ALICE SPRINGS Desert Park

Husbandry Guidelines

MULGARA

(Dasycercus cristicauda)

Alice Springs Desert Park 2007
Compiled by Wes Caton

CONTENTS:

1. Taxonomy

1.1 Common Name: Mulgara

Other Names: Crest-tailed Marsupial Mouse
Canning's Little Dog

1.2 Classification:

Class: Mammalia
Order: Dasyuromorphia
Superfamily: Dasyuroidea
Family: Dasyuridae
Subfamily: Dasyurinae
Genus Species: *Dasycercus cristicauda* (Krefft, 1867)
daz'-ee-ser'-kus; kris'-tee-kaw'-dah:
'crest-tailed hairy-tail"

Subspecies: *D. blythi* and *blighi (*Adams *et al* 2000).

Recent Synonyms: none

1.3 A.S.M.P. Category: Population Management Program; Management Level 1b

1.4 I.U.C.N. Category: Vulnerable; C2a

1.5 O.H.&S. Category: Non hazardous

1.6 Studbook Keeper: Wes Caton, 2003

2. Natural History

2.1 Family

Dasyurids are the group of marsupials that are mainly insectivorous or carnivorous. *Dasycercus* species are carnivorous marsupials belonging to the family Dasyuridae. There are around 50 species of dasyurid in Australia. *Dasycercus* can be distinguished from other dasyurids by their large size, 60 - 170 grams, and the fat tail, which has a black crest on the tip of the tail (Woolley, 1971a).

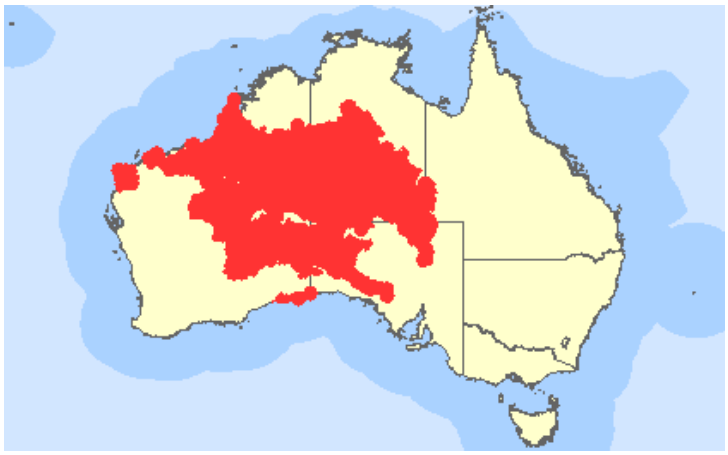
In the early 1900's there were four described species of *Dasycercus*: *D. cristicauda, D. hillieri, D. blythi, and D. blighi*. These were later combined into one species with two sub-species: *Dasycercus cristicauda cristicauda* and *Dasycercus cristicauda hillieri*. Recent genetic analysis has confirmed that there is in fact at least two species, *Dasycercus cristicauda* (Krefft, 1867) the Mulgara and *D. hillieri* (Thomas, 1905) the Ampurta. *Dasycercus: blythi* and *blighi* have been identified as *D. cristicauda (*Adams *et al* 2000).

The Mulgara is an annual breeder, producing a litter once a year despite having a polyoestrus reproductive cycle (Woolley, 1971a; Lee et al 1982). This is known as a Type 3 breeding strategy (Lee et al 1982). Females have a maximum litter size of six with a sex ratio of 1:1 (Baker, 1996; Masters, 1998; Adams *et al* 2000) Individuals of both sexes can survive for more than one breeding season, with only a very small proportion of the population surviving to the third year. Three year old individuals were found to have severely worn teeth (Masters, 1998).

Mulgara populations fluctuate annually, declining during the breeding season (June - October) and increasing again following the influx of juveniles in spring (Masters, 1993, 1997, 1998). On occasion males maybe completely absent by the time pouch young are evident in September. Female offspring have been found to remain near their mother's home ranges but sub-adult males moved to other areas (Masters, 2004). The Mulgara is a solitary species exhibiting high site fidelity and a low propensity for dispersal once a home range has been established (Masters, 2004). Males and females maintain home ranges of 1.4 - 14 ha (Masters, 2004; Manson, 1994) which, on average, overlap by less than 20% (Masters, 2004).

