Husbandry Manual

For

Common Wombat

Vombatus ursinus

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Contents

1. Introduction

The family Vombatidae contains three species of wombats; *Vombatus,* which consists of one species (Common Wombat) and *Lasiorhinus,* which contains two species (Southern and Northern Hairy-nosed Wombat.

Common wombats and southern hairy-nosed wombats are relatively common; however the northern hairy-nosed wombat is one of the world's most endangered species with only 80-115 individuals remaining.

Wombats are marsupials that have a short broad head which accommodates their large masseter muscles that are needed for grinding through tough plant matter. Wombats have rootless ever-growing incisors which are an adaptation to the fibrous character of their natural diet.

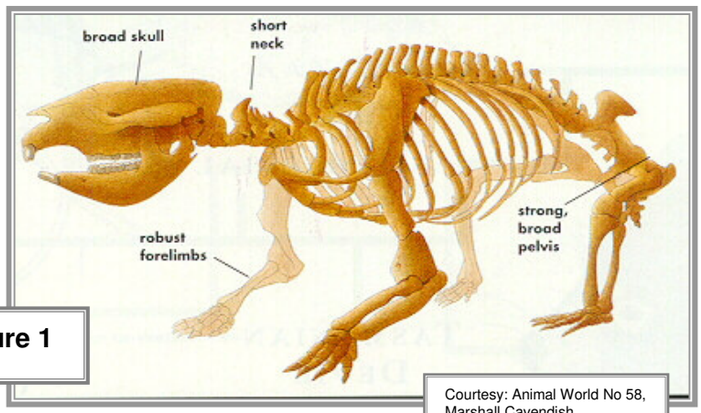


Figure 1

Courtesy: Animal World No 58, Marshall Cavendish

Wombats dig deep and often complex burrow systems that they sleep in throughout daylight hours and have many adaptations to assist them with this way of life.

They are squat and have a barrel like body and a tiny stubby tail. (Figure 1)
Their limbs are short and stout like, but enable brief but powerful digging thrusts to their burrows. The claws are broad and powerful for digging burrows and they have a backward opening pouch.

As with many burrowing animals, their vision is poor.

From this point, unless otherwise stated this manual relates to Common Wombats only.

2. Taxonomy

2.1 Nomenclature

Kingdom:	Anamalia
Phylum:	Chordata
Sub Phylum:	Vertebrata
Class:	Mammalia
Sub Class:	Marsupialia
Order:	Diprotodontia
Sub Order:	Vombatiformes
Super Family:	Vombatoidea
Family:	Vombatidae
Genus:	*Vombatus*
Species:	*ursinus*

2.2 Sub Species

There are three sub-species of common wombat (*Vombatus ursinus, V. ursinus hirsutus and V. ursinus tasmaniensis*) and there are no sub-species of hairy-nosed wombats.

2.3 Other Common Names

The common wombat is also known as the naked-nosed wombat, coarse-haired wombat, island wombat and forest wombat.

3. Natural History

3.1 Morphometrics

Adult common wombats vary in length from 90 – 115cm and weigh between 22 – 39kg

3.2 Distribution and Habitat

The Common Wombats main habitat is the forest covered, often mountainous areas of south-eastern Australia (figure 2): its requirements include a temperate, humid microclimate, suitable burrowing conditions, and native grasses for food. In southern Queensland and northern New South Wales it occurs only in sclerophyll forest above 600m but further south, particularly South Australia and Tasmania, it also occurs at lower altitudes and in more open vegetation such as woodland, coastal scrub and heathland.

Courtesy: The Wombat, Barbara Briggs

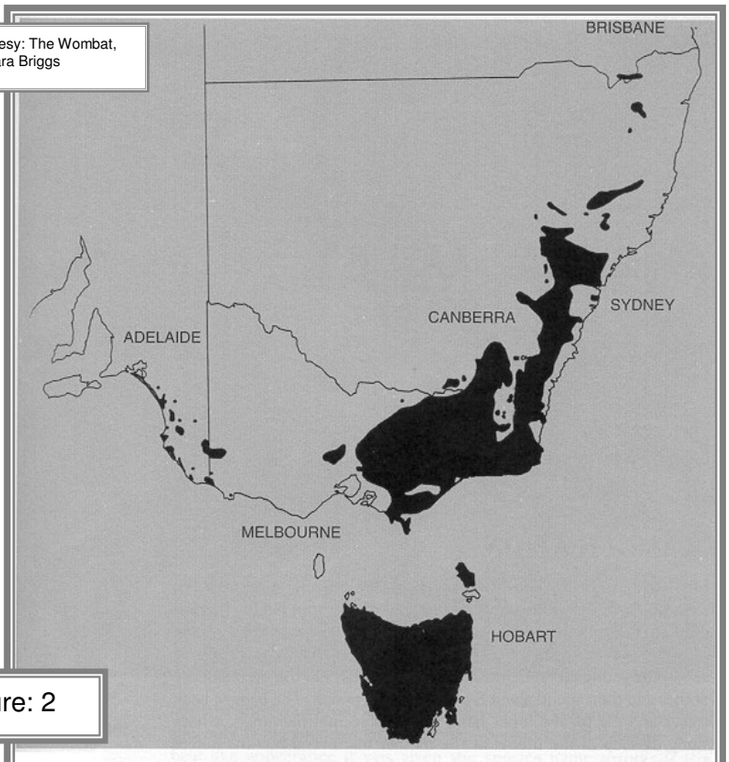


Figure: 2

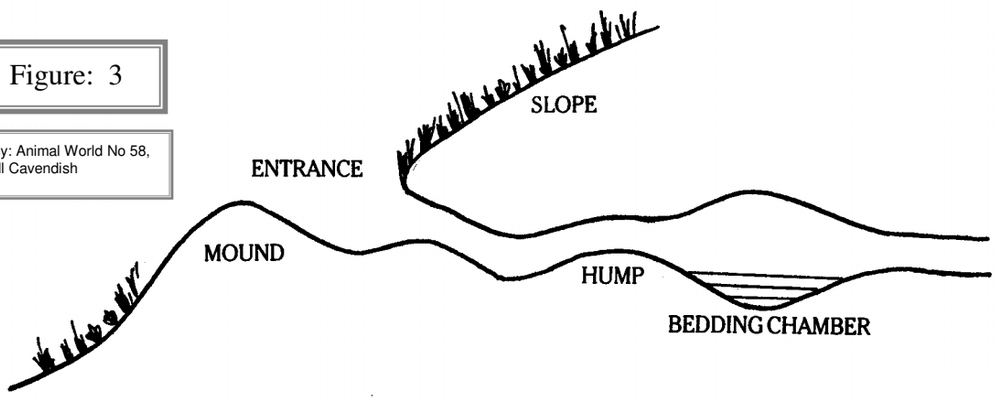
Present distribution of the Common Wombat. The range boundaries shown on this map are only approximate. Wombats are not found continuously throughout the range shown but only in areas of suitable habitat. They avoid rainforest, for example.
Data supplied by:
NSW and Queensland — J. McIlroy, CSIRO Division of Wildlife and Ecology, Canberra.
NSW — L. Dovey, National Parks and Wildlife Service, Queanbeyan. (WILD Data).
Victoria — P. Menkhorst, Arthur Rylah Institute, Heidelberg.
Tasmania — D. Rounsevell, Department of Lands, Parks and Wildlife, Hobart (TASPAWS Biological Records Scheme).
South Australia — K. Mallett and B. Cooke, in their publication *The Ecology of the Common Wombat in South Australia.*

Wombats' burrows (figures 3 and 4) vary considerably in location and size, patterns of use, and functions. The smallest, most numerous, 'minor burrows' (2-5m long) are mainly used for temporary refuge but some of these are eventually developed into 'major burrows' (up to 20m long) for diurnal shelter. Many major burrows contain more than one bedding chamber, divide or connect underground, and have several entrances. Slopes above creeks and gullies are favoured sites.

