Husbandry Guidelines for
Veiled Chameleon

*_Chamaeleo calypttratus_*(Reptilia: Chamaeleonidae)

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OCCUPATIONAL HEALTH AND SAFETY RISKS

This species, veiled chameleon (*Chamaeleo calyptratus*), is classed as an innocuous animal and poses minimal to no risk to keepers. The veiled chameleon is a small, generally non-aggressive species which possesses no anatomical features that could cause any harm.

Though it is common for individuals of this species to be reluctant toward handling, any action performed to avoid being handled is generally for display only and will not result in any physical aggression. Individuals that feel threatened will put on a threat display which involves an open mouth and extension of the throat pouch (see figure). On the odd occasion an individual may bite but it is very rare that this will break the skin or cause any discomfort at all.

Working with any animal species poses a risk of zoonotic disease. Common zoonotic diseases are listed in the table below, as well as other potential hazards that may be present in the work environment.

Potential hazards of working with veiled chameleons and in the work environment in general

| Physical                  | • Injury from manual handling  
|                          | • Falls from ladders if enclosures are above head height  
|                          | • Slips/trips over cluttered workspace or wet floor  |
| Chemical                 | • Injury or poisoning from misuse of chemicals  
|                          | -F10 veterinary disinfectant  
|                          | -Bleach  
|                          | -Medications  |
| Ergonomic                | • Working in confined spaces and awkward positioning to reach certain areas  |
| Psychological            | • Distress from loss of animals  
|                          | • Distress from animal sickness  
|                          | • Distress from abundance of pests  
|                          | • Distress from workload  |
| Radiation                | • Sun (for outdoor enclosures)  
|                          | • UV from lamps  |
Open mouth threat display of a veiled chameleon
DISCLAIMER
This document has been put together by a student of TAFE NSW as a part of the course Certificate III Captive Animals (ACM30310). The suggestions made within are recommendations only and may not be the only way of doing things. While a significant amount of research and communications with experienced keepers has been undertaken in the development of this document to determine best practice, this document should be used as a guide only. Management and husbandry techniques of this species will depend on variable circumstances depending upon the institution involved and the resources available.
Much of the information within is anecdotal, gained from persons with experience keeping this species but with no real scientific background. So the information supplied by them is observational only, simply what they have found to work over the years of working with the species, with no rigorous scientific study conducted. Effort has been made, however, to ensure that the information within this document is current and that it is gained from reputable sources.
# TABLE OF CONTENTS

1 INTRODUCTION.................................................................................................................. 8

2 TAXONOMY .......................................................................................................................... 10
   2.1 NOMENCLATURE ............................................................................................................. 10
   2.2 SUBSPECIES .................................................................................................................. 10
   2.3 RECENT SYNONYMS .................................................................................................... 10
   2.4 OTHER COMMON NAMES ............................................................................................ 10

3 NATURAL HISTORY .............................................................................................................. 11
   3.1 MORPHOMETRICS ......................................................................................................... 12
       3.1.1 Mass And Basic Body Measurements ....................................................................... 12
       3.1.2 Sexual Dimorphism ................................................................................................. 13
       3.1.3 Distinguishing Features .......................................................................................... 13
   3.2 DISTRIBUTION AND HABITAT ...................................................................................... 17
   3.3 CONSERVATION STATUS .............................................................................................. 18
   3.4 LONGEVITY .................................................................................................................... 18
   3.4.1 In the Wild .................................................................................................................. 18
   3.4.2 In Captivity ............................................................................................................... 18
   3.4.3 Techniques Used to Determine Age in Adults ............................................................ 19

4 HOUSING REQUIREMENTS ................................................................................................... 20
   4.1 EXHIBIT/ENCLOSURE DESIGN .................................................................................... 20
   4.2 HOLDING AREA DESIGN ............................................................................................... 26
   4.3 SPATIAL REQUIREMENTS ............................................................................................ 27
   4.4 POSITION OF ENCLOSURES ......................................................................................... 28
   4.5 WEATHER PROTECTION ............................................................................................... 29
   4.6 TEMPERATURE REQUIREMENTS .................................................................................. 30
   4.7 SUBSTRATE .................................................................................................................... 32
   4.8 NESTBOXES AND/OR BEDDING MATERIAL ................................................................... 32
   4.9 ENCLOSURE FURNISHINGS .......................................................................................... 33

5 GENERAL HUSBANDRY ....................................................................................................... 35
   5.1 HYGIENE AND CLEANING ........................................................................................... 35
   5.2 RECORD KEEPING ......................................................................................................... 37
   5.3 METHODS OF IDENTIFICATION .................................................................................. 39
   5.4 ROUTINE DATA COLLECTION ....................................................................................... 39

6 FEEDING REQUIREMENTS .................................................................................................. 41
   6.1 DIET IN THE WILD ....................................................................................................... 41
   6.2 CAPTIVE DIET .............................................................................................................. 42
   6.3 SUPPLEMENTS ............................................................................................................. 44
   6.4 PRESENTATION OF FOOD ............................................................................................ 45

7 HANDLING AND TRANSPORT ............................................................................................ 49
   7.1 TIMING OF CAPTURE AND HANDLING ...................................................................... 49
   7.2 CATCHING BAGS .......................................................................................................... 49
   7.3 CAPTURE AND RESTRAINT TECHNIQUES ................................................................. 49
   7.4 WEIGHTING AND EXAMINATION .............................................................................. 51
   7.5 RELEASE ....................................................................................................................... 52
   7.6 TRANSPORT REQUIREMENTS ..................................................................................... 52
       7.6.1 Box Design .............................................................................................................. 52
       7.6.2 Furnishings .............................................................................................................. 53
7.6.3 Water and Food ................................................................. 54
7.6.4 Animals per Box ............................................................... 54
7.6.5 Timing of Transportation ................................................... 54
7.6.6 Release from Box ............................................................. 54
8 HEALTH REQUIREMENTS ......................................................... 55
  8.1 Daily Health Checks .......................................................... 55
  8.2 Detailed Physical Examination .............................................. 56
    8.2.1 Chemical Restraint ....................................................... 56
    8.2.2 Physical Examination .................................................. 56
  8.3 Routine Treatments ........................................................... 59
  8.4 Known Health Problems ..................................................... 61
  8.5 Quarantine Requirements ................................................... 70
9 BEHAVIOUR ............................................................................. 72
  9.1 Activity ............................................................................. 72
  9.2 Social Behaviour ............................................................... 73
  9.3 Reproductive Behaviour ...................................................... 75
  9.4 Bathing ............................................................................. 77
  9.5 Behavioural Problems ........................................................ 78
  9.6 Signs of Stress ................................................................. 78
  9.7 Behavioural Enrichment ...................................................... 78
  9.8 Introductions and Removals ............................................... 80
  9.9 Intraspecific Compatibility .................................................. 81
  9.10 Interspecific Compatibility ................................................ 81
  9.11 Suitability to Captivity ..................................................... 81
10 BREEDING .............................................................................. 82
  10.1 Mating System ................................................................. 82
  10.2 Ease of Breeding ............................................................... 83
  10.3 Reproductive Condition ...................................................... 83
    10.3.1 Females ...................................................................... 83
    10.3.2 Males ........................................................................ 83
  10.4 Techniques Used to Control Breeding .................................... 84
  10.5 Occurrence of Hybrids ....................................................... 84
  10.6 Timing of Breeding ........................................................... 84
  10.7 Age at First Breeding and Last Breeding .............................. 85
  10.8 Ability to Breed Every Year ............................................... 85
  10.9 Ability to Breed More Than Once Per Year .......................... 86
  10.10 Nesting, Hollow or Other Requirements ............................ 86
  10.11 Breeding Diet ................................................................. 88
  10.12 Incubation Period ............................................................ 88
  10.13 Clutch Size ..................................................................... 89
  10.14 Age at Weaning ............................................................... 90
  10.15 Age of Removal from Parents .......................................... 90
  10.16 Growth and Development ................................................ 90
11 ARTIFICIAL REARING .............................................................. 94
  11.1 Incubator Type ................................................................. 94
  11.2 Incubation Temperature and Humidity ............................... 96
  11.3 Desired % Egg Mass Loss .................................................. 96
  11.4 Hatching Temperature and Humidity .................................. 97
  11.5 Normal Pip to Hatch Interval .............................................. 97
  11.6 Diet and Feeding Routine .................................................. 98
  11.7 Specific Requirements ..................................................... 99
  11.8 Data Recording ................................................................ 100

