIOUR

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### 9.1 ACTIVITY

BTRWs are generally shy animals but can become accustomed to vehicles and people. They are most active at dusk and will come out to sun themselves at sunrise (Muranyi, Monica, 2000).

Strong territorial behaviour is exhibited by both males and females to other members of the same sex. They appear to show linear dominance hierarchies in both males and females. Aggression has resulted in the death of a sub-ordinate female by the dominant female at Healesville Sanctuary (Muranyi, Monica, 2000).

### 9.2 SOCIAL BEHAVIOUR

Brush-tailed Rock-wallabies live in loose colonies limited by the availability of refuge sites in core habitat. Colonies are often fragmented due to the nature of the terrain and by human development. Consequently, dispersal of young animals between colonies is likely to be constrained in these situations.

Brush-tailed Rock-wallabies are nocturnal to crepuscular and spend most of their daylight hours sheltering or sunning themselves in steep, rocky, complex terrain in some sort of shelter (cave, overhang or vegetation), and ranging out into surrounding terrain at night to feed. The use of these refuge areas by BTRW are assumed to supply protection from predators and amelioration of climatic extremes (Department of Environment and Conservation, 2005).

This reliance on refuges leads to the BTRW living in small groups or colonies, with overlapping individual home ranges of about 15 hectares each. In a study at Goulburn River, Short (1980) found that home ranges were roughly rectangular around the cliffline, ranging from 6 to 30 ha in size (400-900 m along the cliff), with an average of 15 ha (700 m along the cliff). Daytime home ranges were much smaller than those at night. Males appear to have larger home ranges than females, and radio-tracking studies indicate that animals usually move no more than 2 km from their refuges. This movement is usually at night when the animals go into the surrounding terrain to feed. Batchelor (1980) found the greatest activity occurred three hours before and after sunrise and sunset, with more movement in the middle of the night than in the middle of the day.

Within colonies, both sexes establish territories that may be defended vigorously. Within their territories, BTRW habituate the same refuges, sunning spots, feeding areas and pathways. Brush-tailed Rock-wallaby rest sites on Motutapu Island in New Zealand were exclusive 95.4 % of the time (of 2,368 records) and never shared by adult males. However, one male's territory will overlap one or more female territories. In a large colony studied by Bayne (1994), a number of persistent close associations between one male and one female sharing the same refuges and territory were observed, as was the transfer of resident females from one male to another when one male displaced the other from its territory.

It appears that BTRW colonies do not generally move. Bayne has observed individuals in the Macleay River Gorge, in northern NSW, are very loyal to their territories, with some individuals seen on the same rock year after year. Similar observations have been made at a colony at Taralga in southern NSW, although both groups of this colony moved or died during the summer of 1997/98. Brush-tailed Rock-wallabies may move in response to disturbances. A local landholder at Mt. Wallerawang in Watagan State Forest reported that BTRW moved in response to a fire (and then returned several years later). Norris and Belcher (1986) suggest there was once a nomadic group of BTRW moving along the Snowy Gorge (Department of Environment and Conservation, 2005).

Bulinski et al. (1997) did a social behavioural study on a captive colony of BTRWs in the Jenolan Caves Reserve in relation to management. Twenty different social behaviour elements were identified during this

study. They classified the social behaviour into four classes, namely:

#### **Neutral behaviour**

59.2% of all social behaviour was neutral. Neutral behaviour was observed most frequently and included a range of behaviours whose context was not obvious.

#### **Aggressive behaviour**

23.9% of all social behaviour was aggressive behaviour (64.8 % of the aggressive behaviour was attributed to female interactions). Eight different types of agonistic (aggressive) behaviour were recognised in this study. This may indicate that aggression is more ritualised than other behaviour types. Animals are therefore able to resolve conflict without undue risk of being injured.

#### **Amicable behaviour**

14.2% of all social behaviour was amicable behaviour. Amicable behaviour included the grooming of each others fur (allogrooming), and other physical contact between animals that not have been classified as aggressive behaviour. It is possible that allogrooming is used to remove parasites. Most of the time this behaviour was initiated by an adult male toward an adult female and perhaps represented low intensity sexual behaviour.

#### **Sexual behaviour**

2.7% of all social behaviour was was sexual behaviour. Batchelor (1980) recorded sexual behaviour elements such as “head rubs”, ‘mating bows’ and ‘copulation’. These elements were not recorded in the Jenolan Caves Reserve, but the touching of the male nose to the female cloaca was recorded. Copulation activities of captive BTRWs have been observed in a successful breeding colony of 15 animals at TNR (Muranyi, Monica, 2000).

### **9.3 REPRODUCTIVE BEHAVIOUR**

A study of BTRW on Mototapu Island, gave an average age to independence of 230 days, and a mean of 1.35 pouch young born per year per female (Bachelor 1980). Breeding seemed to have no particular season and was continuous year-round, probably depending mainly on food availability. Continuous breeding has also been observed in the Shoalhaven Valley where young were seen to vacate the pouch in January, March (twice), April, July, October and November (Susan Robertson pers. obs. cited in NPWS 1999). In contrast, a study in the Macleay River gorges found that April had the highest birth rate, with most juveniles vacating the pouch during August-November and dispersing during March and May (Joblin 1983). In the same area, Bayne (unpub.) has observed some year round breeding with a peak of large pouch young (when they are most easily seen) in late spring, consistent with an autumn peak in birth rates.

Females give birth to a single pouch young at a time, after a gestation period of approximately 30 days (Close 1993). The young remain in the pouch for 6 months. After they first emerge from the pouch, the joey spends a further 7-20 days in and out of the pouch. As BTRW are crepuscular, young may be left at dawn, dusk or at night in refuges while the mother moves out to feed. Weaning is believed to occur 86 days after leaving the pouch, when the joey is 9 months old (Lee and Ward 1989). Sexual maturation of females occurs at 18 months, males at 20-24 months (Department of Environment and Conservation, 2005).