3. Distribution

3.1 Map: Distribution of Mulgara, *D. cristicauda* (Nowak, 1991; DEH, SA)



Distribution

3.2 Habitat

Early habitat descriptions for areas supporting Dasycercus species included open bluebush and saltbush steppe, mulga sand dune country (Wood Jones, 1949; McKenzie & Robinson, 1987), stony tablelands (Spencer, 1896), and spinifex sandplains and dune ridges (Finlayson, 1935, 1961).

Records of Mulgara in the last fifty years have been predominately from sandplains, dunes and laterite rises dominated by spinifex grasslands with or without mulga woodlands. The distribution of the Mulgara appears to be associated with spinifex species that have a hummocky growth habit such as *Triodia basedowii*, (and *T. pungens* when in drainage systems) (Baker, 1996; Masters, 1998). In Western Australia they have been recorded in a variety of spinifex species including *Triodia epactia, T. laniger,T. longiceps, T. schinzii and T. secunda* (Teale, 2002). These conflicts with records collected in the Northern Territory where Mulgaras have rarely been recorded in *T. schinzii* despite substantial search and trapping efforts (Gibson & Cole, 1988, 1992; Masters, 1998).

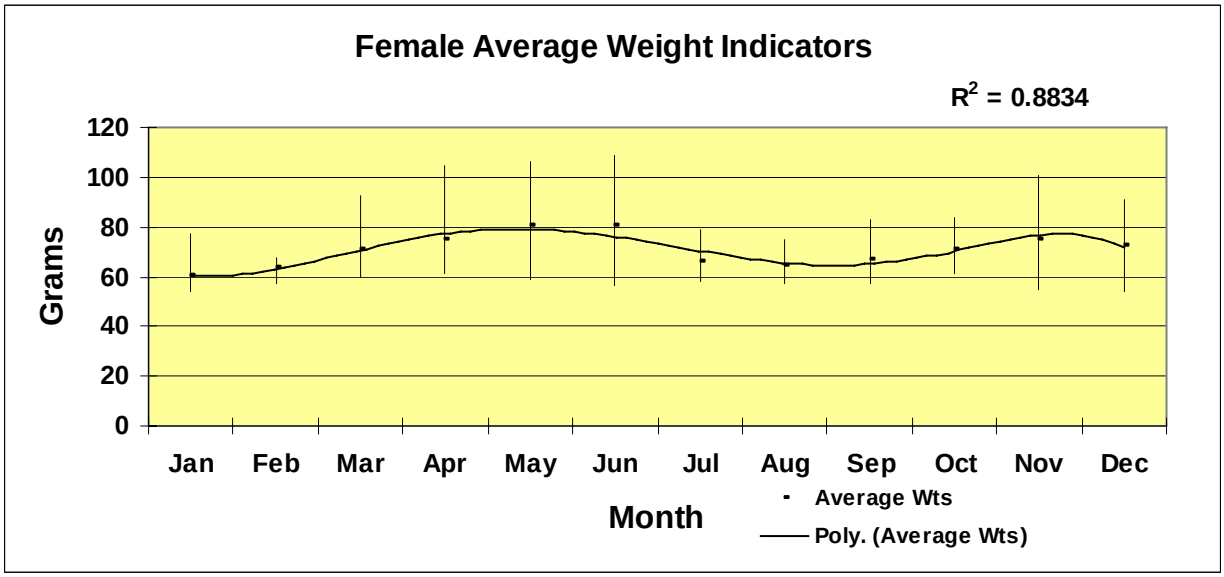
In the Tanami region there was a 40% probability of detecting Mulgara in *Triodia basedowii* habitat, 10% probability in *Triodia pungens* habitat, and 0% probability in *Triodia schinzii* (Masters, 1998). Mulgaras were found to occur in *T.pungens* habitat, if shrubs of *Melaleuca* spp. were present or if the certain geological outcrops were in close proximity. These areas are known to be located over paleodrainage systems where underground water is close to the surface.

