

# Husbandry Manual

## For

### Bridled Nail-tail Wallaby



*Onychogalea fraenata*

**Mammalia: Macropididae**

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## Occupational Health and Safety Risks

### Risks to keeper:

Bridled Nail-tail Wallabies **Onychogalea fraenata** are non hazardous to humans. Do not provoke them to bite, although they will generally shy away from humans. Remember always to use appropriate PPE wherever harm could be caused. This includes: latex gloves, long pants, closed in shoes (working boots preferable), face mask (if working in arid areas with red sand). When working in this environment, manual handling risks are always present. Remember to lift heavy objects keeping back straight and knees bent. If object is too heavy use two handlers. While raking or cleaning remember to stretch the back every 10-20 minutes.

### Risks to the animals:

*O. fraenata* are easily stressed out and very sensitive to new surroundings and human presence. When working with these animals take care to move in a way that doesn't invade their FFF area. When capturing, do so quickly and efficiently and when captured they must be put into a dark area like a hessian bag immediately to prevent capture myopathy. They will react to some chemicals so only use animal friendly chemicals like F10 and animal house and rinse well. Quarantine *O. fraenata* as you would with any other wallaby (2-3 weeks or until clean faecal). All wallabies are prone to teeth problems such as lumpy jaw so monitor them closely. Provide a wide variety of native plant and tree species to prevent this from occurring. They can be housed together up to 6 specimens in an enclosure but need places to hide individually otherwise they will fight over territories and this may cause injury.

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**Introduction:**

The Bridle naitail Wallabies are listed as endangered and are only found in a small pocket of Australia. There is not a lot known about them in the wild although a lot of research has been done in captivity. They are an important species to our environment and are quickly declining in numbers due to habitat loss and competition for food with introduced species and predation from introduced carnivorous species. There are only 400-700 individuals left in the wild.

This husbandry manual will explain how to care for them in captivity and hopefully can be used as a tool for the education of this species and to promote an awareness and help people to take action and stop the decrease in numbers in this species.

Most of the information found on *Onychogalea fraenata* is taken from captive institutions but some field work has been done. There is always more to learn about any species wild habits but the urgency is increased with *Onychogalea fraenata* as their survival now relies heavily on us.

Until 1973 the last reported sighting of a Bridled Nail-tail, or Flashjack, wallaby was in 1937. They are fairly easy to breed in captivity and it's so important that we continue the study of them but also increase the population in the wild aswell.

## **2. Taxonomy**

### 2.1 Nomenclature-

Class: *Mammalia*

Order: *Diprotodontia*

Family: *Macropodidae*

Genus: **Onychogalea**

Species: *Onychogalea fraenata*

### 2.3 Recent Synonyms- none.

### 2.4 Other common names: Flashjack, merrin, waistcoat wallaby and Pademelon

- Queensland Government

- R. Strahan, 1983

## **3. Natural History**

Bridled Nail-tail Wallaby's are relatively easy to keep in captivity. They breed well in captivity and live long lives. In captivity we are able to study their behaviour and learn more about their diet. A study at Taunton NP found diet to be diverse, including herbaceous species, grasses and shrubs. Proportions of these different plant groups varied with season and availability. Wallabies showed selection against grass species in all seasons, particularly during the dry winter. At this time forbs (mostly chenopods) became the major dietary component, and feeding selectivity was high for the relatively rare food items such as sedges. There was strong selection for sedges during spring, when food resources were at their lowest abundance. They showed a preference for food items of relatively high nutritional value (leaf and reproductive parts such as seedheads) and selection against items of relatively high fibre content (grass stem and sheath). They also appeared to prefer younger stages of growth (which have less fibre)- Australian Government, 2009. Until 1973 the last reported sighting of a Bridled Nail-tail, or Flashjack, wallaby was in 1937. The animal was presumed extinct and added to the lengthy list of species that have disappeared from the Australian continent over the past 200 years. Then, in 1973, the animal was reported on a cattle station near the

town of Dingo, Central Queensland. This was an astonishing find, providing the opportunity to protect a species considered forever lost from the earth. – btnwallaby trust. The latest population estimates show that there are between 400-700 *individuals* left in the wild.

### 3.1 Diagnostic features

The Bridled Nail-tail Wallaby is a medium-sized macropod up to 8 kg (males) in weight, with distinctive markings of a white 'bridle' line running from the centre of the neck, along the shoulder to behind the forearm on each side of the body. A black stripe runs the length of the body, and white cheek stripes are present on both sides of the head. A horny 'nail' at the tip of the tail is between 3-6mm and is partly concealed by hair. Their head- body length is 70cm. Total length is 125cm. It is hard to tell the sexes apart. The only stand out features are that males have external genitals and females have pouches. The size does not vary very much.

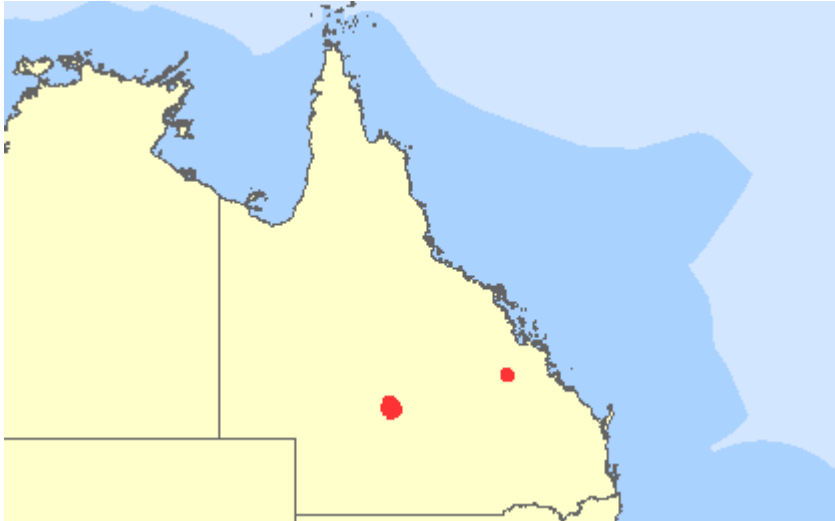



### 3.2 Distribution and Habitat

\*Distribution- At the time of the European settlement, Bridled Nail-tail Wallabies were apparently common in eastern Aust. to the west of the Great Dividing Range. Reports by naturalists indicate that they ranged from the Murray River region of north-western Vic. through central NSW, and north to Charters Towers in QLD. The species' range declined dramatically during the last one hundred years with no confirmed sightings reported during the period 1937-1973. The species was rediscovered in 1973 near Dingo, QLD. The total population was estimated to be 1200-1500 in 1991. During a long drought in the early 1990s and it was estimated that only 400-500 surviving in 1994. Not many are left in captivity in NSW, there are some in captivity in QLD but laws prevent the institutions from transporting the animals to NSW where there are the facilities to breed them. – pers comm. C. Thomson

\*Habitat- Bridled Nail-tail Wallabies generally occupy hot, dry, stony semi-arid regions of eastern Australia. Preferred habitat, however, is a comfortable mix of transitional vegetation, dense acacia scrub and open grassy eucalypt woodland. They tend NOT to be found in areas that are either too thickly vegetated or contain fallen

logs. They are not migratory. They are solitary animals except for when food is scarce, they may form a group of up to 9 wallabies.