Husbandry Guidelines for Veiled Chameleon (Chamaeleo calyptratus) Stuart Daniel (2015)
<table>
<thead>
<tr>
<th>9</th>
<th>IDENTIFICATION METHODS .................................................................</th>
<th>101</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>HYGIENE ...........................................................................</td>
<td>101</td>
</tr>
<tr>
<td>11</td>
<td>BEHAVIOURAL CONSIDERATIONS ..................................................</td>
<td>101</td>
</tr>
<tr>
<td>12</td>
<td>WEANING ...........................................................................</td>
<td>102</td>
</tr>
<tr>
<td>12</td>
<td>ACKNOWLEDGEMENTS ..................................................................</td>
<td>103</td>
</tr>
<tr>
<td>13</td>
<td>REFERENCES ............................................................................</td>
<td>104</td>
</tr>
<tr>
<td>14</td>
<td>BIBLIOGRAPHY ........................................................................</td>
<td>109</td>
</tr>
<tr>
<td>15</td>
<td>GLOSSARY ...............................................................................</td>
<td>111</td>
</tr>
<tr>
<td>16</td>
<td>APPENDICES ............................................................................</td>
<td>112</td>
</tr>
</tbody>
</table>

- Appendix 1: Exo Terra Dripper Plant ................................................................. 112
- Appendix 2: F10 Product Information & MSDS .................................................. 114
- Appendix 3: Roccal D Product Information ........................................................ 117
- Appendix 4: Nolvasan Product Information ......................................................... 120
- Appendix 5: Wombaroo Reptile Supplement ....................................................... 123
- Appendix 6: Repti-Cal - Calcium & Vitamin Supplement for Reptiles & Amphibians 124
- Appendix 7: IATA Live Animal Regulations for shipping lizards .......................... 125
- Appendix 8: Betadine Product Details ................................................................. 127
- Appendix 9: 'Top of Descent' Product Details ..................................................... 128
- Appendix 10: Enrichment Rating Scales .............................................................. 129
- Appendix 11: Enrichment Data Transfer Form .................................................... 131
1 Introduction

The veiled chameleon (*Chamaeleo calyptratus*) is one of the largest of all chameleon species. It naturally occurs in the south west of the Arabian Peninsula and its distribution covers a great variety of habitat and climate types (Necas, 1999). This makes the species quite hardy and able to tolerate varying conditions in captivity. Today it is one of the most common chameleon species kept in the pet trade, within those regions where it is legal to keep exotics, because of its relative ease of keeping it in captivity.

Species within the Chamaeleonidae family possess several attributes unique to the saurian group. These include independently movable eyes, prehensile tail (though some species of other lizard families possess this), laterally compressed body, talon-like feet, and the long projectile tongue. These attributes all assist in the chameleon’s highly specialised and unique lifestyle and behaviour as an almost entirely arboreal predator (Tolley & Herrel, 2014).

Currently in Australia the veiled chameleon is the only chameleon species kept in ZAA member institutions though there is only a small population spread over 6 separate institutions (ASMP, 2015). Wellington Zoo in New Zealand is also listed as holding the species, and Wellington Zoo and Ti Point Reptile Park in New Zealand also hold Jackson’s chameleons (*Chamaeleo jacksonii*). For institutions wishing to hold chameleons, the veiled chameleon is the most viable and recommended by the Reptile TAG (ASMP, 2015).

There is value in maintaining chameleons in Australian institutions due to their unique qualities and adaptations to inhabit a wide range of climates and habitat types. When observed in contrast to many Australian species that are commonly held in zoos and wildlife parks chameleons are a perfect example of the biodiversity found within the saurian (lizard) group. This makes them of great educational value.

There has also been much research on veiled chameleons in particular, mostly at the University of Sydney that has led to a greater understanding of the Chamaeleonidae family as a whole. Though the veiled chameleon is not listed as threatened there are many aspects of chameleon biology and captive husbandry that has been learned from this research that can be applied to other threatened chameleon species that may benefit from captive population management.

This document aims to provide an overview of all aspects relating to the captive husbandry and management of this species. Topics covered include natural history, housing requirements, feeding, handling and transport, health, behaviour, breeding and artificial rearing.

Certain aspects of the biology of the species are not within the scope of this document. For example, chameleons are well known for their ability to rapidly change colour. The ability to change colour, however, is touched upon in this document, particularly in chapter 9 Behaviour. This section includes a table listing some common colour combinations and what they are likely to mean. This is included because as a keeper of
this species it is important to be able to read the signs that the chameleon is communicating. This will allow high standards of husbandry.
It is not in the scope of this document to give a detailed account on the biology and mechanisms behind the colour changing ability of chameleons, however for further reading on the subject I recommend the following texts from the references list: Tolley & Herrel, 2014; Le Berre et al, 2000; Necas, 1999; Martin, 1992.

The layout of these husbandry guidelines follows the standard format as developed by Jackson (2002). This format allows this document to be easily used as a reference tool, as all the chapters are broken into subsections allowing the reader to find the exact information they are after quickly.

1.1 ASMP Category
The veiled chameleon is in the Reptile TAG (ASMP, 2015). There is currently no regional program for this species.

1.2 IUCN Category
This species is listed as Least Concern by the IUCN Red List (Wilms et al, 2012).

1.3 Wild Population Management
N/A for this species

1.4 Species Coordinator
There is currently no species coordinator for the veiled chameleon and there is currently no management program, though the ASMP Regional Census & Plan of 2014 indicates that this species has been managed in the past.