Each wombat visits from one to four burrows within its home range each night and up to thirteen over several weeks. Other wombats also use these burrows if their home ranges overlap, either at separate times or simultaneously. Home range (5-23 ha) varies according to the distribution of burrows in relation to feeding areas but, despite overlap, individuals maintain separate feeding areas through scent marking, vocalisation and aggressive behaviour.

Figure: 3

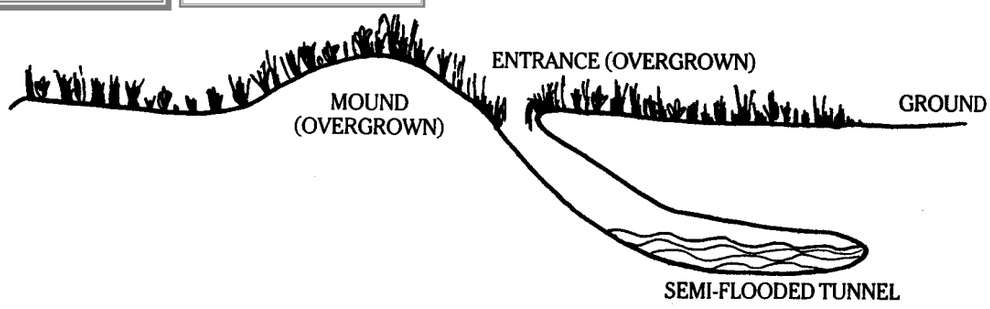
Courtesy: Animal World No 58, Marshall Cavendish



Diagrammatic cross-section of a typical medium or major burrow excavated into a slope.
Redrawn from McIlroy, 1973

Figure: 4

Courtesy: Animal World No 58, Marshall Cavendish



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.
Redrawn from McIlroy, 1973

3.3 Diet in the Wild

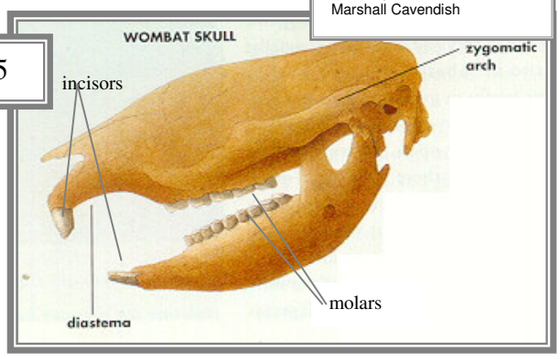
Wombats are strict herbivores and choose to feed on a variety of grasses, sedges, roots and bulbs. Grasses mostly eaten include tussock grass *Poa* sp., kangaroo grass *Themeda australis,* spear grass *Stipa* sp. and wallaby grass *Danthonia penicillata.*

They also make shallow diggings searching for succulent roots, but most digging is done to excavate burrows, not to find food. Free ranging wombats graze closely in a circular pattern surrounding the burrow system, consuming succulent daily growth from which they obtain water and other nutrients.

(Figure 5)The teeth are rootless and grow throughout life. The molars are adapted for grinding the fibrous diet and liberating the more digestible cell contents. It is not uncommon to see broken incisors associated with car trauma, and because the teeth are rootless and there is no pulp cavity, the affected teeth can just be filed even and left to grow back. A coarse diet is essential to keep the teeth worn and avoid malocclusion.

Courtesy: Animal World No 58, Marshall Cavendish

Figure: 5



When the wombat is feeding, the two pairs of incisors grasp the grass stems, usually pulling them free without cutting them. The stems are then arranged in the diastema by the lips and tongue so that their ends are passed on to the cheek teeth, which consist of one premolar and four molars on each side of each jaw. These molar teeth have a flat surface, unlike those of other grazing animals.

The grass stems are first ground between the flattened crowns as the molars move sideways against each other and are then cut by the sharp enamel ridges as the lower ridge passes the upper one. This is a most efficient way of breaking up the tough, fibrous grasses that are the wombat's dominant food.

The wombat's digestive tract (figure 6) has several unusual features. In contrast to the majority of plant-eating animals, including most other herbivorous marsupials, the wombat's stomach is very small. Its external appearance is simple, but internally a region of the mucosa (the mucous membrane lining the stomach wall) is organised into a specialised gland called the cardio-gastric gland.

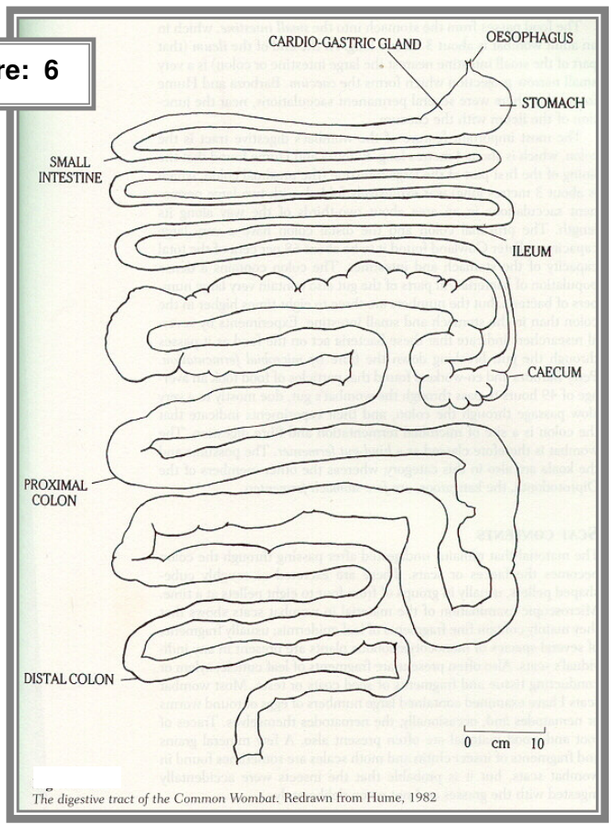
In studies on the digestive tract and digestion in wombats it was found that lipids, proteins and soluble carbohydrates in the plant cell contents were digested and absorbed in the stomach and small intestine.