4. Morphometrics

4.1 Alice Springs Desert Park Yearly Captive Weights

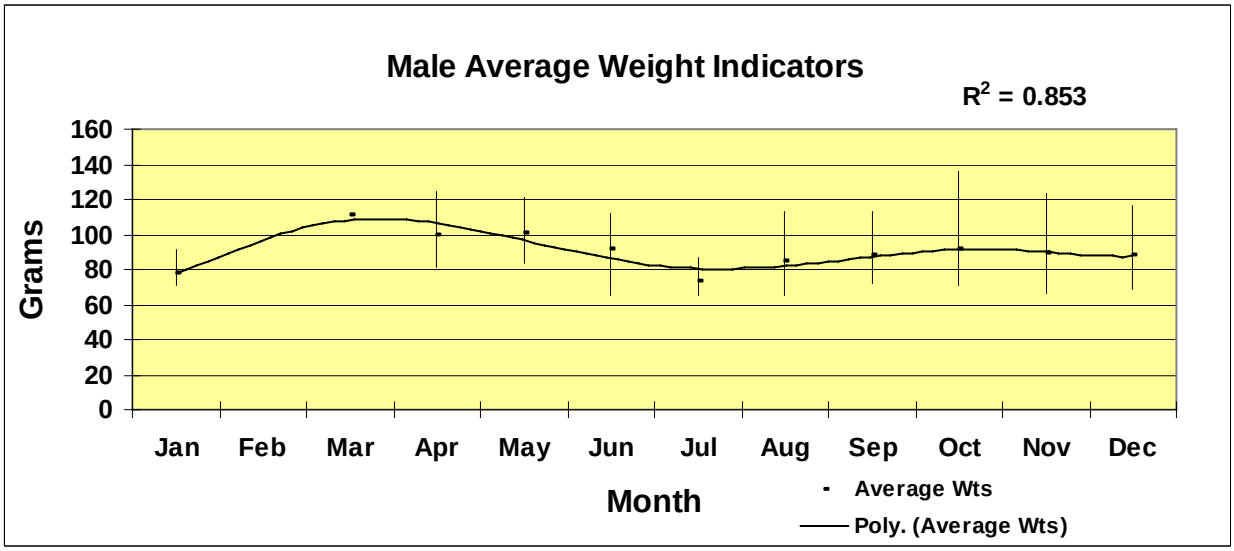
	Captive 2002	**Captive 2003**	**Captive 2004**	**Captive 2005**
♂	**90.24 ± 19.05 (65 - 136) n = 9**	**86.94 ± 14.64 (68 – 125) n = 9**	**82.69 ± 14.85 (63 – 132) n = 8**	**80.92 ± 8.81 (61 – 95) n = 5**
♀	**71.38 ± 12.78 (54 – 109) n = 12**	**74.39 ± 14.85 (54 – 128) n =13**	**71.73 ± 16.21 (52 – 127) n =13**	**73.62 ± 14.77 (58 – 123) n =12**

4.2 Alice Springs Desert Park Average Female Weight Indicators



n = 50 (1998-2007)

4.3 Alice Springs Desert Park Average Male Weight Indicators



n = 31 (1998-2007)

4.4 Sexual dimorphism & Identification

There is quite a marked size difference between the two genders upon reaching independence – the males weighing between 75 - 170 grams and the females 60 - 95 grams (Woolley, 1971a). The males have obvious testes; the females have a pouch and have on average 6 nipples (Masters, 1998).

Head and body length varies from 125 to 220 mm, and tail length is 70 to 130mm. The upper parts of this mammal vary from buffy to bright red brown, and the ventral areas are usually white or creamy. The pelage is close and soft, and it consists principally of under fur with few guard hairs. The tail is usually thickened for about 2/3 of its length and near the body is densely covered with coarse, chestnut hairs. In the middle, the hairs are coarse and black, and they increase in length toward the tip to form a distinct dorsal crest along 33% of the tail (Masters, 2004). This animal is compactly built, with short limbs, a broad head, short ears, and a pointed muzzle. The pouch area consists of only slightly developed lateral skin folds.

5. Captive Husbandry

5.1 Overview

Mulgaras are terrestrial, but are capable of climbing. They also seem to be both diurnal and nocturnal, with most foraging occurring at night. A mulgara avoids exposure to heat during the hot part of the day by remaining in its burrow. However, it basks in the sun whenever the opportunity arises. When sunning, the body is flattened against the substrate, and the tail twitches sporadically (Nowak, 1991). In captivity mulgaras can be kept in pairs or small groups, fighting is sporadic and is dependant on individual behaviours and also in relation to the size of the group and enclosure. Injuries associated with fighting, range from tail bite wounds to clumps of fur missing, extreme cases of tail injuries with bone protrusions have required tail amputations. Mulgaras will also utilise torpor to varying degrees when the temperatures decline below 16ºC in the Breeding boxes and the outdoor enclosures, responsive time from torpor varies and individuals will usually be active again within a few minutes with warming. Latrines are commonly used for this species, particularly throughout the breeding season.