All sub-adult males and most sub-adult females disperse from their refuges of birth (Joblin 1983). Life expectancy in the wild is 5-10+ years but can be longer in captivity. The minimum time between litters is likely to be 210 days. The number of young born per year is related to dominance. A study by Joblin (1983) found the dominant female of a group produced 1.09 young per year, and the subordinate females produced 0.59 per year. Reproductive success appears to be related to both the dominance rank of breeding females and the habitat the breeding unit occupies.

Brush-tailed Rock-wallabies are polygynous, and a dominant male will be found with up to four females. They appear to live in family groups of 2-5 adults and usually one or two juvenile and sub-adult individuals, but are also known to occur in male-female pairs (Department of Environment and Conservation, 2005).

### **Reproductive specificity**

Bee and Close (1993) studied the contact zones and the fertility of hybrids produced in captivity of a number of species of the eastern *Petrogale*. Introgression was identified between BTRW and Herbert's Rock-wallaby (*Petrogale herberti*) (and also two other *Petrogale* species). Both BTRW and Herbert's Rock-wallaby have discrete distributions and only co-occur at the one site where hybridisation occurs. Bee and Close argue the range of morphologically and chromosomally distinct forms of rock Draft NSW Recovery Plan Brush-tailed Rock-wallaby 15 wallabies indicates there is very little to no gene flow between different species of *Petrogale*.

### **Genetic distinctiveness**

Research to date on the genetic typing of BTRW indicates BTRW populations are naturally highly structured and the level of geneflow between colonies is typically limited. For example, restrictions in geneflow can occur over distances of approximately 4 km. Recent studies on BTRW dispersal indicates the females demonstrate strong philopatry within colonies, i.e. they are more related to females in close proximity than those further along the same cliff-line, whereas males are more likely to disperse (Department of Environment and Conservation, 2005).

Relatively undisturbed populations of BTRW still contain high levels of genetic diversity (as measured by microsatellites). However, in areas where BTRW have declined, the remnant populations have lost considerable amounts of genetic diversity and remaining individuals are often highly related. Demographic, environmental and genetic stochasticity severely threaten the survival of these remnant populations. The pattern of sequence divergence of BTRW mitochondrial DNA (mtDNA) indicates the presence of three genetically distinct groups or ESU:

- (i) A highly divergent lineage currently consisting of the remnant Victorian populations. Representatives of this lineage may have previously occurred in southern NSW.
- (ii) A well defined central NSW group consisting of closely related populations in the region from the Shoalhaven and Jenolan Caves to Broke and the Warrumbungles.
- (iii) A less well defined group of populations in south-eastern Queensland and northeastern NSW (at least as far south as Woko National Park (Eldridge and Browning (2004))). The mtDNA of this group appears most closely related to Herbert's Rock-wallaby and may be the result of natural introgression. At the northern most extent, a narrow hybrid zone has formed between BTRW and Herbert's Rock-wallaby (Department of Environment and Conservation, 2005).

While the exact level of taxonomic difference remains to be established, it is clear that these three groups exhibit important genetic variation that should be maintained. In this regard, as indicated in Section 3.0, they have been determined to be Evolutionary Significant Units (ESU) (Department of Environment and Conservation, 2005).

The exact boundaries between these ESU are yet to be determined. The boundary between the northern and central ESU lies somewhere between Broke and Woko National Park, and may be centred on the Hunter Valley. Defining the boundary between the central and southern ESU is likely to remain problematic as there are no animals now known from this area. Therefore, these boundaries should be considered as guides only for management and recovery purposes, and have most applicability to the maintenance of genetic integrity of the three taxonomic groups (Department of Environment and Conservation, 2005).

## **9.4 BATHING**

Although BTRW's do not bath, they do however groom themselves similarly to other macropod species using their grooming claws on the fore feet.

## **9.5 BEHAVIOURAL PROBLEMS**

Highly stressed animals can show aggression. BTRW can be very territorial or very aggressive towards a weaker or socially less dominant animal. Fighting and aggression during mating can also become a problem.

BTRW's that have been hand reared and have become too humanised can be a problem in captivity because of boisterous behaviour towards keepers and sometimes aggression (Thomson, Celia (2006-07)).

## **9.6 SIGNS OF STRESS**

Sweating, panting, completely motionless (AGRIC).

## **9.7 BEHAVIOURAL ENRICHMENT**

Behavioural enrichment can be much more subtle than for other animals. Large rocky platforms, trees that are accessible through a series of logs placed at intervals to enable to BTRW to enter the branched area of a tree. Varied browse growing throughout the enclosure which can also be effected by seasonal change. Tunnels and platforms at varying heights and locations are very good for them. Piles of old tree branches, leaves and bark are fantastic hides for the BTRW's. Each animal should have more than one hide.

## **9.8 INTRODUCTIONS AND REMOVALS**

This can be done almost immediately although it is advised to place the animal in adjoining pens with view to one another and then after a period of time if no aggression is shown allow access to each of the animals.

When giving access you should allow extra platforms and hides for each of the animals at opposite ends of the enclosure to help prevent a possible dominant animal blocking use to the other. There should also be access to two feed stations. There should be a large amount of additional grass and browse accessible in the enclosure.

## **9.9 INTRASPECIFIC COMPATIBILITY**

BTRW's are best kept in smaller groups but this also depends on the size of the enclosure and the number of hides available. BTRW's are territorial and fighting can occur between individuals but they generally tolerate one another.

## **9.10 INTERSPECIFIC COMPATIBILITY**

BTRW's are territorial and fighting can occur between individuals but they generally tolerate one another. Because of their discreet nature they will try to avoid contact with other species.

## **9.11 SUITABILITY TO CAPTIVITY**

BTRW have proved to breed very well in captive/safe environments away from feral pests. So long as they have varied areas and sufficient hides (recommended more than one hide per animal) and are also in a very low stress environment they respond very well to captive circumstances.

## 10 BREEDING

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### 10.1 MATING SYSTEM

The male will select a female and follow her for a periods of time. When the mating begins the male will grab the female around the waist when he attempts to mount her. You will be able to see scratch and bite marks on her side as well as fur missing.