The food passes from the stomach into the small intestine, which in an adult wombat is about 3 metres long. At the end of the ileum (that part of the small intestine nearest the large intestine or colon) is a very small narrow projection, which forms the caecum.

The most important feature of the wombat's digestive tract is the colon, which is about 4 metres long. It was found that the lining of the first part of the large intestine (the proximal colon, which is about 3 metres long) was extensively folded, with two large permanent sacculations in an area about two thirds of the way along its length. The proximal colon and the distal colon have a very large capacity. The colon contains a dense population of bacteria. All parts of the gut also contain very large numbers of bacteria, but the numbers are three to eight times higher in the colon than in the stomach and small intestine. Experiments by several researchers indicate that these

bacteria act on the food as it passes through the gut, breaking down the fibre by microbial fermentation. It has been found that particles of food took an average of 49 hours to pass through the wombat's gut, due mostly to a very slow passage through the colon, and experiments indicate that the colon is a site of microbial fermentation and fibre digestion. The wombat is therefore classed as a hindgut fermenter.

Figure: 6



The digestive tract of the Common Wombat. Redrawn from Hume, 1982

3.4 Longevity

Very little is known about the longevity of common wombats in the wild; however it appears they can live for more than 15 years.

In captivity, they typically live 12 -15 years; however there are records of them living to 26 years of age.

4. Housing Requirements

4.1 Exhibit Design

The principles of wombat enclosure design are set out below. Cages or enclosures need to be sturdy. Wire mesh should not allow noses or feet to fit through or wombats may damage themselves by biting and clawing at the wire. In outdoor enclosures wire mesh buried under a metre of soil prevents escape while allowing some digging. Foot problems in captivity are common if too hard a substrate is used due to pacing or digging at night. Foot problems are also exacerbated by damp conditions.

Wombats need to be provided with a burrow substitute to sleep in during the day. Hollow logs or wooden boxes are suitable. Hospitalised wombats can be provided with lots of straw or a large blanket to hide under.

Enclosure size requirements for nocturnal animals are frequently underestimated because the animals are only observed in daylight when they are inactive. Too small an enclosure will predispose to escape attempts and the risk of self inflicted trauma, to foot wear from pacing and to the development of stereotypic behaviour. The enclosure will quickly show signs of wear if it is too small. A stable makes an ideal enclosure for hospitalisation; healthy wombats should be given as much space as is available.
Home ranges of wombats in the wild have been estimated at 5 to 20 ha and they will travel 2-5 km in a night.

The poor breeding performance of wombats in captivity could be related to inadequate space for their vigorous courtship ritual and from the antagonism created from keeping solitary animals in pairs. Adult wombats should be housed separately as they are capable of inflicting serious wounds on each other (particularly deep lacerations to the rump and bite wounds to the ears).

Principles of wombat enclosure design:

Escape proof - the wombat must not be able to dig, climb, swim or jump out. Water filled moats and electric fences have failed to contain them. Floors constructed of weldmesh or chain link sheets wired together under 1m or more of soil or sand has been used successfully to prevent digging out. If wire joins are not carefully made, and uncovered wire mesh is not regularly recovered, wombats can injure their claws. A concrete base filled with soil or sand would be ideal to prevent self trauma.

The walls - should not be weldmesh or chain link because wombats, especially recently captured ones, will bite and claw at the mesh, damaging teeth, gums and nails in the process. Shade cloth and hessian will be shredded within hours. Colorbond steel or equivalent (e.g. Concrete or Besser Block) should cover the bottom 1.2m of the walls. Great care should be taken at the joins so that there are no gaps that a wombat can work on.

The upper part of the walls - can be weldmesh or chain link. Ventilation is important for good health. It is better to have fully enclosed pens if breeding is planned so that young cannot be predated. It is also better to exclude free ranging cats from the enclosure to reduce the spread of Toxoplasmosis from cat faeces.

The roof - can also be weldmesh or chain link. At least one third of the roof should be weather proof, with an additional one third providing shade and the final one third allowing sun penetration. Misting sprinklers should be installed on the roof to cool the enclosure down during extreme hot weather. These can be set to come on automatically at temperatures above 35 degrees C, or modified according to the responses of the animals to ambient temperature.

Burrow substitute - traditionally wooden boxes, hollow logs or concrete pipes have been supplied. A nest box should be approximately 1m x 1m x 1m with a hinged lid and can be lined with straw. The diameter of a concrete pipe should be that of the burrows in the wild. The floor of the pipe could be rubberised for insulation and add a thin layer of sand for comfort.

Substrate – should be soil, leaf litter or sand that is well drained. This type of substrate allows them to display their natural behaviour of digging and will also assist with wearing down their claws.

Enclosure furniture - should include rock slabs at a high point for marking territory and surveying the scenery, a rubbing post, regularly changed browse branches of local

non toxic tree and shrub species, planted local tussock grasses which are replaced as they are destroyed.

Water Bowls – should be heavy enough so the animal can not easily tip over, however they should never be placed in an area where the wombat can burrow beneath it and become trapped.

Enclosure size – QWPA standards suggest that the following are the minimum sizes for enclosures:

- Minimum surface area for up to two wombats – 30sq.m
- Minimum surface area for one wombat – 20sq.m

The space required for maintenance of nocturnal animals in captivity is always underestimated. If the pen is a minimum of 20m by 20m, then the animal will pace the perimeter less, cause less foot wear and spend less time trying to dig, climb or claw its way out. If the artificial burrow system is long, comfortable and secure, then the animal will spend less time trying to construct one of its own.

5. General Husbandry

5.1 Hygiene and Cleaning

Hygiene and cleanliness is an extremely important part of maintaining any animal in captivity. The following should be part of a daily routine:

- Uneaten food, faeces and litter should be removed
- Food bowls should be removed, cleaned and disinfected
- Water bowls should be cleaned and disinfected
- Substrate should be raked and any holes filled in
- Enclosure perimeters should be checked for damage

5.2 Record Keeping

Keeping records on all animals held in an institution should be an integral part of all zoological husbandry programs. The use of programs such as ARKs allows for standardised records to be kept. The following information should be recorded where possible:

- Specimen Identification – each specimen should have permanent identification
- Gender
- Parentage
- Age
- Source and Provenance
- Disposition Notes
- Veterinary Notes – treatments, exams etc
- Behavioural Changes
- Reproductive Status and Behaviour
- Weights and Measurements
- Diet and Changes to Diets
- Enclosures and any Movements
- Death with Post Mortem Result

5.3 Methods of Identification

- Microchip – inserted between the scapulae (Best option)
- Tattoo – inside of ear
- Visual Identification – should not be used as only form of identification
- Ear Tags – are not recommended as they can get caught on enclosure furniture and pulled out

6. Feeding Requirements

6.1 Captive Diet

In captivity, the basis of the diet should be fresh cut grass and/or palatable but low quality hay (ad lib). Table 1 shows a maintenance pellet formulation specifically for maintenance of wombats, to supplement the hay. Where a customised diet cannot be prepared, wombats can be maintained on a high fibre supplement for grazing ungulates with a high fibre grass hay or straw provided ad lib.