5.2 Housing Requirements

Mulgara's may become obese when housed long term in small enclosures, so the larger the enclosure, the better for maintaining an active and healthy individual / group, otherwise a rotational roster can be utilised to enable animals to be given a larger area for exercise for a period of time, which will also provide stimulation and enrichment. Groups of 1.3 ratio may be housed together with the appropriate space, in the wild they are a solitary species. Animals have also been housed as individuals for research purposes and introduced at the appropriate time required for breeding based on cytology evaluations.

An outdoor enclosure with a floor space of 2m x 6m (Pic. 5.2.1) has been used for a group of 1.2, this enclosure had a cement floor with cement skirting to a height of 100mm, and the walls were constructed of a galvanised wire mesh 12 x 12mm with a tin skirt around the perimeter to height of 900mm. The substrate is a fine loamy sand with a depth of 100mm at the edges and building up to a raised dune approx. 6oomm wide running along the entire length of the enclosure at a height of approx. 700mm. Into this dune nestboxes constructed of 12mm form ply 180 x 180 x 200mm with a 300 x 50mm length of pvc connected to the entrance hole of the nestbox were countersunk. Nestboxes are lined with a substrate of dried grass.

The enclosure was furnished with dead Spinifex sp. and grass sp. animal checking can be carried out at any time as nestbox lids can be removed for visual checking and are frequently occupied. Mulgaras are a burrowing animal so care must be taken when

entering and walking around the enclosure to ensure that burrows aren't collapsed with animals inside of them. Burrows are regularly collapsed to provide continual enrichment and stimulation. During the breeding period burrows are left undisturbed and they will sometimes contain grass nesting material.

5.2.1 Picture: Outdoor Enclosure & Nestbox configuration.

Nestbox Top View

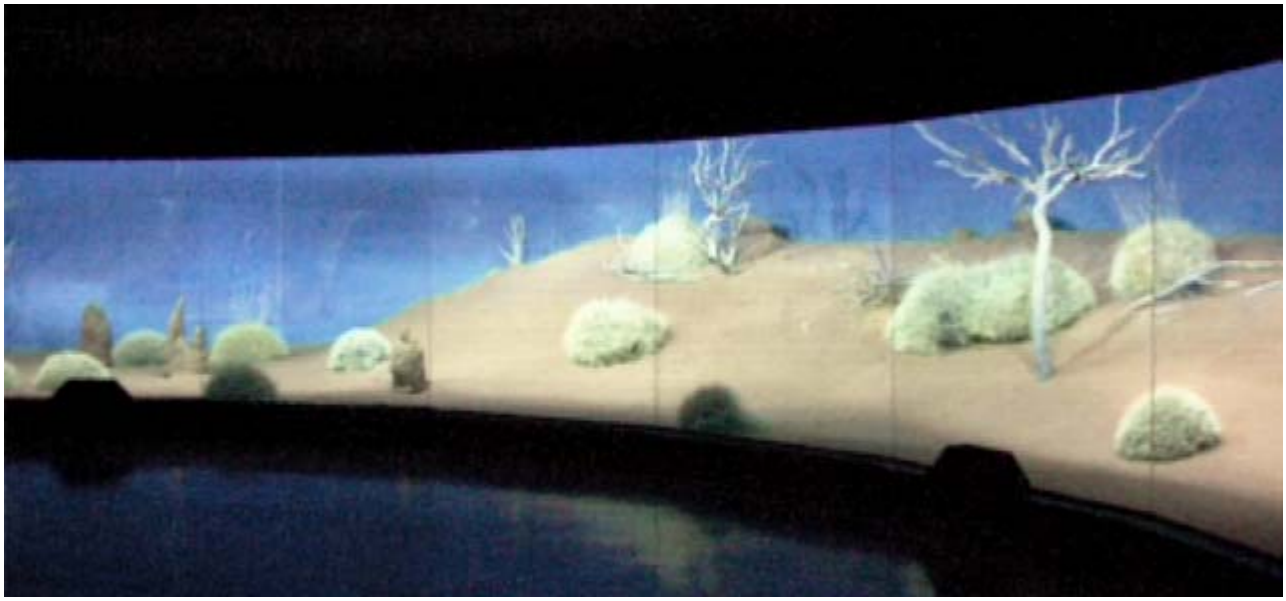
Nestbox Side View

The main indoor enclosure is in the Nocturnal House (Pic.5.2.2) which has previously held group compositions of 0.6, 2.4 and 1.5 animals at different times. This enclosure is on a 12 hour reversed lighting system comprising 17 Metal halide flood lights for the day period of which only 7 need to be used and 6 x LED tubed globes for the night cycle, all are on set timers. The internal heating is controlled by a main thermostat for the entire building and is maintained at between 24 - 27 ºC. During extreme heat, multiple evaporative cooling systems for the entire building are

programmed to initiate at temperatures of approx. 27 ºC and cycle at regular 30min intervals for air change over.

