

# Husbandry Guidelines for The Common Wombat



## *Vombatus ursinus* Mammalia: Vombatidae

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Course Name and Number: RUV30204

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## **DICSLAIMER**

The following document contains guidelines, for the care of Common Wombats *Vombatus ursinus* in captivity based on research into the care of captive wombats and experience of captive husbandry. The author of the following guidelines and cannot be, and are not, legally, financially or in any other way, responsible for the application of techniques described within this document. When undertaking any procedures or techniques outlined in this document, it is up to individual workers to assess the unique circumstances of their situation, apply common sense, and subsequently apply any procedures or techniques at their own risk. In all cases, the reader of this document are cautioned not to use this handbook as an exact step-by-step guide, but rather as a starting reference point for further work.

## **OCCUPATIONAL HEALTH & SAFETY**

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### **Classification:** Hazardous

Wombats have great strength and are equipped with sharp rootless teeth and sharp claws. Although they may look harmless, they are capable of inflicting serious injury to a person. It is highly recommended to take caution when entering a wombat enclosure. They can cause injury through:

- Biting
- Scratching
- Charging
- Crushing with their rump

### **Prevention of Injury:**

- Only experienced staff should be allowed to enter a wombat exhibit.
- To prevent injury to both workers and the animals, only experienced staff should handle wombats (refer to section 7.3 Capture & Restraint Techniques).
- Wear PPE - Steel cap boots, long pants.
- When in a wombat enclosure, be aware of the animal - do not take your eyes off it.

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# 1. INTRODUCTION

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*Vombatus ursinus* - Meaning bear-like wombat.

There are three species of wombats in the Vombatidae family: The Common Wombat (*Vombatus ursinus*), the Southern-hairy Nosed wombat (*Lasiorhinus latifrons*) and the Northern-hairy Nosed Wombat (*Lasiorhinus krefftii*).

Common Wombats are grazing marsupials, and are among the world's largest herbivorous burrowers. Their robust build, blunt head, short limbs and strong spade-like claws make them powerful earth-movers. They differ from all other marsupials by having a single pair of upper and lower incisors. These teeth rootless and grow continuously throughout the wombats life.

They are generally slow moving but can reach speeds up to 40kph in short distances and can maintain that speed for up to 90 seconds.

As with many burrowing mammals their vision is poor and females have a rear opening pouch.

All wombats have a thick skin, especially on the back and rump which gives them considerable protection against predators. If a wombat is chased into a burrow by a predator, it will wedge its strong back against the roof of the burrow to block it (Triggs, 1996).

## Common Wombats in Captivity:

Common wombats have been held in numerous zoos throughout Australia and the world. The first common wombats to be held in a zoo were kept in the zoological gardens attached to the Natural History Museum in Paris in 1803 (Treby, 2005).

### 1.1 ASMP Category

Management Level 3

Planned Category: Husbandry Research; Management Level 3

### 1.2 IUCN Category

Least Concern

### 1.3 Species Co-ordinator

**EAZA Species Coordinator:** Achim Winkler, DUISBURG

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**ARAZPA Species Contact:** Fiona Cameron, Taronga Western Plains Zoo

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

### 1.4 Studbook Holder

JAZGA Studbook Keeper: Satoshi Suda, NAGANO

## 2. TAXONOMY

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### 2.1 Nomenclature

<b>Kingdom:</b>	Animalia
<b>Phylum:</b>	Chordata
<b>Class:</b>	Mammalia
<b>Order:</b>	Diprotodontia
<b>Family:</b>	Vombatidae
<b>Genus :</b>	<i>Vombatus</i>
<b>Species:</b>	<i>ursinus</i>

### 2.2 Subspecies

There are three subspecies of the common wombat:

- *Vombatus ursinus ursinus* (Bass Straight Subspecies only found on Flinders Island).
- *Vombatus ursinus hirsutus* (Mainland common wombat subspecies).
- *Vombatus ursinus tasmaniensis* (Tasmanian wombat subspecies).

### 2.3 Recent Synonyms

None.

### 2.4 Other Common Names

The Common Wombat is also known as the Coarse haired wombat, Naked nosed wombat, Forest wombat, Island wombat and the Tasmanian wombat.



### 3. NATURAL HISTORY

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#### 3.1 Morphometrics

##### 3.1.1 Mass and Basic Body Measurements

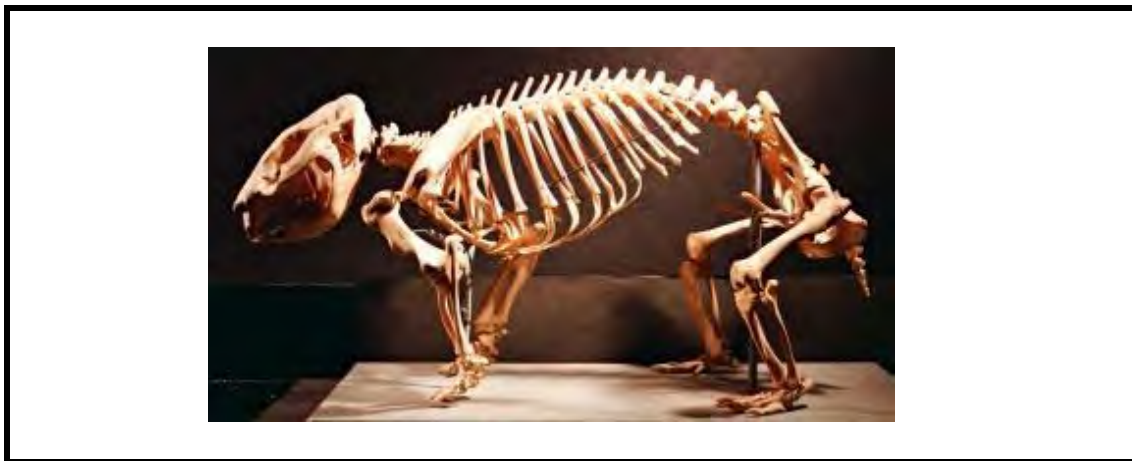
The largest of its species, wild adult Common Wombats vary in body weight, between 22-39 kilograms and average 90-115 centimetres in body length.

The size variation of adult Common Wombats is in accordance to where they live.

On the mainland, adults, on average, are usually about 1 metre in body length and about 26 kilograms, but weights of 35 kilograms are not uncommon (Triggs, 1996).

Tasmanian Wombats are slightly smaller, with an average length of 81 centimetres, weighing roughly 19.5 kilograms.

Flinders Island Wombats are again slightly smaller and lighter, averaging 78 centimetres in body length and 17.6 kilograms in weight.



**Figure 1:** Common Wombat skeleton, taken from website [www.nhc.ed.ac.uk/](http://www.nhc.ed.ac.uk/)

##### 3.1.2 Sexual Dimorphism

There are no distinguishing marks between the sexes of the Common Wombat.

As in all male marsupials, the penis is stored within the body. It is approximately 12-15 centimetres long when erect and is retracted into the body in an S-shaped curve when not erect (Triggs, 1996), while the testes are carried in a heart shaped scrotum.

Females have two teats in a rear opening pouch. The opening is controlled by a strong sphincter muscle to prevent dirt and debris entering the pouch while digging and moving about in the burrows.

##### 3.1.3 Distinguishing Features

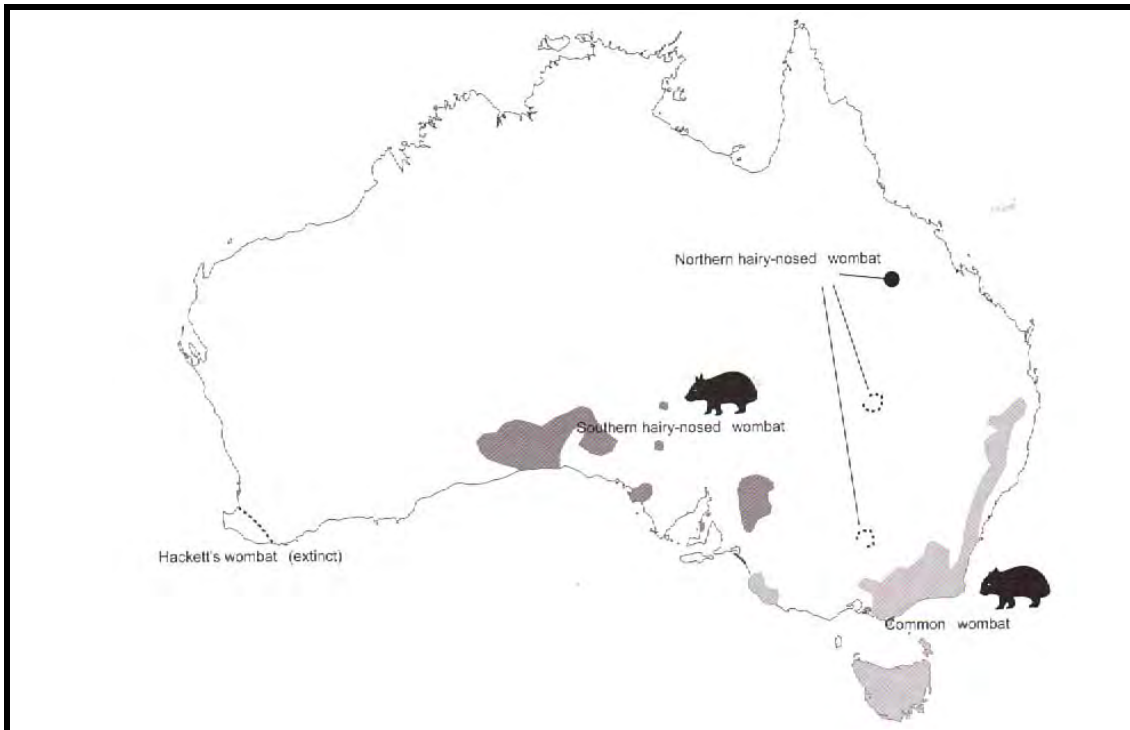
The Common Wombat differs from the Hairy-nosed Wombats having a naked, rounded nose pad, coarser fur and shorter, hairy ears.

Common wombat's front paws are quite dexterous and they can use them like hands. A Hairy nosed wombat cannot make a fist with its paw, however, and so cannot pick things up like the Common wombat can. Because of this difference, a Common wombat can climb, while a Hairy nosed wombat cannot.

The wombat has a small, vestigial tail which is almost entirely concealed by its fur. The texture of the coat is generally coarse, and there is much colour variation. Glossy black, dark grey, silver-grey, chocolate brown, grey-brown, sandy and cream coloured wombats are all found.

### 3.2 Distribution and Habitat

The Common Wombat is found in South Eastern Australia, including Tasmania and Flinders Island, occurring in alpine habitats, heathland, woodland, and wet and dry sclerophyll.

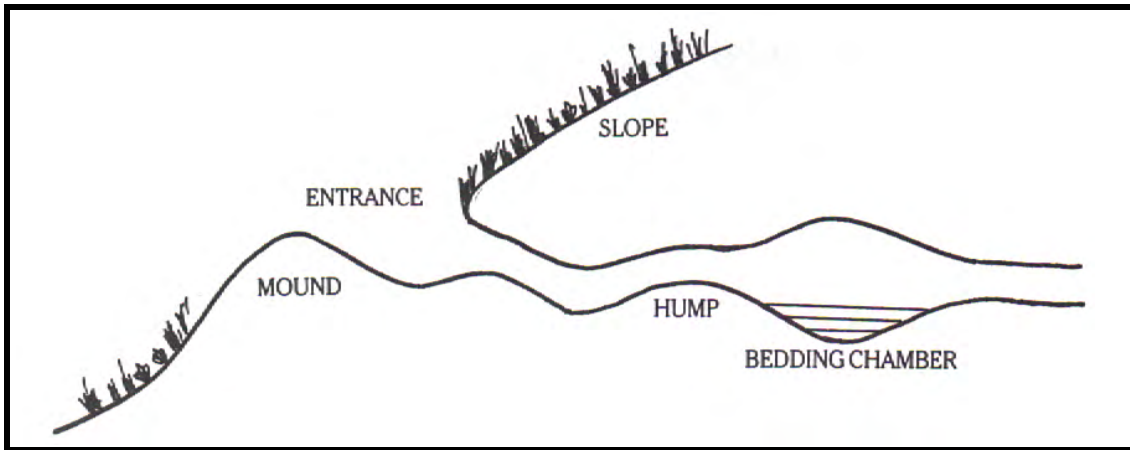


**Figure 2:** Map of Australia showing present and former distributions of all three species of Wombat (Tyndale-Biscoe, 2005).

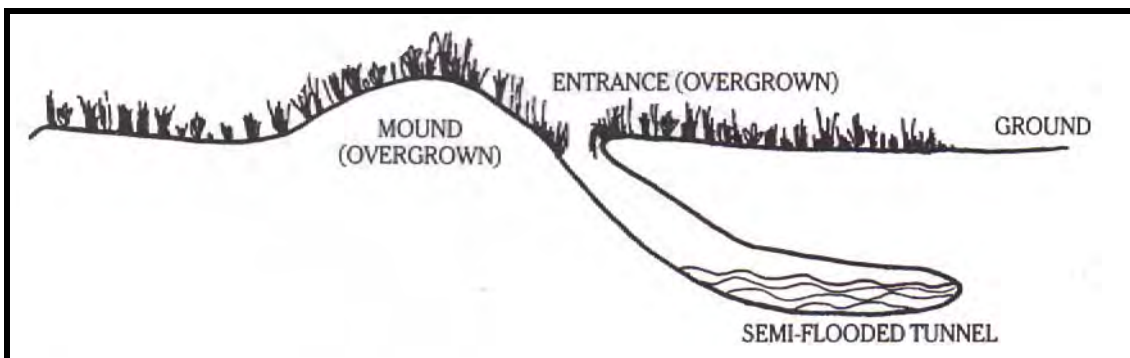
Individual wombats live in complex burrow systems called warrens. There are generally three types of burrows; minor, medium and major.

The burrow provides the wombat with the essential means to survive the ambient temperatures outside their thermo neutral zone. They also provide protection from extreme temperatures during forest fires, and predators.

Wombats generally spend 2/3 of their life underground, carrying out regular tunnel maintenance and resting in leaf lined sleeping chambers during the heat of the day, conserving energy and water.



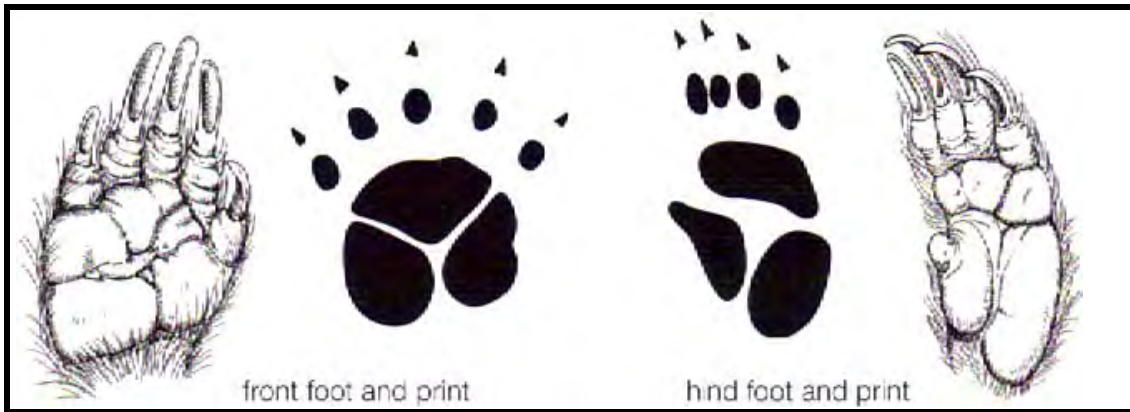
**Figure 3:** Diagrammatic cross-section of a typical medium or major burrow excavated into a slope (Triggs, 1996).



**Figure 4:** Diagrammatic cross-section of a typical minor burrow in flat ground, descending steeply for the first 0.5-1 metre before levelling off and ending abruptly without a bedding chamber (Triggs, 1996).

Finding Common Wombats:

Note the hind foot has a clawless opposable inner toe.



**Figure 5:** Front and hind foot prints of the Common Wombat *Vombatus ursinus* (Parish & Field).

### 3.3 Conservation Status

IUCN - *Least Concern*

Even though their habitat has been heavily reduced by development, the Common Wombat is not considered as threatened, apart from the Southern Australian populations (Bass Strait) which are regarded as vulnerable.

### 3.4 Longevity

#### 3.4.1 Wild

Little is known on the normal lifespan of a Common Wombat in the wild, though apparently they should live for at least 15 years (Triggs, 1996).

In the past, a major cause of mortality in wild wombats is due to human action including road deaths, land clearing and being shot under permit each year as they are considered as pests by pastoralists.