Wombats have the lowest maintenance requirements for dietary energy and protein among herbivorous marsupials so high energy diets can quickly lead to obesity and other health problems. Supplements commonly used in captivity such as lucerne cubes, and fruit and vegetables are likely to be too high in energy and protein and low in fibre and should be avoided for long term maintenance.

There is a place for higher energy supplements during convalescence. Favourites include lucerne pellets, sweet potato, apples, carrots, corn.

Clearly, wombats should not be fed dry dog food, which was once a standard component of the captive diet. Dry dog food has a high protein, low fibre content and a mineral balance designed for carnivores and has no place in the diet of a hind gut fermenter.

Water should also be supplied at all times.

Daily Diet Provided for Wombats at Dreamworld
Ad Lib
Water

Daily Diet (per animal)

5-6 Clumps	Preferred Grass Species
500g	Macropod Pellets
500g	Carrot
50g	Maize
Small Handful	Lucerne

Branches of wattle or eucalypt should be supplied weekly

Table 1: Pellet formulation for maintenance of wombats (Barboza and Hume, 1991), to supplement ad lib high fibre hay

Component	**Proportion % Air Dry**
Milled Straw	40.0
Chopped Lucerne Hay	30.0
Ground Maize	13.9
Ground Oats	15.0
NaCl	0.21
CaH2PO4	0.44
CaCO3	0.12
MgS04	0.13
Micronutrient Mix*	0.20

*Micronutrient Mix for grazing marsupials (per kg of air dry feed)	
Fe	10 mg
Co	1 mg
Mn	58 mg
Zn	50 mg
I	0.7 mg
Se	2 ug
Vitamin A	1200 IU
Vitamin D	2400 IU
Vitamin E	30 IU
Vitamin BI	1 mg
Vitamin B2	6 mg
Vitamin B6	2 mg
Vitamin B 12	20 ug
Pantothenic Acid	5.5 mg
Niacin	26 mg
Choline	200 mg
Vitamin K	0.6 mg
Biotin	320 ug
Folic Acid	0.4 mg

6.2 Supplements

None, however for long-term captivity it is also useful to provide non-toxic branches to allow bark chewing to stop incisor overgrowth.

6.3 Presentation of Food

Food is usually offered in stainless steel trays or hoppers 20cm above the ground to prevent the animal from walking through the feed and defecating. One bowl per animal should be offered.

7. Handling and Transport

7.1 Preparation and Timing

Thorough planning needs to precede any attempt to capture, handle or transport any animal. If you are well prepared, you should be able to minimise the stress and threat of injury to the animal and to yourself and other handlers. Best time of the day to catch a wombat in captivity is during the day, which is usually their most inactive time. Avoid catching any animal during the hottest part of the day if possible.

7.2 Catching Equipment

Pet packs are an ideal way of transporting a wombat within the facility between enclosures or to the vets. Ideally they can be conditioned to enter the pet pack to avoid any unnecessary stress.

7.3 Capture and Restraint Techniques

Methods of Restraint

In general, the equipment and techniques used to capture and handle animals vary depending on:

- Species
- Size and temperament of animal
- Health / injuries
- Reproductive status (pregnant female, parent with young)
- Strength and expertise of the handlers

The method chosen should ensure the safety of both the handlers and the animal. The wide variety of methods falls into two broad categories:

- Physical restraint
- Chemical restraint

Physical Restraint

The range of equipment used to facilitate physical restraint of animals includes, but is not restricted to:

Bare hands	Crush cages
Gloves	Wire netting squeeze
Nets	Chains
Cloth bags / Hessian sacks	Immersible plastic containers
Hoods	Hooks
Towels / blankets	Trap door cages
Hand held shields	

It is best to encourage wombats to run into a large bag or strong box. It is then possible to grasp them from behind around the chest just under the forelegs. Extreme care must be taken because they can bite savagely. Adult wombats are quite heavy and can be very strong, so good lifting technique is necessary to avoid damage to the handler's back.

The illustration shows the correct way to handle a wombat when picking it up.

Juvenile wombats can be picked up under the arm pits as shown in Figure 7; however with larger animals they should be given support beneath their rump with one of your hands.

Figure: 7

Aggressive wombats or animals that don't like to be picked up may retreat into their log, pipe or nest box and present their rear end to you. Extreme care should be taken if this occurs, if you put your hand in to try and get them they may try and crush it on the top of the hollow or pipe. This is where a nest box with a hinged lid is handy as it is safer and quicker to get the animal.

If a wombat does point its rear end towards you, the best way to get it out is to grab it by the back leg and pull it out. Again, conditioning the animal into a pet pack will assist in getting rid of these problems and is less stressful for the animal.

7.4 Weighing

Keeping of accurate weights on all specimens where practicable is a key feature of any preventative medical program. Of equal importance is regular review of recorded weights. If the latter does not occur there is little point in collecting the weight data in

the first place. There is also little point if the weights collected are not accurate. Weights should be collected at the same time (especially in relation to feeding) and on the same scale. Monthly weights should be kept on all specimens where possible and practicable.

Wombats can be weighed by placing them in a pet pack or thick hessian bag and placing them on the scales, remembering to deduct the weight of the pet pack or hessian bag. You can also pick them up and stand on the scales with them and deduct your weight.

If the scales are moveable, a wombat can be conditioned to readily step onto them in order to be weighed with very little stress.

7.5 Release

Care should also be taken when releasing aggressive wombats as they may turn around and bite you on the ankles.

7.6 Transport Requirements

Some of the factors you should consider in the planning stages when transporting animals include:

Animal preparation
Correct animal is identified
Health check
If sick or injured, allowance is made
Dietary preparation (feed up or restricted diet before transport)

Personnel
Handlers are familiar with the species and the possible dangers to the animal and themselves
Sufficient handlers are present and briefed regarding their role in
The exercise (e.g. for handling an ostrich, you will need 4 experienced handlers)
If separating an animal from a group, an extra person to observe the activities of the other animals may be a good precaution

Equipment
Correct equipment is chosen, and available
All equipment is clean and in working order
Handlers are trained in the use of relevant equipment

Transport Cage/Container
Transfer cage / container ready if required (temporary accommodation)
Box design is built as described in IATA manual
Cage / container is clean and secure

Legislative Requirements
Transport conditions meet local / state/national / international regulations
Cage / container is approved type and quality
Paperwork is in order

Destination
New enclosure is prepared and ready for new arrival
If transporting animal to another zoo, they are ready to receive the animal
Impact of new arrival on current occupants has been considered

8. Health Requirements

8.1 Daily Health Checks

Each animal should be visually checked every day for signs of abnormal behaviour, injury or illness. This can be done when cleaning the enclosure or when feeding the animal. Other things to keep an eye out for while in the enclosure are how much food has been eaten, quantity of faeces present and their consistency.