1.5 Studbook Holder
There is no studbook holder for this species
2 Taxonomy

The family Chamaeleonidae contains all the species of chameleon known today, of which there are 196 currently recognised, plus an additional 13 subspecies. The taxonomy within the Chamaeleonidae family has been under constant revision with several changes over the years and currently some differences in opinion amongst taxonomists. The following, though, gives a general overview.

Chamaeleonidae is divided into 2 sub-families, Chamaeleoninae which includes the ‘true’ and dwarf chameleons, and Brookesininae which includes the stumptailed chameleons. Historically, there were 6 genera making up the family Chamaeleonidae. The most recent publication on the subject though identifies 11 different genera. They are Archaius, Bradypodion, Brookesia, Calumma, Chamaeleo, Furcifer, Kinyongia, Nadzikambia, Rhampholeon, Rieppeleon and Trioceros.

The genus Chamaeleo, to which the veiled chameleon belongs, contains 14 different species, 5 sub-species, and is the most geographically widely spread ranging over most of the African continent as well as containing all chameleon species found in Europe, Asia and the Middle East.

Features present in all species contained in the genus Chamaeleo include, similar casque structure, similar lung structure, a gular pouch, and tarsal spurs (Tolley & Herrel, 2014).

2.1 Nomenclature

Class: Reptilia
Order: Squamata
Family: Chamaeleonidae
Genus: Chamaeleo
Species: calyptratus

Chamaeleo – from Greek khamai “on the ground” and léōn “lion”
calyptratus – from Latin calyptra, a hood like structure

2.2 Subspecies

There are no subspecies formally recognised though in the past some researchers had believed C. calyptratus could be split into 2 subspecies:

Chamaeleo calyptratus calyptratus (larger subspecies)
Chamaeleo calyptratus calcarifer (short casqued veiled chameleon – smaller subspecies)

Further research found that C. c. calcarifer was a hybrid between the 2 closely related species C. calyptratus (veiled chameleon) and C. arabicus (Arabian chameleon) with overlapping ranges (Necas, 1999).

2.3 Recent Synonyms

Chamaeleo calcaratus

2.4 Other Common Names

Yemen chameleon; Cone-headed chameleon
3 Natural History

The veiled chameleon (*Chamaeleo calyptratus*) belongs to the sub-family Chamaeleoninae and so is considered a ‘true’ chameleon. Their distribution covers the south-west of the Arabian Peninsula in the countries of Yemen and Saudi Arabia covering quite a diverse range of habitats and climates from mountainous sub-tropics in the north of their range to much drier valleys in the south (Necas, 1999). They are a very hardy species and can tolerate a broad range of temperatures.

They are one of the largest of the chameleons with the males attaining a total length of 60cm in some cases and the female approximately half this length (Dorval, 2006). Their diet consists mostly of insects but they will also eat small mammals such as mice and some vegetation including leaves, fruits and blossoms. They rarely drink from bodies of water and are much more likely to source their water from droplets on leaves and vegetation. In dry periods they rely mostly on the water content of leaves as their main water source (LeBerre et al, 2000).

The veiled chameleon is a highly arboreal species, spending most of its life in trees and shrubs and very rarely coming to ground. Generally they will only come to ground when searching for a mate to change trees, or when the female is ready to lay eggs, she will start to dig nests in the soil at the base of a tree (Necas, 1999; Tolley & Herrel, 2014).

The veiled chameleon is not a social animal, preferring to live a solitary life, though groups of individuals can live communally within a reasonably small area without much conflict, though this is dependent on the dynamics. Groups of females will most often tolerate each other, each individual ignoring the presence of other females. A single male will often live amongst a group of females where they will ignore and be ignored by the females until a female becomes receptive. There is very rarely aggression displayed between males and females in the wild. It is only when they are paired up in captivity in a confined space where one can’t get away from the other that any serious aggression is displayed (Necas, 1999).

Males will not tolerate the presence of other males. In densely populated areas there may be a single male per tree and they will not tolerate another male invading their territory. Aggression between males is usually displayed with the males facing each other with mouth agape, throat pouch extended and hissing. They will then lunge at each other to hit the flanks of the opponent or to grab the legs or head casque of the opponent with the mouth. One animal will submit and retreat to another branch leaving the winner to his area. The winner rarely follows to chase the weaker male further off (Necas, 1999).

In most areas breeding can occur year round if the conditions are favourable. In dry areas breeding is mostly restricted to the months of September and October. A male can mate with several females. Females are gravid for 20-30 days and will start digging several shallow holes in the ground in the days leading up to laying. She will then choose one hole in which to lay and deepen it. Number of eggs can range from 12-93 (in captive
conditions) though 30-40 is most common and the eggs will hatch after about 200 days, though this period can vary greatly depending on the conditions (Necas, 1999).

The hatchlings will stay within their parent’s territory for the first few months before dispersing. Sexual maturity is attained at approximately 6 months of age (LeBerre et al, 2000).

This species is diurnal, being most often observed active in trees and bushes between 1-3m from the ground. They are a very adaptable species and can live in a range of vegetation types though are very commonly found on acacias and eucalypts. They have adapted well to urban areas and are a familiar sight in urban gardens and in trees alongside roads (Necas, 1999).

Natural predators of this species include birds of prey, baboons and snakes native to the Arabian Peninsula (Necas, 1999).

Chameleons are well known for their colour changing abilities. It was once believed that chameleons would change their colour for the primary reason of camouflage, and this is still a common thought amongst the general public. It is now, however, understood that colour changes are an indication of mood of the individual as colour is a method of communication between individuals. Colour is also dependent on light exposure and temperature, as well as overall health of the animal (Le Berre et al, 2000).

Camouflage, though, is still achieved with colour in combination with posture and manner of movement. A chameleon in its normal relaxed state and colouration is generally well camouflaged in its environment. The veiled chameleon, being a highly arboreal species, blends into its environment well with its mostly green colouration, its laterally flattened body, and its jerky gait resembling the movement of a leaf blowing in the wind (Le Berre et al, 2000).

### 3.1 Morphometrics

#### 3.1.1 Mass and Basic Body Measurements

Adult males can reach a total length of 60cm though are usually in the range of 40-50cm, and adult females usually grow to a total length of 25-35cm (Necas, 1999). The tail length makes up roughly half of the total length in both sexes. Healthy individuals can be within quite a large weight range. Males can range from 100-200g and females can range from 90-120g (Zoological Education Network, 2007).
3.1.2 Sexual Dimorphism

There is great sexual dimorphism in this species with obvious differences between the sexes.

As adults, males tend to be significantly larger and females smaller (see 3.1.1 above). Males have a larger and taller head casque than the females and right from hatching the males have a visible spur on their hind feet that the females lack (LeBerre et al, 2000). Males tend to have a swollen tail base when compared to a female. This is where the hemipenes lie inside the base of the tail.

There is also a difference in the colouration between the sexes, though of course the colours will vary depending on the state or the mood of the individual animal. Generally, in a relaxed state, the female is a bright light green colour with thin bands of aqua and a dull yellow/orange extending dorso-ventrally (vertical). The male, in a relaxed state, also has a base colour of green though of a duller shade, but the patterning and spectrum of colours is much more complex. The dorso-ventral bands are thicker and of speckled blue, black and maroon. There is a yellow/orange margination around these bands. There are 2 lateral stripes often of a white or yellow colour and there is speckled yellow on the throat pouch and down the length of the tail (See Figure 3.1 for a photo comparison of the sexes).