### 10.2 EASE OF BREEDING

The BTRW breeds well but in the wild have many predators and this is one of the main reason for their drop in numbers

### 10.3 REPRODUCTIVE CONDITION

#### 10.3.1 Females

Females reach sexual maturity from about 21 months onwards (Brush-tailed Rock-wallaby Recovery Team).

#### 10.3.2 Males

Males reach sexual maturity at 23 months. The size of their testies is an important factor in the maturity. Scrotal diameter 33mm and length 21mm (Brush-tailed Rock-wallaby Recovery Team).

### 10.4 TECHNIQUES USED TO CONTROL BREEDING

- Pouch managing and removal of joeys
- Separation
- Castrating the male



*Joeys approx. 5-10 days old removed from the mothers pouch while “pouch managing”*

## 10.5 OCCURRENCE OF HYBRIDS

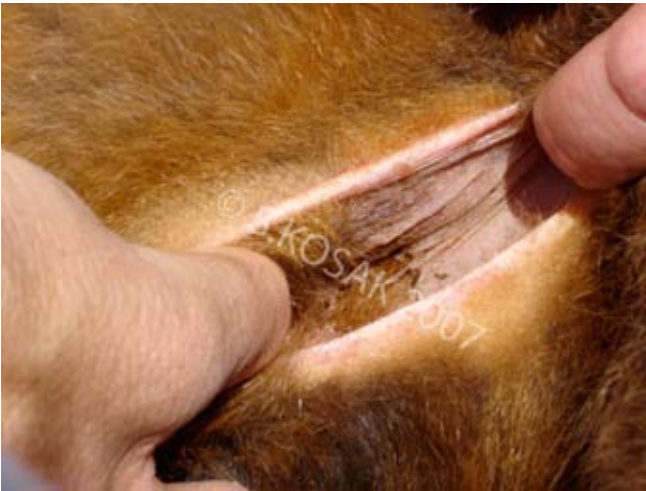
In parts of its range, the BTRW comes into contact with a related species, Herbert's Rock-wallaby (*Petrolgale herberti*). Where the species meet they interbreed, forming a hybrid rock wallaby (Readers Digest, 2005).

BTRW and Yellow-footed Rock-wallaby could possibly breed together but would most likely produce infertile offspring (Thomson, Celia, 2006-07).

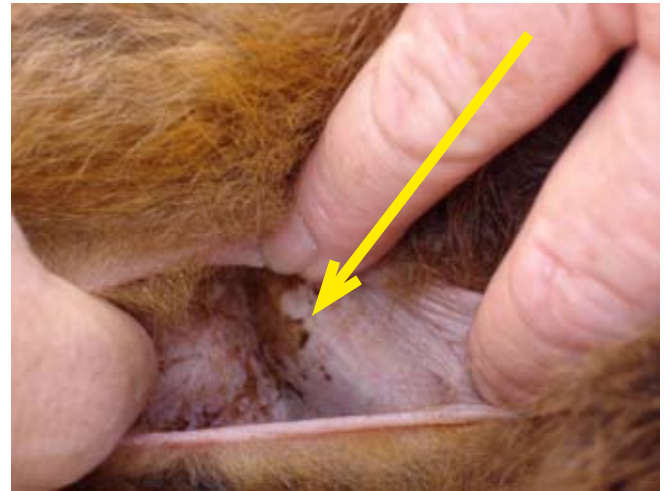
## 10.6 TIMING OF BREEDING

In a controlled breeding facility all year round. In the wild they can breed all year round but tend not to during summer. Main breeding from approx. July until Dec.

### Pouch checking should be done every month



*A pouch being opened*



*A dirty pouch - wallaby not ready to give birth  
The brown area is referred to as "dirty"*

## 10.7 AGE AT FIRST BREEDING AND LAST BREEDING

Youngest recorded breeding of a BTRW was at 21 months

Last breeding is at or before about 8 years

Males reach sexual maturity at 23 months. The size of their testies is an important factor in the maturity. Scrotal diameter 33mm and length 21mm.

## 10.8 ABILITY TO BREED EVERY YEAR

Given the correct conditions. BTRW will breed all year round. Depending on how they are being bred will determine how many joeys are produced in a year.

## 10.9 ABILITY TO BREED MORE THAN ONCE PER YEAR

Given the correct conditions. Although it has been noted that the births drop off in the peak summer periods. Depending on how they are being bred will determine how many joeys are produced in a year. (Thomson, Celia, 2006-07).

## 10.10 NESTING, HOLLOW OR OTHER REQUIREMENTS

Plenty of hides ie logs, rocks and boulders, browse, trees and man made hides.

## 10.11 BREEDING DIET

There is no specific breeding diet as such but food needs to be kept as varied and plentiful as possible as macropods are able to postpone development of their unborn foetus, in the case of a drought. Therefore reduced food intake could be seen as 'drought conditions'.

## 10.12 OESTROUS CYCLE AND GESTATION PERIOD

The average period for gestation is 25 days (+ or - 6 days)

Oestrous cycle is the same as the Gestation period. When the gestation period ends the oestrous cycle begins. This is known as Embryonic Diapause.

## 10.13 LITTER SIZE

One Joey is produced at a time. Other macropod species are known to have twins but there is no record for the BTRW.

## 10.14 AGE AT WEANING

186 - 203 days. Note that the BTRW weans earlier than a YFRW.

## 10.15 AGE OF REMOVAL FROM PARENTS

There are various reasons why a joey is removed from its parents

Southern BTRW - For pouch transfers the joey is removed when it is less than 2 weeks old. 9 days is perfect.

Central BTRW - If a joey is removed to be hand reared to encourage the mother to breed again it is about 4 - 6 months

Natural removal from the mother - The joey will stay with the mother for a substantial period of time if allowed to suckle. The joey needs to be removed from the mother before it reaches sexual maturity to protect against inter breeding.