This enclosure 15 x 6 x 3.6m has a concrete floor that has been mounded to represent a natural dune with a gradual slope to a height of 2.4m; the dune is covered with fine loamy sand to a depth of approx. 100mm. The front section 15m in length is constructed of viewing glass from floor to ceiling and the remaining walls are painted cement sheeting. The enclosure is furnished with large numbers of Spinifex sp. and Acacia sp. The animals have free run of this natural landscaped enclosure and utilise the Spinifex sp. for nesting. Animals can be visually checked daily as they are out and about, for monthly weights or required health checks the animals can be caught by utilising Elliot traps baited with mouse pinkies first thing in the morning.

5.2.2 Picture: Nocturnal House Display



Other holding for this species are the Breeding boxes (Pic.5.2.3), which are 800 x 480 x 500mm and are constructed from 12mm form ply. The front panel has two sections that are hinged for ease of cleaning and servicing. The top section of the front panel and the roof are constructed from 8mm Perspex whilst the bottom section of the front panel is 12mm form ply, the side panels of the box have an opening 160mm x 290mm, approx. 105mm off the base with a section of metal ventilation mesh attached. The substrate used for the breeding season is coarse river sand whilst in the non-breeding season fine river sand is used.

The internal nestbox is a small lunchbox container 150mm x 120mm x 100mm with a click top lid for ease of inspection. The entrance is a 50mm diameter hole, drilled into the front section to one side of it, it is lined with shredded paper torn into120mm lengths. The room that holds the Breeding boxes is equipped with Fluorescent lighting on a controlled timer that can be used in conjunction with timber blinds on the windows to manipulate photo period, the room is also on a cooling thermostat for temperature manipulation.

For breeding purposes and stimulation requirements, animals are kept separate and introduced at the appropriate time for breeding. These enclosures are kept quiet bare for breeding purposes with cardboard tubes joined and scattered as furniture and enrichment tools.

5.2.3 Picture: Breeding Box

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6. Breeding

6.1 Gestation Period

The gestation period is approximately 28 - 30 days, with a polyoestrus reproductive cycle (Woolley, 1971a).

6.2 Reproductive History

Little is known about breeding in the wild, except the breeding season which is known to occur from mid May till July. The litter size is six and they are born in an atricial state, being relatively underdeveloped, they are unable to feed, care for themselves or move independently for a period of time after birth. The young first detach from the nipples at approximately 44 - 55 days and are independent at approx. four months. Females nurse their young in the pouch and care for them until they reach independence (Pic.6.3.1). Individuals of both sexes have been known to come into breeding condition each year for up to six years, suggesting that they are fairly long-lived animals, though field research indicates that reproduction may only extend to three years of age (Masters, 2005 pers. Com).

6.3 Captive Reproductive Breeding Strategy

Reproduction in captivity is seasonal and extends from May – July [ASDP, 23 42 (S): 133 52 (E)]. The instigation for breeding is attributed to the photoperiod and climatic cues during this time of year. Cytology samples prior and during this period can determine the reproductive viability and stage of cycle for each individual and indicate

the timing for introductions. Cytology is carried out every second day, along with the collection of weights which will also assist in determining and indicating the stage of cycle for each female. Males are also evaluated for sperm production prior to the breeding season, if viable and mature, they will be introduced to the female on a four day rotational roster, four days in with female and then four days out, these rotations are also in association to cytology outcomes. Breeding has occurred in both the main display on occasions with no management manipulations and in the Breeding boxes with management manipulations. The main display has a breeding period delay of approx. two months; this is with no variation in photoperiod, though environmental cues such as temperature may be an influencing factor, whilst in the Breeding boxes it occurs at the recorded breeding period of May - July.

At ASDP, female's behaviours have been monitored during the breeding period over the last four years and it has been noted that most females aren't behaviourally mature for breeding at one year of age. Their behaviour is erratic and they demonstrate uneasiness and a high level of stress in the presence of the male, this in turn spurs them to escape and avoid the male at all costs from being held and copulated. In the wild such behaviours may be preventable as they could escape the male, whilst in captivity some females have had approx. 70% of their fur removed from their bodies in a single night. Females over one year of age portray the typical Dasyurid breeding behaviour of isolating themselves and then accepting the male at the appropriate time in their reproductive cycle for copulation. This behaviour is note worthy as indications from studies of wild populations; note that there is a three year cycle of recruitment or population increase, which fits this hypothesis (Masters, 2005 pers. Com).