Contributing natural causes can include:

- Predators such as foxes, Tasmanian devils and wild dogs
- The hazards which beset the animals of the bush including bush fires, flooding and drought.
- Disease such as cancer, pneumonia, arthritis and asthma and external parasites, in particular, severe cases of Sarcoptic Mange (Mange Mite) and ticks.

#### 3.4.2 Captivity

Captive wombats average life expectancy is 20 years, however there are records of them reaching 26 years of age at London Zoo (Jackson, 2003).

#### 3.4.3 Techniques Used to Determine Age in Adults

There are no reliable techniques to age a mature wombat (over two years of age). Patterns of tooth wear are commonly used to age mammals, however this is not possible in wombats as all the teeth grow continuously.

## **4. HOUSING REQUIREMENTS**

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### **4.1 Exhibit Design**

As with any good enclosure design, considerations need to be given to the animals natural behaviour. Wombats have a destructive behaviour, so an enclosure of only basic design is required, and the structure must be strongly made, constructed from sturdy materials due to their powerful build and digging habits.

As wombats are burrowing marsupials provision for digging should be given. In exhibits where wombats are kept outdoors where they cannot construct burrows, shelter from weather extremities must be provided by mock rock, over storey planting, roofing or a burrow substitute. Burrow substitutes can be constructed from camouflaged concrete pipes, hollow logs so they can behaviourally thermoregulate and feel secure.

Where natural burrows are allowed to be constructed, the substrate must be composed of adequate clay material to minimise the occurrence of burrow collapse (EAPA, 2002).

Treated timber must not be used in the construction of the exhibit as wombats may chew these materials (EAPA, 2002).

The flooring must be constructed with wither a mesh underlay or concrete layer to prevent the wombat digging out under the fence. The surrounding wall must be a minimum of 1.2 metres high, and continue 1m underneath the surface to prevent the wombat digging out. Walls ideally should have a smooth surface such as concrete, brick or other suitable fencing as wombats will climb and chew on mesh fencing. Other materials such as cyclone fencing (above 3.15mm diameter) may be used with an overhang to prevent escape. Corrugated iron is not recommended due to the reflective heat in summer.

Water can be provided by a water feature, a stainless steel bowl or an automatic filling device (Jackson, 2003).

### **4.2 Holding Area Design**

The holding area design needs to be of only basic design due to the wombats destructive behaviour. The floor should be of soil or other suitable substrate with a mesh underlay or concrete layer, approximately 1 - 1.5 m below the surface to prevent escape. The walls should be approximately 1.2 m high and be constructed from a smooth material such as concrete as a they may dig or chew through a wire fence and leave damage themselves, or alternatively climb over it.

If held in pairs, provision should be made to minimise the effect of aggression (Jackson, 2003).

### **4.3 Spatial Requirements**

The enclosure size for exhibiting wombats is unfortunately often underestimated as they are observed during daylight when they are less active. The average home range of a wombat in the wild is estimated at 5 to 20 ha, and they will travel 2-5 km in a night in search for food. Insufficient enclosure size can lead to destructive, or stereotypic behaviour such as pacing, and can increase the likelihood of escape attempts.

Common wombats are naturally solitary, therefore they generally prefer to be kept solitary in captivity. This is an important consideration when housing a pair, as incompatible animals can inflict a lot of damage on each other.

The minimum enclosure size for exhibiting common wombats as directed by the Exhibited Animals Protection Act (EAPA) (Standards for exhibiting mammals in New

South Wales, 2002) is shown in the table below:

<b>Head-Body Length (cm)</b>	<b>Total Length (cm)</b>	<b>Minimum Enclosure Area (m )</b>	<b>Minimum Enclosure Height (cm)</b>	<b>Additional floor area each extra animal</b>
100	105	45.00	120	3.00x3.00

In the wild, each common wombat will have a home range of about 5 - 25 hectares, which will encompass a number of burrows and will overlap the territory of other wombats. Due to their naturally large home range, housing wombats in small enclosures in captivity leads them to express stereotypic behaviours (see 9.5 Behavioural Problems). As with most animals in captivity it is recommended to exceed the minimum requirements as stated by the EAPA, and provide as large an enclosure as possible.

#### **4.4 Position of Enclosures**

The position of the enclosure must provide sufficient protection for the wombat from weather extremities. It must provide shade during hot weather, and sunny areas (where possible) during cold weather to allow the wombat to bask. A enclosure facing North will enable the wombat to take full advantage of the favourable weather coming from the North, and provide shelter from the unfavourable weather from the South.

#### **4.5 Weather Protection**

Enclosure design can be fully enclosed, semi-enclosed or open. If the enclosure is open, it must always provide adequate shading/shelter for the wombat from wind, rain and in particular, extreme temperatures. Shelter and cooling can be provided by suitable furniture, overhanging rock furnishings, and the installation of sprinkler systems.

#### **4.6 Temperature Requirements**

The common wombat does not have any particular heating requirements, however as these animals do not sweat, they are highly susceptible heat stress and can show signs of overheating when temperatures exceed 24 c. The provision of adequate shading and cooling systems as mentioned above within the enclosure will keep the animal cool.

#### **4.7 Substrate**

A sufficiently hard substrate of soil, leaf litter, mulch, or sand will allow for the wombat to express its natural behaviour to dig. This activity enables wombats to wear down their claws, which may otherwise grow too long (Jackson,2003). The provision of sand or soil will also allow the wombat to dust bath.

The substrate must be well drained to prevent flooding.

Cement is not recommended as it allows no provision for digging, which can allow for their claws to grow excessively.

As stated in the Exhibited Animals Protection Act (EAPA) (Standards for exhibiting mammals in New South Wales), a mesh underlay or concrete layer approximately 1 - 1.5m under the substrate must be provided to prevent the wombat from digging out.



#### 4.8 Nest Boxes and/or Bedding Material

Enclosures which do not allow the wombat to construct burrows, need to have a burrow substitute for the wombat to sleep in during the heat of the day, as it will not be able to thermoregulate itself. This will also allow some ease when handling animals.

Substitute burrows can be achieved by the use of hollow logs, a wooden nest box or large terracotta piping buried in the substrate.

Nest boxes should be approximately 1m x 1m x 1m with a hinged lid for easy access. The entry should be approximately 30cm high to allow the wombat to rub its back against the frame upon entry. Dry, clean nesting material such as straw or hay should be available at all times within the nest box.

When using terracotta piping, the diameter should resemble that of a burrow in the wild.

#### 4.9 Enclosure Furnishings

Due to the wombats highly destructive nature, few furnishings are required within the exhibit. Large rocks, mock rocks, branches, and hollow logs are commonly used in captive wombat exhibits as they are durable and naturally aesthetically pleasing, resembling the wombats natural habitat. These furnishings will also act as rubbing posts, allowing the wombat to scratch places on their bodies they cannot reach with their claws.

Furnishings need to be secure to prevent any movement or collapsing when wombats dig. The addition of local tussock grasses and other shrubs can also provide additional shading and food for the wombat. These will need to be replaced as required. Larger shrubs and larger tussocks have a better chance of surviving than seedlings.

The following is a list of some plants considered toxic to wombats (Dennis. L), therefore should be avoided in the enclosure :

- Wisteria - All parts of the plant are considered toxic.
- Privet - Both the leaves and berries are considered toxic.
- Philodendron - All parts of the Philodendron shrub is poisonous if consumed.
- Oleander - All parts of the oleander shrub are extremely poisonous and can cause death. Even a small amount of the plant being eaten or sucked can be fatal.
- Lilly of the Valley - All parts of the plant are poisonous.
- Lantana
- Kikuyu Grass
- Hydrangea
- Hyacinth - The bulb is the main toxic part of the plant.
- Honeysuckle - The plant and berries of the Honeysuckle bush are poisonous if consumed, although they are considered minimally toxic.
- Daffodil - The bulbs of the daffodil are poisonous if consumed.
- English Ivy - Berries and leaves are poisonous if consumed.
- Buttercup - The entire plant is poisonous if consumed.

## 5. GENERAL HUSBANDRY

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### 5.1 Hygiene and Cleaning

It is important to maintain a healthy and sanitary environment for both the wombat to live in and for keepers to work in.

A daily cleaning routine of the wombats enclosure should include:

- Raking and cleaning to remove any faecal matter.
- Removal of any uneaten food and disinfect feed container.
- Change of water and disinfect water container (see chemical agents below).
- Enclosure perimeters should be checked for damage.
- Scarify substrate to fill in any holes and maintain aesthetics.
- Any wet or soiled bedding in dens should be replaced as required.

Monthly duties should include:

- Complete bedding change and clean nest box.
- Maintenance of plantation.

Annual Duties should include:

- Maintenance on enclosures - fencing, roofing.

The removal/replacement of any furniture including logs, rocks, tussocks, shrubs should be carried out as required, along with substrate changes.

When individuals permanently leave an enclosure, it should be scrubbed out if possible and thoroughly cleaned before any new animals are admitted (Jackson, 2003).

#### **Chemical agents**

The following are some cleaning agents which do not have adverse side effects on humans or animals and are recommended within the veterinary trade, and can be safely and effectively used during cleaning routines:

- F10 Disinfectant (MSDS attached).
- Virkon S Disinfectant (MSDS attached).

### 5.2 Record Keeping

Systematic observations and record keeping of all individuals is important so that the health condition and reproductive status of captive wombat individuals can be monitored. The following information should be recorded where possible:

- Individual Specimen identification
- Gender
- Age
- Parentage
- Source and origin
- Veterinary exams
- Treatments administered
- Reproductive behaviour or conditions
- Weights and Measurements
- Diets and any changes in Diet
- Behavioural changes or problems
- Movements of individuals, either between enclosures or institutions
- Deaths with post mortem results



### 5.3 Methods of Identification

Identification of individual wombats can be made by the following:

- Microchip - Implanted between the scapulae.
- Tattoos - On the inside of the ear, or the medial aspect of the hind leg.
- Ear Notching - Mammals can be permanently marked by cutting U- or wedge shaped notches out of the ear margins.
- Ear Tags - However these are highly likely to be torn out.
- Visual Identification - This requires an intimate knowledge of individuals and should not be used as the only form of identification.
- Temporary Marking - Serves well for veterinary treatment. Dyes, paint, bleach, spray paint and nail polish are all useful tools for temporarily marking animals. Most of these mark the animal for less than a month.

### 5.4 Routine Data Collection

Data collection in zoo's can provide answers to management questions as well as basic information about the biology of captive animals.

Initial records should include:

- Acquisitions
- Age
- Weight
- Body measurements
- Sex
- Parentage
- Distinguishing marks
- Formulas given

Daily records should include:

- Time fed
- Quantity
- Any change in formula
- Introduction of solids
- Frequency & consistency of urine and faecal matter
- Behavioural notes

## 6. FEEDING REQUIREMENTS

### 6.1 Wild Diet

Wombats are specialised grazing herbivores, with their diet in the wild consisting of native grasses, sedges, rushes, shrubs, bark, fungi and tree roots, where they use their forefeet to tear and grasp pieces of vegetation. During times of scarcity wombats will dig up dead grass to get the roots or scratch away the surface soil to uncover small roots of grass and other plants that have been nibbled off.

They prefer to feed in open grassy areas and are known to follow regular feeding paths, travelling up to 2.5 kilometres each night in search of food. Separate feeding areas, typically less than 20ha are maintained through territory scent markings, vocalisation and aggressive behaviours.

#### Favoured Grasses:

Wombats tend to prefer young tender grass shoots when available, and favour the coarse, high fibre grass of *Poa*, Wallaby grass *Austrodanthonia spp.* (formally *Danthonia*), kangaroo grass *Themeda australis*, and the rush of *Lomandra*.

#### Water:

Although wombats like to drink frequently, they require less water than most other mammals as they conserve energy and limit water loss through staying in the burrow during the heat of the day.

#### Dentition:

The dental arrangement is unique and unlike any other marsupial, with 24 rootless teeth, growing continuously throughout its life from pulpy bases, adapted for the wear of processing tough vegetation, as well as for digging burrows. They are the only marsupials that possess two large incisors both in the upper and lower jaw. The lower incisors are forward pointing while the upper incisors curve backwards to form a cutting edge. There are no canines so there is a substantial gap between the incisors and the cheek teeth called the 'diastema' which consists of 1 premolar and 4 molars on each side of the jaw. This gap is used to rearrange food with the tongue. The molars have enamel on the surface side only, resulting in a sharp edge for cutting and chewing the abrasive vegetation.

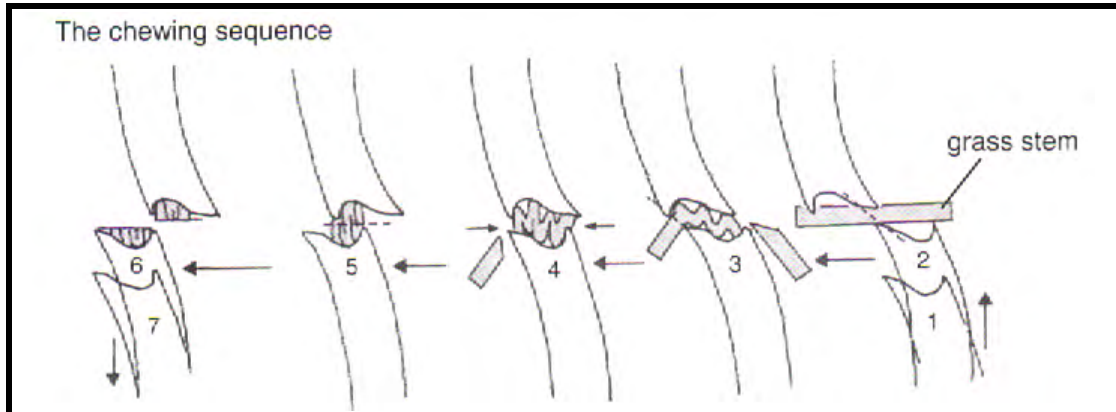
The dental formula for wombats is as follows:

Dentition
1.0.1.4
1.0.1.4

This formula represents the teeth on one side of the mouth, upper teeth/ lower teeth. In total the Wombat has 4 incisors, 0 canines, 4 premolars, and 16 molars.



**Figure 1:** Common Wombat (*Vombatus ursinus*) skull showing the large incisors and the diastema (K. Elliott, 2009).



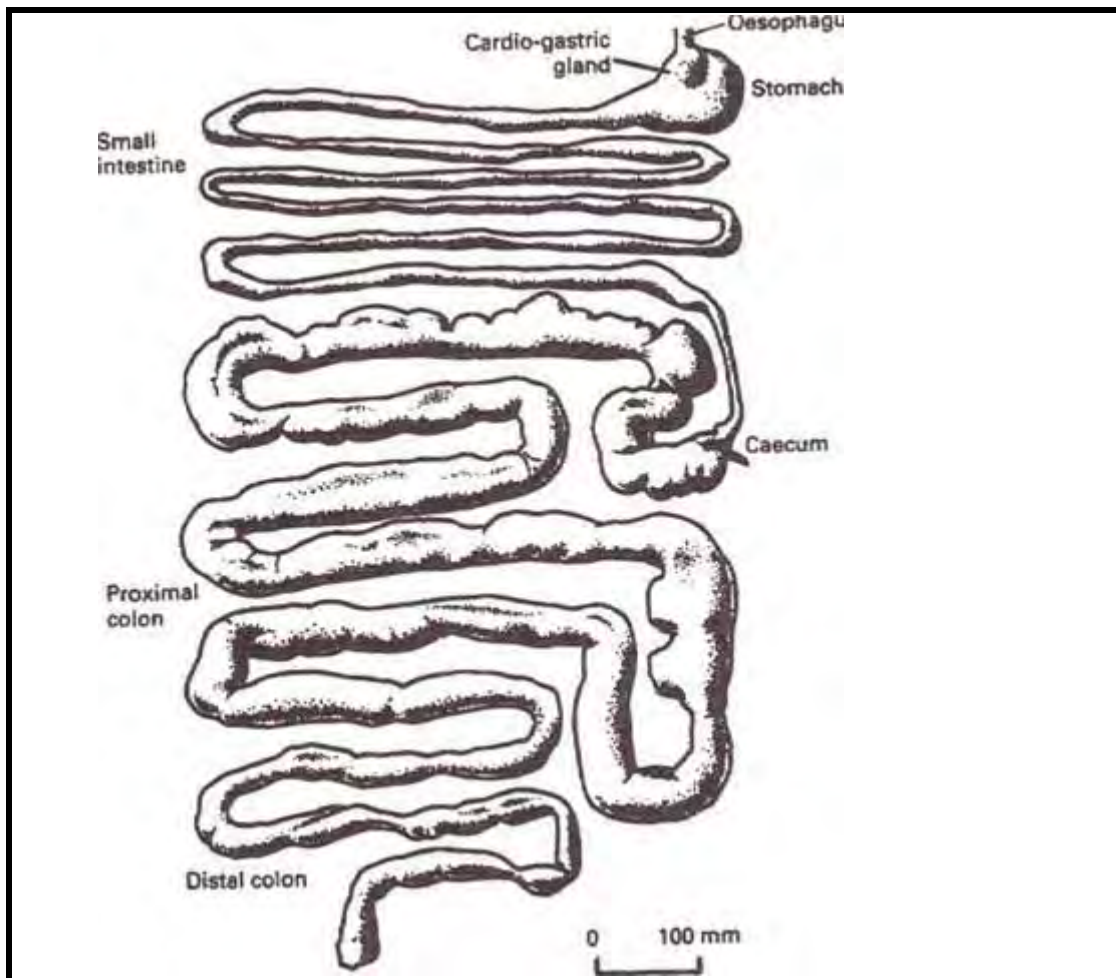
**Figure 2:** Chewing sequence showing the side to side movement to finely cut herbage (Tyndale-Biscoe, 2005).