8.2 Detailed Physical Exam

Annual physical exam should include the following (Taken from Dreamworld Protocols):

- Record identifying information
- Record body condition (determine if significant weight loss since last examination)
- Conduct a dental examination
- Collect blood for CBC, biochemistry and serum at initial annual examination then subsequently as determined by veterinary staff (CBC stands for complete blood count and includes such parameters as white blood cell counts and red blood cell counts that determine if there is infection/inflammation or anaemia present. Biochemistry examines enzymes and substances in the blood that may pinpoint a problem with a particular organ or tissue, such as the liver or kidneys. Serum banking means storing a serum sample in the freezer from each animal in the collection. These can be used later by researchers or clinically if the animal ever becomes ill)
- Record BW and RT
- Pouch check if applicable
- Mark all significant skin lesions on a body chart to be kept with paper records.

8.3 Known Health Problems

Maintaining animals in optimum state of health is a major function of zookeeping. The importance of regular, careful, informed observation cannot be overstated. The role of the zookeeper is that of daily care giver, with the responsibility to recognise and report suspicion of any change in an animal's health.

General Signs of Ill Health

Some signs of ill health may be associated with disease in a number of body systems. Some of these are listed below.

Weight loss	Lethargy
Dehydration	Haematuria
Straining	Polyuria and Polydipsia
Diarrhoea	Vomitting
Regurgitation	Jaundice
Abdominal swelling	Abdominal pain
Anaemia	Nasal Discharge
Sneezing	Coughing
Dyspnoea (difficult or laboured breathing)	Alopecia
Skin tumors	Cysts
Ocular discharge	Cloudy eyes
Ataxia	Paralysis/Paresis
Convulsions	Collapse

Disease
Disease may be described as any condition, which prevents part of the body from functioning normally. The causes of disease are divided into two broad categories - infectious and non-infectious diseases.

Infectious Disease
Infectious diseases are caused by living organisms, which include bacteria, viruses, protozoa, fungi, worms and insects.

Non-infectious Disease
Non-infectious diseases are those, which are not caused by living organisms. Non-infectious diseases may be categorised as nutritional, hormonal, degenerative, genetic, congenital, physical, chemical, immunological, psychological and stress related illness.

Diseases / Problems in Common Wombats

Table 2: Outlines recorded parasites of wombats

Ectoparasites

Fleas	*Lycopsylla nova*	Wombat specific genus
	Echidnophaga spp	Various species collected from all wombat spp.
Ticks	*Aponomma auruginans*	Wombat specific, probably the most common
	Ixodes cornuatus	Recorded from Powelltown, Vic.
	Ixodes victoriensis	Few specimens recorded
	Ixodes tasmani	Wide host range
Mites	*Acaroptes spp.*	Apparently harmless
	Cytostethum spp.	Apparently harmless
	Raillietia australls	The ear mite of *V. ursinus*
	Sarcoptes scabiei	Major pathogen of *V. ursinus*
Lice	*Boopia tarsata*	From *V. ursinus*

Endoparasites

Protozoa	*Elmeria arundeli*	Coccidian of *V. ursinus*, possible cause of enteritis
	Toxoplasma gondii	Major cause of death in hand raised wombats
Cestodes	*Progamataenia festiva*	*V. ursinus* in the bile duct, causes mild cholangitis
	Phascolotaenia comani	*V. ursinus* small intestine, non-pathogenic
	Paramonieza johnstoni	From *L. latifrons* and *V. ursinus*, non-pathogenic
Trematodes	*Fasciola hepatica*	*V. Ursinus* in swampy areas, may cause extensive hepatic fibrosis
Nematodes	*Oesophagostomoldes longispicularis*	*V. ursinus* colon non-pathogenic
	Phascolostrongylus turleyi	As above
	0. giltneri	As above

Strongyloides sp.	*V. ursinus* small intestine, associated with mild enteritis
Marsupostrongylus coulstoni	*V. ursinus*
Allacropostrongyloide lasiorhini	Both species, caecum & colon
Baylisascaris tasmaniensis larvae	Visceral granulomata in *V. ursinus*, definitive hosts are Tasmanian dasyurids

Sarcoptic Mange – Infectious Disease
Below I have given an outline on Sarcoptic mange which is probably the major infectious disease of wombats. *Sarcoptes scabiei* is the mange mite which causes this problem.

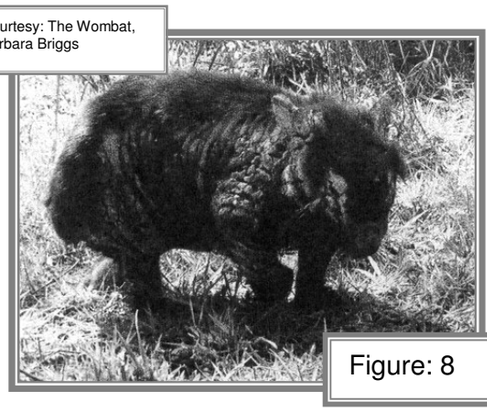

Courtesy: The Wombat, Barbara Briggs

Figure: 8

Clinical Signs
Typically, the sarcoptic mange mite burrows in the deeper parts of the stratum corneum and causes severe pruritus (itchiness), hyperkeratosis and acanthosis with resultant hair loss. The intense pruritus results in rubbing of the skin causing loss of epidermis and secondary infection of the dermis.
In wombats lesions vary from mild encrustations on the head to generalised wrinkled thickened scaly skin with haemorrhagic cracks in the dermis, often with secondary cutaneous myiasis.

Movement, vision and mastication may be impaired by the severity of the skin changes. Affected wombats are often active during the day. Death through starvation or misadventure is the likely outcome without human intervention.

Transmission
The spread of Sarcoptes scabiei could occur through direct contact or through sharing of rubbing posts and burrows. Wombats are solitary but use several burrows and rubbing posts in an area. The mites only survive for up to three weeks in optimal conditions away from the host (Soulsby, 1982).

Treatment
Treatment of individual cases in the early stages may be warranted if there is suitable habitat for the animal to be returned to.

For mild cases, topical acaricides may be effective. Soaking in keratolytic solutions first to remove crusts may be necessary.

Pour-ons such as Porect (phosmet) have been used successfully at the same rate and frequency as for pigs.
Ivermectin 1% injection has been used at a dose of 200-300 mcg/kg subcutaneously. Repeat injections at 10 day intervals. Ivermectin is now available in a pour on formulation which has been used to treat wild wombats without the need for manual restraint.

Euthanasia is often the most humane approach for advanced cases. Relapses following treatment are common.

9. Behaviour

9.1 Activity

They are a nocturnal animal that spends up to 16 hours each day sleeping in their burrows to conserve energy.

9.2 Bathing

They like to dust bathe in sand or dusty soil.

9.3 Behavioural Problems

Hand reared animals have been known to have problems such as chasing feet if they were encouraged to do this during the hand raising process.
Bored wombats may pace at fence lines or continually scratch at walls in an attempt to escape.

9.4 Signs of Stress

Teeth gnashing and loud vocalisations may be associated with stress when an animal is trying to be caught and restrained.