## 10.16 GROWTH AND DEVELOPMENT

### Joey Milk formulas

< 0.4 - Too young to hand rear

0.4 - Eyes open, Ears starting to come away from the head

0.6 - Eyes open, a very fine covering of fur or just visible, ears fully up

0.7 - Fully furred and hanging out of pouch

> 0.7

### Descriptions of Growth Stages

Embryonic phase

Pinkie

Unfurred Joey

Furred Joey

At foot Joey

# 11 ARTIFICIAL REARING OF MAMMALS

---

## 11.1 HOUSING

The joey will need a pouch. This is ideally made from natural fibres to allow it to breath and this will also help maintain a more even temperature.

The most common elements to a pouch are:

An outer layer - possibly a canvas bag

A mid layer - a woollen jumper or garment

An inner layer - a pillowcase or light weight pouch which can be changed regularly

The joeys pouch needs to be kept in a quiet location with an even temperature. No excess heat or cold drafts. The pouch should ideally hang so that it just touches the ground. The area should also be free of sharp objects or small items or material that can be ingested.

### HYGIENE AND OTHER SPECIAL PRECAUTIONS

Wash hands between handling animals. Wash all equipment thoroughly, sterilise bottles and teats in infant bacterial solutions. Leftover milk should be discarded.

To keep the pouch clean, toilet the joey after every meal. The mother licks their young to stimulate urination and defecation.

If the joey grows up in a person's house make sure than it has no contact with domestic pets. When the joey is released it should have a natural fear of domestic pets.

Until the joey is settled into its new environment make sure that there are no loud noises in the joeys environment. However, do not protect it too much from everyday sounds, because they will become over-nervous.

The joey is normally stimulated to move its muscles by the movements of the mother's pouch. Unfurred joeys should be massaged or gently moved about in their pouches after each feed to exercise their muscles. Short furred joeys can do their exercises outside of the pouch, in a warm environment. Older joeys should be able to go in and out of the pouch, whenever they wish.

## 11.2 TEMPERATURE REQUIREMENTS

Unfurred or just furred joey can not maintain its own body temperature, so it needs an artificial heat source.

A constant pouch temperature is important and should be monitored.

A temperature indication is:

For unfurred or just furred joeys: 31°C.

For furred or fully furred joeys: about 28°C.

Overheating is as bad as under heating and can result in long term health problems. Animal heating pads are preferable for a heat source. BTRWs do not cope well with temperatures over 30°C. It is important to monitor maximum temperatures.

Furred joeys can regulate their own temperature without artificial warmth. Make sure that in cold weather their room is well heated. During the summer months the joeys should not be overheated.

The natural mother's pouch is moist so that joeys will not dehydrate on hot days. Unfurred orphaned joeys should be oiled daily using appropriate natural creams, such as lanoline, so that the skin will not crack and dry out. Monitor signs of dehydration with the 'skin pinch test'.

## 11.3 DIET AND FEEDING ROUTINE

Feeding bottle

Set of teats suitable for the joeys age - For wallabies the teat should be short and thin

Equipment to sterilise the bottles and teats

Measuring containers and storage containers

### WOMBAROO CHART AS A GUIDE ON HOW MANY FEEDS A JOEY NEEDS PER DAY

AGE STAGE	NUMBER OF FEEDS	FAECES CONSISTENCY
Unfurred (stage < 0.4)	8 feeds a day	Like custard
Unfurred (0.4)	5 feeds a day	Like custard
Just furred – smooth (0.6)	5 – 4 feeds a day	Like toothpaste
Long fur, emerging from pouch (0.7)	4 – 3 feeds a day	Forming pellets
Long furred, fully emerged (>1.0)	2 feeds a day	Pellets

It is critical that the flow through the teat does not exceed the amount of milk the joey can swallow. Otherwise the milk will flow into the lungs and result in pneumonia. The milk should be luke warm before it is fed.

When you first start feeding the joey put a hand over its head to cover its eyes, after a few days this is not necessary any more. You can also wrap the tips of your fingers gently under its throat which can help to indicate whether it is swallowing. Initially you will probably have to carefully open the joeys mouth with your fingers to help insert the teat. When feeding, position the joey in a warm pouch, either sitting up or lying sideways. Do not lay the head back, so that if too much milk flows into the mouth the excess will run out rather than going down into its lungs.

Sometimes it takes a few days or weeks to adapt the joeys stomach to the artificial milk. If it gets diarrhoea feed only glucose water for 24 hours, if diarrhoea continuous, seek a vets advice.

You should also keep a feeding and report chart. This needs be filled in after every feed to accurately record the joeys progress. The joey should also be weighed at least once a week to help chart its progress.

There is no hole in the teats, so the carer can make a hole to suit the age of the animal. Pierce the tip of the teat with a hot needle to make a hole about 1 mm in diameter, or for large animals, cut a hole with scissors. If the hole is too small, excessive sucking will quickly weaken the tip and the end will blow out. If this is happening then the hole is probably too small for the animal. Make a larger hole. The hole should be large enough for milk to drip out slowly, when the bottle is inverted.

Small animals can be fed using a syringe with a teat pulled over the end, to give greater control of milk flow with the plunger. Guidance should be obtained from experienced carers on correct feeding technique for different animals.

Latex is a natural product. Deterioration can be slowed by storing teats in a dry place away from light. An opaque, airtight container should be used. Immediately after use, teats should be washed in warm soapy water, dried and stored as above. Some carers sterilise by boiling or with infant sterilising solutions. (Wombaroo, 2007)

## WOMBAROO TEAT SIZES

For more information visit [www.wombaroo.com.au](http://www.wombaroo.com.au)



STM - For small  
in-pouch wallabies



MTM - For in-pouch  
wallabies



120mL bottle recommended  
with an 18-24mm neck

## SOLID FOOD

When the joey is old enough to spend time outside of its pouch you can provide it with solid food, such as: macropod pellets, lucerne hay and carrots and sweet potato. The joey will require milk feeds and fresh water should also be provided.

When the joey is starting to emerge from the pouch browse should be given morning and evening. This can include grass with roots and dirt attached, leaves, soft branches and other native browse.