#### Digestive System:

Wombats have a more efficient digestive system than other grazing marsupials. The stomach is quite small. The food is passed from the stomach to the small intestine, which is approximately 3 metres long in adults, where lipids, proteins and soluble carbohydrates in the plant cell contents are digested and absorbed.

The most important part of the digestive tract is the colon, which is approximately 4 meters long, taking up around 70% of the whole digestive tract, containing a dense population of bacteria. It breaks down the fibres by microbial fermentation, making the wombat a hindgut fermenter.

As their food is high in fibre and hard to digest, it is held in their digestive system, taking up to seventy hours to break down the fibre and release the nutrients, due mostly to the slow passage through the colon. Low rates of metabolism and low rates of nutrient turnover provide them with an enormous advantage in terms of their ability to survive long periods of food shortage under adverse environmental conditions (Hume,1999).



**Figure 3:** Digestive tract of the Common Wombat (*Vombatus ursinus*). Taken from website [www.journals.cambridge.org](http://www.journals.cambridge.org)

## 6.2 Captive Diet

If the wombats do not have free access to natural forage, fresh grass and a palatable, low quality hay offered ad lib should be the foundation of a wombats diet in captivity. Due to their slow metabolic rate and slow digestive passage rate (refer to section 6.1 Wild Diet) wombats have a tendency to become obese in captive situations. Therefore the provision of food such as pellets, maize, fruit and vegetables should only be offered in small quantities to avoid obesity and other health problems as they are too high energy for long term maintenance. Dry dog food must NOT be offered.

### Newly Caught Wombats:

It may take some weeks for newly caught wombats to eat artificial diets, although freshly cut grass is usually readily eaten shortly after capture. Grated carrot, apple and sweet potato may also tempt reluctant feeders.

### Water Requirements:

Fresh drinking water must be provided ad lib.

The following is the recommended feeding requirements (taken from Jackson, 2003). The amount is rationed per animal.

### **Daily Diet:**

- Ad lib Meadow Hay

- Ad lib Oaten Hay
- Ad lib Fresh Grass
- 500g Carrots
- 1 x Eucalypt or Wattle browse
- Lucerne and Maize given on alternate days
- Ad lib Fresh Water

**Alternative Diet:**

- 400g Pellets
- 50g Maize
- 50g Crushed Oats
- 50g Wheat
- Ad lib Fresh Water

The following is daily diets fed to wombats at a variety of institutions. The amount is rationed per animal:

Daily Diet Provided for Adult Wombats at **Symbio Wildlife Park:**

<b>Monday</b>	1 bowl of Barley Hay + Fresh Grass ad lib as available
<b>Tuesday</b>	1 bowl of Barley Hay + 2 cups Pellets + 1 cup Stud Mix + Fresh Grass ad lib as available
<b>Wednesday</b>	1 bowl Lucerne Hay + Fresh Grass ad lib as available
<b>Thursday</b>	1 bowl of Barley Hay + Fresh Grass ad lib as available
<b>Friday</b>	1 bowl of Barley Hay + 2 cups Pellets + 1 cup Stud Mix + Fresh Grass ad lib as available
<b>Saturday</b>	1 bowl Lucerne Hay + Fresh Grass ad lib as available
<b>Sunday</b>	1 bowl lucerne Hay + Fresh Grass ad lib as available

Supplementary food items:

- 500g Carrot/Pumpkin
- Kangaroo Pellets
- Eucalypt or wattle browse as available

Daily Diet for Adult Wombats at **Dreamworld** (Lane. C & Barnes. M) :

- 1 ½ cups Macropod Pellets
- 3 Native Grass Clumps
- 1 Handful Lucerne

Twice Weekly

- 20g Maize

Daily Diet for Adult Wombats at **Taronga Zoo** (Pers com. Bell. N):

- 500g carrot

- 200g sweet potato
- 60g maize or dried corn kernel
- Browse material such as grass and native eucalypt shoots

NOTE: Favoured foods including bread may be used as a vehicle to administer oral medicines.

Toxic foods to AVOID (Dennis, L, 2008):

- Avocado - The flesh and the seed can be toxic if consumed.
- Onion and Garlic - All parts can be toxic if consumed.
- Potato - The leaves and immature fruit are considered toxic. Potatoes that have turned green can cause severe illness if consumed.
- Rhubarb - The leaves are considered toxic.

### **6.3 Supplements**

No specific supplements are required, however lucerne and kangaroo cubes, fruit and hard vegetables can be offered in small quantities. As these food items are high in energy and protein and low in fibre, long term maintenance is not recommended. Do not offer unprocessed oats as the spikes can become embedded in gums causing disease.

Browse of Eucalypt or Wattle should be supplied weekly or as available as chewing the bark can assist in wearing their teeth down.

### **6.4 Presentation of Food**

Food should be presented in a strong stainless steel bowl or hoppers 20cm above the ground are recommended to prevent the wombat defecating or walking on their food. One bowl per animal is required.

Water should be presented in a bowl which cannot be tipped over such as a ceramic bowl, as wombats have been observed standing in their water bowls to cool off during hot weather.

Wombats may destroy or ingest plastic bowls, therefore they should be avoided.

## 7. HANDLING & TRANSPORT

### 7.1 Timing of Capture and Handling

Captive wombats are best caught early morning when the temperature is cooler and they are less active. Where possible, avoid the capture of any animal during the hottest part of day.

### 7.2 Catching Bags

Wooden boxes or strong hessian bags are generally used when transporting wombats.

### 7.3 Capture and Restraint Techniques

Wombats are known for their aggressive nature and are capable of causing severe injury through biting and scratching with their strong claws. Captive wombats are also known to charge. Care should be taken during handling to avoid injury to yourself and the animal.

As wombats can be quite heavy and strong, a good lifting technique is necessary to avoid back strain. Juvenile wombats typically less than 18-24 months of age are generally easily picked up under the armpits with the head facing away from you and placed in a hessian bag or suitable container.



**Figure 1:** Restraint of Charlie, a hand reared Juvenile Wombat at the Australian Reptile Park (K. Elliott, 2009).

Some animals may retreat to their nest box, pipe or hollow log and present their rump to you. The general method in this case is to pull the wombat out by gripping one of the hind legs, and pulling the animal out. Care needs to be taken as the wombat will attempt to crush your arm or hand against the side or roof of the hollow. Boxes with a hinged lid are useful in this situation as it provides easy access to the wombat.

When physical restraint is necessary, the wombat can be held in position by placing a foot against the rump so it cannot reverse, and placing a hand on each shoulder so that it cannot turn or go forward. The hands then firmly hold the shoulders in place and move back towards the armpits, where one arm slides under the armpit and slides across the



chest. Pick up the animal by placing one arm under both forelimbs close to the body so it cannot reach your hands to bite them, and support the rump with your other arm.



This method can also be used with two handlers for aggressive or heavier individuals. This involves one handler to restrict the wombat's movement by placing a foot against the rump and the hands firmly holding the shoulders (as above), while the second handler slides one arm under the armpit and across the chest of the wombat ready to lift. Communication is essential to prevent injury to either handlers or the animal.

Alternatively, using the same principal as above, the wombat can be restrained by placing both arms under the front legs and firmly holding the wombat against your body.

I would recommend this technique for handlers who may not possess as much upper body strength as needed, as you can keep a firm hold of the wombat against your body with the strength of both arms for a longer period, or until the animal settles down.





**Figure 3:** Example of physical restraint using both arms (K. Elliott, 2009).

It is important to keep your head tilted back when lifting wombats as they are known to thrash their head and try to bite. You must be wary of this.

Alternatively you can throw a blanket over the head as this seems to have a calming effect and then coax them into a box.

Conditioning the animal to enter pet packs is recommended as it reduces the stress impact on the animals and the level of risk associated with capture and restraint to handlers.

#### Chemical Restraint:

Chemical restraint can be used to sedate aggressive individuals to enable safe handling and veterinary checks. This can be done by darting or through an intramuscular injection.

A Southern Hairy Nosed Wombat from Symbio Wildlife Park was sedated for veterinary examination with zoletil 3mg/kg, given intramuscularly.

\* Chemical restraint will require veterinary assistance and any use of controlled substances should be practised by a trained professional.

### **7.4 Weighing and Examination**

It is important to keep accurate weights of all specimens where possible and practical. The normal weight range of an adult Common Wombat is between 22-39 Kilograms. Males tend to be slightly larger than females.

Wombats can be weighed by firmly holding the animal while stepping onto the scales, weighing yourself with the wombat and subtracting your own weight. They can also be placed into a heavy duty hessian sack and weighed on stand on scales or spring balances. Alternatively a pet pack or suitable container can be used by weighing the wombat in the container and subtracting the weight. Wombats can also be conditioned to walk onto a weighing platform, to reduce stress.

Electronic scales are preferred as they are more accurate. If using spring balances it is recommended to use the same set time to reduce the differences between the scales.

### **7.5 Release**

Care should be taken when releasing the animal as they can turn and bite.

Aggressive animals should be released over a barrier wall so that it cannot turn and bite. Alternatively, the animal can be released while standing in a plastic or metal garbage bin as protection, and leave the enclosure once the animal has calmed down.

## **7.6 Transport Requirements**

### **7.6.1 Box Design**

Sections 7.6.1, 7.6.3 and 7.6.4 is as directed by the International Air Transport Association (IATA) for transporting live animals.

#### **Container Construction:**

##### Materials

Wood or plywood lined with weldmesh, sheet metal, rigid plastic, strong welded wire mesh and wire mesh.

##### Dimension

When constructing travel containers for these species the normal habits and movements must be considered, they must be able to move freely.

##### Frame

The strong weld mesh lining can form an internal cage round which the outer casing of wood or other suitable material is constructed. Wooden framed containers must have their joints bolted or screwed together.

##### Sides

The whole interior must be lined with sheet metal or heavy gauge weld mesh as these species are well known for their ability to gnaw. Heavy gauge wire meshed ventilation openings, with a diameter of 2.5cm, must be present on the sides and roof, the diameter of the mesh must not permit the snout or feet of the animal to protrude.

##### Floor

The floor must be solid metal and leak proof, it must be covered with a thick layer of absorbent material, such as wood shavings, for bedding.

##### Roof

Must be made of solid sheet metal or weld mesh lined wood with ventilation openings over its surface.

##### Doors

A sliding door must be provided at the front and rear of the container and give access into the container. The front door must have a narrow gap of 2.5cm at the bottom of the weld mesh so that food and water can be passed into the container, the weld mesh must be braced on the inside of the bottom. Each compartment of a container must have its own pair of sliding doors. All doors must be provided with a secure fastening so that they cannot be opened accidentally.

##### Ventilation

Ventilation is provided by guarded perforations through to the exterior of the sheet metal or heavy gauge wire or weld meshed ventilation openings, with a minimum diameter of 2.5cm, must be present on all sides and the top. The total ventilated area must be at least 20% of the area of the four sides and the top.

##### Spacer Bars/Handles

Made out of 5cm spacer bars, with handles attached to them, must be present on all four

sides.

### Feed and Water Containers

Rounded edged food and water containers must be provided, which can be passed into the container when required, as described above.

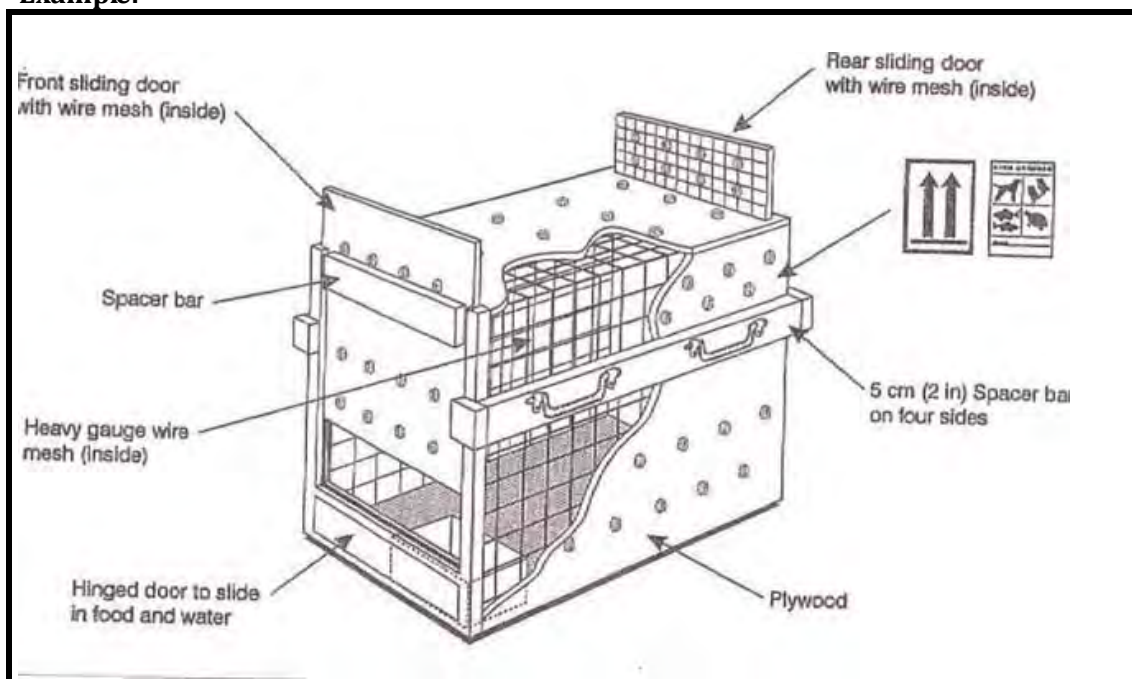
### **Preparations before Dispatch**

No special requirements.

### **General Care and Loading**

No special Requirements.

### **Example:**



**Figure 1:** Example of transport container for wombats. Taken from Live Animal Regulations (IATA) (27<sup>th</sup> Edition).

The following images are of a wombat transport container, designed and built at Symbio Wildlife Park:



**Figure 2:** Side view of transport container showing upper and lower ventilation holes, handles stretching the whole length of the container, and three legs (K. Elliott, 2009).

The container has been constructed from 12mm plywood, which has been glued, then screwed with chip board screws for extra strength. It measures 900mm x 600mm x 500mm to allow the wombat to comfortably move freely.

Handles measure 45mm x 45mm and stretch the whole length of the container to counteract where the wombat is sitting within the container.



**Figure 3:** Back of Container (K. Elliott, 2009) **Figure 4:** Front of container, showing door closed (K. Elliott, 2009).

Door:

The door frame is constructed from aluminium with a channel for the door to easily slide closed. Once the wombat is inside the container, ready for transport the door will be screwed shut to the frame.



**Figure 5:** Front of container showing door open (K. Elliott, 2009).

**Figure 6:** Aluminium channel which door slides into to prevent wombat pushing its way out (K. Elliott, 2009).



**Figure 7:** Close up of ventilation holes covered with 10mm aviary mesh. (K. Elliott, 2009).



**Figure 8:** Close up of top (open) ventilation holes (K. Elliott, 2009).

The ventilation holes at the top will let the heat within the container out, while the bottom ventilation holes will allow good air flow if the wombat is lying down.

### 7.6.2 Furnishings

No furnishings are required due to their destructive behaviour.

### 7.6.3 Water and Food

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, fruit or grain must be provided.

For longer journeys, food and water should be provided in a deep dish. The shippers instructions must be followed.

### 7.6.4 Animals Per Box

These animals must be packed individually into a container or compartment of a

container. Transportation of mothers with pouch young should be avoided, unless the young are still attached to the teat.

#### **7.6.5 Timing of Transportation**

Transportation should be either early morning or overnight when the temperature is cooler. Transporting animals in temperatures above 25 c should be avoided due to their inability to tolerate high temperatures.

It is important that the time from boxing to destination is minimised where possible.

It is recommended that the attending veterinarian be consulted on conditions of transportation before transporting injured or sick wombats for medical treatment or diagnosis.

#### **7.6.6 Release from the Box**

Generally the box is placed into the enclosure, open the door and allow the wombat to exit in its own time. Once the wombat has established another site as its den, remove the box.