9.5 Behavioural Enrichment

Behavioural enrichment for wombats can include:

- Placing suitable browse in the enclosure
- Adding grass tussocks
- Taking for a walk on a harness (dog car harness)

9.6 Introduction and Removals

Care should be taken when introducing animals as pairs. A male should have access to the enclosure prior to adding the female to allow him to establish his territory.
Careful monitoring should always be undertaken and animals should preferably be put together of a morning to allow staff to monitor them during the day.

9.7 Intraspecific Compatibility

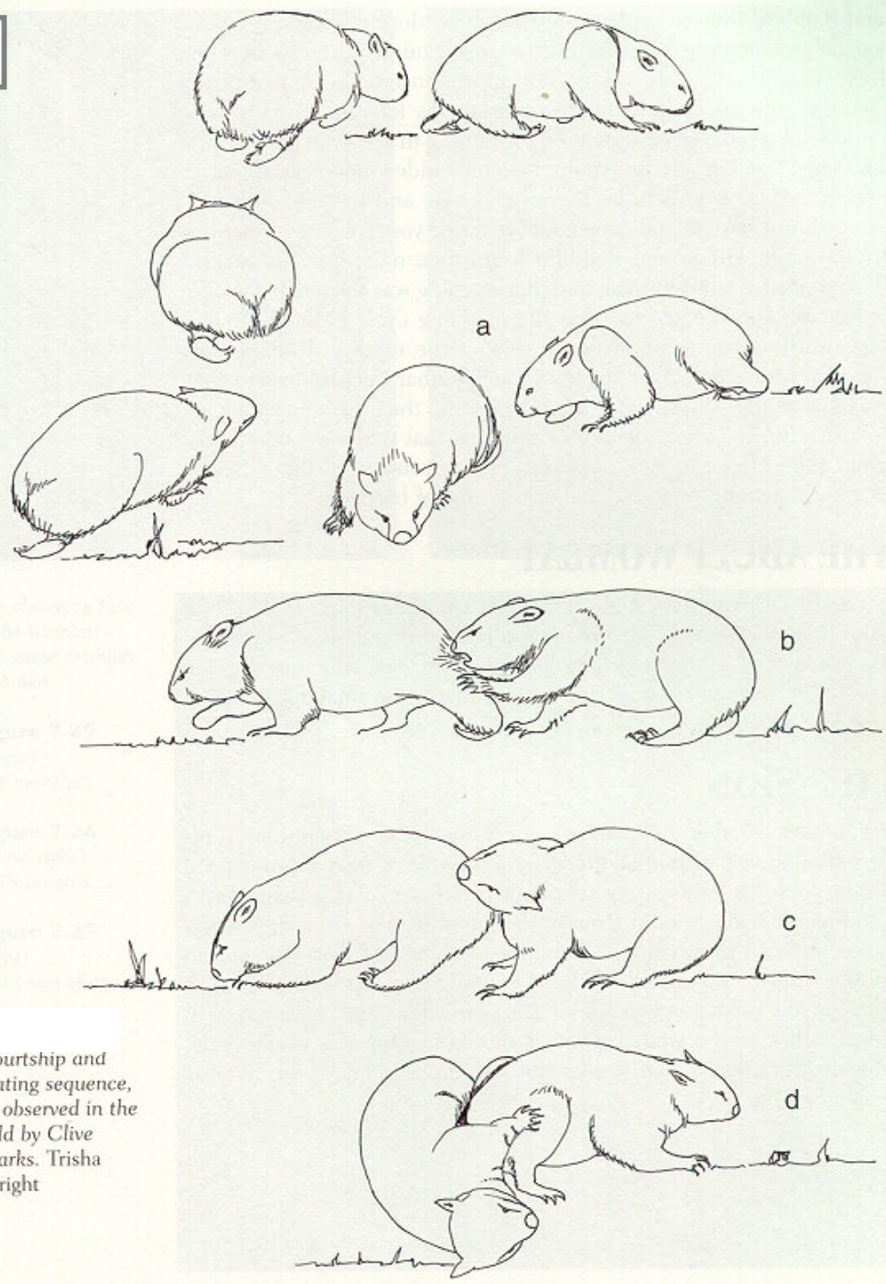
Common wombats can be held solitary or in pairs, if they are compatible. Pairings could be 2 females, 1 male and 1 female or 2 males under the age of 18 months.

10. Breeding

10.1 Mating System

A courtship and mating behaviour has been observed in free ranging common wombats. A pair of wombats were observed on an open pasture, over a period of 25 minutes, during which time a series of repeated behaviours took place (figure 9) Courtship behaviour consisted of the male chasing 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 of this chasing behaviour, the male delivered a powerful bite to the female's rump. At once, the female stopped running and the male then grasped her hindquarters with his forelimbs, rolled her over on her side and mounted her. While they were copulating, the female rolled over into the prone position. After several minutes, the female rose and broke into a half run, pursued by the male, and the chasing behaviour began again.

Figure: 9



Courtship and mating sequence, as observed in the wild by Clive Marks. Trisha Wright

Courtesy: The Wombat, Barbara Briggs

Courtesy: Michele Barnes

10.2 Timing of Breeding

Most species of mammals have seasonal cycles of sexual activity, and in many marsupials this cycle occurs at the time of year which will ensure that the young emerge from the pouch in spring. As a wombat leaves the pouch at about 9 - 10 months of age, this would mean that wombats would mate in late spring to early summer, giving birth about a month later, however pouch young of all ages have been found at all times of the year.

10.3 Age at First Breeding

Sexual maturity is reached at around 2 years; however they generally start to breed around 3 years of age.

10.4 Ability to Breed Every Year

Common wombats appear to breed annually.

10.5 Ability to Breed More Than Once Per Year

Due to the length of time required to raise their young, wombats can only breed once per year.

10.6 Nesting requirements

Ideally a nest box should be provided for females with nesting material such as straw or hay.

10.7 Oestrous Cycle, Gestation Period and Development

Wombats are polyoestrous - that is, that they have a series of oestrous cycles during their breeding season, each cycle taking about 33 days to complete. By observing changes in the cells present in vaginal smears taken from the wombats, each cycle was found to consist of three distinct phases. The first, or pro-oestrous phase, occurs 4 - 5 days before the brief period, probably only about 15 hours, of oestrus or 'heat', during which ovulation occurs. The third phase, the post-oestrus, is of about 4 weeks' duration.

As a young female approaches her first cycle of sexual 'heat', called the oestrous cycle, her scats, conspicuously displayed and with pheromones attached, act as scent bearers and convey the message that she is approaching oestrus to any male that passes by. She becomes very active and aggressive, and during the brief 'heat' her urogenital opening becomes moist and swollen.

Once mating has occurred, the male plays no further part in the reproductive process. No kind of bond is formed between male and female, nor does the male have anything to do with the rearing of the young.

If, following mating, the female becomes pregnant, her oestrous cycle ceases and probably do not start again until some time after the young is weaned.