 = Distribution

### 3.3 Longevity

\*Wild- Not much information is available regarding the lifespan/longevity of this species.

\*Captivity- Individuals in captivity have lived 5-10 years.

\*Determining Age- Once they have reached full adult body size, age can be determined through examination of molar eruption and molar progression (the forward movement of teeth within the mouth).

## **PREPARE AND MAINTAIN ANIMAL HOUSING**

### 4. Housing Requirements

#### 4.1 Exhibit/Enclosure Design

As the exhibit is the permanent home of the animal/s it needs to include appropriate substrate such as, red sand (preferred), grass/clover, mulch or dirt/soil. These animals are crepuscular therefore the substrate needs to be soft enough to make a 'hip-hole' to rest in during the day

while still being viewed by the public, although they do need areas to escape public view even if it is just a small hollow rock that is provided. Minimum measurements are below. They must be kept outside with access to sunlight and shade. The exhibit should include native food plants as wallabies are grazers and also need the bark of native plants and trees to prevent lumpy jaw and also to encourage natural behaviour. Bridles select the following plants often in the wild: *Portulacca/Zalea* spp., *Trianthema triquetra*, *Stellate* spp., *Sclerolaena* spp., *Enchylaena tomentosa*, *Chloris divaricata*, Sedges and *Chloris truncate*.

#### 4.2 Holding Area Design

The holding area for the *Onychogalea Fraenata* can be quite different to the exhibit design. Concrete is an acceptable substrate for a temporary holding area but not for a permanent exhibit or enclosure. It doesn't need to be as big as a permanent enclosure, but it has to be big enough for them to move freely and even move quite quickly without injuring themselves by bumping into obstacles if they feel threatened, but doesn't have to be big enough so they can get up to their full speed.

#### 4.3 Spatial Requirements

Minimum Enclosure Area: 30m<sup>2</sup>

Minimum Enclosure Height: 2m

Additional Floor Area for Each Extra Animal: 3.2m x 3.2m

#### 4.4 Position of Enclosure

The enclosure must be at least partly in the sun as *Onychogalea Fraenata* are semi arid animals. They must also have proficient shelter from the elements, cold, wind, rain etc. This can be fulfilled by the use of shelters, browse and awnings as you will read in 4.5 and 4.9

#### 4.5 Weather Protection

As mentioned above, the enclosure needs to be at least partly in sun as the animals are semi arid. An open enclosure is preferred to let as much natural sun light and air in as possible. The walls must be 2m or higher to prevent the animals escaping. There should be some kind of mesh on the top of the enclosure also to prevent the animals escaping, but also to prevent anything outside getting in. They also need to have a sheltered area to protect them from the elements eg. wind, rain, and sun. They will try to find higher ground or protection when it is windy because they rely on sight for protection against predators instead of hearing when it is windy. – Queensland Government, 2009.

#### 4.6 Heating Requirements

There are no heating requirements for *O. Fraenata* as they are to be kept outdoors because they come from arid lands. Pers com- Rhian Phillips and Michael Drinkwater, mammal keeper, SWW.

#### 4.7 Substrate

The substrate must be made up of material that is non-abrasive to macropod feet. Some suitable substrate examples are:

- Red sand (preferred as this is generally where they would be found in wild)
- Grass and clover
- Mulch
- Dirt/soil

There must be enough soft substrate/bedding for the animal to make a 'hip-hole' for comfortable resting. – Australian Government, 2009.

#### 4.8 Bedding Material

- Rocks
- Grass tussocks
- Low plants/bushes
- Small shade trees
- Solid and hollow logs
- Dried grass
- Soil deep enough to dig
- Australian Government, 2009.

#### 4.9 Enclosure Furnishings

Some furniture items include:

- Browse (important for diet and also to eat the bark and keep gums strong to prevent lumpy jaw)
- Large rocks, rock crevices, over hangs (to hide and shelter in).
- Water bowl or pond. Important even though bridles will not always drink from a water source, getting moisture from the browse they are given, but if this is not sufficient or if it is particularly hot they have been observed drinking water.
- Other enrichment includes housing them with other members of their species, also other species that will be compatible and a varied diet. – Australian Government, 2009.

### **5. GENERAL HUSBANDRY**

#### 5.1 Hygiene and Cleaning

##### Daily cleaning routine of Bridled Nail-tail Enclosures:

PPE: gloves, long pants, long sleeves, hat, sunscreen, sunglasses and closed in working boots.

Other things to consider: always keep one airlock door shut while you are working and if possible, have an idea of where the animals are. You will need a scrubbing brush, rake, wheelie bin and appropriate PPE as listed above.

- Remove all old browse from enclosure, place it into a wheelie bin if necessary.
- Remove all faeces and food scraps and old leaves, throw away into rubbish bin.
- If the area is sand or similar substance, use a rake to remove all faecal matter and old food. Gather into small piles and sift the sand out, put what is left into a rubbish bin.
- You may have to clean the enclosure substrate with animal-friendly disinfectant such as F10 Super Concentrate Disinfectant to sanitise. For this use a scrubbing brush and a spray bottle filled with F10. Keep a bowl of water or a hose with you to rinse the scrubbing brush.
- Clean food and water bowls with F10 and rinse.
- Replace old browse with fresh browse. Always place it up off the ground to keep clean, but low enough so that the animal can reach it.
- Clean and refill water bowl.