## **8. HEALTH REQUIREMENTS**

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### **8. Daily Health Checks**

Observations of each animal within the enclosure should be undertaken daily, generally during your morning keeper rounds to monitor for any signs of injury or illness.

Assessments should be made on the following:

- General body condition and condition of the coat.
- Discharges - Any mouth, nasal, ocular or cloacal discharges should be noted.
- Appetite - Check if there is any leftover food from the day before.
- Changes in demeanour.
- Consistency of faecal material, colour and number. Adult wombats normally have a dry, large squarish scat, usually deposited in groups of four to eight.
- Injuries - Check all the limbs are moving freely, and look for any visible wounds.
- Presence and development of pouch young (if housing breeding pair).
- Presence of ticks on the body.

#### Heat Stress:

As wombats are highly susceptible to heat stress in temperatures above 24 c, close observations should be maintained during the warmer summer months to ensure the wombat does not overheat. Signs of heat stress can include bright pink pads on the sole of the feet and pink ears (primarily noticed in Joeys), agitation, they may be observed standing/sitting in water bowl in an attempt to stay cool. Wombats may also have a reduced appetite in warm extreme temperatures.

Ways to prevent heat stress include installing sprinkler systems within the enclosure, or lightly hosing the wombat and enclosure furniture, ensure the enclosure has adequate shading and you must provide fresh drinking water daily.

#### Dehydration:

To check if a wombat is dehydrated, gently pinch the skin around the folds of the tummy and leg and pull the skin slightly upward and let go (only possible on a tame wombat). If the skin goes back down straightaway, this is normal and the wombat is not dehydrated. If it takes a few seconds the wombat requires hydration.

#### Signs of ill health include:

- Regurgitation
- Vomiting
- Vocalisation
- Unusual gait
- Lethargy
- Dyspnoea (respiratory problems)
- Sneezing
- Coughing
- Swelling
- Convulsions
- Weight loss
- Alopecia, patchiness or clumping of the fur.
- Cloudy eyes
- Collapse
- Dehydration
- Straining
- Diarrhoea
- Jaundice
- Discharges

## 8.2 Detailed Physical Examination

A detailed physical examination should be conducted once a year. Examinations can be conducted while the wombat is conscious for tame individuals, sedation may be required for wild or aggressive individuals. Pre anaesthesia fasting is not required for adult wombats as they are not prone to regurgitation (Treby, 2005).

### A detailed physical examination should include:

- General body condition assessment. The following body condition index has been developed for wombats (Jackson, 2003) providing a score from one to five:
  1. Ribs visible, backbone and pelvis.
  2. Ribs covered but easily felt, backbone still visible, and the rump is sunken.
  3. Pelvis, backbone and ribs covered.
  4. Pelvis, backbone and ribs well covered.
  5. Wombat in excellent/fat condition.
- Temperature - Normally 32-36.7 c. Temperature can be taken through the anus via the cloaca (Jackson, 2003).
- Weight - Normal weight range of an adult Common Wombat is between 22-39 kilograms, with males generally slightly larger than females. Weight should be compared to previous weight records.
- Pulse Rate - Resting rate normally 40-45 beats per minute and 55-60 when active. Taken over the femoral artery, or by auscultation of the heart.
- Respiratory Rate - Normally 12-16 beats per minute during deep sleep and 26-32 while dozing (Jackson, 2003).
- Check condition of fur- Alopecia, signs of mange, ectoparasites, fungal infections or trauma; including digit trauma.
- Check all limbs are moving freely and nail condition.
- Eyes:
  - Should be clear, bright and alert. - -
  - Normal bilateral papillary light response. - - -
  - Normal corneal reflex and no discharge should be present. -
- Nose and nostrils should be clean.
- Mouth - Check lips and mucous membrane colour, capillary refill time, check cheek pouches and look for any abnormal swellings.
- Dental exam - Check for tooth wear and make sure teeth are not overgrown.
- Abdominal palpitation.
- Cloaca - Should be clean and free from faeces.
- Females - Pouch Check: Check condition of pouch, whether lactating or not, and if young are present record: sex, stage of development, weight (if detached from the teat), and measure to determine age from growth curves if necessary.
- Males - Check testes: size (length, width, depth) and consistency (firm, not squishy). Extrude penis and assess. Measure accessory gland bulge (length and width) which is an indicator of reproductive status.
- Blood sample - Blood can be collected from the cephalic, radial, caudal, tibial, femoral or jugular veins. As the skin is thick, a tourniquet helps to visualize the peripheral veins on the shaved limb (Treby, 2005).





**Figure 1:** Blood sample being taken from a Southern Hairy Nosed Wombat, via cephalic vein. Photo's courtesy of Matt Radnidge, Symbio Wildlife Park.

- Faecal sample collection - Perform a faecal float test to check for parasites.
- Urine sample test using multi sticks and a refractometer for specific gravity.

### 8.3 Routine Treatments/Vaccinations

None Required.

### 8.4 Known Health Problems

#### 8.4.1 Ectoparasites

##### **Sarcoptic Mange *Sarcoptes scabiei* var. *wombati***

###### Cause:

Sarcoptic Mange is caused by infestations of the skin by a microscopic mite *Sarcoptes scabiei*, which effects the Common Wombat throughout its range and is often fatal if left untreated.

The female mite burrows under the skin and deposits approximately three eggs per day, as she tunnels extensively through the underlying skin tissues (up to 0.5mm a day). Male mites and other stages of the mite live on the external skin and base of the hair follicle.

The wombats response to the irritation of the female's eggs, faecal waste and other mite debris is what causes the irreparable skin damage. Sarcoptic Mange has the potential to cause dramatic population decline.

This mite is highly contagious, and is easily transmitted to and from infested animals as well as any surrounds the animal has been in contact with, for example enclosure furniture, substrate, rubbing posts and burrows. The mite has the ability to survive without a host for up to three weeks in an ideal environment, such as a burrow.

Although the mange is usually host specific and will thrive on their individual host animal, they will readily attack a new host should the opportunity arise.

###### Signs:

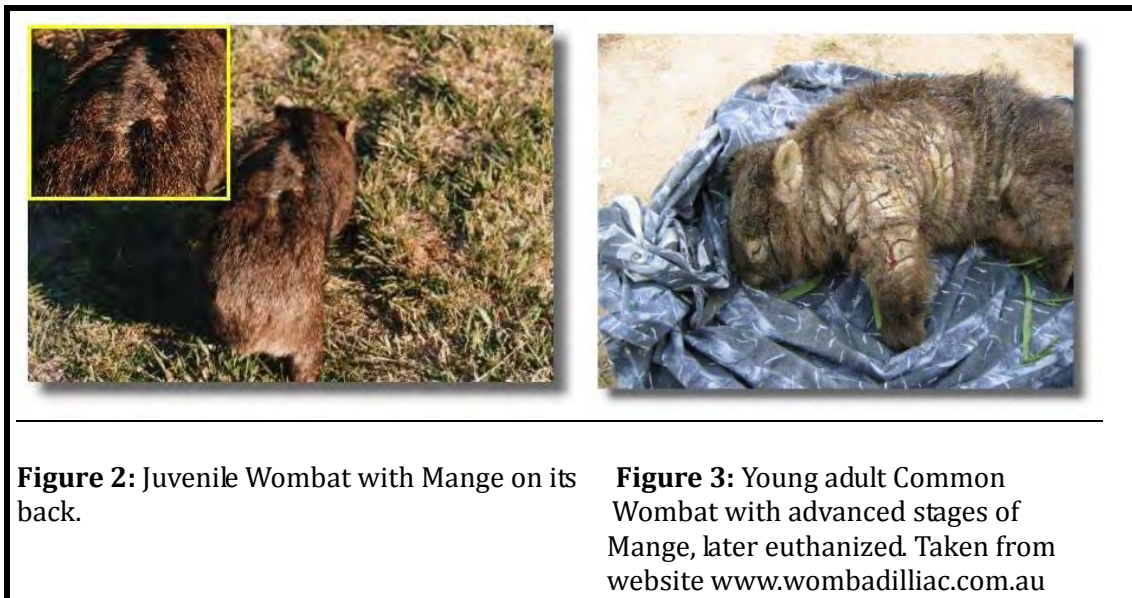
Clinical signs of Sarcoptic Mange develop and progress in the same way, irrespective of the intensity of the infestation.

- Severe erythema (reddened skin) due to congested capillaries, and severe pruritis

(itching) caused by rubbing of the skin, causing irreparable skin damage including mutilation and alopecia.

- Parakeratosis (thickened skin) and crusting over the body including eyes and ears, which often leaves the animal blind and/or deaf. As the wombat moves, the bald thickened skin cracks open and creates open wounds, where opportunistic bacterial infections can now enter the wombat through open wounds and they often become flyblown.
- As the infection spreads malnutrition and dehydration may occur as the animal becomes too weak to search for food.

Advanced stages of the infection has devastating effects on the internal organs including the heart, liver, kidneys, lungs and reproductive organs. Respiratory infections and pneumonia can deplete the wombat further (Holme).



**Figure 2:** Juvenile Wombat with Mange on its back.

**Figure 3:** Young adult Common Wombat with advanced stages of Mange, later euthanized. Taken from website [www.wombadillac.com.au](http://www.wombadillac.com.au)

#### Treatment:

An infested wombat can completely recover if it is treated early.

Do not wash a wombat suffering from a mange infestation as when the skin is wet, the wombat can then scratch off the now loose scab, where the skin then weeps and the animal dies from toxic shock and fluid loss very rapidly. It is recommended to instead use one of the spot on/ pour on or injectable mange treatments. For aggressive or non tame individuals spot on or pour on solutions may be administered at a distance by attaching a syringe with the solution to a long pole.

Mild cases of mange should be treated with an acaricide. Cydectin, registered in Australia as a cattle and red deer pour on to remove a variety of ecto and endo parasites has been used successfully to remove mange mites from wombats. The dosage rate and method of application should be marked on the containers.

In advanced cases Euthanasia is the most humane method of treatment as relapse is common.

If left without treatment the mites will exponentially increase, and the wombat will die a slow and painful death.



**Figure 4:** Effects of a manged wombat washed in a commercially available anti-itch solution. Following the first bath in the solution the wombat scratched off 200 grams of skin and collapsed and died within 24 hours. Taken from website [www.wombatprotection.org](http://www.wombatprotection.org)

#### Prevention:

- It is important to address the first signs of a mange infestation before it progresses.
- Quarantine new arrivals before introducing into the collection.
- All enclosure furniture, bedding material and substrate should be cleaned/replaced where infested animals have been held, as the mite may survive up to three weeks in optimal conditions without a host.
- Barrier Nursing

Other ectoparasites commonly found on the wombat include:

#### Fleas

- *Lycopsylla nova*
- *Echidnophaga spp.*

#### Lice

- *Boopis tarsata*

#### Mites

- Ear mite *Raillietia australis*
- Skin mite *Acaroptes vombatus*

#### Ticks

Ticks often establish themselves on the outer rim of a females pouch, and sometimes inside the pouch, rendering the wombat virtually helpless to remove them. A severe tick burden can cause anaemia in a wombat, which can weaken the animal to the point of killing it.

- The Common Wombat tick *Aponomma auruginans*
- *Ixodes cornuatus*
- *Ixodes victoriensis*
- *Ixodes tasmani*

Ticks and fleas can be treated with insecticidal wash (malawash) diluted as recommended

for dogs, given in 14 day intervals. Alternatively ticks can be removed manually using tweezers. Place the tweezers as close to the animals flesh as possible and pull out in one clean motion. The head should dislodge with the body, but if not, the bodies natural defence mechanism will reject it in time.

In a study by Lee Skerratt of parasites of the Common Wombat, it was observed that the ear mites, skin mites and the Common Wombat tick were not found on the wombats suffering from Sarcoptic Mange, but were common on those without mange (Triggs, 1996).

Prevention:

Continual coat checks, especially if the wombat is in a natural habitat enclosure, and change bedding material regularly.

### **8.4.2 Endoparasites**

Wombats are host to several internal parasites such as worms of various kinds.

**Nematodes**

Thick white roundworms are common in the colon of the wombat including *Oesphagostomoides giltneri*, *O. longispicularis* and *Phascolostrongylus turleyi*, whereas smaller roundworms have been found in the walls of the small intestine and various organs including the lungs.

**Cestodes**

Several species of tapeworm have been found in the intestines of wombats including *Progamataenia festiva*, *Phascolotaenia comani* and *Paramonieza johnstoni*.

Wombats are not hosts for Hydatid Worm *Echinococcus granulosus*

**Trematodes**

*Fasciola hepatica* have been commonly found in the common wombat in swampy rivers or in areas suitable for the intermediate hosts.

Treatment:

Nematodes can be treated with anthelmintics such as Ivermectin given Subcutaneously (S/C).

Trematodes can be treated with anthelmintics such as Albendazole or triclabendazole (Jackson, 2003).

Prevention:

- Clean enclosure and remove faeces daily.
- Ensure enclosures are well drained to prevent swampy areas.
- Surveillance by faecal float.

### **8.4.3 Protozoans**

**Coccidiosis *Eimeria arundeli***

Cause:

*Eimeria arundeli* is the widespread Coccidia species found in the Common Wombat. Coccidia are microscopic spore forming, single cell parasites which usually occurs in hand raised Joeys as they start grazing as hand raised joeys do not have the immunological advantage of wombats raised on their mothers milk. It may also be associated with the stress of exploring outdoor areas for the first time.

### Signs:

The main clinical sign of Coccidia in wombats is enteritis (inflammation of the intestines) usually manifested with diarrhoea or chronic soft faeces and weight loss.

It appears at approximately 10 months of age or sometimes earlier in hand reared animals.

### Treatment:

Toltrazuril is usually used as a treatment for clinical coccidiosis but not as a preventative. Generally amprolium (Coccivet) is used as a coccidia preventative.

### Prevention:

Coccivet (80 g/l amprolium and 5.1 g/l ethopabate) may be used in the drinking water for the prevention Coccidiosis at the dose rate of 15mls per 10 litres of drinking water (Jackson, 2003).

## **Toxoplasmosis *Toxoplasma gondii***

### Cause:

Toxoplasmosis infection caused by the coccidian parasite *Toxoplasma gondii* is a major cause of death in hand reared captive wombats and wild marsupials. Wombats become infected after ingesting plant material containing the microscopic *Toxoplasma gondii* oocysts, often passed in the faeces of cats. Marsupials and new world monkeys are the most susceptible for developing the clinical disease.

### Signs:

Toxoplasmosis develops suddenly and severely with animals showing almost no symptoms before collapsing and dying.

An infected animal-

- May exhibit signs associated with respiratory or enteric disease.
- Neurological signs such as ataxia (lack of muscle control), circling and blindness or respiratory signs or both
- Poor growth or weight loss
- Focal encephalitis

### Treatment:

Toxoplasmosis treatment can be successful if treatment is administered as soon as clinical signs are apparent.

Do Not wait until the diagnosis is confirmed as this may take several days (Jackson, 2003).

Nonetheless the disease is usually fatal.

### Prevention:

Ensure joeys avoid all access to cats and their faeces.

## **8.4.4 Fungal Disease**

Spores of the fungus *Emmonsia parvum* and *E. crescens* are common in wombats and have been found in captive animals.

### Signs:

Appears to be sub clinical.

### Treatment:

Not required.



Prevention:  
Not required.

### **Thrush**

Cause:

Thrush is a yeast fungal infection that can effect the mouth, gut or both. It is quite common in hand reared joeys.

Signs:

- White build up in and around the mouth.
- Saliva may appear rusty in colour (when mouth is wiped).
- Mouth and gums are inflamed.
- Yellow diarrhoea with bubbles
- Excessive wind.
- Cloaca becomes sore and itchy.

Treatment:

Thrush can be treated orally with Nilstat. Dosage rates for joeys as taken from A guide to the care of Bare-nosed Wombats 2.2 (Dennis .L) is as follows:

- Furless - .25ml per kg.
- Furred - 0.5ml per kg.
- 3 doses a day for 5 days.

## **8.4.5 Bacteria**

### **Leptospirosis**

Cause:

Leptospirosis is a bacterial disease which causes severe kidney damage, caused by *leptospira* bacteria that are found in infected animal urine and animal tissues. It remains contagious as long as it is still moist. The spiral shaped bacteria enter the body through wounds and abrasions on the skin, the mucous membranes, inhalation, and possibly ingestion of contaminated food or water. Wombats probable acquire the bacterial infections when grazing on swampy pastures.

Signs:

The incubation period for Leptospirosis in animals is anywhere from 2 to 20 days. Some infected animals may show no clinical signs of the disease, although general indicators of a leptospiral infection in animals are:

- Vomiting
- Fever
- Failure to eat
- Reduced urine output
- Unusually dark or brown urine
- Lethargy
- Kidney Failure

Treatment:

Leptospirosis is treated with antibiotics, which should be given early to avoid severe organ damage and facilitate early recovery.