The female, however, is capable of equally complex colours and patterns as both sexes have the same skin regions that can be controlled in isolation to the rest of the body (see Figure 3.4). When comparing the sexes both in a relaxed state though, the male’s patterning is more complex (Necas, 1999).

![Fig 3.1: Female (left) and male (right) veiled chameleons, both in relaxed state.](image)

3.1.3 Distinguishing Features

The physical attributes of the veiled chameleon are quite similar to several other species within the Chamaeleo genus.

The veiled chameleon is one of the larger species of chameleon so it may be helpful to research total sizes to distinguish one species from another.

Both males and females possess a dorsal crest of spines that extends from the back of the neck to about two-thirds of the way down the tail. The spines at their largest are approximately 5mm and they tend to decreases in size in the caudal direction.
They both also possess a ventral crest of spines starting underneath the chin, again where they are approximately 5mm, and extending to the cloaca, decreasing in size toward the tail (Necas, 1999), see Figure 3.2.

Both males and females possess a head casque, though the male’s is much larger and more erect than the female’s.

![Figure 3.2: The ventral crest is visible in this photo](image)

There are a couple of closely related species to the veiled chameleon that are quite similar in appearance (see Figure 3.3). Namely they are the Arabian chameleon (*Chamaeleo arabicus*) and the Indian chameleon (*Chamaeleo zeylanicus*). The Arabian chameleon is found within a similar range to the veiled but the Indian chameleon is found only in India and Sri Lanka (Necas, 1999).

To distinguish a veiled chameleon from one of these two similar species the quickest method would be to compare the head casque. The veiled’s casque is much larger than the Arabian or Indian casque. This, however, has the potential to be inaccurate as the casque varies in size dependent on sex and age of the individual.
Another method to distinguish between species is the colour and patterning scheme. Necas (1999) outlines the colour scheme of the veiled chameleon in detail (see Figure 3.4). This colour scheme is unique to the veiled chameleon.
106. Color scheme in Chamaeleo calyptratus:
1 = ventrolateral stripe, 2 = dorsolateral stripe,
3 = belly and throat, 4 = transversal stripe, 5 = contrast
stripes of the tail, 6 = contrast stripes of the extremities,
7 = contrast stripes of the head, 8a = dorsal part of the in-
between-stripe, 8b = ventral part of the in-between-
stripe, 9 = basal stripe of the tail, 10 = basal stripe of the
extremities, 11 = basal stripe of the head, 12 = parietal
crest, 13 = occipital lobes, 14 = gular and ventral crest;
sexual dimorphism is expressed by dotted lines (head and
tail).

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</table>

Tab. 1: Coloration on the skin zones (1–14 = skin zones,
s. above); W = white, Bl = black, Bw = brown,
Gn = green, Y = yellow, O = orange, Gy = gray,
+ = color present, − = color absent.

Fig 3.4 Colour scheme of Chamaeleo calyptratus
3.2 Distribution and Habitat

The veiled chameleon is native to the south-western corner of the Arabian Peninsula. The range extends in a band running along the western coast of the Arabian Peninsula from the Asir province in Saudi Arabia in the north down to surroundings of Aden in Yemen in the south (Necas, 1999). Figure 3.5 shows a distribution map.

![Distribution map of the veiled chameleon](image)

**Fig 3.5**: Distribution range of the veiled chameleon (Wilms et al, 2012)

The climate and vegetation types within this range are quite varied. There are locations that are quite dry and sparsely vegetated but also locations that are a lot wetter and heavily vegetated with a sub-tropical to tropical climate (Le Berre et al, 2000). This species is abundant in northern Yemen in high plateau and grassland environments as well as mountainous regions ranging in altitude from 500-2900m above sea level. These areas have relatively abundant vegetation and a sub-tropical climate. These chameleons are also quite abundant in more southern regions of Yemen that are a lot drier and can have quite cold periods (Le Berre et al, 2000). Veiled chameleons, then, are very tolerant of a range of temperatures and climates. Dorval (2006) states that this species can tolerate temperatures as high as 38°C and as low as 10°C. Dorval also suggests that the ideal temperature for veiled chameleons is 29-32°C.

This species is most abundant, however, between the cities of Ibb and Tai’zz in Yemen. There are reports that almost every tree is occupied by an adult male (Necas, 1999). This region incorporates a large valley surrounded by mountainous regions up to 2900m above sea level. The annual rainfall in this region can reach 2000mm but is highly variable with periods of heavy rains in the wet season and short periods of ‘drought’ in the dry season. The average temperature in this area is 20°C with a range of ±14°C (Necas, 1999).
3.3 Conservation Status

The IUCN Red List classifies the veiled chameleon in the category ‘Least Concern’. This is justified due to the species’ tolerance of a large range of habitats, including man-made environments, and the fact that supply for the popular pet trade these days is largely from captive bred individuals and rarely from wild caught animals (Wilms et al, 2012).

Jones (2000), however, suggested that the veiled chameleon is experiencing ever growing pressures due largely to a growing human population and urbanization of its natural range. Loss of natural habitat is a major issue as is the fragmentation of the habitat. The slow moving nature of this species has resulted in populations becoming isolated within pockets of habitat surrounded by built-up areas. These populations are then prone to suffering from a lack of genetic diversity. Also, the number of animals that fall victim to cars when moving from tree to tree is quite significant.

Wilms et al (2012) do concede that development of roads and urbanisation may create localised threats to certain populations, though there is no reason for any concern for the species as a whole.

The veiled chameleon is listed on CITES Appendix II. CITES is the Convention on International Trade in Endangered Species of Wild Flora and Fauna. The following excerpt from the CITES website explains what being listed on Appendix II means:

“Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i.e. species whose specimens in trade look like those of species listed for conservation reasons. International trade in specimens of Appendix-II species may be authorized by the granting of an export permit or re-export certificate. No import permit is necessary for these species under CITES (although a permit is needed in some countries that have taken stricter measures than CITES requires). Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met, above all that trade will not be detrimental to the survival of the species in the wild.”

3.4 Longevity

3.4.1 In the Wild

No data has been found that indicates the lifespan in the wild for this species but it is believed to be very similar to the lifespan in captivity (see below).

3.4.2 In Captivity

Males in captivity may live for 6-8 years
Females in captivity may live for 4-6 years
3.4.3 Techniques Used to Determine Age in Adults

There are no techniques for aging adult veiled chameleons. Size is not a good indication as with most reptiles size is dependent on feeding schedule, supplementation of nutrients and husbandry techniques.

There is no recognisable wear of the teeth to indicate age either.

Hatchling veiled chameleons are generally 5.5-7.5cm in total length (TL) and grow to 20-30cm within the first 4 months. After this it is practically impossible to get an indication of age (Le Berre et al, 2000; Fife, 1999).