## 5.2 Record Keeping

- \* Health Problems- Any health problems are to be reported on an ID card and monitored daily.
- \* Veterinary examinations and treatments should be available for the specimens if needed.
- \* Behavioural problems should be dealt with immediately as to not effect any other animals that specimen is housed with and to prevent damage to itself.
- \* Reproductive stage should be monitored and recorded but not intervened!
- \* All movements within the institution and between institutions should be recorded.
- \* All weights and measurements should be recorded monthly or whenever there is birth, treatment, death or acquisition.

## 5.3 Methods of Identification

Ear tags may be used for macropods also injectable microchips. To tell individuals apart, use their size, body markings, face shape, age, and preferred diet. Other means of identification can be punch holes numerically positioned around the ears, small metal ear tags or tattooing along the ventral surface of the tail base or ears. - ASZK

## 5.4 Routine Data Collection

Any records from recording pouch checks, weighing, conditioning, D/E (deaths), ACQ (acquisitions of animals), B/H (births or hatchings), INT (internal movement) etc need to be entered into a data system on a computer and/or filed in a filing cabinet. Also, onto ISIS (International Species Information System) or ZIMS (Zoological Information Management System) which are international record keeping systems.

# **6. PREPARE AND MONITER FEEDING**

## 6.1 Wild Diet

Mainly consists of native browse- i.e. shrubs, vines, eucalypts and ferns. They will also eat grasses, fungi, reeds and seeds. Will eat fruit when available but not a lot and not soft fruits (melons, citrus fruits, tropical fruits etc). Bridles select *Portulacca/Zalea* spp., *Trianthema*

*triquetra*, *Stellate* spp., *Sclerolaena* spp., *Enchylaena tomentosa*, *Chloris divaricata*, Sedges and *Chloris truncate*.

## 6.2 Captive Diets

A constant supply of browse must be supplied for them at all times and can be selected from the list above or other similar species (native Australian species, eucalyptus is a favourite of the bridles at Sydney Wildlife World). Other foods include Lucerne hay, chaff, grass pellets, root vegetables such as carrot and sweet potato but these are to be given as a supplement, not as often as grass and leaf matter.

At Sydney Wildlife World one Bridle (per day) is given:

- 200gm grass pellets – Appendix one
  
- 50gm carrots, this can be replaced by sweet potato if no carrot is available but too much sweet potato is fattening. A small amount of hard vegetables is recommended for the cleaning effect it can have on the gums and teeth by clearing grass pellets that can become soft and get lodged in the gums. Also, carrot contains vitamin A which is important for vision and bone growth.
  
- 100gm corn
  
- Ad lib eucalypt browse, this can be replaced by any native Australian species that is listed in 'Wild Diet' above

Pers comm. K. Marshall

## 6.3 Supplements

- 5gm parsley or spinach
- 10gm Sweet potato
- 50gm Carrot
- Salt and mineral licks (to replace minerals they would naturally gain from soil and dirt in the wild)

## 6.4 Presentation of Food

Food should be presented in troughs or feeding rocks up off the ground. Hygiene is of utmost importance. Troughs and feeding rocks must be kept clean by scrubbing everyday and disinfecting with animal friendly disinfectant such as F10 or similar substance once a week. Also, enrichment items such as wild native grasses and taller browse or trees should be placed in the exhibit at random to encourage the natural behaviour of browsing and grazing.

## **CAPTURE RESTRAIN AND ASSIST IN MOVING ANIMALS**

### **7. Handling and Transport**

#### 7.1 Timing of capture

Preferred time of capture is early morning so it is cool, prior to public arriving and gives plenty of time if the animal needs to be transported and released. –K. Marshall

#### 7.2 Catching bags

A small to medium size catching bag can be used. Bag should be made out of cotton, hessian or similar open-weave material.

#### 7.3 Capture and Restraint Techniques

##### How to:

Technique one- always moving very slowly, never using fast, sharp movements, back the animal into a corner or as it runs past quickly place the hoop of the catching bag over the animal.

-Pick the bag up so that the animal moves to the bottom of the bag

-Twist the bag from the top as quickly as possible to prevent the animal escaping

-Place the animal on the floor or a surface (while still in bag) to reduce stress. The animal will start to calm down when it is in a dark bag.

Beware of sharp teeth and claws and strong tail. They will use these as weapons if they feel threatened.

Chemical restraint can be used although is not always necessary. Valium is the preferred drug. Some precautions to be noted are that the animal will over heat alot quicker than usual so must be monitored constantly, also because the animal is limp and if it's head is touching the chest it may restrict airways. Dose rates are as follows- 2.5ml for a 10g animal, 2.75ml for a 15kg animal, 3ml for up to 20kg, 4ml for up to 35kg, 4.5 for up to 40kg, 5ml for up to 50kg and 6ml for up to 60kg. Keep in mind the individual animal's temperament. If the animal is hand raised it will likely to be less panicked, therefore will not need as much as a younger, more 'wild' animal. If you need to top up the valium during the trip,  $\frac{3}{4}$  of the dosage should be proficient for an hour. Remember that that animal has to be fully out of the sedation prior to its release. Lynda Staker, 2006

Technique two- Using a net flat on the ground, herd the animal on top of it and then lift one side so it becomes trapped. You can then put the animal in a catching bag. Pers com K. Marshall

Technique three- Feed the animal and while it is distracted quickly grab firmly by the base of the tail. Pers com K. Marshall

#### 7.4 Weighing and Examination

Hold the animal by the base of the tail or if pouch checking or medical examining, put the animal into a catching bag, keeping the head and the majority of the animal inside the bag, maneuver the animal around so that you can examine the pouch or the area that needs attention.- Pers com M. Drinkwater

#### 7.5 Release

-When releasing into the enclosure, always make sure you are situated far enough away from any obstacles (eg walls, windows, enclosure furniture) and away from public.

-If releasing into enclosure, make sure the area is secure so the animal cannot escape.