Prevention:

It is essential to maintain high standards of hygiene and ensure the enclosure is well

drained to help prevent bacterial infection.

#### 8.4.6 Jaw Misalignment

Young wombats have a tendency to consistently suck on items. Persistent sucking behaviours have been implicated in development misalignment of the jaws and subsequent dental malocclusion (Vogelnest and Woods, 2008). Poor feeding tendencies where carers may fail to alternate sides of the mouth whilst bottle feeding may also contribute to jaw misalignment.

#### 8.4.7 Other Diseases

Other Diseases that are known to effect the Common Wombat include arthritis, asthma, cancer, diabetes and pneumonia.

### 8.5 Quarantine Requirements

The purpose of animal quarantine is to detect those animals which may be incubating disease. Quarantine protocols are primarily aimed at:

- Preventing the spread of disease entering the country
- Prevention of transmission of disease *within* institutions.
- Prevention of transmission of disease *between* institutions.
- And reducing the risk of Zoonoses.

Australian Quarantine Inspection Service (AQIS) should be contacted when transferring animals.

The following is a list of health screening procedures as taken from Quarantine and health screening protocols for wildlife prior to translocation and release into the wild (Woodford):

#### **The quarantine period for wombats is 60 days.**

Serology for herpes virus, *Leptospira spp*, *Toxoplasma gondii* antibodies (methodology as described above) should be done. Any skin lesion should be examined carefully for the presence of *Sarcoptes scabiei* mites. Even if mites are not seen, and there are skin lesions, the animal should be treated using acaricidal washes or ivermectin (Ivomec Antiparasitic Injection for Cattle, ivermectin 10 g/L, Merck Sharpe and Dohme, or Ivomec Liquid for Sheep, ivermectin 0.8g/L, Merck Sharpe and Dohme) . There should be three consecutive negative faecal flotations. Heavy infections of coccidia, nematodes or cestodes should be treated appropriately. Any infestation of *Strongyloides spp* should be treated. Faeces should be submitted for complete bacteriologic examination including routine culture, anaerobic culture, *Salmonella* culture, *Campylobacter* culture and ZN staining for acid-fast bacilli.

#### Barrier Nursing:

Precautions must be taken to minimise the risk of exposure of the quarantine staff to zoonotic diseases that may be present in the newly acquired animals.

Each quarantine section should have:

- Own tools-feed/water bowls, cleaning equipment.
- Footbath.
- F10 or other suitable disinfectant.
- Gumboots.
- Disposable gloves, face mask.
- Overalls/surgical gown.

The following records should be kept for each individual requiring quarantine:

- ID number.
- ID type - microchip, tag, notching etc.
- Age - in years, or where unknown if adult or juvenile.
- Sex - male, female, unknown.
- Outcome - Final disposition of each individual (e.g. moved, move delayed, cancelled).
- Comments - explanation of outcome.
- Duration of quarantine - Date quarantine begins/ends and total days.
- Project veterinarian.
- Disease of concern - A complete list of diseases to which the species and its close relatives are susceptible should be compiled and evaluated for consideration of impact upon the animal movement.
- Specific diagnostic tests - With assistance from the project's veterinary advisor check the diagnostic samples to be collected and plan the date of collection.
- Routine screening/diagnostic samples
- Any treatment/vaccinations and dates - List all planned treatments and vaccinations to be given during the quarantine period.
- Samples to be forwarded to - List each laboratory's address and phone number. Make arrangements with laboratory prior to sampling.



## **9. BEHAVIOUR**

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### **9.1 Activity**

Wombats are nocturnal, spending up to 16 hours a day in the burrow. Most of this time is thought to be spent resting to conserve both water and energy, though some time may be spent carrying out burrow maintenance. While they are in their burrow, they often remain completely still for many hours, but short periods of activity will occur from time to time, when they scratch, change position, or move to another chamber (Triggs, 1996).

After sunset when the wombat is preparing to emerge from a burrow it moves towards the burrow entrance, and if the temperature and other external conditions are favourable, a wombat will emerge to begin grazing. If it encounters high temperatures or low humidity it retreats again (Tyndale-Biscoe, 2005). Wombats will move over a part of its range each night as it feeds; usually 1-2 kilometres each night and up to 4 kilometres. The wombat will then retreat to the depths of a burrow before sunrise.

The wombat's heart rate decreases rapidly when returning to the depths of the burrow, as the respiratory rate slows from 30 times a minute to about 14 times while sleeping (Triggs, 1996), and its body temperature falls to its 'normal' temperature of about 34.7 c.

In a study measuring the air temperatures in burrows during summer months, where temperatures of 35 c and even 40 c were common outside, it showed that temperatures in the burrow did not exceed 25 c (Triggs, 1996). Consequently the wombat is able to stay cool and comfortable in the burrow during extreme temperatures.

### **9.2 Social Behaviour**

Although the Common Wombat is classified as solitary, in the wild they do have overlapping home ranges, and it is not uncommon for them to share burrows, though rarely simultaneously.

#### Home Range:

A wombat's home range varies from 5 - 23 ha, which may increase or decrease in different seasonal conditions. This is achieved by using different burrows on successive nights.

In a radiotelemetry study, it showed that each individual used or shared from 3-11 burrows throughout its home range with 5-7 other wombats, and together they used more than 40 burrows (Tyndale-Biscoe, 2005).

#### Feeding Grounds:

Wombats are possessive about their particular feeding grounds and will aggressively defend their territory against intruding wombats. They mark out these areas by leaving scent trails and droppings around the boundaries and are quick to detect the presence of a stranger.

Three metres appears to be the wombat's 'individual distance', it will either attack or move away from any wombat which comes closer than that (Triggs, 1996).

#### Aggression:

Aggressive encounters usually begin with a series of vocalisations including low growls, a rasping hiss, as well as a 'chikker' 'chikker' sound. A series of calls can continue for some time until the intruding wombat either retreats to a safe distance, or stands its ground and makes similar aggressive signals, which will then be followed by chasing and fighting.

### **9.3 Reproductive Behaviour**

Common wombats can breed at any time of the year, though more births occur between December and March than at others.

The courtship and mating of the common wombat is vigorous and has been observed in the wild to involve a sequence of repeated behaviours (detailed in section 10.1 Mating System). The male chases the female while she does a 'hard to get' dance trotting around in wide circles and figures of eight in open pasture. The male delivers a powerful bite to the females hindquarters causing her to stop running and allowing him to mount her.

Several recordings of wombat courtship and mating in the wild, give details of the same behaviours which seems to suggest that this is typical.

#### 9.4 Bathing

Although wombats are efficient swimmers, they do not usually bathe in water. They will instead seek out a dusty patch of sand or soil and dust bathe to keep themselves clean. Lying on its side, they will scoop the loose sand or soil over their flanks. This could aid in the prevention of parasites.



**Figure1:** A dust bathing wombat scooping soil over its flanks (Triggs, 1996).

#### 9.5 Behavioural Problems

In 2006, the University of Queensland conducted a study into the cause of stereotypic behaviour in common wombats residing in Australian zoos. The study revealed that the amount of time a wombat spent feeding per day had an influence on stereotypic expression, as the stereotypic behaviours peaked on average 1 hour before expectancy of food and 4 hours after feeding schedule times.

Other factors to cause stereotypic expression in captive wombats are feed intake restriction and motor restraint resulting from lack of space.

The most common stereotypies expressed by captive wombats include:

- Straight line pacing.
- Gate pawing.
- Fence pawing.
- Boundary pacing.
- Rubbing.
- Continuous scratching or biting enclosure walls in an attempt to escape.
- Frequent vocalisations.

The study also showed there was a strong association between the variables of wombat gender and stereotypic development, with males being far more susceptible than females. (Hogan & Tribe, 2006). This could be due to the males notably larger home range in the wild, and that males also travel further at night (males average 883m versus females 512m).

Other behavioural problems in captive wombats may include:

- Hand reared wombats have been known to chase feet, if they have been taught to do this in the hand rearing process.
- Some wombats may also show increased aggression towards keepers, in this case husbandry practices should be adjusted to deal with these animals (Treby, 2005).

For suggestions to prevent stereotypic and undesirable behaviours refer to section 9.7 Behavioural Enrichment.

## 9.6 Signs of Stress

Stress signs in wombats include the following:

- Loud vocalisations.
- Teeth gnashing
- Ears down.
- Chronic stress can result in alopecia.

### Signs of distress in a Joey wombat:

- Teeth Gnashing
- Hiccups (although some joeys do hiccup after a bottle or when excited).
- Stress hollows in temples (stress hollows and the death cross are one of the final signs in a severely distressed Joey, and urgent action is required).
- Sleeping curled up tightly into a ball with legs facing downward and head tucked under body.
- The Death Cross (indents in the shape of a cross on the top of the head indicate severe stress – and that death is near).
- Heat stress - bright pink pads on the soles of the feet.

Note: Stress hollows are more visible in furless joeys, however to check a furred Joey you can gently probe the area behind the eye with your finger to feel if there are indents.



**Figure 2:** Stress hollows in the temple and first signs of the death cross in a Joey (Dennis, 2008).

## 9.7 Behavioural Enrichment

Invariable husbandry procedures can result in predictable feeding strategies that result in captive wombats expressing undesirable stereotypic behaviours. Therefore it is important to continuously stimulate our wombats to relieve boredom and encourage the wombats to express natural behaviours.

The following are examples of enrichment activities suitable for wombats.

Food related enrichment strategies:

- Scatter feed throughout enclosure.
- Spread seed sprouts in mulch to allow the wombat to forage.
- Cardboard box food dispenser to encourage the wombat to work out how to get the food (any remains of the box will need to be later removed from the enclosure).
- Hanging cardboard box food dispenser.
- The inclusion of tree roots are great for teeth development and nourishment.



**Figure 3:** 'Betty' exploring a cardboard box food dispenser at Symbio Wildlife Park (K. Elliott, 2009).

Behavioural enrichment strategies:

- Walk on a harness, allowing the wombat to stop and graze where it chooses.
- Provide Browse.
- Mulch pile (placed away from fence).
- Garbage bin to climb in and on.
- Planting tussock grasses in the enclosure to allow the wombat to chew and dig them up.
- Fill log/burrow substitute with mulch to encourage the wombat to dig.
- Place log or large rocks in path or entrance to log/burrow substitute.
- Provide adequate amount of sand or dusty soil in enclosure to allow the wombat to dust bathe/dig.

Sensory stimulation strategies:

- Placing scats of other wombats/animals in the enclosure to stimulate olfactory senses.
- Spraying a herbs spray around the enclosure, encouraging the wombat to explore the different smells.
- Furniture swapping: Swapping furniture such as rocks, rubbing posts, logs etc between wombats and/or other animals.

## 9.8 Introductions and Removals

As the common wombat is solitary, introductions are generally made for breeding purposes. To ensure the female is not dominant over the male, the male should be released into the enclosure first to allow him to establish a territory. Introducing the female first into the enclosure could minimise the chance of successful breeding, as the female will not allow the male to mount if he is not dominant.

Encounters can be quite aggressive, therefore introductions should be made in the

morning to allow keepers to closely observe the wombats throughout the day, and remove the female if need be.

Animals are usually removed from each other with few social problems when they return (Jackson 2003).

Any wombat newly acquired should be quarantined for a 60 day period before being introduced into the collection (see quarantine requirements section).

### **9.9 Interspecific Compatibility**

It is not recommended to house Common Wombats with other species due to their aggressive nature.

### **9.10 Intraspecific Compatibility**

Common wombats are naturally solitary, therefore they generally prefer to be kept solitary in captivity. This is an important consideration when housing a pair, as incompatible animals can inflict a lot of damage on each other, in particular deep lacerations to the rump and bite wounds to the ears.

If compatible, pairs may be held in (Jackson, 2003):

- Male and Female
- Two Females
- Two Juvenile males under the age of 18 months

If held in pairs, provision should be made to minimise the effect of aggression (Jackson, 2003). Daily observations of the pair will indicate if aggression levels have become too severe and if separation is required.

### **9.11 Suitability to Captivity**

Due to historically poor breeding success in captivity, wombats are commonly introduced as hand reared orphans and readily settle into captivity. Most wombats eat fresh grass within 2-5 days after being captured and commercial food after 1-2weeks (Jackson, 2003).

## 10. BREEDING

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### 10.1 Mating System

#### Scats:

In the wild, a wombat's home range is marked with the particular individual's scent. Prior to sexual maturity, the young wombat will deposit its faeces in undergrowth, due to their vulnerability. Though as a young female wombat approaches her first oestrous cycle, she will deposit her faeces in a prominent position to indicate her sexual receptivity to any passing males.

Scenting of the home range has also been found in captivity (McEwan, 2000).

#### Flehmen:

In response to the female's pheromones, the male makes a lip curling grimace known as Flehmen. This appears to be a part of how the male detects if a female is in oestrus.

Flehmen usually involves the male standing with his head stretched towards the female's cloaca with his mouth open while he retracts his upper lip, baring the gum and wrinkling his nose, moving his nostrils in an erratic fashion.

Rapid licking and mouth movements are often associated before and after showing Flehmen (Jackson, 2003).

The Common Wombat and the Southern-Hairy Nosed wombat are the only marsupials known to display Flehmen (McEwan, 2000).

#### Courtship and Mating:

In the wild, wombats are solitary animals coming together solely to mate. Both males and females are polygamous, mating with several partners.

In the wild, mating is usually done in the burrow where the male can trap the female. Males fight for mating rights and females fight off males during courtship, so any pair that mates is usually bloody and scarred.

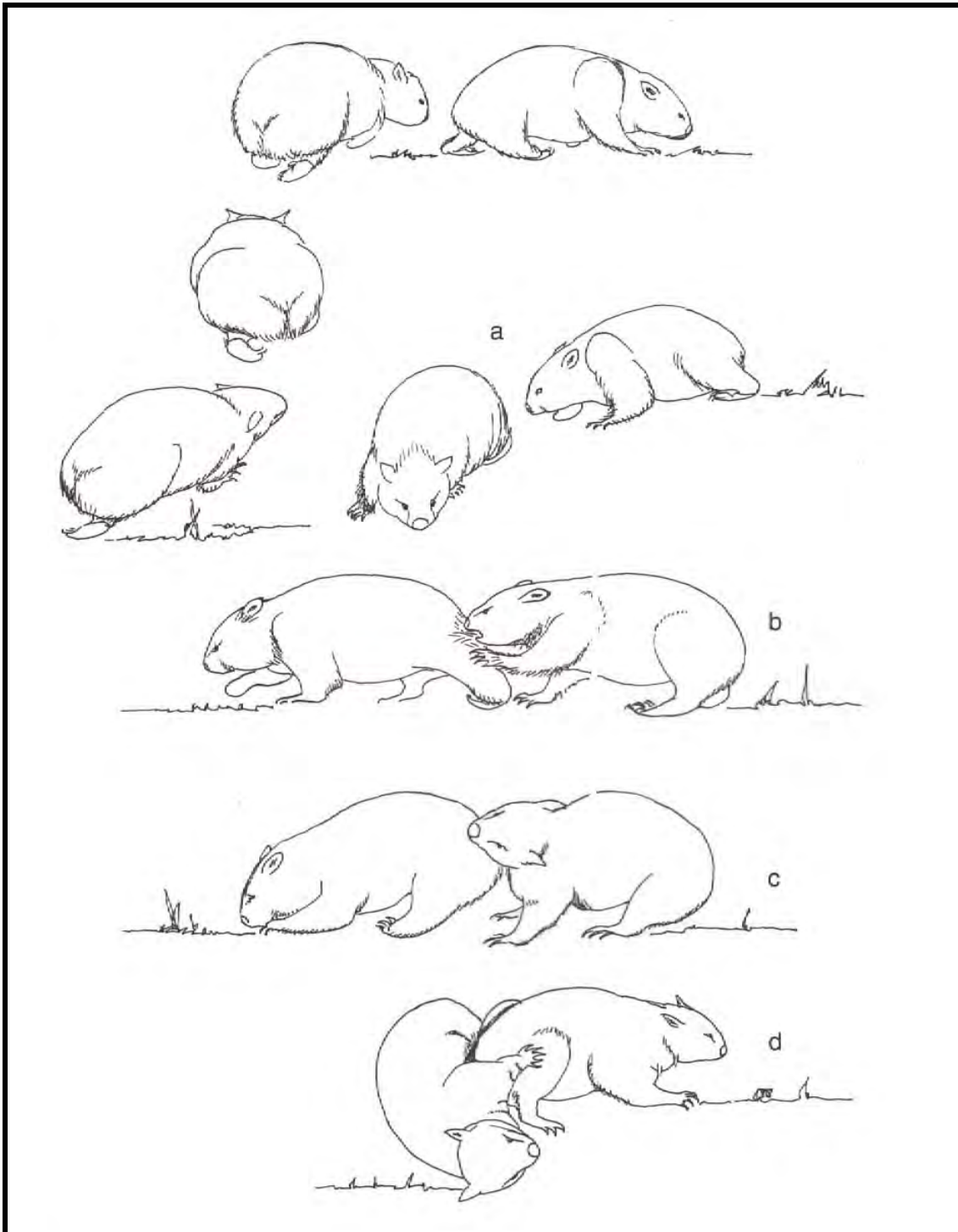
In captivity, mating has been observed above ground, and recorded through the use of infra red cameras.