## 11.4 SPECIFIC REQUIREMENTS

The BTRW is an extremely stressful animal and can be very difficult to handle in captivity when fully grown if humanised because of their “skittish” behaviour. If they are raised with a minimal amount of contact so as to retain the fright and flight when dealing with keepers - this becomes a benefit. (C.Thomson 2006)

## 11.5 DATA RECORDING

The following data needs to be recorded:

- Births - Parents
- Location bred
- Location held
- Microchip number
- Breeding program
- Area located from/released to
- Dates

## 11.6 IDENTIFICATION METHODS

Methods used can include:

- Micro-chipping but the age of the joey can inhibit this - the earlier to micro-chip the better when in an enclosure with females with joeys of the same age as pouch swapping has been recorded. (C.Thomson 2006)

- Isolation from other animal with a similar age joey
- When a BTRW joey comes into care it is important to determine its age as accurately as possible. Measure foot, head and tail lengths and weigh the joey.

After the identification, it is important to diagnose the status of the joey. Possible problems are: dehydration, diarrhoea, injuries, burns, shock, infections, pneumonia, worms and other parasites. These can all be used as identification.

- Removal of joey for hand rearing

## 11.7 HYGIENE

Wash hands between handling animals. Wash all equipment thoroughly, sterilise bottles and teats in infant bacterial solutions. Leftover milk should be discarded.

To keep the pouch clean, toilet the joey after every meal. The mother licks their young to stimulate urination and defecation.

If the joey grows up in a person's house make sure that it has no contact with domestic pets. When the joey is released it should have a natural fear of domestic pets.

Until the joey is settled into its new environment make sure that there are no loud noises in the joey's environment. However, do not protect it too much from everyday sounds, because they will become over-nervous.

The joey is normally stimulated to move its muscles by the movements of the mother's pouch. Unfurred joeys should be massaged or gently moved about in their pouches after each feed to exercise their muscles. Short furred joeys can do their exercises outside of the pouch, in a warm environment. Older joeys should be able to go in and out of the pouch, whenever they wish.

## 11.8 BEHAVIOURAL CONSIDERATIONS

If it is known that the joey is going to be passed on to another carer, ensure that all relevant information is passed on to the new carer. Bring its own pouches with it, as these familiar articles will help the joey settle.

Hand raised BTRWs lack the mother taught survival skills, so if possible it is better to raise several joeys of slightly different ages together. They should be released together as this is a good support system.

## 11.9 USE OF FOSTER SPECIES

Cross-fostering refers to the transfer of a pouch young from a threatened species into the pouch of a surrogate mother from a similar common species. This has two main benefits for the endangered species:

- (i) it frees the mother from the burden of carrying a young to term (seven-eight months in the case of the BTRW) and
- (ii) it allows her to cycle again, mate and produce another pouch young, which can in turn be fostered off to a surrogate mother. (Brush-tailed Rock-wallaby Recovery Team, 2006).

Cross fostering started in 1997 in Tidbinbilla Nature Reserve using Tammar Wallabies as surrogate mother. The Tammar Wallaby was selected as a potential surrogate species, as it is a common captive species; a great deal was known about its reproduction; it can be maintained in large breeding groups; females are a similar size to the BTRW females and they are generally quiet by nature. Young brush tails

as small as one gram and as large as 100 grams were transferred during these trials. These trials were completed in 1998. However, Tammar Wallaby females only cycle between January and the end of June and so a second surrogate species was required that cycled year round.

The Yellow-footed Rock-wallaby (YFRW) was chosen for this role as it is a close relative of the BTRW; females are around the same size in both species; female YFRW's breed year round and they can also be maintained in large breeding groups. Cross fostering between YFRW and BTRW commenced in 1998 at Adelaide Zoo and were completed in 1999. (Victorian Brush-tailed Rock-wallaby Recovery Team, 2006). For more detailed information about this procedure visit [www.vicrockwallaby.com/breeding.htm](http://www.vicrockwallaby.com/breeding.htm)

## **11.10 WEANING**

Gestation Period - The juvenile BTRW is born after a gestation period of  $25.0 \pm 6.2$  days

Emergence from the pouch in BTRW - Weaning starts from the time the joey is emerging from the pouch  
- 186 - 203 days

Weaning in BTRW - from approx. 186 - 203 days

Permanent pouch exit in the BTRW between 8 - 10 months

Juvenile dispersal occurs between the age of 11-15 months. (Brush-tailed Rock-wallaby Recovery Team, 2006).

## **11.11 REHABILITATION AND RELEASE PROCEDURES**

This primarily depend on where the animal is going and for what purpose it will be used for. The following are release scenario options:

- Captive breeding
- Release into the wild
- Zoo display

## 12 ACKNOWLEDGEMENTS

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Celia Thomson for endless, quality information and support during my time with Waterfall Springs

Graeme Phipps and Jackiw Salkeld for knowledge and support throughout the project

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Sydney University for the use of their research and library facilities

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## 15 GLOSSARY

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BTRW - Brush-tailed Rock-wallaby  
ESU - Evolutionary Significant Unit  
Lethobarb - Pentobarbital sodium. C<sub>11</sub>H<sub>17</sub>N<sub>2</sub>NaO<sub>3</sub>. Synthetic substance under international control according to the UN Convention on Psychotropic Substances 1971, Schedule III. Molecular weight: 248.3  
Percentage of anhydrous base: 91.1. A white crystalline or powdery barbiturate used as a hypnotic, a sedative, and an anticonvulsive drug. Also called pentobarbitone.  
YFRW - Yellow-footed Rock-wallaby

## 16 APPENDIX

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### MACROPOD PELLETS

Telephone: (07) 3007 6888  
Email: mailbox@riverina.com.au

### WOMBAROO FOOD PRODUCTS

ph / fax: (08) 8391 1713  
PO Box 151  
Glen Osmond  
South Australia 5064  
email: wombaroo@adelaide.on.net  
web: www.wombaroo.com.au

### TAREE AND WINGHAM PRODUCE

Whitbread Street Taree NSW 2430  
Phone: 02 6551 0543  
Fax: 02 6551 2478  
Email: tareeproduce@manningcbd.com.au

Primrose Street, Wingham NSW 2429  
Phone: 02 6553 4111  
Fax: 02 6553 0273  
Email: winghamproduce@manningcbd.com.au

### PET BARN

Tel: 02 9417 1744  
Unit 3, 372 Eastern Valley Way, Chatswood  
Sydney's lower north shore

PET BARN

Tel: 02 9557 8300

175 McEvoy St, Alexandria

Corner Harley Street & McEvoy Streets.