-Time of day: either early morning or late afternoon as this would be the time the animal would choose to be out in the open, and also to avoid heat. It should be in daylight so the animal can orientate itself. If the animal has travelled to the place of release, it should be released as soon as possible to reduce risk of capture myopathy. Pers com K. Marshall

#### 7.6 Transport Requirements

##### 7.6.1 Box Design

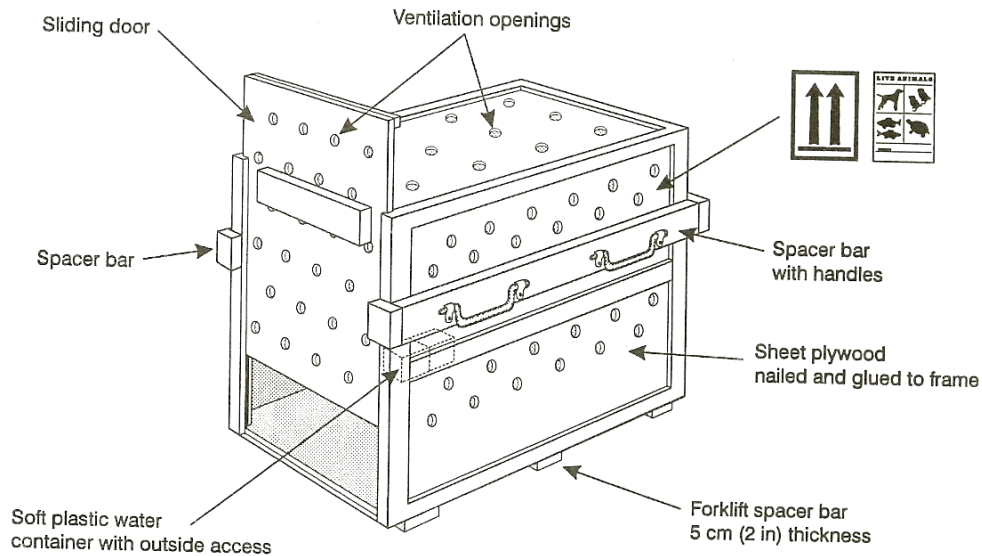
Materials used-

i) For transport trips of less than 24 hours duration, macropods must, wherever possible, be transported in suspended bags made of hessian or similar open-weave material.

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

#### Design-

- Framework must be 20mm x 20mm light timber if the animal is less than 20kg
- Must be 25mm x 25mm light timber if the animal is over 20kg
- Transport containers must not have internal framing
- Bottom and fixed sides must be of 6mm (13mm for animals weighing more than 20kg) plywood glued and screwed. Macropod transport containers must not have slatted floors.
- The end is to be closed by a sliding door of 6mm (13mm if the animal weighs more than 20kg) plywood which, once in place, must be secured by screws at each end.
- The ceiling must not be solid. It must 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.
- The container must be large enough for the animals to turn around, to lie down and to stand comfortably. Dimensions must not exceed these criteria as no room for exercise is needed and animals may hurt themselves if too much room is provided.
- A transport container for macropods must not allow entry of light, except through ventilation holes. The ventilation holes must 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 must be pierced at no greater than 10cm centres at the top and bottom of each side.
- Spacing blocks of 2.5cm must be fixed to the outside of the box on all four sides. – IATA Standards



### 7.6.2 Furnishings

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.

The roof must be padded with a soft non-destructible material in case the animal becomes agitated and jumps. - IATA Standards

### 7.6.3 Water and Food

A soft plastic water container must be provided, raised off the floor and with outside access. They do not normally require feeding or watering during 24hrs 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. - IATA Standards

## **MONITOR AND MAINTAIN ANIMAL HEALTH**



## 8.1 Daily Health Checks

Observations are generally made during cleaning and feeding in the mornings and any other time you are in the enclosure and include:

- All limbs appear to be moving freely. Check the gait of the animal, any limping should be investigated. Monitor the animal closely and if the limping continues, you may have to capture the animal to find where the problem stems from. It could be caused by an injury from dominance/play, tetanus or vitamin deficiency.
- Feeding well. If the animal is not eating it may have a tooth abscess or Lumpy Jaw and may need to be checked.
- Eyes clear and fully open. Weepy/partially closed eyes are a good indicator that the animal is sick.
- General appearance – body condition and condition of coat. Loss of fur can indicate extreme stress and could lead to Capture Myopathy. Check for any obvious cuts or scratches, skin in general is in good health and paw health.
- Discharges – any nasal, ocular, ear or cloacal discharges should be noted.
- Changes in behaviour. It should be noted if the animal is unusually depressed, aggressive, active or uninterested in food.
- Consistency of faecal material – note if it is sloppy, not the normal colour, contains blood or is not present at all.

- Drooling. Could indicate Lumpy Jaw or a tooth abcess.
- Twitching. Could indicate mites or some other skin irritation.
- pers comm- S. Gildon
- pers comm- J. Carver

## 8.2 Detailed Physical Examination



### Capture and Restraint Techniques:

Technique one- always moving very slowly, never using fast, sharp movements, back the animal into a corner or as it runs past quickly place the hoop of the catching bag over the animal.

-Pick the bag up so that the animal moves to the bottom of the bag

-Twist the bag from the top as quickly as possible to prevent the animal escaping

-Place the animal on the floor or a surface (while still in bag) to reduce stress. The animal will start to calm down when it is in a dark bag.

Beware of sharp teeth and claws and strong tail. They will use these as weapons if they feel threatened.

Chemical restraint can be used although is not always necessary. Valium is the preferred drug. Some precautions to be noted are that the animal will over heat alot quicker than usual so must be monitored constantly, also because the animal is limp and if it's head is touching the chest it may restrict airways. Recommended dose rates are as follows- 2.5ml for a 10kg animal, 2.75ml for a 15kg animal, 3ml for up to 20kg, 4ml for up to 35kg, 4.5ml for up to 40kg, 5ml for up to 50kg and 6ml for up to 60kg. Keep in mind the individual animal's temperament. If the animal is hand raised it will likely to be less panicked, therefore will not need as much as a younger, more 'wild' animal. If you need to top up the valium during the trip,  $\frac{3}{4}$  of the dosage should be proficient for an hour. Remember that that animal has to be fully out of the sedation prior to its release. Lynda Staker, 2006

Technique two- Using a net flat on the ground, herd the animal on top of it and then lift one side so it becomes trapped. You can then put the animal in a catching bag. Pers com Katie Marshall, Rhian Phillips

Technique three- Feed the animal and grab by the base of the tail. Pers com K. Marshall

#### Examining the animal:

Hold the animal by the base of the tail or if pouch checking or medical examining, put the animal into a catching bag, keeping the head and the majority of the animal inside the bag, maneuver the animal around so that you can examine the pouch or the area that needs attention.- Pers com M. Drinkwater

#### Gauging the health of the animal:

Check pouch for young, condition of skin (any abrasions, cuts, scratches etc) condition of coat, paw health, check for tooth abcess, eye condition (fully open, weepy), limbs moving freely, any nasal, ocular, ear or cloacal discharges, if possible check consistency of faeces.