Wombat courtship requires a lot of energy. It involves a lot of running, chasing, biting, grunting, loads of heavy breathing and digging so that he can prove to her that he is the wombat of her dreams. If the male is not dominant, successful copulation is unlikely to occur.

Observations of wombat courtship behaviours have been documented as "The male [chased] the female while she trotted around in wide circles and figures of eight; periodically she would slow down, allowing the male to catch up with her. After about two minutes the male delivered a powerful bite to the female's rump. At once, the female stopped running; the male then grasped her hindquarters with his forelimbs, rolled her over on her side and mounted her." (Triggs, 1996). The chase and mate sequence continues several times. And while they were copulating, the female rolled over into the prone position.

In another recording of Common Wombat courtship and mating in captivity in Australia, it was observed that "If the male was slow to mount, she would kick back aggressively and not let him roll her on her side again until she had run round in more circles and figures of eight." (Marks, 2005).







**Figure 2:** Courtship and mating sequence as observed in the wild (Triggs, 1996).

- A. Male chasing female as she trots around in wide circles and figures of eight.
- B. Male delivers a powerful bite to the females rump.
- C. The female stops running.
- D. Male grasps her hind quarters with his limbs, rolls her over on her side and mounts her.

Semen Plug:

Male wombats are among few marsupials that produce a copulated plug of coagulated semen in the female tract. This mating plug may be retained 2-3 days after mating, providing an easy means to identify when a female has been mated.



**Figure 3:** 5cm long Semen Plug found one day after mating in what appeared to be the females faeces, at Dreamworld (Lane. C & Barnes. M).

Parturition

Barbra Triggs described how a female wombat gives birth, based on a similar pattern has been observed in other marsupials, as the mother adopting the same position as the one she uses when cleaning the pouch opening, that is, sitting on her rump with the hind legs extended forward, so that the cloaca, is directed slightly upward (Triggs, 1996).

Dreamworld described the behaviour of what they thought to be the female wombat giving birth as 'The female was bent over, vocalising, tapping her front paws, shaking and teeth grinding, with her rump doing thrusting movements. Then her legs were fully spread and she was standing then squatting, her tail was erect and she appeared to be in a daze, with the floor beneath her moist.' This behaviour was recorded, and continued for over an hour (Lane. C & Barnes. M).

## 10.2 Ease of Breeding

Common wombats are notoriously difficult to breed in captivity. It is thought that poor breeding success in captivity is due to:

- Incorrect housing.
- Unsuitable diet (Refer to Section 10.11 for recommended breeding diet).
- Lack of enrichment.
- Incompatible pairs.
- That most captive wombats are hand reared, being denied to acquire learned behaviours essential to courtship.
- Small enclosure size: If the female only permits mounting after a 'chase', insufficient space may prevent this. If the male uses a 'bite on the bum' as a cue for her to stop and permit mounting, it is possible that any sexual encounter will result in escalating aggression without copulation taking place as the female has little space to perform her 'hard-to-get' figure eight dance, and therefore not allowing the male to mount her.

Catriona MacCallum at Western Plains Zoo in Dubbo found breeding success after joining and modifying the pen systems to permit a chase, resulting in the first recorded case of wombat twins (Marks, 2005).

The following are recommendations from institutions that have been successful in breeding wombats:

- House sexes separately prior to breeding.
- Introduce fresh green grass daily leading into the breeding season.
- Provide tunnels and access to digging. Each wombat should have a separate box/burrow.
- Have more than one male in the collection so they can stimulate each other to a state of reproductive readiness via competition.
- After mating it is recommended to check the female over for superficial wounds as it encounters can be quite aggressive.
- Female is checked for seminal plug if mating is suspected.
- Remove male from exhibit no later than 20 days after first seminal plug is observed.

### **10.3 Reproductive Condition**

#### **10.3.1 Females**

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

1. Juvenile non-breeding (non-parous) – pouch clean and dry teats very small.
2. Adult non-breeding (parous) – pouch dry and dirty.
3. Pregnant – pouch pink in colour and glandular in appearance.
4. Pouch young present- pouch deep, very moist and young attached to teat.
5. Lactating (young absent from pouch but still suckling) – pouch area large, teats enlarged.
6. Post breeding- teats are still enlarged, expressing only clear liquid and regressing in size.

If pouch young are present, the following developmental stages should be recorded:

- Sex distinguishable
- Tips of ears free
- Papillae of facial vibrissae evident
- Eyelashes visible
- Eyes open
- Fur visible
- Eyes open
- Fur visible – slight tinge, medium or well developed
- Tips of first incisors through the gums
- At foot
- Eating solids
- Self feeding
- Independent

Measurements of the pouch young that need to be recorded (Jackson 2003):

- Weight (g) – if detached from the teat.
- Crown rump length (mm) – primarily for very small neonates where measurements are difficult.
- Head length (mm) from the occiput to snout tip.
- Head width (mm) maximum width across the zygomatic arches.
- Snout next to length (mm).

- Tail length (mm) – from the cloaca to the end of the last vertebrae of the tail tip.
- Length of right tibia (mm) – from the stifle to the heel.
- Pes length (mm) – from the heel to the base of the longest toe, not including the claw.

### **10.3.2 Males**

The reproduction condition of males is not easily identified once they reach adult size. The testes must be firm with the epididymis distinct (Jackson, 2003).

### **10.4 Techniques Used to Control Breeding**

The separation of sexes should be all that is needed. As wombats are historically not well bred in captivity, excess breeding should not be an issue.

### **10.5 Occurrence of Hybrids**

None are known to occur.

### **10.6 Timing of Breeding**

Many marsupials have a seasonal cycle occurring at the time of the year that will ensure the young emerges from the pouch in spring. However in wombats pouch young have been found at all times of the year.

Common Wombats appear to be able breed at any time of the year in areas of high forage quality and abundance, though more births occur between September and March (Tyndale-Biscoe, 2005). This fits with observations that the testes of males are larger during September to December than at other times (Tyndale-Biscoe, 2005).

### **10.7 Age at First Breeding and Last Breeding**

Sexual Maturity is at two years of age, although they generally don't start to breed until the age of three. Dreamworld successfully bred a male Common Wombat at 15 years old, showing they are still viable at this age.

### **10.8 Ability to Breed Every Year**

Common Wombats appear to be able to breed annually, although due to the length of time that the young is dependant on the mother, it is more likely that females only rear one young every two years as females do not return to oestrus and breed again until the close association with the young ceases.

### **10.9 Ability to Breed More than Once Per Year**

Wombats can breed more than once per year, though this is unlikely to occur in the wild due to the length of time required to raise their young. However if the female loses her pouch young or if conditions are good enough for it to leave the pouch early, she may raise another.

### **10.10 Nesting, Hollow or Other Requirements**

Each female should be provided with well built nest box, or large hollow log or artificial burrow to retreat to. A small entrance will allow female to retreat into the box and block the opening to inhibit entrance by the male. When she is receptive she can then allow him to enter the nest box.

Nesting material such as straw or hay should be provided.

### **10.11 Breeding Diet**

As there is believed to be a link between the wombats diet and breeding in captivity, it is suggested to feed a basic diet of hay, grass, pellets and hard veg for the majority of the year. Fresh green grass should be increased to every day for several months prior to the breeding season, and continued through to the end of the breeding season (Yarde). This allows the female to invest in fat in order to meet the higher energy demands of reproduction and lactation.

Dreamworld have successfully bred wombats on the following diet (Lane. C & Barnes. M):

- 1½ cups Macropod Pellets
- 3 Native grass clumps
- 1 Handful Lucerne
- 20g Maize - Twice Weekly.

As wombats may lose weight during lactation, females carrying pouch young should have their diet modified to provide them with as much nutrition to assist them while feeding the young. The Western Plains Zoos diet for female common wombats carrying pouch young is to feed twice daily (morning and afternoon): Fresh grasses, Kangaroo pellets, Corn and sweet potato (Treby, 2005).

### **10.12 Oestrous Cycle and Gestation Period**

The wombat is polyoestrous which means that it has a series of oestrous cycles during a season. Each cycle takes about 33 days to complete and has three distinct phases; pro-oestrous, oestrous and post-oestrous. The first phase, the pro oestrous period is around 4 to 5 days before the oestrous period, when the wombat is “on heat” and becomes very active and aggressive. Oestrus is very brief, lasting only around 15 hours, during which the females urogenital opening becomes moist and swollen. The third phase, the post-oestrous period takes around 4 weeks.

Gestation is approximately 30 days where upon the embryonic Joey crawls from the cloaca to the backwards opening pouch where it attaches itself one of the two teats where it suckling from its mother it grows and continues development for about 8 months.

Once mating has occurred the male has no further part in the reproductive process, or in the upbringing of the Joey. If following mating, the female becomes pregnant, her oestrous cycles cease and probably do not start again until some time after the young is weaned (Triggs, 1996).

### **10.13 Litter**

#### **Size**

Generally the female produces a single altricial Joey, which attaches itself to one of the two teats in her pouch, although twins can occur.

Once the young is born, any other wombats housed in the enclosure should be removed to prevent loss of the young.

### **10.14 Age at Weaning**

The Joey begins to eat solids at around 8 months old, and is usually weaned at around 12 to 15 months of age when females weigh around 8.65 kg and males 8.38 kg. They are

usually independent at 18 months of age when they reach adult weight of 22kg.

### 10.15 Age of Removal from Parents

Young should be removed at 20-28 months of age (Jackson, 2003) as the mother can become increasingly aggressive towards their young as she comes into her next oestrus. Chasing by the mother has been observed and severe biting of the young are often observed at this stage resulting in the young hiding and cowering in the corner of the enclosure.

### 10.16 Growth and Development

#### **Birth**

Weight - 0.5 grams

Hairless Joey with well developed forelimbs (to aid in climbing from the cloaca to the pouch) with sharp claws. Hind limbs are underdeveloped. Joey has a mouth with lips joined at outer edges. Most other organs, including the eyes are embryonic. Approx 15mm long.



12 Days Old (Lane. C & Barnes. M)

#### **1 month old**

Weight: 5 grams

Permanently attached to teat. Ears fused to top of head. Outer edges of lips fused together. Furless. Hind limbs developing. Approx 7cm Long.

#### **3 months old**

Weight: 100 – 110 grams

Facial structure is forming. The ears are fully unfolded but lying close to head. Whiskers forming but otherwise totally hairless. Lips still joined and permanently attached to teat.



(Dennis. L, 2008).

**3.5 months old**

Weight: 230 – 250 grams

Fine fur may be appearing on ears. Eyes starting to open. Permanently attached to teat.

**4 months old**

Weight: 380 – 400 grams

Eyes fully open. Lips beginning to separate.



Approx 4 1/2 Months Old (Dennis. L, 2009).

**5 months old**

Weight: 750 – 800 grams

Fine layer of fur developing on limbs. No longer permanently attached to teat and lips fully separated, still suckling frequently. Lower incisors erupting.



(Dennis. L, 2008).

**6 months old**

Weight: 1 - 1.5 kilograms

At 6 months of age the fur approximately 1mm long over most of the body. Skin on nose and soles of feet are pink. First molars are visible, lower incisors 3-4mm long and upper incisors are erupting. Pink nose, forepaw or occasionally whole back leg can be sometimes seen popping out of the pouch.

**7 months old**

Weight: 2 - 2.5 kilograms

Fur is getting thicker. Joey ventures out of pouch when in burrow and only for short periods, keeping in close contact with the mother. Premolars and second molars are erupting.



(Dennis. L, 2008).

**8 months old**

Weight: 3 - 3.5 kilograms

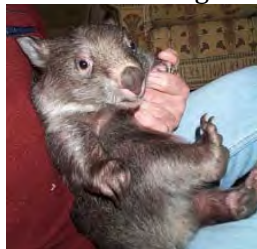
Fully furred. Large ears, appearing too large for head. Tail still visible. Out of pouch more often and quite active while still in burrow. Nibbles grass while poking head out of pouch. Starting to emerge while out of the burrow. Begins some digging practice, scraping at the burrow walls.

A captive reared wombat at this age was observed to eat small moist faecal pellets produced by the mother (Tyndale-Biscoe, 2005).

**9 - 11 months old**

Weight: 3.5 - 6.5 kilograms

Joey leaves the pouch permanently during this period. Skin on nose and on soles of feet is darkening. Still suckles from the teat, which can be elongated and protruding out of the pouch. Stays close to the mother whenever out of the burrow, often not breaking physical contact. Eats more and more grass and maybe its mother scats to increase gut flora.



Approx 10 Months Old (Dennis. L, 2008).



**12 - 15 months old**

Weight: 7 - 19 kilograms

Weight range for 12 months of age is from 7.3 to 11.3 kilograms and 12 to 19 kilograms for 15 months of age. Mothers milk supply gradually dwindling as the Joey eats more grass. Joey is weaned at 15 months but remains with the mother for some time.



Approx 12 Months Old (Dennis. L, 2008).

**18 months old**

Weight: 16 - 24 kilograms

Usually independent at this age, though very vulnerable. The young is always more alert and ready to run for cover than its mother if a strange sound disturbs it.

## 11. HANDREARING

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### 11.1 Housing

When a joey comes into your care, it is important to provide an environment that is SECURE, DARK, WARM and QUIET to help minimise stress.

#### Substitute pouches:

Pouches can be made ideally from soft, washable material, such as old blankets, old sheets, pillow slips, jumpers and windcheaters. As a mother's pouch fits tightly around the joey, it should be wrapped up and placed in such a way that it remains in a natural position. The pouch can then be placed in a laundry basket or suitable box lined with clothing or blankets.

As the wombat gets older, due to their inquisitive and destructive nature, it is essential to place the pouch, along with another blanket into a solid wooden box with a secure lid.

A mother marsupial's pouch has a thick waxy substance discharged from the skin which coats the entire pouch lining, keeping it moist. This natural lubrication keeps a pouch-bound joey's skin soft and supple. When handrearing unfurred marsupials, it is wise to mimic this and keep the skin lubricated to prevent the skin from drying out and to maintain humidity.

#### Skin Lubrication:

- **Furless joey:** will need to be lubricated over the entire body otherwise the skin can become red, raw, cracked and dry (ensure that you avoid the eye area and nostrils).
- **Just furred joey:** will need to have the fleshy bits lubricated, such as the paw pads, nose and sometimes the cloaca.
- Once the joey is quite active and the paw pads are darkening, lubrication is not normally required. However, you should constantly check for dry or damaged skin and apply lubrication when required.

There are several things you can use, and it is up to each individual carer to find the right product for them:

- **Lucas Papaw ointment** is very easily softened and warmed to skin temperature for easy use. This is a natural product that will not harm the joey if licked off.
- **Pure Sorbolene** (with no artificial additives or perfume). Sorbolene doesn't always absorb well, especially in cold climates, but does work efficiently if warmed first (Dennis. L, 2008).
- **Olive Oil** is another all natural alternative to use as a topical application. Although this can work it does tend to leave a sticky residue on makeshift pouches which results in them needing to be washed more often.
- **Eucerin cream** is a wool fat cream that has no additives. It is a lot easier to spread than the other wool fats. This can be quite thick so apply thinly, do not allow the cream to become cloggy between the cracks of the skin.

Common sense should be used in how often this needs to be applied (usually once or twice daily), and do not lubricate the joey too thick or the it will get blocked pores.

#### Topical applications to avoid (Dennis. L, 2008):

- Baby Oil
- Petroleum Jelly

### 11.2 Temperature Requirements

Unfurred marsupial joeys are unable to regulate their own body temperature, and therefore require constant warmth from an external heat source. As the joey develops,

the need for heat will be reduced.

Warmth can be provided through the following:

- Adding extra layers of cloth.
- Heat pads can be effective, though it is important not to overheat the joey.
- An electric blanket with the ties removed (available at some pet stores) may be used on a low setting, hung inside a box or carton with pouch hung against it. DO NOT FOLD ELEC BLANKET AROUND JOEY! This can cause the Joey to overheat.
- Hot water bottles may be used, however as the bottle does not retain heat for long periods it must be reheated every four hours (Jackson, 2003) can also add warmth. Hot water bottles should be well wrapped inside towels, or a piece of cloth and should not be placed too close to the Joey to prevent overheating or dehydration.