6.3.1 Picture: Mother and young

Caton 2006

On detection of young the male is removed from the Breeding boxes and the dietary requirements adjusted in accordance for parental rearing. In the main display females with young are removed and maintained in Breeding boxes (Pic.5.2.3) till young have weaned.

7. Capture and restraint

It is considerably easier to restrain an animal in a nest box than it is to catch an animal from within an enclosure using a net. Moreover, there is far greater likelihood of damage to the animal utilising the latter method. Animals can be removed from the nestbox in numerous ways depending on the experience of the keeper and more so the number of animals in the box.

If the animal needs to be transferred to a calico bag from the nest box, a bag can be placed over the side of the box at the entrance hole. The animal is then encouraged to leave the nest box; tapping at the end of the box opposite to the entrance and tipping the box up may be sufficient. Once the animal is in the bag, the neck of the bag can be closed and tied securely. Another method of retrieving the animal from the box is to place your hand into the reversed calico bag (seams inside of bag), gripping the animal gently and securely around the base of the head and then reverting the bag over it. Once the animal is in the bag, the bag can be tied, now that it is secure and the animal can be weighed. For further observations and health checks the animal can be restrained by placing your hand flat on the bag, grasping the animal in the same grip as before and peeling back the bag over the head or body, depending on which area is to be examined.

Animals should not be left in calico bags for long periods, as they will readily chew out. Animals left unattended when in a calico bag should always be held in a secure box as they can chew out; also mulgaras have been observed to rub the skin off their rhinarium, when left in bags for extended periods of time.

Capture and manual restraint should only take place during the coolest part of the day.

8. Diet and food presentation

8.1 Feeding Behaviour

Mulgaras are opportunistic or nonspecialist carnivores, eating a range of items including various types of invertebrates, lizards and small mammals but with a preference for larger rather than smaller invertebrates (Baker, 1996; Fisher & Dickman, 1993a,b, Chen *et al* 1998, Masters, 1998). There is no difference in diet between sexes, but a difference was recorded by Masters (1998) between study areas, with more scats containing reptiles at Uluru and more containing scorpions in the Tanami Desert.

8.2 Daily Captive Diet. Alice Springs Desert Park

Mulgara

Monday	Crickets	12g
Tuesday	Adult Mouse (Cal. & Vit-E dusted)	12g
Wednesday	Crickets	12g
Thursday	Roaches	12g
Friday	Mealworms	12g
Saturday	Starve Day	
Sunday	Mouse pinkies (Cal. & Vit-E dusted)	12g

Insects are fed either live or dead and in such a manner that ensures if fed live, that they can't escape the enclosure. All other food is presented in a clean plastic bowl or dish. If there are problems with ants in the enclosure, food dishes can be sat in a shallow dish of water to deny ants' access to the food. Animals should be fed as late in the day as possible to ensure that food is still in optimum condition (it has not been spoiled by the sun or heat) when the animal eats.

❖ **Special dietary requirements**

Females when either pregnant or lactating will have greater energy demands than other times of the year. Sub-adult animals, which are growing, will also have large appetites. One can expect animals to eat more in cooler weather than in warm – more energy is involved in maintaining body temperature. Average food quantities for females with pouch young will increase from an average of 12g daily and progresses upwards prior to pouch young's independence at approx. 75 days. Individual food consumption and variance in food selection is common in this species and notable prior and throughout the breeding season when variations in food intake becomes evident.

8.2.1 Picture: Feeding Behaviour

Strahan

8.3 Water

Water is provided *ad libitum* and is presented in water bottles with a stainless steel ball drip feeder (Rat & Mouse water bottle). Animals quickly learn to use these; though daily checking is required to ensure that the ball in the dispenser is free moving and operational as mineral build up can effect its operating capabilities.

8.4 Daily Husbandry

Enclosures should be cleaned on a daily basis to avoid a build-up of faecal material.

- Removal of all uneaten food.
- Removal of all faecal matter.
- Animal should be sighted every second day. Should no food be consumed, then the animal should be checked.
- Water supply should be checked and replenished daily.
- The integrity of the enclosure should be checked.

- Food provided in a clean dish as late in the day as possible (dependant on breeding requirements).