### 8.3 Routine Treatments

- Worming. There are a number of endoparasites that effect wallabies but none do a significant amount of damage. The most common is tapeworm *Echinococcus*

*granulosus*. (Adelaide Zoo, 1996). Cleanliness is the best prevention method. Symptoms of internal parasites include weight loss, progressive anorexia and

death if severe - Miller, 2001. Many nematodes can be treated with Ivermectin at 0.2mg/kg intramuscularly but cestodes and protozoa will not be eliminated by this commonly-used treatment - Miller, 2001

- Vaccinations. Tetanus is the only recommended vaccination. – Miller, 2001

#### 8.4 Known Health Problems



- Lumpy Jaw actinomycosis:

*Cause*: bacteria *Fusobacterium necrophorum* and/or *Corynebacterium pyogenes* penetrate gums.

*Signs*: Facial swelling, usually on one side of the face/mouth, weight loss, drooling, decay of jaw bone/teeth, behavioural changes such as seemingly uninterested in food.

- pers comm J. Carver

*Treatment*: antibiotics (the best way to administer is to soak a treat such as bread in the fluid, injections are also available), tooth removal, abscess irrigation, continual monitoring and euthanasia if severe.

*Prevention:* feeding high quality browse, feeding solid but not sharp foods to strengthen gums, good hygiene within the enclosure, food and keepers handling the food and animals.

- Miller, 2001
- pers comm- S. Gildon

- Capture Myopathy

*Cause:* excessive physical activity, stress, fear, anxiety.

*Signs:* slow/stiff gait, paralysis, muscle spasms, labored breathing, limb twitching, reluctance to move.

*Treatment:* vitamin E and selenium injection, wrap forearms, inner thighs, thorax and forehead in iced towels, fluid therapy, relax muscles, sedation (intravenous sodium bicarbonate)

*Prevention:* avoid prevention to causes, practice safe capture techniques, feed diet with proper Vitamin E and selenium levels, 30-40 IU Vitamin E during capture and/or transport.

- Miller, 2001
- pers comm- K. Marshall

NOTE: Capture Myopathy can lead to Cardiac Failure and other shock related diseases.

- Hypervitaminosis

*Cause:* refers to the effects of excessive vitamin A intake.

*Signs:* nausea and vomiting, headache, dizziness, blurred vision, and loss of muscular coordination.

*Treatment:* correct the diet and will subside

*Prevention:* vitamin A supplements

- pers comm- S. Gildon

- Anorexia

*Cause:* lack of food or nutrients in food. Also, if the animal has lumpy jaw, a tooth abscess or similar disease it could stop the animal from eating, hierarchy (highest animal not allowing lower animals to eat)

*Signs:* disinterest in food, underweight, ribs or hips showing.

*Treatment:* isolating animal, monitoring closely, noting how much food it eats, feed preferred food to prompt eating.

*Prevention:* feeding a variety of food so as the animal does not get turned off certain foods, regular health checks for tooth abscess and lumpy jaw.

- Obesity

*Cause:* excess of food, hierarchy (highest animal not allowing the lower animals to eat and therefore eating too much)

*Signs:* overinterest in food, overweight, inability to move freely, appearance (rounded belly, unable to feel bones)

*Treatment:* lessen amount of food, if necessary isolate animal and monitor food intake and weight.

*Prevention:* monitor hierarchy behaviour, give recommended amount of food.

– Tooth Abscess

*Cause:* bacteria in the mouth/tooth

*Signs:* Facial swelling, usually on one side of the face/mouth, weight loss, drooling, decay of jaw bone/teeth, behavioural changes such as seemingly uninterested in food.

- pers comm J. Carver

*Treatment:* antibiotics (the best way to administer is to soak a treat such as bread in the fluid, injections are also available), tooth removal, abscess irrigation, continual monitoring and euthanasia if severe.

*Prevention:* feeding high quality browse, feeding solid but not sharp foods to strengthen gums, good hygiene within the enclosure, food and keepers handling the food and animals.

- Miller, 2001
- pers comm- S. Gildon

## 8.5 Quarantine Requirements

The animal will have to have faecal and/or blood tests before leaving the institution it is coming from if acquiring to make sure it is completely clear of disease.

The duration in quarantine will depend on clear faecals. Generally 3 clear faecals is sufficient to gauge the animals health. The use of foot baths and barrier nursing (that is the area having

its own tools and materials and not being mixed with other enclosures) is crucial for preventing the spread of disease. The incubation period of each disease that may be found must be considered.

## **9. Behaviour**

### **9.1 Activity**

Bridles are crepuscular which means they are active during dusk and dawn. They will come out to feed and roam at those times, other times they will rest, sleep or hide away. Usually active between 6pm and 6am in the more arid regions. - Jackson, 2003

### **9.2 Social behaviour**

Bridles are generally solitary although they will come together to feed in small groups of four or five. Oestrus females are usually accompanied by a single male. They are sexually promiscuous in both sexes in the wild and aggression between males occurs only around oestrus females. Males do not appear to form a predetermined dominance hierarchy, however body weight and age strongly influence priority access to females. Females mate with several males within and between oestrus cycles. - Jackson, 2003

### **9.3 Reproductive behaviour**

There is not much courtship that goes on with bridles. The male will follow the female and investigate her cloaca. He will attempt to grip her tail while emitting a clicking sound and follow her around. Mating takes place when the female remains stationary and crouches with the male behind. Mating is detectable by examining the female's cloaca as it will contain a semen plug shortly after the mating, which is then expelled onto the ground. Flehmen has been observed in male macropods which just describes a kind of lip curling that the males exhibit when they encounter the urine of females. The animal will stand with his head stretched toward the female's cloaca or urine on the ground with his mouth open while he retracts the upper lip. This bares the gum and wrinkles the nose, and appears to be a mechanism to aspirate into the vomeronasal organ. (Coulson and Croft 1981; Triggs 1990). This sometimes goes hand in hand with the animal with the animal making licking and mouthing movements during and after showing flehmen. This process seems to be involved with the males detecting if the female is in oestrus and therefore ready to mate - Coulson and Croft 1981; Triggs 1990

### **9.4 Bathing**

Generally, bridles do not bathe - Jackson, 2003. I have never observed any doing so in my experience with captive bridles. As they do not sweat they lick their forearms to lower their body temperature if too hot.