Temperature Requirements (Dennis. L):

Fur Development		Temperature
Furless or just furred Joey (under 600 grams)	Joeys of this size cannot regulate their own body temperature and must be placed on a heat source.	28 to 30 °C Any higher than this and you may overheat the Joey, resulting in brain damage.
Developing fur (over 600 grams)	Joeys of this size are just starting to regulate their own temperature, however there should still be a heat source available. Place the heat source so that the joey can move away from it if it wants to.	No higher than 28°C.
Furred Joeys	Furred joeys can regulate their own temperature and should not need a heat source. <u>* However</u> a sick or injured Joey may need to be kept warm.	Sick or injured furred joeys may be kept at a temperature no higher than 28°C.

Constant vigilance is required to monitor temperature as it will fluctuate, and both overheating and under heating can put the joey at risk. The use of a temperature gauge is recommended to ensure the joeys requirements are being met.

### 11.3 Diet and Feeding Routine

Because the milk of marsupials must support the young from its tiny size until it is an independent animal, the composition changes profoundly through lactation (Tyndale-Biscoe, 2003). Due to this it is important to artificial milk formulas that are graded according to age and development of the joey to mirror the changes which occur in nature.

### Feeding Equipment:

- Milk formula.
- Bottles.
- Teats.
- Syringes (if necessary).
- Cloths to wipe up spills.
- Container of warm water.
- Towel to place over lap.

### Recommended Formulas:

There are several low lactose formulas available that have been successfully used on Wombats:

- Digestelact (Human Formula)
- Divetelact (Animal equivalent of Digestelact)

Di-Vetelact is a universal milk formula and can be offered to all Australian marsupials.

Di-Vetelact is offered according to the weight of an animal. The general rule when offering Di-Vetelact to a native animal is 10% of body weight to survive and between 15% and 20% to thrive. It is important to remember however, that the recommended quantity to offer is for a joey that is totally dependent on milk (furless or just furred) (Dennis>>>>). Start on Dilution A and increase consistency slowly. Not all joeys will tolerate Dilution B and it may cause constipation or diarrhoea – so adjust accordingly.

- Biolac (M100), (M150) and (M200).
  - **M-100** is used on furless joeys.
  - **M-150** is a transitional milk and used on joeys when dense fur has developed.
  - **M-200**, which contains elevated lipids in the form of canola oil, is used on joeys that are producing solid, dark pellets.
- Wombaroo <0.4, 0.4 and >0.6:
  - **Stage <0.4** (under point 4) is for joeys that are less than 40% through pouch life. <0.4 joeys are completely furless with pink skin, eyes closed and ears drooped to erect.
  - **Stage .4** (point 4) is for joeys that are 40% through pouch life. They are furless to fine fur, eyes are open and ears are erect.
  - **Stage >.6** (greater than point 6) is for joeys that are greater than 60% through pouch life. They are completely furred (short to dense long fur), and they spend time out of pouch.
- Passwell Formula One is a universal milk supplement that can be offered to all Australian marsupials and to domestic pets such as kitten and puppies. This formula is offered at 5% of body weight. The manufacturer suggests the total milk required be fed over 4 feeds a day.

\* As marsupials are lactose intolerant, cows or goats milk is not recommended. This contains too little fat and too much lactose which is poorly digested and often results in diarrhoea and other symptoms.

Remember to always transition between milk formula's. This includes when moving through the different composition formulas of, or if swapping a joey from one product to another.

### Emergency Diets:

The following formulae can be used until advice and the correct Wombaroo Milk Replacer can be obtained: FULL CREAM powdered milk, at half strength, with baby cereal (e.g. Farex) added to it. This mixture is carefully spooned into the wombat joeys mouth. Cow's milk is NOT RECOMMENDED for feeding marsupials as the milk has too much lactose, which marsupials are intolerant to.

Water:

Joeys should be offered fresh water in a sturdy container, especially once the joey begins to vacate the pouch and eat solids.

Preparing Formulas:

When making up formulas ALWAYS use pre-boiled water, as the joey will have either no immune system a weak one. It is important to strictly adhering to the manufacturers' directions for dilution rates as shown on the labels. Always warm your wombats bottles and check the temperature of the formula on your wrist before feeding. Avoid microwaving milk formula's as this process destroys some of the nutritional content of the formula and could scald your joey. The joey can be fed in the pouch to reduce stress.

Milk Additives:

This is a personal choice for each carer. Milk additives are not generally required if using milk formulas correctly, although some carers do like to add different elements for extra nutrition, vitamins or minerals.

The following suggested milk additives have been taken from A Guide to the Care of Bare Nosed Wombats (Dennis .L):

- **Wombaroo Impact** is a colostrum powder that is considered by many as an essential milk additive for furless or just furred joeys to boost the immune system. It can also be used for an unwell joey that may have a compromised immune system. See the leaflet included in bottles of Impact for directions.
- **Heinz Baby Cereal Powder** is sometimes added to Di-Vetelact formula for added nutrition but should only be started once the joey has its eyes open and ears are starting to detach from head.
- **Olive or Canola Oil** is used to keep the coat shiny and in good quality. Only a few drops per bottle are needed.

**The following guide to feeding has been taken from A guide to the Care of Bare Nosed Wombats (Dennis. L):**

<b>Age/weight</b>	<b>Feeding Frequency</b>
<b>3.5 months / around 250 grams.</b>	Feed every 3 to 4 hours around the clock – day and night. Feed the joey while it is on a heat source as it will not retain heat for long when removed.
<b>4 months / around 380 to 400 grams.</b>	Feed every 4 hours around the clock. Feed the joey while it is on a heat source as it will not retain heat for long when removed.
<b>5 months / around 750 to 800 grams.</b>	Feed every 4 to 5 hours. The midnight feed is not required, however the first feed should be around 6am and the last around 11pm. The joey can be moved off the heat source to feed as it will retain its body temperature for short periods.

<b>6 months / around 1 to 1.5 kilograms.</b>	Feed as per 5 month. Joey will probably not require a heat source at all at this age.
<b>7 months / around 2 to 2.5 kilograms.</b>	Feed every 6 hours.
<b>8 months / around 3 to 3.5 kilograms.</b>	Feed every 6 to 8 hours.
<b>9 to 11 months / around 3.5 to 6.5 kilograms.</b>	Feed every 8 hours.
<b>12 to 15 months / 7 - 19 kilograms.</b>	Feed every 12 hours. Joey should be weaned during this period.

Joeyes have to be trained to drink artificial milk formulas from artificial teats, so PATIENCE and PERSISTENCE is required. Very small wombats will often still have their mouths fused at the sides, making feeding extremely difficult. This is because they are under developed and have permanently attached to the mothers' teat. This fusion usually separates after a few days, probably because the joey starts exercising its jaw (yawning).

Feeding Apparatus:

Furless and just furred joeyes can be fed using a syringe (5, 10 or 20ml) fitted with a suitable teat. The best type of syringes are glass as they flow smoothly, however they can be hard to find. Plastic syringes are prone to sticking and this often results in an influx of milk flooding into the mouth as the syringe stem is pushed through the canister. This can result in inhalation pneumonia.



**Figure 2:** Wombat Joey being Syringe fed (Dennis. L).

Most wombat joeyes however will be large enough to feed from a 50 or 100ml plastic bottle feeder with a special wombat teat attached (see below).






**Figure 3:** Wombat Joey being bottle fed (Dennis L).

When bottle feeding a joey, always keep the bottle on an angle (as pictured) to ensure the teat is filled with milk at all times. Allow the joey to control the milk flow through the sucking motion, **DO NOT SQUEEZE THE BOTTLE!** This can cause the milk to flow too fast and can cause inhalation pneumonia. Feeding a joey should never be rushed. The action of sucking on the bottle not only feeds the joey, but also gives the joey a feeling of security. Each feed should generally take 15-30 minutes.


Teats:

A joey's mouth is easily damaged, and ulcers or small irritations can occur if normal baby teats or hard tubing are substituted for the correct teat. A latex teat that resembles the wombat mother's teat should be used for the joey's comfort, fit and for tooth eruption. Feeding bottles and a range of specially made, soft marsupial rubber teats, designed for various marsupials are available from Wombaroo and Biolac suppliers, or may be purchased through most veterinary clinics, pet clinic and produce shops.



Teats Supplied by Wombaroo:

<p><b>LD Teat.</b> LD stands for Large Dog. Wombaroo recommend LD teats for small wombats.</p>	
<p><b>FM Teat.</b> FM stands for Fat Marsupial. Wombaroo recommend FM teats for larger wombats.</p>	
<p><b>MTM Teat.</b> MTM stands for Medium Thin Marsupial. This teat is often used for in-pouch macropods and possums. It has also been used successfully on furless or just furred wombat joeys.</p>	



<p><b>TM Teat.</b> TM stands for Thin Marsupial. This teat is often used for out of pouch macropods but has also been used successfully on small furred wombat joeys. The TM teat is longer than the MTM teat.</p>	
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Teats supplied by Biolac:

<p>T1 - Joey teat. Hard or soft.</p>	
<p>T3 - Short multi purpose teat.</p>	

\* Normal baby teats are not recommended as a joeys mouth is easily damaged, and ulcers or small irritations can occur if baby teats or other hard tubing are substituted.

Changing Teats:

It is important to ensure you are regularly replacing old or damaged teats. Excessive suckling can weaken the tip and cause the end to blow out. If the hole is too large, it will make the joesy to receive the milk flow too fast, which can cause inhalation pneumonia.

**11.4 Specific Requirements**

All furless or just furred joeys need to be toileted before or after each bottle feed - purely for hygiene reasons. A joesy that is allowed to lie in its wee or poo may develop illness or disease.

Toileting a Joesy:

To prevent soiling the pouch liners, you will need to move the joesy into a position where its bottom is poking out of the pouch and gently stimulate the cloaca with a soft, preferably damp, cloth. Not all joeys will tolerate this technique however, and may respond better to gentle pressure between the cloaca and the tail.

Hygiene:

- Chux wipes are ideal as they are ultra absorbent and soft on fragile cloacas. Cut one chux (or equivalent product) into four pieces for a handy sized cloth. Have a bowl of warm water at hand to rinse any wee or poo off the cloth.

- Toilet paper or tissues can also be used, however you need to ensure that the product you choose is unperfumed and soft so not to cause irritation to the skin in and around the cloaca.
- It is not recommended that you use paper towels as they are too rough and may cause irritation to the skin in and around the cloaca.

### **11.5 Identification Requirements**

Generally not required as a single joey is usually produced. If needed see section 5.3 Methods of Identification.

### **11.6 Hygiene**

When feeding a furless or just furred joey it is essential to ensure ALL your feeding utensils are spotlessly clean. A joey of this size has a weak immune system and the gut cannot tolerate introduced bacteria. Therefore good hygiene practices must be carried out after each feed.

#### Recommended Hygiene Practices:

- Maintain a clean pouch lining at ALL times.
- Only heat milk up once, discard leftovers.
- Wash hands before and after feeding joey.
- Rinse utensils under cold water after use.
- Then wash utensils using hot soapy water; Dettol Hand Wash, Miltons or Johnsons sterilisation solutions are recommended with hot water to break down the fat component and bacteria that builds up on the bottle walls.
- The use of a bottle brush is ideal as it scrubs away formula build up, especially in the hard to reach bottom of the bottle.
- Thoroughly rinse utensils after washing with boiling water to remove detergent. If using antibacterial agents, such as Dettol Hand Wash, any left over residue may build up and result in loss of gut flora (which may cause diarrhoea).
- Allow to air dry and store in airtight container, stored in the fridge until the next feed.

### **11.7 Behavioural Considerations**

Most young animals are energetic and playful, and joey wombats are no different. Wombats are extremely adventurous and chewing, digging and biting behaviour is normal. Making any housing areas wombat proof is recommended to protect both your things and the mischievous joey.

Once a wombat reaches 18 months of age and becomes independent of its carer, it will generally become more aggressive. It is important to remember that aggression is normal behaviour in wombats, especially after emergence from the pouch. Mother wombats appear to be quite tolerant to this, but a wombat bite can be painful.



**Figure 4:** Bites from a juvenile wombat, taken from website [http://www.wombadillac.com.au/pet\\_wombats.htm](http://www.wombadillac.com.au/pet_wombats.htm)

### 11.8 Use of Foster Species

Fostering within the wombat species has been conducted, with a 100% success rate observed in the southern hairy nosed wombats, Young as small as 1.5g have been transferred successfully to foster mothers using this process and growth rates have been unaffected (Jackson, 2003). This may be advantageous in the ability to cross foster with their endangered sister species the Northern hairy Nosed Wombat.

### 11.9 Weaning

The weaning process of a wombat joey begins when it starts to take solid food. This is a slow process which begins at approximately 8 months of age. Wombats will often wean themselves, and refuse to drink formula as they become more and more interested in solid food stuffs.

At this time the number of daily feeds can be reduced, though keeping the same volume of milk and providing pieces of solid food (see below). When the wombat is at two feeds per day, the amount of the formula can be decreased, without watering down, until fully weaned. As a general rule you may decrease the formula by 5% per week as long as the joey continues to gain minimum 5-10% body weight per day (Jackson, 2003).

Between the age of 12-15 months, a young wombat is weaned (Triggs, 1996). It is important to ensure this does not happen before 12 months of age (Jackson, 2003), and ensure the wombat is drinking plenty of water and eating lots of solids before full weaning.

#### Introducing Solids:

When initially introducing Wombats to solid foods, wombats can be fed a couple of teaspoons of Heinz High Protein baby cereal mixed into the Wombaroo Milk Replacer. Freshly cut grass, wombat pellets, carrots, apples, lucerne hay, rolled oats and lucerne pellets are all food stuffs wombats can be weaned onto.

## **12. ACKNOWLEDGEMENTS:**

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## 14. APPENDIX 1 - Glossary

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- **Acquire** - To gain possession of.
- **Anaesthesia** - Medically induced loss of sensitivity to pain in all or a part of the body.
- **Alopecia** - Hair loss; baldness.
- **Altricial** - Having young that are hatched or born in a very immature and helpless condition so as to require care for some time.
- **Ambient Temperature** - Air Temperature
- **ARAZPA** - Australasian Regional Association of Zoological Parks and Aquaria.
- **Bacteria** - Micro-organisms made up of a single cell that has no distinct core. Bacteria are ever-present in every habitat on Earth, growing in soil, acidic hot springs, radioactive waste, water, as well as in organic matter and the live bodies of plants and animals.
- **Bilateral** - Relating to two sides.
- **Behavioural Enrichment** - Provision of food, objects or olfactory stimulation to enhance natural behaviours and activity patterns.
- **Burrow** - a hole or tunnel excavated underground.
- **Capillary** - an extremely narrow thin-walled blood vessel that connects small arteries arterioles with small veins venules to form a network throughout the body.
- **Caudal** - Near the tail.
- **Cestodes** - Any of various parasitic flatworms of the class Cestoda, including the tapeworms, having a long flat body equipped with a specialized organ of attachment at one end.
- **Cloaca** - A common passage for urine, faecal and reproductive discharges.
- **Colon** - The part of the large intestine extending from the caecum to the rectum.
- **Convulsion** - A violent shaking of the body or limbs caused by uncontrollable muscle contractions.
- **Copulation** - To engage in sexual intercourse.
- **Corneal Reflex** - Blink reflex.
- **Courtship** - The behaviour in animals that occurs before and during mating, often including elaborate displays.
- **Dehydration** - An excessive loss of water from the body.
- **Diarrhoea** - Excessive and frequent evacuation of watery faeces, usually indicating gastrointestinal distress or disorder.
- **Discharge** - Secretion.
- **Distribution** - An area or range occupied by a species.
- **Dose** - A specified quantity of medicine to be taken at one time.
- **Dyspnoea** - Shortness of breath.
- **Ectoparasites** - A parasite that lives on the surface of the hosts body.
- **Endoparasite** - A parasite that lives within the body of the host.
- **Epididymis** - A long, oval-shaped structure attached to the rear upper surface of each testicle, consisting mainly of the sperm ducts of the testicles
- **Erythema** - abnormal redness of the skin due to local congestion of the capillaries, often a sign of inflammation or infection.
- **Euthanasia** - The act of putting to death painlessly and humanely.
- **Excretion** - To eliminate waste material from the body.
- **Femoral** - Relating to the femur or thigh.
- **Flank** - Side of the lower torso between the last rib and the hip.
- **Flehmen** - A behavioural response of many male mammals, consisting of lip curling and head raising after sniffing a female's urine.
- **Fly blown** - To deposit eggs or larvae on.
- **Focal** - Relating to a focus.
- **Foster Species** - When a lactating female of one species is used to rear a juvenile of another species.