ARAZPA

[www.arazpa.org.au](http://www.arazpa.org.au)

WATERFALL SPRINGS WILDLIFE SANCTUARY

Tel: (02) 4376 1066

Email: [waterfallsprings@redranger.com.au](mailto:waterfallsprings@redranger.com.au)

BRUSH-TAILED ROCK-WALLABY RECOVERY TEAM

[mick.bramwell@dse.vic.gov.au](mailto:mick.bramwell@dse.vic.gov.au)

TUGGERAH VETINARY CLINIC

Suite 1/13, Anzac Road TUGGERAH

Tel: (02) 4353 9414

MELBOURNE ZOO

Elliott Avenue,

Parkville, Vic. 3052

Tel: 61-3-9285 9300

Fax: 61-3-9285 9350

Email: [mz@zoo.org.au](mailto:mz@zoo.org.au)

HEALESVILLE SANCTUARY

Badger Creek Road,

Healesville, Vic. 3777

Tel: 61-3-5957 2800

Fax: 61-3-5957 2870

Email: [hs@zoo.org.au](mailto:hs@zoo.org.au)

WERRIBEE OPEN RANGE ZOO

K Road

Werribee, Vic. 3030

Tel: 61-3-9731 9600

Fax: 61-3-9731 9606

Email: [worz@zoo.org.au](mailto:worz@zoo.org.au)

NSW NATIONAL PARKS AND WILDLIFE SERVICE

43 Bridge Street

(PO Box 1967)

Hurstville NSW 2220

Tel: 02 95856444

[www.npws.nsw.gov.au](http://www.npws.nsw.gov.au)

THREATENED SPECIES UNIT, WESTERN DIRECTORATE

NSW National Parks and Wildlife Service

P.O. Box 2111

Dubbo NSW 2830

Tel: (02) 6883 5330

Email: [todd.soderquist@npws.nsw.gov.au](mailto:todd.soderquist@npws.nsw.gov.au)

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Email: [tz@zoo.nsw.gov.au](mailto:tz@zoo.nsw.gov.au)

PO Box 20

Bradleys Head Rd

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WESTERN PLAINS ZOO

Ph: +61 2 6881 1400

Fax: +61 2 6884 1722

Email: [wpz@zoo.nsw.gov.au](mailto:wpz@zoo.nsw.gov.au)

PO Box 831

Obley Rd

Dubbo NSW 2830

**ANNUAL CYCLE OF MAINTENANCE FOR THE BRUSH-TAILED ROCK-WALLABY**

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
<b>POUCH CHECKS</b> (Refer 10)	●	●	●	●	●	●	●	●	●	●	●	●
<b>FRONTLINE</b> (Refer 8.3)	●		●		●		●		●		●	
<b>CORN ADDED TO DIET</b> (Refer 6.1)					●	●	●	●	●	●		
<b>ENCLOSURE SPELLING</b> (Refer 4.4)										●		
<b>MAINTENANCE AUDIT</b> (Refer 4.1)	●						●					
<b>ANIMAL AUDIT</b> (Refer 5.4)					●						●	
<b>WEEDING</b> (Refer 4.1)	●		●		●		●		●		●	
<b>BAITING RATS &amp; MICE</b> (Refer 5.1)		●			●			●			●	
<b>ANNUAL VET CHECK</b> (Refer 8.2)												●

# MSDS - MATERIAL SAFETY DATA SHEET

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Chemicals and medicines used in the husbandry regimes can be harmful to both the animals and humans. Strict guidelines must be observed when handling them.

**Bleach - If a person injests bleach DO NOT induce vomiting. Seek medical attention immediately, CALL 000.**

- This must not be consumed or touch any part of the skin.
- The appropriate PPE should be worn when handling bleach.
- If bleach makes contact with your skin, wash thoroughly with water immediately.
- Always use in a well ventilated environment.

**Lethobarb - If a person is accidentally injected Seek medical attention immediately, CALL 000. -**

- This can be fatal to humans and animals. Pentobarbital sodium. C<sub>11</sub>H<sub>17</sub>N<sub>2</sub>NaO<sub>3</sub>. Synthetic substance under international control according to the UN Convention on Psychotropic Substances 1971, Schedule III. Molecular weight: 248.3 Percentage of anhydrous base: 91.1.
- A white crystalline or powdery barbiturate used as a hypnotic, a sedative, and an anticonvulsive drug. Also called pentobarbitone.

**Valium diazepam - If a person is accidentally injected seek medical attention immediately, CALL 000.**

- Seek emergency medical attention.
- Symptoms of a Valium (diazepam) overdose include sleepiness, dizziness, confusion, a slow heart beat, difficulty breathing, difficulty walking and talking, an appearance of being drunk, and unconsciousness.

**Fertilizers - If ingested seek medical attention immediately, CALL 000. Do Not induce vomiting.**

- This must not be consumed or touch any part of the skin.
- The appropriate PPE should be worn when handling.
- If it makes contact with your skin, wash thoroughly with water immediately.
- Always use in a well ventilated environment.

**Herbisides/Pesticides - If ingested seek medical attention immediately, CALL 000.**

- **Do Not induce vomiting.**
- This must not be consumed or touch any part of the skin.
- The appropriate PPE should be worn when handling.
- If it makes contact with your skin, wash thoroughly with water immediately.
- Always use in a well ventilated environment.