### 9.5 Behavioural problems

Some individual male (particularly males that have been hand-raised) can become aggressive and attempt to grab and kick anyone within their enclosure, especially when there is a female in oestrus. If you know there is a particular troublesome individual inside an enclosure, make sure you locate all of them before entering. If an animal is showing signs of aggression, it can often be addressed by:

- Crouching down: the animal will hopefully think that you no longer pose a threat to its dominant position. If the animal is very used to humans, this technique may not work. Alternatively;
- Reach out the head of a rake or shovel over the head of the animal so that it knows you are much larger than it and therefore more dominant. - Jackson, 2003

A rake or shovel can also be used to keep the animal out of kicking range. But bridles do not get very big, and they are quite skittish so will most likely move away from you, and if they do approach you, they cannot do nearly as much harm as, say, a Red Kangaroo in which case you would have to take many precautions.

### 9.6 Signs of stress

- Vocalization
- Flinching
- Escape attempts
- Thumping the ground with the hind feet
- Body trembling
- Head shaking
- Ear flicking
- Teeth grinding
- Licking the forearms, shoulders and flanks depending on the degree of stress (resulting in increased thirst)
- Reduced food intake (associated with chronic stress)

- Diarrhoea - Jackson, 2003

### 9.7 Behavioural enrichment

- Provide various native species of browse
- Provide more than minimum space to encourage free movement
- Change the food from week to week so they do not become bored
- Change the set out of the exhibit/enclosure

### 9.8 Introductions and removals

When animals are introduced for the first time, particularly males, they can show some signs of aggression towards each other until their hierarchy is determined. This behaviour is natural but it is advisable to monitor the animals so they cannot do too much harm to each other.

When animals are taken out and returned later there are generally few problems. - Jackson, 2003

### 9.9 Intraspecific compatibility

Bridled Nail-tail Wallabies are solitary in behaviour (Evans 1996). Home ranges of males ( $65.6 \pm 13.3$  ha) were considerably larger than for females ( $23.3 \pm 2.9$  ha) and ranges tended to vary in size inversely with the availability of preferred food items (Fisher 2000). Home ranges of males overlapped with those of from 4 to 21 females, and those males which overlapped with more females were observed to associate more often with oestrous females, but there were no apparent correlations between male range size, male body size or female density - Fisher & Lara, 1999.



**‘Mary’ Bridled nail-tail at Sydney Wildlife World emitting a low quiet growl**

#### 9.10 Interspecific compatibility

Generally, smaller macropods can be housed with other species with no problems (Jackson, 2003). The bridles I have worked with in captivity have shown signs of aggression toward larger macropods (Red kangaroos) but it has never resulted in an attack, let alone an injury. Most macropods are content with a warning and would prefer not to injure themselves by using physical force.



**‘Mary’ Bridled nail-tail at Sydney Wildlife World emitting a quiet low growl at the red kangaroo**

## **10. BREEDING**

### 10.1 Mating System

Most macropods are Polygynous and as bridles are solitary animals their young is mostly sired by different males. - Jenkins and Lowry, 2005-2009

### 10.2 Ease of Breeding

Generally breed well in captivity if pair is compatible

### 10.3 Reproductive Condition

#### 10.3.1

Macropods are generally placed in several categories depending on their reproductive status. For females these include:

- Non-parous (females that have never been bred) – pouch small with no skin folds, clean and dry, teats very small.
- Parous (females that have been bred previously but not presently) – pouch is small but distinct, dry and dirty, the teats are slightly elongated.

- Pregnant – pouch pink in colour and glandular in appearance, skin folds may be observed on the lateral margins of the pouch.
- Pouch young present – attached to the teat.
- Lactating (young absent from the pouch but still suckling) – pouch area large, skin folds flaccid, hair sparse and stained, skin smooth and dark pink, teats elongated.
- Post lactation with teats expressing only clear liquid and/or regressing.

#### 10.4 Techniques used to control breeding

Several techniques can be used in situations where large numbers of bridles are held together. These include:

- Separation of the sexes – this can be done by taking either the male(s) or female(s) off exhibit or out of enclosure, or simply barricading the enclosure/exhibit so that the males do not have access to the females
- Vasectomy of the dominant male (can include all independent males as well)
- Castration of all breeding age males
- Removal of pouch young
- Immune-contraception
- Tubal ligation in females
- Culling

#### 10.5 Occurrence of Hybrids

Care needs to be taken that hybridisation does not occur between different species of macropods. There have been no records of hybridisation in bridles. Hybrids have occurred between species that do not have the same number of chromosomes and between genera. Numerous hybrid macropods have been produced to date, however they generally are not fully fertile as they usually have deformed reproductive organs, including empty scrota, small testes, no spermatogonia and small non everted teats. - Jackson, 2003

### 10.6 Timing of breeding

Birth season is all year round.

### 10.7 Age at First and Last Breeding

Males and females are sexually mature from 270 and 136 days respectively. The age of sexual maturity and maximum annual fecundity suggest they have a much higher potential reproductive output than other similar sized macropods. - Jenkins and Lowry, 2005-2009. They will breed up until they die or until they are too old and their bodies are too frail to support and nurture A Joey. - Jackson, 2003

### 10.8 Ability to Breed Every Year

All macropods have the ability to breed every year. - Jackson, 2003

### 10.9 Ability to Breed More Than Once Per Year

Macropods are not able to fully raise more than one young in a year. Most macropods are able to mate shortly after birth (post partum oestrus) but bridles cannot. They can however have one embryo 'on hold' while another Joey is still too young to leave the pouch. They are able to have 3 young at different stages of development: 1) one in a state of embryonic diapauses, 2) one in the pouch attached to the teat, and 3) one which has vacated the pouch permanently and which puts its head into the pouch to feed - Jackson, 2003. Females may breed one to two months after permanent pouch emergence. Mating during pouch life has been recorded when pouch young were between 78-99 days old. Pouch life ranges from 119-126 days

- Jackson, 2003
- Jenkins and Lowry, 2005-2009

### 10.10 Nesting Requirements

Not required but it is preferable to supply them with several shelters from the elements and also male bridles. This can include medium sized wooden boxes, rock crevices and hollows, and upturned browse made into hides.