The best way to age individuals is to maintain accurate records of hatch dates and to acquire these records from previous keepers if the animal is a new acquisition.
4 Housing Requirements

4.1 Exhibit/Enclosure Design

When planning a new exhibit or facility for a new species it is useful to think about the needs of all parties involved. Generally there will be three separate parties, namely, the keeper, the visitor, and the animal itself.

Keeper Needs:
- Access for routine tasks, e.g. cleaning, feeding, changing of heat and UV lamps – should be easily accessible for OHS and quality of work (hard to reach spots are likely to be missed when cleaning)
- Visibility of animal for daily observation
- Safe work environment

Visitor Needs:
- To see the animal
- To be able to view the animal in a naturalistic environment
- To learn something about the species via signage or interpretive material

Animal Needs:
- The ‘5 Freedoms’ could be listed here:
  1. Freedom from hunger & thirst
  2. Freedom from discomfort
  3. Freedom from pain, injury or disease
  4. Freedom to express normal behaviour
  5. Freedom from fear and distress
- Safe environment – escape proof, barrier from heat source, no toxic plants/furnishings, out of reach of visitors, pest proof, clean and hygienic to prevent disease
- Optimal climatic conditions – temperature & humidity
- Shelter from adverse conditions (weather, draughts if indoors)
- Ability to exhibit natural behaviour
- Access to food and water - presented in a way suitable to the species
- Natural day/night cycle
- Suitable substrate for females to lay eggs in (or provided when expecting a clutch)
- To live comfortably – suitable furnishings provided and the ability to hide (or feel ‘hidden’ amongst foliage)
Basic principles in providing housing for this species:

- As the veiled chameleon is an arboreal species it is recommended to provide a tall vertical enclosure rather than a wide horizontal enclosure.
- There should be plenty of criss-crossing branches of a variety of diameters to allow the chameleon to make use of the majority of the volume of the exhibit (Dorval, 2006)
- There should be plenty of foliage – real plants are recommended by most authors
- Substrate provided should absorb and retain moisture to aid in maintenance of humidity
- A heat gradient must be provided and heat source should come from above in the form of a lamp/globe (Monge, 2015)
- Branches can be used to create an ideal basking spot under the heat lamp – perches approximately 20cm directly under the heat lamp
- There must be a barrier for the heat source to prevent direct contact by the chameleon (caged or behind mesh)
- UV must be provided
- There must be some ventilation – most authors recommend an enclosure made entirely of mesh – this is likely not practical in a zoo exhibit so as much ventilation as possible should be provided in other ways
- An automatic misting/drip system is ideal, or if not feasible regular misting by hand is required. See Figures 4.1 & 4.2 for a commercially available automatic drip system (Product details in Appendix 1). Alternatively a ‘home-made’ system could be devised and installed in the enclosure.

Fig 4.1: ExoTerra Dripper Plant product
Fig 4.2: Diagram showing product assembly (a pump in a water bowl pumps water through a pipe and up the stem of the fake plant and then drips down the leaves back into the bowl)

*Ficus benjamina* (Weeping fig)  
*Taraxacum officinale* (Dandelion)

*Hibiscus rosa-sinensis* (Chinese Hibiscus)  
*Morus Alba* (White Mulberry)
Husbandry Guidelines for Veiled Chameleon (*Chamaeleo calyptratus*)

Stuart Daniel (2015)

*Soleirolia soleirolii* (Baby’s Tears)

*Abutilon x hybridum* (Chinese Lantern)

*Sempervivum tectorum* (Hen & Chickens, Devil’s Beard)

*Impatiens balsamina* (Garden Balsam)
Husbandry Guidelines for Veiled Chameleon (*Chamaeleo calyptratus*)

Stuart Daniel (2015)

*Alcea rosea* (Hollyhock)

*Yucca glauca* (Dwarf Yucca)

*Schefflera spp*
4.2 Holding Area Design

Holding area designs can be smaller than permanent enclosures used for display. Short term holding enclosures should hold individuals for a maximum of 90 days (NSW DPI, 2009). Once this time has expired the individual should be moved to permanent housing adhering to the minimum standards.

See below for the spatial requirements for lizards as stated in The Standards for Exhibiting Reptiles in NSW – Draft (DPI, 2009).

The holding areas should meet all the same basic criteria as permanent housing in regard to shelter, temperature and suitable furnishings as discussed below. The substrate of holding areas can be solely for practicality, and so paper is sufficient.
4.3 Spatial Requirements

The following is based on a draft version of the Standards for Exhibiting Reptiles in NSW as developed by DPI in 2009. These are general standards that cover the whole lizard group and so it is conceded that different species will have varying requirements and so a Note is included that states:

“The formulas used to determine the size of enclosures for lizards are a guide only as it is difficult to adequately address the varying spatial needs of all captive lizards with one simple formula. The guidelines will be used by the Director-General, his delegates and inspectors in assessing the sufficiency space provided by lizard exhibits. The formulas do not prescribe mandatory standards, however the Director-General does have the power to decide whether or not an enclosure fits the general requirements relating to sufficient space…… If applying to use a space less than indicated by the formulas listed below exhibitors must provide justification as to how the smaller space will address the animal’s welfare needs.”

The Standards for Exhibiting Reptiles in NSW – Draft (DPI, 2009) states that:

Clause 10
‘1) a) Sufficient space must be provided, both horizontally and vertically, to meet the activity needs of the animals, to allow them to withdraw from undue dominance or conflict and enable the husbandry of the animals

b) The enclosure must be large enough to provide a temperature gradient that allows the reptile(s) to thermoregulate

c) The minimum floor space allowable for any enclosure must be increased in area by 20% for each additional specimen over one or two specimens for which a minimum floor space formula is established

d) All enclosures provided must be adequate for the size of an average sized adult animal. This condition does not apply to newly born or hatched reptiles but these must be placed in full size enclosures once an individual reaches 50% of the average body length for that species.

2) The following formulas refer to the minimum floor area applicable for an enclosure containing up to two specimens. ‘L’ refers to the extended length (snout to tail-tip) of the longest specimen housed in the enclosure. ‘SVL’ refers to the extended head-body length (snout to vent) of the longest specimen housed in the enclosure.

a) Animal display establishments and home base for exhibitors authorised to exhibit at temporary establishments:
Minimum floor area = 20cm x 30 cm OR 6.25L² (e.g. 2.5L x 2.5L), whichever is greater, with no dimension less than 2L
b) Medium term holding enclosures (holding less than 90 days) and display at temporary establishments:

Minimum floor area = \(20cm \times 30cm\) or \(2.25L^2\) (e.g. \(1.5L \times 1.5L\)), whichever is greater, with no dimension less than 1L

c) Minimum height for terrestrial species

The larger of either \(2 \times SVL\) or 40cm, whichever is greater

d) Minimum height for arboreal species

The larger of either \(4 \times SVL\) or 60cm, whichever is greater

Based on the maximum size gained by male veiled chameleons being 60cm for total length (L) and approximately 30cm for snout-vent length (SVL) (see Section 3.1.1) the following enclosure size should be provided in an exhibit for the veiled chameleon:

For permanent display enclosure:

Minimum floor area: 22,500cm² (with no side less than 120cm)

Minimum height: 120cm

For holding enclosure:

Minimum floor area: 8100cm² (with no side shorter than 60cm)

4.4 Position of Enclosures

The Standards for Exhibiting Reptiles in NSW (DPI, 2009) states that:

Clause 4

‘1) All captive reptiles must be kept in conditions that ensure temperature, humidity, and light cycles are appropriate to the species and allow normal physiological functioning and behaviour’

and

‘4) Reptiles must not be kept in areas with excessive noise or vibration, or which are subject to excessive temperature fluctuation’

If the chameleon is being housed outdoors it is important that sufficient shelter be provided against wind and rain. Shade cloth should cover at least a portion of the roof to protect the animal from heavy rain.