As in all marsupials a newborn wombat is extremely undeveloped and very small - about the size of a small bean. Birth occurs after a very short gestation period of 30 days; following its birth the young makes its way to the pouch, where, suckling from its mother, it grows and develops for about 8 months. It leaves the pouch permanently at about 10 months of age, but it may still stay with its mother for a further 8 - 10 months before it is finally independent. See figure 10 and 11.

10.8 Litter Size

Usually only one young is born.

10.9 Growth and Development

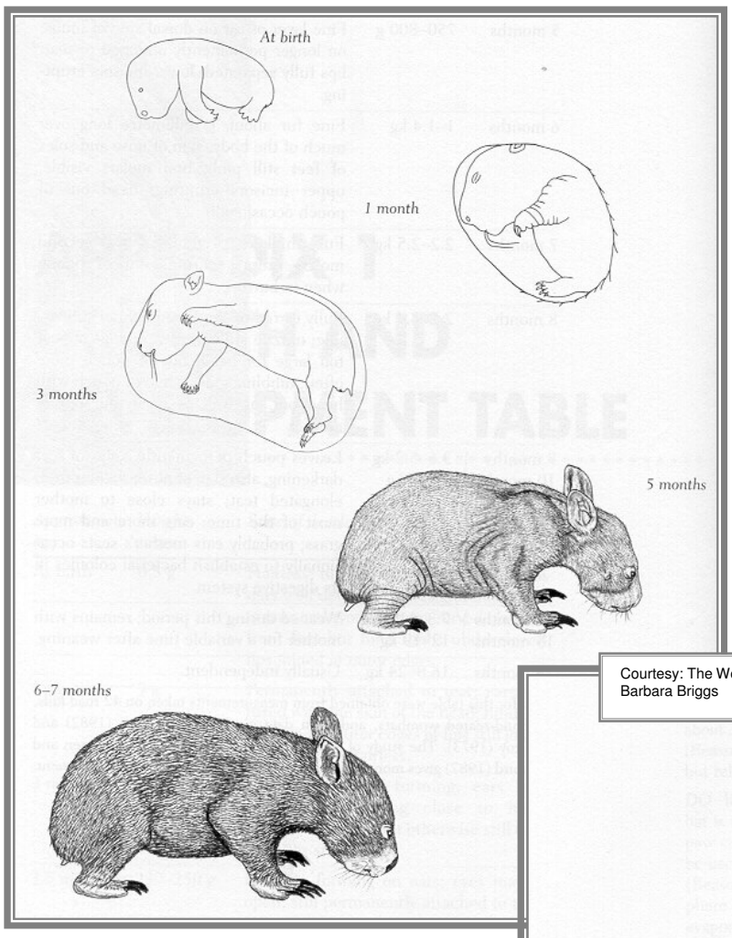


Figure: 10

Courtesy: The Wombat, Barbara Briggs

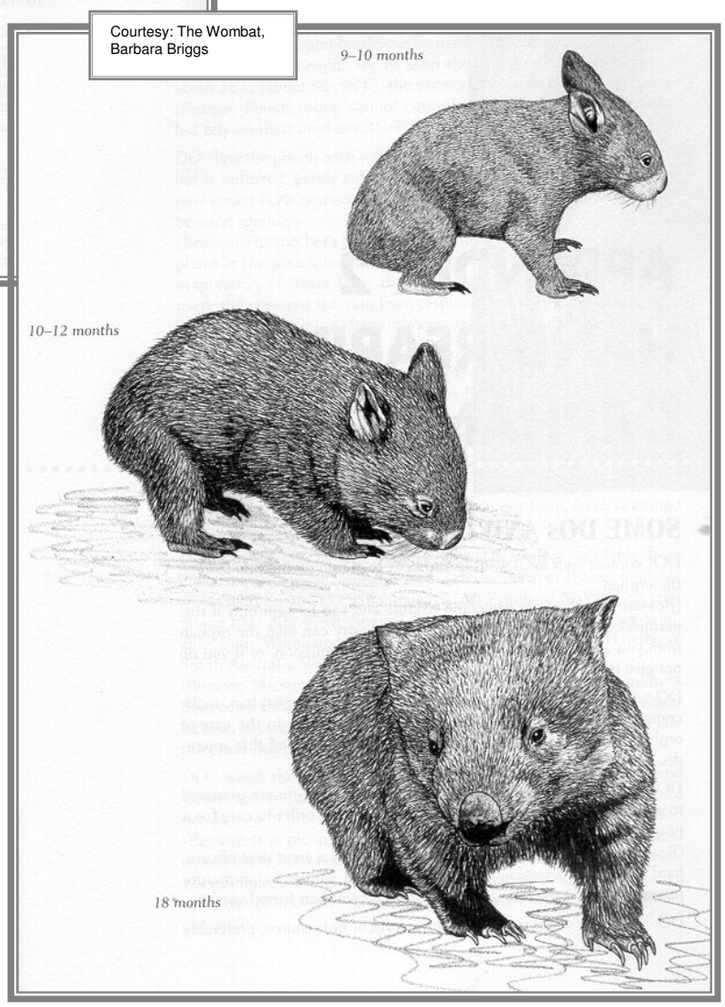


Figure: 11

Approximate Age	Weight Range	State of development
At birth	0.5 g	Hairless; mouth, front limbs and shoulders well developed; eyes and most other organs embryonic; sharp curved claws on front feet but hind limbs undeveloped lips joined at outer edges.
1 month	5 g	Permanently attached to teat; ears still fused with the skin of the head; hind legs outer edges of lips still joined together; still hairless.
3 months	100-1 10 g	Facial structures forming; ears fully unfolded but lying close to head; whiskers forming but otherwise still hairless; lips still joined.
3.5 months	230-250 g	Fine fur forming on ears; eyes may be open; still permanently attached to teat.
4 months	380-400 g	Eyes open; lips beginning to separate.
5 months	750-800 g	Fine layer of fur on dorsal side of limbs; no longer permanently attached to teat; lips fully separated; lower incisors erupting.
6 months	1-1.4 kg	Fine fur about 1 millimetre long over much of the body, skin of nose and soles of feet still pink; first molars visible, upper incisors erupting; head out of pouch occasionally.
7 months	2.2-2.5 kg	Fur thicker; premolars and second molars erupt; ventures out of pouch when in burrow.
8 months	2.7-3.4 kg	Fully furred but rudimentary tail still visible; muzzle still narrow and ears appear too large for head; out of pouch more often; nibbling grass while in pouch with head out, as well as when out beside mother.
9 months	3.6-5.2 kg	Leaves pouch permanently; soles of feet
10 months	5-6.4 kg	darkening, also skin of nose; suckles from elongated teat; stays close to mother most of the time; eats more and more grass; probably eats mother's scats occasionally to establish bacterial colonies in its digestive system.
12 months	7.3-11.3 kg	Weaned during this period; remains with
15 months	12-19 kg	mother for a variable time after weaning.
18 months	16.8-24 kg	Usually independent

11. Artificial Rearing

11.1 Criteria for Intervention

It may be necessary to intervene and hand-raise young if they are failing to thrive whilst suckling, are sick or injured, their mother has rejected them or they have been orphaned. Hand-raising any animal requires a lot of time, effort and patience and should not be entered into half-heartedly.