- Jackson, 2003
- Pers comm. K. Marshall

### 10.11 Breeding Diet

There is no specific diet that is required prior to or during the breeding season - Jackson, 2003 however it is also acceptable to increase the diet while breeding as macropods will not breed if conditions are undesirable. Ensuring quality food and water is readily available, also, having a variety of food.

### 10.12 Oestrus Cycle and Gestation Period

Bridled naittail wallabies breed continuously with an oestrous cycle length of 30-45 days and a mean gestation period of 21-26 days. - Jackson, 2003

### 10.13 Litter Size

Only one young is born at a time. - Jackson, 2003

### 10.14 Age at Weaning

Permanent pouch exit: 119-126 days

Weaning: 190-245 days - Jackson, 2003

### 10.15 Age at Removal from Parent

As bridles are solitary in the wild and do not have a mob mentality where the young would stay close to the mother until it was full grown, it would be advisable to remove young as soon as weaned as the parents often become intolerant of them. - Jackson, 2003

### 10.16 Growth and Development

Development of the joey can be recorded on a growth chart with age (in days) on the horizontal axes and the body weight (in grams) on the vertical axes. The joey should be weighed every 50 days. It is also advisable to first record the predicted body weight on the graph. At around 126 days the joey will leave the pouch but still suckle the mothers' milk. Around 70-110 days later the joey will be weaned and able to feed on solids.

- Jackson, 2003
- Australian Government

## **11. Artificial Rearing**

### **11.1 Housing**

Macropods are very susceptible to diseases from stress. as many precautions as possible need to be taken into consideration to minimise these risks. These include:

- Secure the area from other animals and children
- Make sure area is easy to maintain
- Area must be escape proof
- Clear the area of any obstacles and hazards
- Area must offer shelter from weather and noise
- Hygienic and easy to keep hygienic

Macropods (and all marsupials) are under developed when they are born and would naturally be raised in a very warm pouch. It is important to get the joeys warm initially with the heating inside the pouch set to 32-34 deg C. The pouch should be made of a thick material such as a canvas bag or wind cheater or even a think rain jacket. Then there should be an inner layer made of a natural material (no synthetic materials are to be used on young joeys especially furless) such as cotton or wool. This needs to be easily taken out to clean and be disinfected daily as bacteria thrives in the warm conditions that the joeys need. When joeys are furless and very young, one technique that has worked is placing the pouch inside an esky with a hot water bottle at a temperature of approximately 40 deg C which is covered in a sheepskin rug. The temperature needs to be monitored with a thermometer and the joey monitored to be sure it is not over heating or dehydrated.

Once the joey is fully furred it can be placed in a hanging pouch that allows them to go in and out as they please.

### **11.2 Temperature Requirements**

If the joey is furless the temperature of the bag should be 32-36 deg C. As the joey grows the temperature can reduce to 28-30 deg C when fully furred. The temperature can be controlled using hot water bottles and heat pads but these must be well wrapped in towels or blankets of a natural material and constantly monitored as these young animals can easily overheat or get too cold causing hypothermia. Small electric blankets can also be used available from Wombaroo Food Products. – Appendix two.

### 11.3 Diet and Feeding Routine

Naturally when a joey is suckling, the milk components change as it grows. So when we are hand rearing, we need to replicate this change as best we can. In late lactation the carbohydrates decrease with the proteins remaining the same.

Milk formulas:

Biolac- there are three formulations for different stages of development. For furless M100, M150 is a transitional milk to use when dense fur has developed, and M200 to be used when the animal starts producing solid dark pellet droppings. When changing between formulas use a ratio of 3:1 for the first week, 2:2 for the second week, 1:3 for the third week and fully onto the next formula the following week. Joeys should be fed 10-15% of their body weight in this formula per day.

Di-Vetelact- this particular milk is a low lactose formula. This should be fed at approximately 20% of the joeys body weight. Some institutions also add a tablespoon of High Protein Baby Cereal per litre for furred joeys.

Wombaroo Kangaroo Milk- different formulas are used for the different stages of development to mimic the changes that would occur naturally in the pouch during lactation. These range from <0.4 for joeys with less than 40% of pouch life completed, that are furless with ears closed and down; a 0.4 formula for joeys with 40% of pouch life completed, dark skin (just before fur), eyes open and ears nearly erect; a 0.6 formula for joeys with 60% pouch life completed with fine short fur and ears erect; and a >0.7 formula for joeys that have completed more than 70% of pouch life, have short dense fur and spend time out of the pouch. Charts are provided with the product to help determine the volume to be fed.

Cow's milk should not be fed to marsupials as it is too high in fat and lactose and can cause dehydration and diarrhoea.

Gut flora can be established by offering dry dirt and fresh grass as macropods are known to eat soil, this habit is called pica.

Very small joeys can be fed using a syringe fitted with a plastic intravenous catheter or one inch of gastric feeding tube. However most macropods will be large enough to feed from a 50 or 100 ml plastic feeder bottle. Milk should be fed at approximately 36 deg C.

The rate at which the milk is squeezed into the joeys mouth should be no faster than it can swallow it. The hole in the teat should be made with a hot pin, no bigger, to avoid the milk flowing too fast into the joeys mouth. Very young unfurred joeys should be fed every 2-3 hours around the clock. For furred joeys the number of feeds is reduced to 5 and the volume increased per feed. At full emergence when the joey is fully furred the number of feeds is reduced to 2 or 3 per day (no night time feeds required). By this time the joey should have access to grass and browse such as eucalypt, wattle and other native shrub and finely chopped carrot, sweet potato, grass pellets and apple.

#### 11.4 Specific Requirements

I have read in many different papers and manuals that you can rub sorbelene cream into the joeys skin to prevent in drying and cracking which happens very easily when hand rearing one. Naturally, in the pouch, the mother would excrete certain oils which would prevent drying of the skin. Some other natural skin creams that have been used with success are Wool Fat Bp Standard (pesticides removed), Eucerine ointment and Alpha keri oil, applied three times per day. Baby oil should not be used as it seems to rub off too easily and I believe that it is drying and irritating to the skin.

When the joey is first brought into care it may be dehydrated. You can test this by pinching the skin on the back of the neck and watching how quickly it falls back into place. If dehydrated give plain boiled water with 5g or one teaspoon of glucose to 100ml of water. Stress is a major problem in the successful rearing of native marsupials, especially macropods, and can be fatal. Therefore it is important to keep noise and movement to a minimum. Try not too over handle and always maintain high standards of hygiene.