A solid wall should be provided on the southern side of the enclosure to protect the animal from cold southerly winds.
Outdoor enclosures should make maximum use of natural light and warmth from the sun. The enclosure design should allow the morning sunlight to reach the animal. This can be achieved by having the north-eastern side and roof made entirely of mesh.

4.5 Weather Protection

Veiled chameleons fare well in both indoor and outdoor enclosures. Within a captive animal display facility such as a zoo, however, indoor enclosures are by far more commonly used. The enclosure being indoors, then, eliminates the need to consider things like the aspect in which the enclosure faces and shelter from wind and rain.

It is, however, important to allow plenty of ventilation. In a typical reptile house within a zoo, the temperature can rise very quickly and air can become stale with so many enclosures in a relatively small area, each with its own heat source.

It is suggested that all enclosures be constructed with at least one side/or roof made from mesh to allow air circulation, and the building that houses all the enclosures be well ventilated.

Other means of controlling the surrounding indoor environment, such as air conditioning, may be necessary.

If outdoor enclosures are used then the provisions discussed above (Section 4.4) regarding protection from rain and wind should be followed.

It is important that suitable humidity levels are maintained within the ‘microclimate’ of the enclosure and that the surrounding conditions do not interfere with humidity control.

The Standards for Exhibiting Reptiles in NSW (DPI, 2009) states that:

Clause 5
‘3) a) For most species 50-70% relative humidity is regarded as suitable, but specific preferences vary, and can best be determined by learning as much as possible about the natural history of a given species

b) Where live plants are used to decorate the exhibit, care must be taken to ensure that the relative humidity does not become excessively high. Artificial plants may be used as an alternative

c) Floor substrate may also be adjusted to vary humidity’
4.6 Temperature Requirements

The veiled chameleon has been known to tolerate a large range of temperatures both within captivity and in the wild as evidenced by the range of climates found over its natural range (see Section 3.2). In general though, if available, veiled chameleons will spend most of their time in the warmest and lightest area of their enclosure, at least during the day (Dorval, 2006).

Dorval (2006) suggests that *C. calyptratus* can tolerate temperatures as high as 38°C and as low as 10°C, though the preferred basking temperature is from 29-33°C. Young chameleons, however, cannot tolerate the same high basking temperatures as adults.

Overnight, a temperature drop of at least 10°C is recommended. In most locations this can be achieved by simply turning off the heat source in the late afternoon. However, in locations of extreme cold, a low heat of no more than 20°C may still need to be provided overnight.

The Standards for Exhibiting Reptiles in NSW (DPI, 2009) states that:

Clause 5

‘1) a) An appropriate thermal gradient must be provided within enclosures so that terrestrial reptiles can regulate their body temperatures sufficiently by shifting between appropriately warmer and cooler positions in the enclosure. In the case of arboreal species, this thermal gradient must be present at elevated levels as well

b) Heating devices must be designed and positioned so that parts of the enclosure floor are not heated thereby providing a range of temperatures

c) Temperature readings must be taken regularly at the site where the reptile spends substantial amounts of time, or be constantly monitored using a maximum-minimum thermometer (or other appropriate mechanism) to ensure that extremes of temperature are prevented

d) Light globes, exposed heat pads, aquarium heaters, or other heat sources must be designed, constructed and positioned to prevent fire or injury to a reptile. Thermostatically controlled heat sources hot enough to burn a reptile must either be out of reach of the animal or within a protective barrier to prevent burns to unsuspecting animals on activation.’

To provide heat for an arboreal chameleon such as *C. calyptratus*, it is important that the source comes from above in the form of a lamp/globe and not from below such as a heat mat as this would be entirely ineffective. Most chameleons, particularly *C. calyptratus*, love to bask in a heat source from above rather than sit on a warm surface or soak up ambient heat (LeBerre et al, 2000).
The heat source should be positioned so that it is focused to one side of the enclosure to create a heat gradient. The positioning of furniture can be put to good use to assist in creating a gradient both horizontally and vertically.

Ceramic heat emitters are the preferred heat source. They have a much longer life than incandescent bulbs as the constant turning on and off from the attached thermostat doesn’t have the life limiting effect on ceramic emitters as it does on incandescent bulbs (personal experience). Also, should a lower heat need to be provided during the night (if the animal is being held in a very cold climate), the ceramic emitter does not produce light and so does not disrupt the day/night cycle.

![Fig 4.4: An example of a ceramic heat emitter](image)

This species also requires significant levels of UV. A lamp or tube that emits both UVA and UVB should be positioned in the roof of the enclosure and turned on for at least 6 hours in the middle of the day. It is important to know here that the distance of the UV lamp from the basking spot is very important as the further away it is the less UV reaches the animal. A distance of 20-30cm from the preferred basking spot is recommended for most types of UV lamps though this can vary depending on brand and quality. It is also important to state here that UV does not travel through glass (or at least only a minute amount of the original output) and even heavy mesh can filter a significant portion of the UV emitted from a bulb. Positioning of the UV bulb so that it is unobstructed is key.
4.7 **Substrate**

The Standards for Exhibiting Reptiles in NSW (DPI, 2009) states that:

Clause 6

‘1) a) Whilst a sterile-type setting, e.g. paper substrate, is adequate for off-exhibit holding areas, this is not a suitable substrate for the exhibition of reptiles

b) The substrate must be deep enough to keep the animals dry

c) Where practical natural substrates must be chosen that reflect the known habitat of the species in the wild’

The best substrate to use for this species is potting mix or some other similar soil. This type of substrate soaks up and holds moisture well, which is important for maintaining the humidity levels.

Dorval (2006) suggests that perlite and vermiculite be avoided in the substrate as chameleons have been known to eat these materials and they have proven to be fatal. When choosing a substrate it is important to consider the size of individual particles and the effect they could have on the chameleon should they be ingested. Other substrates to avoid for this reason include wood chips, wood shavings, small pebbles, coconut or peat fibre, or coarse sand (Haggett, 2009).

Necas (1999) and Dorval (2006) suggest suitable substrates for display enclosures would include fine soil or sand.
Suitable substrates for off display enclosures include astro turf, paper, large stones or large pieces of cork bark (Dorval, 2006).

4.8 **Nestboxes and/or Bedding Material**

Arboreal chameleons, such as *C. calyptratus*, do not utilise any form of bedding material normally. When in a resting state they simply hide amongst the abundant foliage of the tree in which they live. It is therefore important to provide the chameleon with plenty of leafy coverage.