- **Fungus** - Single celled spore producing organism, that lives by absorbing nutrients from organic matter.
- **Gnashing** - Grinding teeth together.
- **Gait** - A manner of walking, stepping or running.
- **Gestation Period** - Duration of pregnancy.
- **Grazer** - Feed on growing grass and pasturage.
- **Habitat** - The natural environment occupied by a particular organism.
- **Herbivorous** - Animals that subsist in their natural state entirely by eating plants and plant products.
- **Hindgut Fermenter** - An animal in which anaerobic digestion of food by microbes (bacteria only) occurs in the caecum, as opposed to the fore-gut fermenter, which is an animal with several compartments developed from the oesophagus in which fermentation of cellulose occurs (e.g. ruminants)
- **Home Range** - The area in which an individual travels in order to fulfil nightly feeding requirements, social behaviour, reproduction and nests.
- **Hybrid** - An offspring of parents of different strains, variations, species or subspecies.
- **Hyperbilirubinemia** -
- **Immunology** - Dealing with the immune system.
- **Incisor** - A tooth adapted for cutting and gnawing.
- **Incubation Period** - the period between the egg being laid and the individual inside hatching from the egg.
- **Interspecific** - Between species.
- **Intramuscular** - Referring to administering medication by entering a muscle.
- **Intraspecific** - Within species.
- **Joey** - Term used to call a young marsupial, usually under the age of 12 months.
- **Jugular Vein**- Any of the three jugular veins each side of the neck: anterior, external, and internal.
- **Jaundice** - Yellowness of the skin, sclera (outer coat of the eyeball), mucous membranes and excretions due to hyperbilirubinemia and deposition of bile pigments.
- **Labial** - Outer edge of the tooth.
- **Laceration** - A jagged wound or tear.
- **Lactate** - To produce milk.
- **Lactose** - A sugar disaccharide found in milk, composed of glucose and galactose.
- **Lethargy** - A condition of drowsiness or indifference.
- **Lipid** - a biological compound that is not soluble in water, e.g. a fat. The group also includes waxes, oils, sterols, triglycerides, phosphatides, and phospholipids.
- **Longevity** - Age until which an individual lives.
- **Nematode** - Any of several worms of the phylum Nematoda, having unsegmented, cylindrical bodies, often narrowing at each end, and including parasitic forms such as the hookworm and pinworm. Also called *roundworm*.
- **Neonate** - A newly born animal.
- **Neurology** - Nervous System.
- **Nocturnal** - Active during the night.
- **Malnutrition** - Poor nutrition because of an insufficient or poorly balanced diet or faulty digestion.
- **Marsupial** - A group of mammals, where females are characterised by a distinctive pouch in which to raise the young through early infancy.
- **Oestrous** - Being in heat.
- **Oestrous Cycle** - The regular interval between periods during which the female is sexually active.
- **Papillary Light Response** - Reflex that controls the diameter of the pupil. Greater intensity light causes the pupil to become smaller, whereas lower intensity light causes the pupil to become larger.

- **Parakeratosis** - Persistence of the nuclei of the keratinocytes (cells of the epidermis that produce keratin) as they rise into the horny layer of the skin causing a lesion.
- **Parturition** - The act of giving birth.
- **Pastoralists** - Generally a cattle or sheep farmer, especially the owner of a large area of land in the Australian outback
- **Pasture** - Grass covered land used for grazing livestock.
- **Peripheral Veins** - Are the veins located away from the central part of the body, i.e. in the arms, hands, legs and feet.
- **Polygamous** - A pattern of mating where both males and females have more than one sexual partner during a single breeding season.
- **Polyoestrous** - When a species has more than one oestrous cycle per year.
- **PPE** - Personal Protective Equipment.
- **Protozoan** - Any of a group of single-celled, usually microscopic, eukaryotic organisms.
- **Pruritus** - Symptom of itching which is the prominent feature of most parasitic skin diseases.
- **Quarantine** - Restrictions placed on entering or leaving premises where a case of communicable disease exists or is suspected.
- **Scat** - Faecal droppings from an animal.
- **Sclerophyll** - type of vegetation characterized by hard, leathery, evergreen foliage
- **Serology** - The characteristics of a disease or an organism shown by study of blood serums.
- **Sexual Dimorphism** - Characteristics to distinguish between males and females.
- **Solitary** - Species which avoid the company of others.
- **Stereotypic Behaviour** - Constant and repetitive actions (often undesirable) such as vocalisations, grooming, walking or weaving which would otherwise be seen normally in the species.
- **Stress** - An individual under pressure or tension.
- **Subspecies** - The rank below the species level.
- **Thermoregulate** - To regulate body temperature.
- **Tibial**- the inner of the two bones of the leg, that extend from the knee to the ankle and articulate with the femur and the talus; shinbone.
- **Tourniquet** - A device, typically a tightly encircling bandage, used to check bleeding by temporarily stopping the flow of blood through a large artery in a limb.
- **Trematodes** - Any parasitic flatworm of the class Trematoda, including both external and internal parasites of animal hosts, that have a thick outer cuticle and one or more suckers or hooks for attaching to host tissue.
- **Vestigial Tail**- Hidden, no longer functional.
- **Weaning** - The act of separating the young from the dam which has been suckling, or has been receiving milk diet provided by the dam or from artificial source.
- **Zoonoses** - Any infectious disease transmitted from animals to humans and vice versa.

## 14.1 APPENDIX 2 - Food Suppliers

### 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)

### Biolac

PO Box 93

Bonyrigg Plaza, New South Wales, 2177  
Ph: +61 2 9823 9874  
Web: [www.boliac.com.au](http://www.boliac.com.au)

**Divetelact:**

Sharpe Laboratories  
Animal Health Division  
12 Hope Street  
ERMINGTON NSW 2115  
Phone: (02) 9858 5622  
Fax: (02) 9858 5957

## 14.2 APPENDIX 3 - MSDS

### MATERIAL SAFETY DATA SHEET

#### F10 SUPER CONCENTRATE DISINFECTANT

#### COMPANY DETAILS MANUFACTURER:

AUSTRALIAN DISTRIBUTOR: Health and Hygiene (Pty) Ltd  
COMPANY: Chemical Essentials (Pty) Ltd P O Box 347. Sunninghill 2157,  
Address: 13 Abelia Str, Doncaster East, South Africa.  
Victoria 3111 Tel:+27 11 474-1668  
Emergency Telephone number:+03 9841 9901 Fax: +27 11 474-1670  
Fax: +03 9841 9909 e-mail: [info@healthandhygiene.co.za](mailto:info@healthandhygiene.co.za)

#### IDENTIFICATION

PRODUCT NAME: **F10 SUPER CONCENTRATE DISINFECTANT** UN Number: None  
D G Class: None  
Hazchem code: None  
Poisons Schedule: 5

#### HAZARDOUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA IN THE PACK CONCENTRATE ONLY (eyes and skin irritant)

**USE:** Biodegradable multi purpose Disinfectant for all hard surfaces, equipment and  
airspace

#### PHYSICAL DESCRIPTION/PROPERTIES

Appearance: Clear, colourless liquid, with a slight natural odour.  
Boiling Point: 110°C  
Vapour Pressure: Not known  
Specific Gravity: 1.00  
Flash Point: Not flammable  
Flammability Limits: Not flammable  
Solubility in water: Soluble

#### INGREDIENTS

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%

#### HEALTH HAZARD INFORMATION

##### HEALTH EFFECTS:

##### Acute

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

**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°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**

**MATERIAL SAFETY DATA SHEET  
VIRKON S DISENFECTANT**

Pharmaceutical Research Laboratories Inc. · 562 Captain Neville Drive, Waterbury CT 06705  
(203) 755-4908 · 800-243-5350 · FAX (203) 755-4309

www.pharmaceutical.com

**VIRKON-S POWDER**

**ISSUE DATE: 03/07/2007**

**I. IDENTIFICATION OF THE SUBSTANCE/PREPARATION AND COMPANY**

**PRODUCT: VIRKON-S EPA REG # 71654-6**

MSDS HSD/US41

**IMPORTER:** Pharmaceutical Research Laboratories

562 Captain Neville Drive Waterbury CT 06705

Tel: 800-243-5350

**Supplier:** Antec International Limited

Sudbury Suffolk CO10 2XD

Tel: 44-(0)1787-377305

All information provided in this Material Safety Data Sheet refers specifically to the Virkon

S powder, as supplied, & **not** the in-use solutions, unless otherwise stated.

**II.COMPOSITION/INFORMATION ON INGREDIENTS**

**Chemical %**

**Concentration**

**CAS Exposure**

Potassium

peroxomonosulfate

40-60 70693-62-8 1mg/m<sup>3</sup>, total dust, 8 &

12 hr. TWA –

manufacturer's

recommendation.

Sodium

Dodecylbenzenesulphonate

10-20 25155-30-0 None assigned.

Sulfamic Acid 1-10 5329-14-6 0.5mg/m<sup>3</sup>, 8 & 12 hr.

TWA – manufacturer's

recommendation.

**III.HAZARDS INFORMATION**

**Potential Health Effects**

**Danger: Powder is corrosive.** Causes skin burns & irreversible eye damage.

Harmful if swallowed, absorbed through skin or inhaled. Do not get into eyes, on skin, or on clothing.

None of the components present in this material at concentrations equal to or greater than 0.1% are listed by IARC, NTP, OSHA or ACCIH as a carcinogen.

HMIS

Health-3 Fire-0 Reac- 0

**IV. FIRST AID**

**INHALATION**

**Symptom:** - Inhalation of this powder in sufficient quantities may cause irritation of the upper respiratory passages, nose & throat. Gross over

exposure may cause ulceration of mucous membranes.

**Treatment:** - Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

#### **SKIN CONTACT**

**Symptom:** - If allowed to become moist the dry powder may cause severe irritation and in cases of prolonged contact may cause burns or ulceration. Contact with the dry powder may cause skin irritation with discomfort or rash, or allergic skin reactions in sensitive individuals.

**Treatment:** - Flush skin with plenty of water. Remove contaminated clothing & shoes after use. Call a physician. Wash contaminated clothing before reuse.

#### **EYE CONTACT**

**Symptom:** - Eye contact with the powder may cause eye corrosion or ulceration; eye irritation with discomfort, tearing or blurring of vision. Severe eye damage may result if not treated immediately.

**Treatment:** - In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Call a physician.

#### **INGESTION**

**Symptom:** - Ingestion of this product in sufficient quantities may cause gastritis, with stomach pain, nausea, vomiting, diarrhoea, headache or weakness; possibly progressing to necrosis or haemorrhage with gross overexposure.

**Treatment:** - If swallowed, do not induce vomiting. Give 2 glasses of water immediately. Never give anything by mouth to an unconscious person. Call a physician.

#### **V. FIRE FIGHTING MEASURES**

**Flammable properties:** Not applicable

**Extinguishing media:** Water, dry powder (sand or Met-L-X), CO<sub>2</sub>.

**Fire Fighting instructions:** Evacuate personnel to a safe area. Wear self-contained breathing apparatus (SCBA) & full protective equipment. When heated above 70°C, decomposes with evolution of corrosive gas (SO<sub>2</sub>). Virkon S itself is not flammable or oxidizing, but may assist combustion of other materials under exceptional circumstances.

#### **VI. ACCIDENTAL RELEASE PROCEDURES**

##### **Safeguards (Personnel).**

Review FIRE FIGHTING MEASURES & HANDLING sections. Use appropriate Personal Protective Equipment during clean-up.

**Environmental precautions:** Do not allow the powder concentrate to enter drains. Infrequent disposal of small quantities (<0.5kg) may be diluted to waste with large quantities of water, subject to local waste disposal regulations. Do not allow entry to surface waters.

**Methods for clean up:** Sweep up carefully, preferable with the aid of a suitable dry anti-dusting agent if available. Place in suitable containers for disposal. Prevent powder from becoming moist while awaiting disposal, if possible. Moist product awaiting disposal must be kept away from combustible material & stored in a manner that allows suitable ventilation of the waste.

#### **VII. HANDLING AND STORING**

**Handling Personnel:** Avoid inhalation. Do not get in eyes and avoid contact with skin. Wear Personal Protective Equipment in accordance with section 8.

Handle with sufficient care to prevent dust generation.

**Storage:** Keep containers tightly sealed & avoid coming into contact with moisture during storage. Keep containers tightly sealed. Keep away from combustible material. Avoid contamination of the product.

**1% solution:** Store in a clean, loosely capped plastic container at room

temperatures, and away from direct sunlight. Do not allow solution to freeze. Discard any used or contaminated solution & dispose of any stock solutions after 7 days from date of preparation.

## **VIII. EXPOSURE CONTROLS/PERSONAL PROTECTION**

### **Engineering Controls:**

Appropriate Local Exhaust Ventilation may be necessary for handling the product where dust formation is a problem, i.e. product in bulk quantities, or operations in small and/or poorly ventilated areas. Not normally necessary for preparation of solutions from small pack sizes (10lb or less).

### **Personal Protection Equipment:**

**Respiratory:** Where a Health and Safety assessment shows the dusting levels to be sufficiently high when handling the powder product, wear a NIOSH approved respiratory mask against fine particles. Respiratory protection is not normally considered necessary when handling solutions of diluted product. However, when working with spray mists of Virkon S, respiratory protection in the form of a NIOSH approved respirator unit in conjunction with an organic vapor – fine particle filter cartridge.

### **Protective clothing:**

**Eye:** Chemical splash goggles.

**Skin:** Overalls.

**Hand:** Rubber gloves.

### **Exposure Guidelines & Applicable Exposure Limits:**

Potassium peroxomonosulfate

PEL (OSHA): None Established

TLV (ACGIH): None Established

AEL\* (DuPont): 1 mg/m<sup>3</sup>, total dust, 8 & 12 hr. TWA

Sulfamic Acid

PEL (OSHA): None Established

TLV (ACGIH): None Established

AEL\* (DuPont): 0.5 mg/m<sup>3</sup>, 8 & 12 Hr. TWA

1.5 mg/m<sup>3</sup>, 15 minute TWA

\*AEL is DuPont's Acceptable Exposure Limit. Where governmentally imposed occupational exposure limits which are lower than the AEL are in effect, such limits shall take precedence.

## **IX. PHYSICAL AND CHEMICAL PROPERTIES**

Boiling point: Decomposes on heating

Solubility in water: Approximately 8.3oz/gal

Form: Free flowing powder

Color: Yellow

Specific gravity: ~1.07

## **X. STABILITY AND REACTIVITY**

**Chemical stability:** Stable at normal temperatures & storage conditions.

**Incompatibility with other materials:** Incompatible with strong alkalis. In contact with halogen salts (e.g. KCl, KBr, KI, NaCl), Virkon S may react to release toxic halogen gases, such as chlorine, bromine & iodine. In exceptional cases Virkon S may support combustion; avoid contact with combustible materials.

**Decomposition:** Under certain extreme conditions sulphur dioxide & chlorine may be generated if the powder is allowed to become moist.

**Polymerisation: Polymerisation will not occur.**

## **XI. TOXICOLOGICAL INFORMATION (Animal Data- VIRKON-S POWDER)**

**Acute Dermal Toxicity:** LD50 >2.0g/kg (rabbit).

Acute Oral Toxicity: **LD50 = 1.70g/kg (male rats) & 1.16g/kg (female rats)**

**Acute Inhalation Toxicity:** 4 hour LC50 > 6.147mg/1 (male & female rats).

**Guinea Pig Dermal Sensitisation:** Virkon S displayed no fatiguing or sensitising



effects.

**Primary Skin Irritation:** The powder is corrosive to the skin of rabbits with an irritation index of 7.00. A dilution of 5% results in an irritation index of 0.08 in rabbits.

**Primary Eye Irritation:** The powder is corrosive to rabbit's eyes. A dilution of 5% produces conjunctival irritation.

**Effects of Overexposure:** Inhalation of dust may cause choking, coughing or wheezing. A 1% solution is normally non-irritating.

## **XII. ECOLOGICAL INFORMATION**

### **Aquatic Toxicity:**

#### **Oxone Monopersulphate:**

96 hour LC50 – rainbow trout: 53 mg/L

48 hour EC50 – daphnia magna: 3.5 mg/L

#### **Sodium Dodecylbenzenesulfate:**

96 hour LC50 – rainbow trout: 1.7 mg/L

#### **Sulphamic Acid:**

**96 hour LC50 – fathead minnows: 7.650 mg/L**

## **XII. WASTE DISPOSAL CONSIDERATIONS**

Treatment, storage, transportation, & disposal must be in accordance with applicable Federal, State/Provincial, and Local Regulations.

## **XIV. TRANSPORT INFORMATION**

### **Shipping Information:**

Not Regulated as a hazardous material by DOT, IMO, or IATA.

## **XV. U.S. REGULATORY INFORMATION**

TSCA Inventory Status: Listed

The following components are TSCA listed:

Oxone

Sodium Dodecylbenzenesulfonate

Sulphamic Acid

Those not stated are proprietary & non-hazardous. However, all components over 0.1% inclusion are TSCA listed.

This information is based upon technical information believed to be reliable. It is subject to revision as additional knowledge & experience is gained.