#### 11.5 Data Recording

On immediate arrival of joey, its sex and approximate age should be recorded.

The following information should be recorded on a daily basis:

- Date
- Time
- Body weight
- General activity
- Characteristics and frequency of defecation and urination
- Amount of different food types given
- Food consumption
- Veterinary examinations and results

#### 11.6 Identification Methods

Visual ID or implant chips can be used when the animal is fully furred. If not the animals pouch could be identified.

## 11.7 Hygiene

As I have already stressed it is critical to the survival of the joey that hygiene is maintained.

- Maintain a clean pouch lining at all times. Older joeys can be trained to urinate on newspaper by keeping the smell of the urine on the paper but while it is still in the pouch for all of the majority of its time it needs to be cleaned every day.
- Always maintain personal hygiene by washing and disinfecting hands before handling the joey.
- Wash hands between feeding different joeys.
- Used boiled water when making up formula
- Clean spilled milk formula, faeces and urine straight away before it dries
- Store the bottles and teats in fridge to slow the growth of bacteria
- Only heat milk once and discard leftovers
- Stimulate toilet behaviour after feeding, this way keeping the pouch cleaner, dryer and warmer.

## 11.8 Behavioural Considerations

Imprinting can make it difficult when it comes to the weaning process. This means it has become too attached to the raiser. Minimising stress is also very important and this can include inappropriate temperature, being removed from mother, constant handling, different people feeding and even sounds and smells of cats, dogs and other predators and these should not be introduced until the animal is older.

- The Complete Guide to the Care of Macropods – Lynda Staker, 2006
- Katie Marshall – Mammal keeper at SWW

## **Acknowledgements:**

I would like to thank everyone who helped in the completion of this manual. All the keepers at Sydney Wildlife World were very helpful, Michael Drinkwater, Beverly Matthew, Katie Marshal, Kate Blount, Jarred Carver and Sian Gildon. Also, Celia Thomson from Waterfall springs, a very knowledgeable person and happy to help and answer questions.

Thankyou to the teachers at Richmond TAFE who taught me everything they know and helped me on my way to becoming a keeper.

And thankyou to my family and colleagues who were also very helpful and patient.

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## Appendix 1:

Page 1 of 2		
<b>MATERIAL SAFETY DATA SHEET</b>		
<b>COMPANY DETAILS</b> AUSTRALIAN DISTRIBUTOR: COMPANY: Chemical Essentials (Pty) Ltd Address: 13 Abelia Str, Doncaster East, Victoria 3111 Emergency Telephone number: +03 9841 9901 Fax: +03 9841 9909 mail: <a href="mailto:info@healthandhygiene.co.za">info@healthandhygiene.co.za</a>	<b>MANUFACTURER:</b> Health and Hygiene (Pty) Ltd P O Box 347, Sunninghill 2157, South Africa. Tel: +27 11 474-1668 Fax: +27 11 474-1670 e-	
<b>IDENTIFICATION</b>		
PRODUCT NAME: <b>F10 SUPER CONCENTRATE DISINFECTANT</b>	UN Number: None D G Class: None Hazchem code: None Poisons Schedule: 5	
<b>HAZARDOUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA IN THE PACK CONCENTRATE ONLY (eyes and skin irritant)</b>		
USE: Biodegradable multi purpose Disinfectant for all hard surfaces, equipment and airspaces		
<b>PHYSICAL DESCRIPTION/PROPERTIES</b>		
Appearance:	Clear, colourless liquid, with a slight natural odour.	
Boiling Point:	110 <sup>o</sup> C	
Vapour Pressure:	Not known	
Specific Gravity:	1.00	
Flash Point:	Not flammable	
Flammability Limits:	Not flammable	
Solubility in water:	Soluble	
<b>INGREDIENTS</b>		
	CAS Number	Quantity (w/w)
Benzalkonium Chloride	68424-85-1	5.4%
Biguanide	27083-27-8	0.4%
Ingredients not determined to be hazardous to 100%		
<b>HEALTH HAZARD INFORMATION</b>		
<b>HEALTH EFFECTS:</b>		
<b>Acute</b>		
SWALLOWED:	Low. Substantial ingestion may cause irritation to mouth, throat and digestive tract.	
EYE:	Low. Will cause irritation but not serious damage.	
SKIN:	Low. Concentrate may act as mild degreasant to sensitive skin.	
INHALED:	Low. No significant hazard.	

**Chronic**

INHALED:                    Low.                    No significant hazard

**FIRST AID**

SWALLOWED:            DO NOT induce vomiting. Give milk or water to drink. Seek medical advice where necessary.

EYE:                        Rinse eyes with water. Seek medical advice where necessary.

SKIN:                        Wash affected area with soap and water.

INHALED:                    Non-toxic. Avoid long term inhalation of neat liquid. Remove to fresh air.

**FIRST AID FACILITIES:** Contact a doctor or Poison Information Centre (phone 131126)

**ADVICE TO DOCTOR:** Treat symptomatically

**F10 SUPER CONCENTRATE DISINFECTANT**

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**PRECAUTIONS FOR USE**

EXPOSURE LIMITS: No data found

Engineering controls: None required

PERSONAL PROTECTION: Not required

FLAMMABILITY: Not Flammable

**SAFE HANDLING INFORMATION**

Storage and Transport: Store below 30<sup>0</sup> C in dry conditions

SPILLS AND DISPOSAL: Soak up on an inert material e.g. dry earth and dispose of in an area approved by local authority by-laws. Flush small spills with copious amounts of water

FIRE/EXPLOSION HAZARD: The product is not flammable or explosive.

OTHER INFORMATION: Ensure good industrial hygiene.  
DO NOT mix with soaps or other chemicals.

**CONTACT POINT:** Managing Director, +03 9841 9901  
Chemical Essentials Pty Ltd

**KEEP OUT OF THE REACH OF CHILDREN**

**Issue number:** 2

**Issue Date:** August 2004

**Appendix 2:**

Grass pellets used at Sydney Wildlife World from Aviculture Accessories  
91 Vine street, West Marsden Park, NSW 2765  
(02) 9838 1256

**Appendix 3:**

Wombaroo Food Products  
PO Box 151  
Glen Osmond  
South Australia 5064

Ph/fax: (08) 8391 1713  
Email: [wombaroo@adelaide.on.net](mailto:wombaroo@adelaide.on.net)  
Web: [www.wombaroo.com.au](http://www.wombaroo.com.au)