The female veiled chameleon does, however, bury her eggs in the substrate. When suspecting a female is gravid, a loose soil or sand should be provided so that the female can exhibit this natural behaviour (if this type of substrate is not normally provided). See section 10.10 Nesting, Hollow or Other Requirements for more information.
4.9 **Enclosure Furnishings**

The Standards for Exhibiting Reptiles in NSW (DPI, 2009) states that:

Clause 6

‘2) a) The interior design and landscaping of enclosures must portray appropriate aspects of the habitat of the species, and where practical must include furnishings that encourage natural behaviour

b) To allow natural behaviour, basking species, held indoors, must be provided with a ‘basking’ site such as a rock slab or log, upon which a radiant light/heat source must be directed for appropriate periods of time, at an appropriate intensity.

d) Sufficient number of climbing structures such as branches, ledges or boxes must be provided to allow arboreal species to express natural climbing and basking behaviour.

e) At least one visual barrier must be provided (not at the low end of the temperature range)’

Chameleons tend to prefer enclosures that contain an abundance of branches and leafy coverings, whether live plants or plastic substitutes. Dorval (2006) highly recommends the use of plastic leaf material for its ease of cleaning and maintenance, and the fact that live plant material is more likely to harbour bacteria. Necas (1999), however, emphasises the importance of live plants in an enclosure but doesn’t elaborate on why.

If live plants are selected for the enclosure, both de Vosjoli (2004) and Ferguson et al (2007) recommend *Ficus benjamina*. Branches should be larger in diameter than the chameleon’s grasp and there should be a great amount of variation in thickness (Ferguson et al, 2007).

The positioning of furnishings, branches and leafy coverings should be well thought out. Branches positioned at different angles and crossing each other and at differing heights will allow the chameleon to navigate and use the entire volume of the enclosure. Leafy coverings should be located in at least 2 positions, one in a warm spot and one in a cool spot, so that the animal can hide without disrupting its thermoregulation. Branches should lead to an ideal basking spot that is close enough to the heat source to allow optimal basking temperatures, but not too close as to allow access to the hot surface of the heat source. A cage or other form of barrier must be used to eliminate the risk of burns to the animal. This is particularly important for the arboreal nature of *C. calyptratus*. 
Fig 4.5: Enclosure with ideal furnishings – plenty of crossing branches of varying thicknesses and dense foliage
5 General Husbandry

5.1 Hygiene and Cleaning

The Standards for Exhibiting Reptiles in NSW (DPI, 2009) states that:

Clause 14
‘2) Water containers must be cleaned regularly to ensure that they are kept in a clean and hygienic condition’

Clause 15
‘1) Faecal and urine wastes and uneaten food must be removed daily, and the substrate regularly cleaned or replaced, though a small amount of faeces may be left each time the cage is cleaned as the pheromones that are released mark the cage with the animal’s own scent

2) Ponds and other aquatic displays must have regular water changes to maintain a clean water environment, where the water is not filtered. If a recirculating water system is used each tank must have a self-contained filtration system to minimise the chances of cross contamination

3) Hard surfaces of enclosures, perches, shelves, hide boxes and water ponds/bowls must be cleaned regularly to prevent the accumulation of faecal matter and urine

4) Presenters must advise members of the public to thoroughly wash their hands after touching any reptile and ensure that facilities are available to do so’

The recommended cleaning product to be used is ‘F10SC Veterinary Disinfectant’ (see Appendix 2 for product information and MSDS).

Other commercial products that are regularly used for animal hygiene include Roccal-D and Nolvasan. See appendix 3 & 4 for information on both of these products.

Warm water and soap can be almost equally as effective as any commercially produced chemical for routine hygiene and cleaning should the chameleon keeper choose not to use chemicals.

Bleach is commonly used though great care must be taken as it is highly toxic to both humans and the chameleons, or any animal (Kaplan, 2014). If bleach is used, it must be rinsed thoroughly with clean water and allowed to dry completely before the animal is
returned to the enclosure, or before furnishings or water/food bowls are used, to ensure there is no bleach residue remaining. The use of bleach is not recommended for routine hygiene and cleaning. If a suitable schedule for hygiene and cleaning is maintained, then the use of bleach is not necessary. Other products that would be classed alongside bleach as ‘unsafe’ products would include ammonia and products containing the following substances (Gaiam, 2014):

- Chlorinated phenols - found in toilet bowl cleaners are toxic to respiratory and circulatory systems.
- Diethylene glycol - found in window cleaners depresses the nervous system.
- Phenols - found in disinfectants are toxic to respiratory and circulatory systems.
- Nonylphenol ethoxylate - a common surfactant (detergent) found in laundry detergents and all-purpose cleaners, is banned in Europe; it has been shown to biodegrade slowly into even more toxic compounds.
- Formaldehyde - found in spray and wick deodorizers, is a respiratory irritant and suspected carcinogen.
- Petroleum solvents - in floor cleaners damage mucous membranes.
- Perchloroethylene - a spot remover, causes liver and kidney damage.
- Butyl cellosolve - common in all-purpose, window and other types of cleaners, damages bone marrow, the nervous system, kidneys and the liver.

The following table suggests tasks that should be performed daily, weekly, monthly and yearly.

<table>
<thead>
<tr>
<th>Table 5.1: Suggested hygiene schedule</th>
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<tbody>
<tr>
<td><strong>Daily Tasks</strong></td>
</tr>
<tr>
<td>Remove faeces</td>
</tr>
<tr>
<td>Remove uneaten food</td>
</tr>
<tr>
<td>Remove sloughed skin</td>
</tr>
<tr>
<td>Misting of enclosure</td>
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</tbody>
</table>
Pest & Parasite Control
An important factor in maintaining the health of any captive animal is that of pest and parasite control.

The Standards for Exhibiting Reptiles in NSW (DPI, 2009) states that:

Clause 18
1) All reptiles must be routinely checked for internal and external parasites and treated as required under veterinary supervision

2) All enclosures used to house reptiles must be monitored for parasites and cleaned as required to remove infestations’

Enclosures should be designed to prohibit access to vertebrate pests, particularly rodents. This can be achieved by maintaining the enclosure in good condition and using a mesh of a small enough gauge that mice cannot fit.

Regular cleaning and a good standard of hygiene will assist in not attracting pests in the first place.

Keepers should be vigilant for signs of invertebrate pests such as ants.

5.2 Record Keeping
The ‘Standards for Exhibiting Reptiles in NSW – draft’ (NSW DPI, 2009) covers the minimum requirements in regard to record keeping. These are outlined below:

Clause 12 – Record Keeping
1) Feeding records must be maintained for all individual reptile species, and include feeding date, as well as quantities and type of food both offered and eaten.