Weekly Husbandry

- Water bottles and feeding utensils soaked / sterilised
- Fresh browse / cardboard tubing to be added *ad libitum*

Monthly Husbandry

- Holding boxes and tubs to be emptied and cleaned
- Substrate fully changed and replenished
- Nestboxes changed and replenished with new shredded paper
- Cleaning of equipment / boxes/ tubs / nestboxes etc. with detergent and water, then rinsed and sprayed with Avisafe® - Halogenated Tertiary Amines at a rate of 1:100ml and allowed to air dry.
- Water bottles and feeding utensils soaked / sterilised
- Weights and general examinations taken of individuals

    - On substrate changes use coarse substrate throughout winter (breeding period) and fine substrate throughout summer; this coincides with the breeding requirements and reduces eye irritations obtained through displaced sand during the mating period.

9. Individual Identification

Almost all animals in programs with a captive component have a unique identifier. In the case of Mulgara, the animals are implanted interscapularly (between the shoulder blades) with a Trovan® microchip. When applying the microchip to juveniles Vetbond™ (a tissue adhesive) is used to secure and bind the opening. This is usually carried out once the individuals reach a weight of approx. 40 grams. Other means of identification can be punch holes numerically positioned around the ears, small metal ear tags or tattooing along the ventral surface of the tail base or ears.

All correspondence and records should refer to this unique identifier.

10. Vaccinations

None

11. Known Health Problems

Ref: Australian Mammals, Biology and captive management (Jackson, 2003).

11.1 Ectoparasites

Ectoparasites in dasyurids include fleas, ticks and mites (Booth 1994; Cunningham 1994; Woolley 1982). The flea, *Uropsylla tasmanica*, has been reported in thylacines, Tasmanian devils, eastern quolls and spotted-tailed quolls where heavy infestations have been recorded in the distal limbs, ears, groin, scrotum and face which can cause considerable irritation and result in severe scratching and hair loss (Obendorf 1993). The number of ectoparasites can be greatly reduced or eliminated by changing the nest material and washing the nest boxes frequently (Woolley 1982). They can also be controlled using Carbaryl topically or Ivermectin 1% injectable (200mcg/kg subcutaneously).

Mite infestations have been known to occur after their transfer from laboratory rodents used as food (Woolley 1982). These have been treated with the sarcopticide Tetmosol (ICI) diluted 1: 15 with water and drenching the dasyurids in this (while anaesthetised), however this has led to several deaths, so the feeding of rodents with mites is not recommended (Woolley 1982). Most species of dasyurids appear to undergo an annual moult, particularly after the breeding season (Woolley 1982).

11. 2 Endoparasites

Various species of endoparasites have been found in dasyurids including nematodes (eg. Ascarids, *Strongyle* spp. and *Trichinella spiralis*) and cestodes (eg. *Taenia ovis* and *Anoplotaenia*)(Cunningham 1994). In wild populations, antechinus have been found to carry numerous species of endoparasites which rise sharply during the breeding season in males, compared with females, and are considered directly involved with the seasonal mortality of males (Beveridge & Barker 1976).

11. 3 Toxoplasmosis

Toxoplasma gondii has been observed in kowari, antechinus, dunnarts, mulgara and kultarr and has caused significant mortality in captive populations (Attwood & Woolley 1972; Obendorf 1993). Affected animals show a variety of abnormalities including altered behaviour, blindness, incoordination, paralysis or death without prior symptoms (Obendorf 1993). Clouding of the cornea or lens of one or both eyes and destructive retinochloroiditis has also been observed in several kowaris and a white-footed dunnart (Attwood & Woolley 1982). Other signs of infection include difficulty in walking and can drag one or both hind limbs and show signs of meningomyelitis (Attwood & Woolley 1982).

High incidences of toxoplasmosis via the protozoan *Toxoplasma gondii* has been found to occur due to raw sheep meat in the diet so unless the meat is frozen for several weeks, which appears to reduce the infectivity of *Toxoplasma* cysts its use is not recommended (Dubey 1974; Woolley 1982; Attwood *et al*. 1975; Attwood & Woolley 1982).

11. 4 Calcium Deficiency

Animals fed only meat can suffer from calcium deficiency, so additional calcium in the form of calcium carbonate can be added to meat preparations (Woolley 1982).