Initial Care / Stabilisation

The initial care will be dependant on whether the young has been removed by you or rejected by its mother. The latter will require you to physically check the animal for any bleeding, breathing difficulties, broken bones, hyperthermia, hypothermia, parasites, shock or wounds. Although basic first aid can be applied, veterinary assistance should be sought right away.

It is important to remember when dealing with sick/injured or orphaned animals, to try and create a stress free environment.

It is essential to establish the young animals age before beginning to hand raise. This may be determined by a combination of head and leg measurements, weight and milestones. (Table 3)

Prior to offering formula it may be necessary to give high-energy fluids like Lectade, an electrolyte / glucose replacer, (if the animal has diarrhoea) or Glucodin for a period of up to 24 - 48 hours. High-energy fluids help stabilise the animal, combat dehydration, maintain body temperature and rest the stomach before different foods, such as artificial milk formulas, are introduced[2]. Milk formula can be made up slightly diluted at first and gradually increased to full strength over a 48-hour period to reduce the possibility of causing unnecessary diarrhoea. Note: Oral fluids or formula should only be offered to a warm animal.

Table: 3

COMMON WOMBAT - GROWTH & FEED ESTIMATES [33,43]

Milk	Age days	Body length mm	Weight g	Feed ml/day
<0.4	20	65	2	2
	40	86	12	6
	60	107	45	15
	80	128	103	25
	90	149	151	30
	100	156	213	45
	110	162	291	50
Transition from <0.4 to 0.4	111 to 113	40ml <0.4 + 2ml 0.4		50
	114 to 116	25ml <0.4 + 4ml 0.4		50
	117 to 119	10ml <0.4 + 6ml 0.4		50
0.4	120	169	387	55
	130	175	502	65
	140	182	640	75
	150	188	802	90
	160	195	984	100
	170	201	1191	115
Transition from 0.4 to >0.6	171 to 173	60ml 0.4 + 20ml >0.6		80
	174 to 176	40ml 0.4 + 40ml >0.6		80
	177 to 179	20ml 0.4 + 60ml >0.6		80
>0.6	180	208	1426	85
	190	214	1691	100
	200	221	1936	110
	210	228	2244	120
	220	234	2584	135
	230	241	2956	150
Emerging from Pouch	240	247	3363	160
	250	254	3783	180
	260	260	4203	190
	270	267	4623	205
	280	270	5043	220
Fully out of Pouch	290	280	5463[A]	230[B]

11.2 Housing and Temperature Requirements

The young should be placed in an artificial pouch, sock or similar, and placed on a heat source and left somewhere quiet. Sick/injured adults should be kept at 26 degrees Celsius, furred young at 28 degrees Celsius and furless young at 32 degrees Celsius. Artificial warmth can be provided by way of electric heat pad or hot water bottle. The heat source should preferably be placed on the outside of the cage or have towels wrapped around it to prevent the animal from coming into direct contact with it.

Air temperature should be monitored closely as over heating can be fatal and under heating may also cause problems. An internal/external thermometer is a good way to monitor the temperature without disturbing and stressing the animal.
Something to keep in mind is that young animals are not toys or play things and require lots of rest and uninterrupted sleep in order to grow.

11.3 Diet and Feeding Routine

11.3.1 Milk Formulas

There are many low lactose milk formulas on the market that are suitable for hand-raising young wombats:

- Biolac, which has 3 formulations
- Di-vetelac
- Wombaroo Wombat Milk

It is important that once a formula has been chosen that you stick to it, as changing may cause unnecessary problems such as diarrhoea.

Remember that these formulas are a food and young will need to have access to fresh water at all times.

The temperature of formula is very important and should always be checked on your wrist prior to offering it to your young. Some animals will not drink if the milk is just a little too cold or may burn their mouth if it's a little too hot. It is also important not to over feed young, as this can cause diarrhoea. Once made up, formula should never be kept for longer than a 24hour period. If formula is left out of the fridge for any extended period it should be discarded and fresh formula made up.

11.3.2 Equipment Required

Always be prepared, have all your hand-raising equipment on hand prior to receiving an animal if possible.

Artificial pouches / bedding	- made from natural fibres with no loose hanging threads
Maximum/minimum thermometer	- to maintain / monitor temperature
Feeding aids	- wombat teat, syringe, measuring spoon
Electrolyte / glucose replacer	- Lectade
Small feeding bottles	- relevant for quantity of food
Bottle Brush	- for cleaning of feed bottles
Milton or Boiling water	- for sterilisation of feeding equipment
Food	- milk formula - Solid foods, supplements - Natural foods such as grass
Heat source	- To provide warmth
Food bowl for solids	- shallow bowl
Water bowl	- shallow bowl
Baby wipes (Chux) / tissues	- for toileting, cleaning
Nappy wash	- Sanitising/cleaning of pouches/bedding

11.3.3 Feeding Routine

Feeding is age dependant, the younger the animal the more often they are fed. An unfurred wombat is fed every one to two hours, just furred wombats four hourly, gradually being reduced to once or twice daily prior to weaning. It is also very important to maintain consistency when feeding young animals

11.4 Data Recording

Detailed, accurate records should be maintained, as they can be a great source for future reference. shows a possible format. Initial records should include things such as age, weight, body measurements, sex, distinguishing marks, parentage (if known), formula given (and at what strength), what you are housing them in (pouches, heat source, cages etc).

Daily records should include items such as time fed, quantity given, any change in formula or introduction of solids, frequency of urine and faecal matter, consistency of faeces, and behavioural notes.

11.5 Hygiene

Strict hygiene, such as personal hygiene, sterilisation of all bottles, teats and other equipment after each use, should be maintained. All bedding and pouches should be maintained to a high standard.

11.6 Weaning

Weaning usually starts to occur once the wombat reaches 14-15 months of age or at around 12-19kg. By offering young animal's fresh grass and pellets from an early age the weaning process can be made easier. Reduction in amount of bottles fed should occur over a several week period and monitoring of weight at this time is important.

Table: 4

Handraising Records

Common Name: **Scientific Name:**

House Name: **Sex:**

Date of Birth: **Reason:**

Food Given:

Date	Time Fed	Quantity	Total	Weight	Comments

12. References

Caring for Australian Wildlife	- Sharon White
VN1-14 Basic Care of Marsupials	- (Dept Animal science)
Animal World No. 58	- Marshall Cavendish
The Wombat	- Barbara Triggs
Care & Handling of Australian Native Animals	- Ed. Suzzanne J Hand
Australian Mammals – Biology & Captive Management	- Stephen Jackson
Intensive Wild Husbandry 2	- Zookeeping Workbook
Reproductive Management	- Zookeeping Workbook
Exhibit Design	- Zookeeping Workbook