**Rat Poison - If ingested seek medical attention immediately, CALL 000. Do Not induce vomiting.**

The most common types of rat poison use a common blood thinner to cause internal bleeding in rodents. Touching rat poison is as safe as handling blood thinning medication and is generally not harmful. Ingesting rat poison is extremely dangerous.

**Symptoms of Rat Poison Ingestion** - Symptoms may take hours or days to appear, there may not be any way to see which type of poison was ingested. Victims that exhibit more than one symptom from this list may have ingested one or both types of rat poison.

- nosebleeds and/or bleeding gums
- blood in the urine
- bloody diarrhea
- hair loss
- extensive bruising
- fatigue and shortness of breath

## CONTAINER REQUIREMENT 83

- The illustrations shown in this Container Requirement are examples only. Containers that conform to the principle of written guidelines for the species but look slightly different will still meet the IATA standards.

Applicable to:

<i>Small Species</i>	<i>Large Species</i>
Bettong species	Kangaroo
Cuscus species	Tree kangaroo
Rat kangaroo	Wallaby species

See *USG Exceptions in Chapter 2.*

### 1. CONTAINER CONSTRUCTION

(see *Exception QF-01 in Chapter 3*)

#### Materials

Wood, plywood, hardboard, fibreboard.

#### Principles of Design

The following principles of design must be met in addition to the General Container Requirements outlined at the beginning of this chapter.

#### Dimension

The container must allow the animal to stand fully erect, to turn around and lie down comfortably but these criteria must not be exceeded as too much space may cause the animals

to hurt themselves. The measurements will vary with the species involved. If the total weight of the container plus animal exceeds 60 kg (132 lb) metal reinforcement of the whole container must be carried out.

#### Frame

The frame must be made from 2 x 2 cm (3/8 x 3/8 in) light wood with its parts screwed together.

#### Sides

The sides, top, bottom and door of the container for the large species must be made of 1 cm (3/8 in) plywood (or similar), this can be reduced to 0.6 cm (1/4 in) plywood (or similar) for the small species. The parts can be screwed or nailed and glued with a non-toxic glue to the frame.

#### Floor

The floor must be solid and covered with a deep layer of absorbent material, such as wood shavings, for bedding.

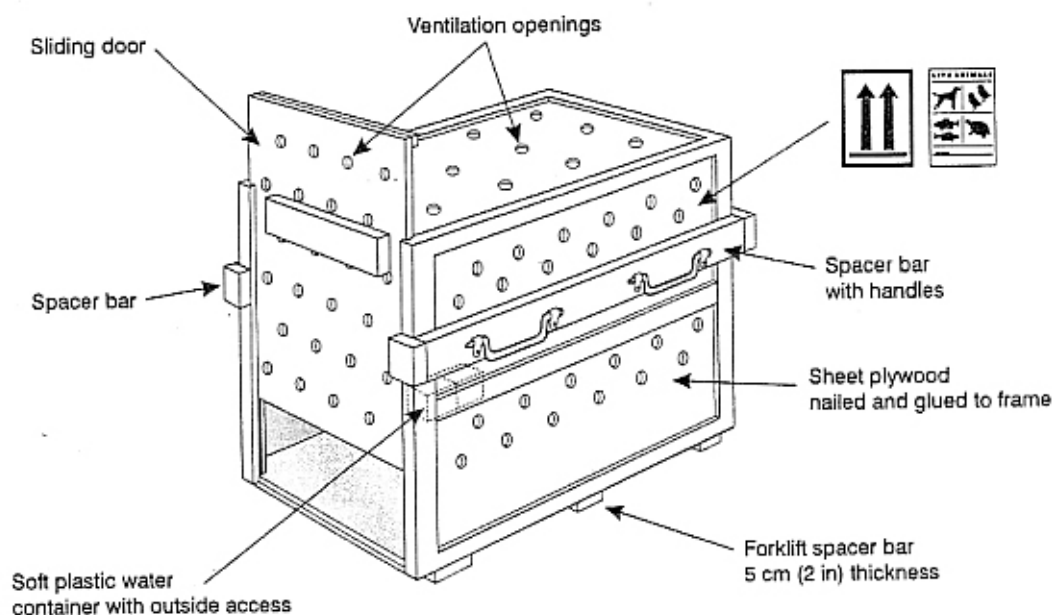
#### Roof

The ventilated plywood (or similar) roof must be padded with a soft non-destructible material in case the animal becomes agitated and jumps. The roof must have ventilation openings made over its entire surface.

#### Doors

A sliding door of 0.6 cm (1/4 in) wood or plywood must be provided at one end of the container. It must be fastened with screws after loading so that it cannot be opened accidentally. Alternatively the top of the container can be used as the access in which case it must be screwed to the frame and not nailed and glued.

#### EXAMPLE:



## CONTAINER REQUIREMENT 83 (cont'd)

### Ventilation

Ventilation must be provided by openings with a minimum diameter of 2.5 cm (1 in) spread over the four sides and the top. The lower openings must be at least 5 cm (2 in) above the absorbent bedding in order to prevent spillage. When compartmentalised containers are used the dividing partitions must also have these ventilation holes spread over their whole area, in addition the corners of the partitions can be cut away to give a better air circulation. When the smaller species are being transported the ventilation holes must be covered with screening on the inside. Any sharp edges of the mesh screening must be protected by smooth material.

### Spacer Bars/Handles

Spacer bars or blocks, made to a depth of 5 cm (2 in), must be present on all four sides of the container as shown in the illustration.

### Feed and Water Containers

A soft plastic water container must be provided, raised off the floor and with outside access.

### Special Requirements

Wallabies require curtaining over the door and ventilation openings to give reduced light inside the container. Because cuscus and tree kangaroo are arboreal species it is recommended that branch-like bars be fixed into the container.

### Rigid Plastic Pet Containers

(see Container Requirement 1)

Rigid plastic pet containers can be used for the air transport of individual animals.

Animals over 35 kg (77 lb) are carried at the discretion of the carrier.