11. 5 Tumours

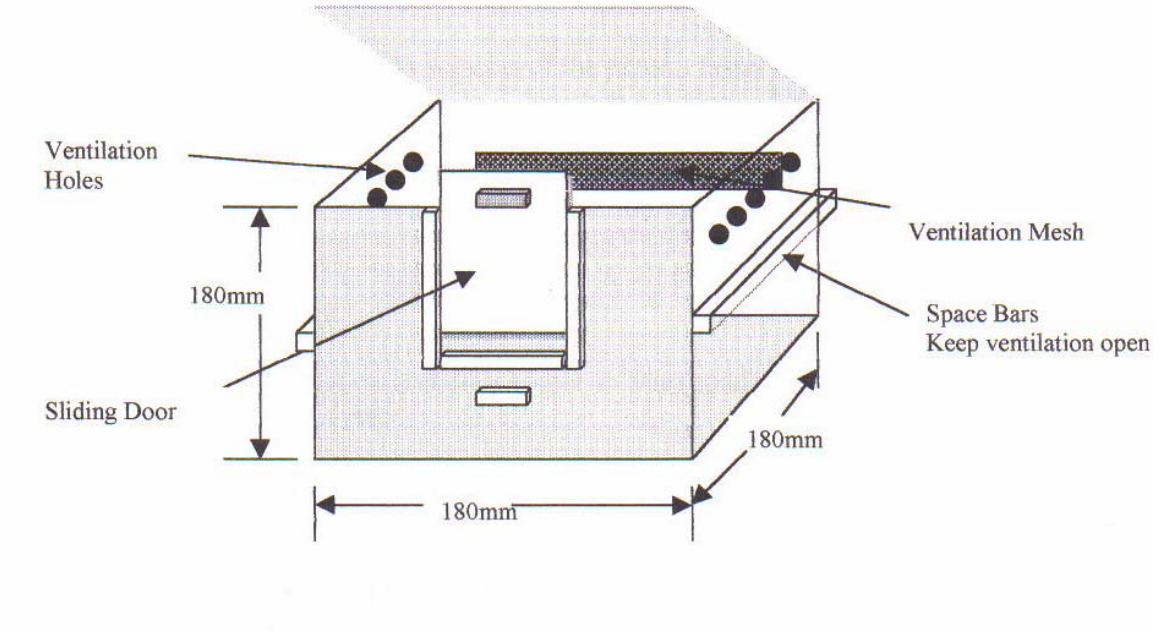
Tumours have frequently been observed in dasyurids in captivity (Attwood & Woolley 1973; Reece & Hartley 1994). Neoplasia (abnormal growth of tissue) is frequently observed in the deaths of dasyurids in captivity (Attwood & Woolley 1973), with tumours observed including lymphatic, haemangiomas, heptacellular carcinomas, osteosarcomas, mesotheliomas, melanosarcomas, fibrosarcomas, medulloblastomas, pulmonary adenomatosis, lymphosarcoma, lymphatic leukemia mammary and cutaneous tumours and papillomas (Arundel *et al*. 1977; Reece & Hartley 1994).

12. Transport

12.1 Transportation

Transport is ideally undertaken either in an air-conditioned motor vehicle or by air. With any mode of transport, care should be taken to ensure that stress is kept at a minimum. Provide a quiet and comfortable environment from the moment the animal is placed in its transport box to the moment it is placed safely in its new enclosure. A comfortable temperature for travelling would be between 18 - 25ºC. Whether the animal travels by day or night a number of factors need to be taken into consideration: duration of the trip, temperatures to be encountered, mode of transport and period of time in between and where will they be kept. Animals being transported should be moved throughout the winter period when temperatures remain cooler throughout the day, if transport is required throughout the summer period, supplementary fluids should be administered prior to shipment.

12.1.1 Diagram: Transportation Box



12.2 Transportation Box

A wooden box with a sliding door is the most satisfactory method of transporting mulgaras. The box must have adequate ventilation, either with drilled holes or a wire mesh panel. The wire mesh panel can be covered with hessian to reduce light and noise. Ensure there is a smooth finish inside the box, no splinters of wood or wire ends. Ensure that the locking devices are adequate, barrel bolts or a sliding door that screws shut. The box should comply with IATA regulations. Figure 12.1.1

Some form of nesting material is required: hay, sea grass or shredded paper. Loosely ¾ fill the box with the material and make a depression in the middle to accommodate the animal / s. All animals should be housed individually for transportation. Animals should be placed individually in a cloth bag for transporting, and placed in the bedding material to restrict the bag moving during transportation.

Transporting females with young should be avoided whenever possible until the young are weaned, this will prevent any from being thrown, lost or injured during transportation.

It is not necessary to provide food or water during transfers over short distances, this is dependent on the location of the institution and the climatic conditions. Subcutaneous fluids may be required as a precautionary measure.

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14. Appendix

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