The following modifications must be undertaken:

- the container must allow the animal to stand in a natural position, turn around and lie down comfortably but not have any excess space in which to hurt itself if agitated;
- the top of the container must be padded with a soft non-destructible material to prevent head injury;

- the door must have at least two fastenings placed at the top and bottom. The grill must be covered with a curtain or ventilated plywood board that will reduce the amount of light inside the container but allow air to circulate freely, especially for wallaby;

- slanting branch-like bars can be fixed to one side of the container for the arboreal cuscus and tree kangaroo;

- a soft plastic water container with outside access must be fixed inside the container;

- the container must be correctly labelled.

- If a container has wheels, they must be removed or rendered inoperable.

## 2. PREPARATIONS BEFORE DISPATCH

(see Chapter 5)

The floor of the container must be covered with a minimum of 2.5 cm (1 in) layer of soft material, such as wood shavings or wood wool packing, placed over a layer of newspaper.

Food may be placed inside each compartment of the container.

## 3. FEEDING AND WATERING GUIDE

(for emergency use only)

Animals do not normally require additional feeding or watering during 24 hours following the time of dispatch.

If feeding is required due to an unforeseen delay, carrots, fruit and water must be provided. Care must be taken not to overfeed.

## 4. GENERAL CARE AND LOADING

Under no circumstances may more than one animal be contained in one compartment of the container.

Little or no attention must be paid to these animals since they are extremely nervous. Disturbance may cause them to become unnecessarily fractious.

## CHAPTER 9 — MARKING AND LABELLING

### 9.1 GENERAL REQUIREMENTS

#### 9.1.1 Shipper's General Responsibility

The shipper is responsible for all necessary marking and labelling on each live animal container. Each container must be of such size that there is adequate space to affix all required markings and labels.

### 9.2 MARKING

#### 9.2.1 Quality and Specification of Markings

##### 9.2.1.1 General

Markings required under 9.2.2 must be durable and printed or otherwise marked on or affixed to the external surface of the live animal container.

##### 9.2.1.2 Language

English must be used in addition to the language which may be required by the state of origin.

#### 9.2.2 Container Marking

9.2.2.1 Unless otherwise specified in these Regulations, each live animal container must be marked, durably and legibly on the outside of the container, with each of the following:

(a) The full name and address and contact number of the shipper, consignee and a 24-hour contact (if it is not one of the aforementioned persons responsible for the shipment).

(b) The scientific and common name of the animal(s) and quantity of each animal contained in the container, as shown on the shipper's certification.

(c) Containers carrying animals which can inflict poisonous bites or stings must be boldly marked "POISONOUS". Aggressive animals or birds that can possibly inflict injury through the bars or ventilation openings of the container must have an additional warning label "This Animal Bites".

(d) In general, tranquillisation is not advocated for the transportation of live animals. However, certain wild species require the use of such medication. Whenever used, they must be administered under competent supervision and the name of the sedative, time of administration and the route of administration must be clearly marked on the container and a copy of the record must be attached to the documents relating to that shipment. Any further medication administered must be recorded and accompany the shipment with the name of the sedative, time of administration and the route of administration.

### 9.3 LABELLING

#### 9.3.1 Quality and Specification of Labels

##### 9.3.1.1 Durability

The material of every label, the printing and any adhesive thereon, must be sufficiently durable to withstand normal transport conditions and to ensure that the label remains recognisable and legible during transportation.

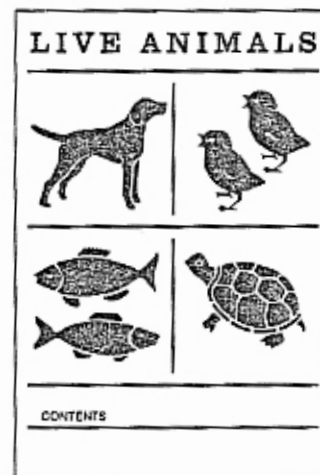
##### 9.3.1.2 Label Specification

All labels used on live animal containers must conform, in shape, colour, format, symbol and text to the specimen designs reproduced in 9.3.2.

#### 9.3.2 Applicability of Labels

##### 9.3.2.1 "Live Animals" Label

It is mandatory to attach at least one IATA "Live Animals" or one "Laboratory Animals" label or tag, properly completed, to each live animal container, unless otherwise stated in the individual container requirements. Dog and cat containers may have the appropriate labelling imprinted.



Name: Live Animals.

Colour: Bright green on light background.

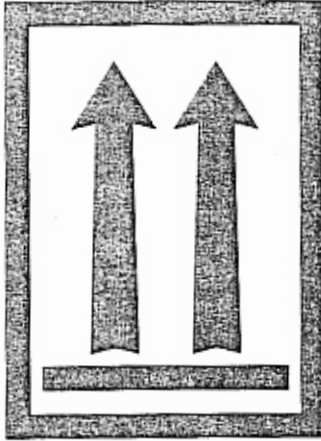
Minimum dimensions:

for label: 10 × 15 cm (4 × 6 in);

for lettering: 2.5 cm (1 in) high.

### 9.3.2.2 "This Way Up" Label

In addition to the "Live Animals" label, it is mandatory that the "This Way Up" labels be placed on all four sides of the container whenever possible.



Name: Package Orientation "This Way Up";  
ISO 780-1984.

Colour: Bright red or black on light background.

Minimum dimensions: 10 × 15 cm (4 × 6 in).

### 9.3.2.3 "Laboratory Animals" Label

Consignments of Specific Pathogen Free (SPF) axenic (germ free) or gnotoxenic (defined flora) animals for laboratory use shall have the special laboratory animals label attached instead of the green "Live Animals" label.



Name: Laboratory Animals.

Colour: Bright red on light background.

Minimum dimensions: 10 × 15 cm (4 × 6 in).

**Note:** The use of standard "Live Animals" label or tag on SPF container is optional.

### 9.3.2.4 Prohibited Labelling

Any labelling, especially on small containers, must not occlude or block ventilation openings.

### 9.3.2.5 Replacement of Labels

After acceptance, if a carrier discovers that labels have been lost, detached or are illegible, they must be replaced.