2) For all reptile species prescribed by Schedule 2 of the Exhibited Animals Protection Regulation 2005 (and ideally other species as well), more detailed records must be kept, providing at least the following information:
   a) The date or estimated date of egg laying and/or birth/hatch.
   b) Breeding and details of any offspring
   c) The date of occurrence of skin shedding and any problems encountered
   d) Clinical data, including results of physical examination by a qualified veterinarian and details of, and date when, any form of treatment was given
   e) Opportunistic measurements of body weight and lengths.
   f) The date of death and results of post mortem

3) All relevant records must accompany an animal when it is transferred to another establishment.

4) The exhibitor must identify each individual animal, if required by the Director-General, with an approved form of identification, such as Passive Integrated Transponders (PIT) tags, and keep a record of each individual.
An effective way to keep records for this species is by the use of cage cards (see Figure 5.1). Data to be entered onto these cards would include: food offered and taken, type and quantity of food item, shedding, weight and length measurements, medical examination and treatment, breeding behaviour, gravid females, laying of eggs etc. Codes can be used for each of these events and they can be listed on the rear of the cage card. Table 5.2 lists examples of codes used.

Also on the rear of the cage card there should be room for additional notes. These notes would refer to events recorded on particular dates and go into further detail – as there is minimal room within each date square on the front of the cage card. For example, the code Tx may be entered on a particular date. In the notes section on the rear of the card you would refer to the date and detail what the medical treatment was, what it was for and the dosage.

![Fig 5.1: An example of a cage card suitable for the species C. calyptratus](image)
Table 5.2: common codes used for use with cage cards
(to be listed on rear of cards)

<table>
<thead>
<tr>
<th>Code</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Insects offered</td>
</tr>
<tr>
<td>Gr</td>
<td>Greens offered</td>
</tr>
<tr>
<td>M</td>
<td>Mouse offered</td>
</tr>
<tr>
<td>C</td>
<td>Food consumed</td>
</tr>
<tr>
<td>SB</td>
<td>Shedding – begin</td>
</tr>
<tr>
<td>SE</td>
<td>Shedding – end</td>
</tr>
<tr>
<td>P</td>
<td>Paired for mating</td>
</tr>
<tr>
<td>G</td>
<td>Gravid</td>
</tr>
<tr>
<td>PL</td>
<td>Pre-laying behaviour</td>
</tr>
<tr>
<td>L</td>
<td>Laying of eggs</td>
</tr>
<tr>
<td>W/L</td>
<td>Weight/Length measurements</td>
</tr>
<tr>
<td>V</td>
<td>Vet examination</td>
</tr>
<tr>
<td>Tx</td>
<td>Medical treatment</td>
</tr>
</tbody>
</table>

5.3 Methods of Identification

The preferred method for identification for this species is a microchip inserted on the left side of the inguinal region or the base of the tail. This is a permanent means of I.D. that is ideal for exhibited animals as it is not visible to the public. When applying the microchip to a male, however, care should be taken to avoid the hemipenes in the tail base. The microchip number should be recorded on the cage cards as well as on the database used for animal management, whether it be ARKS or ZIMS or some other similar database.

5.4 Routine Data Collection

Observations should be made on a daily basis and data collected opportunistically as events arise. For this species data could include:
- weight and length measurements at regular intervals
- successes and non-successes of pairing for mating
- number of eggs laid in a clutch
- period between laying and hatching
- conditions associated with breeding/incubation/hatching such as temperature and humidity
- medical treatments and their effectiveness and dosage
- changes in diet
- changes in behaviour – and the conditions at the time
- illnesses
- acquisitions/dispositions
- internal movements
- enrichment

Keeping records of all of these things leads to increased understanding of the species as over time it is possible to identify trends. It is also recommended to obtain records of an individual that has been newly acquired from another institution.
6 Feeding Requirements

6.1 Diet in the Wild

Chameleons, generally, are opportunistic feeders of invertebrates. Occasionally chameleons, particularly the larger species such as *C. calyptratus*, will eat small vertebrates such as rodents, small birds and small reptiles and amphibians as well.

Invertebrates regularly eaten include:

- Grasshoppers
- Locusts
- Beetles
- Butterflies
- Moths
- Phasmids
- Mantids

The veiled chameleon is one of only a few chameleon species that will readily eat vegetation as well as insects (Mattison & Garbutt, 2012). A variety of leaves, flowers and fruits are eaten by this species in the wild.

During the drier periods veiled chameleons will increase their intake of vegetation. This is because there are fewer insects present when it is dry. Ingesting the plant material also provides the chameleon with the water content that would be present during the wetter periods (Ferguson et al, 2007).

Tolley & Herrell (2014) call the chameleon’s method of finding food “cruise foraging”. This is an intermediary feeding strategy between sit and wait or ambush, and active foraging strategies. A cruise forager examines its environment, moves a short distance, and then conducts more scans. This method is very effective for coming across insects that could often be very flighty.
6.2 Captive Diet

In captivity, veiled chameleons are fed a diet primarily of insects, with greens and vegetables offered one day a week. Some veiled chameleon keepers also offer small vertebrates (pinkie mice) on occasion or even more regularly.

The feeding schedule for the veiled chameleons at the Australian Reptile Park is as follows:

<table>
<thead>
<tr>
<th>Day</th>
<th>Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>Insects</td>
</tr>
<tr>
<td>Tuesday</td>
<td>Greens + Fruit &amp; Veg</td>
</tr>
<tr>
<td>Wednesday</td>
<td>Insects</td>
</tr>
<tr>
<td>Thursday</td>
<td>Insects</td>
</tr>
<tr>
<td>Friday</td>
<td>Pinkie mice</td>
</tr>
<tr>
<td>Saturday</td>
<td>Insects</td>
</tr>
<tr>
<td>Sunday</td>
<td>Insects</td>
</tr>
</tbody>
</table>
The insects fed in captivity are primarily crickets, as these are readily available commercially or they can be bred relatively easily.

Other insects commonly fed in captivity, though some may be harder to source than others, include:

- Mealworms
- Wax worms
- Silk worms
- Cockroaches
- Wood roaches
- Mantids
- Grasshoppers

The quantity of insects fed on any day can vary significantly. Often it will be the chameleon that decides how many it wants to eat. From my experience working with this species, adults may refuse insects on any given day or eat as many as up to 30 ‘large’ crickets.

If tongs are used to feed the insects out individually then often time can be a factor in how many insects the chameleon eats. If, as a keeper, you are limited for time, you may not be able to wait around until the chameleon has had its fill and cut its meal short. As a keeper, it is your responsibility to decide upon the best feeding method for your animal to ensure it is getting the best nutrition (see Presentation of Food, section 6.4).

If feeding pinkie mice, two or three should be sufficient for an adult.

When feeding greens, fruit and vegetables, a small bowl holding a mixture of a size roughly that of a billiard ball (when compacted) is sufficient.

Ferguson et al (2007) lists some vegetation that can be offered in captivity:

- Non-toxic leaves and flowers
- Chopped greens and spinach
- Small pieces of broccoli
- Grated carrot
- Small pieces of fresh soft fleshed fruit (particularly grapes and berries)
- A live hibiscus plant could be maintained in the enclosure for the animal to forage on as desired
- Young specimens can be offered alfalfa sprouts or pureed vegetable baby food (spread onto the live vegetation or fake plant leaves)

Dorval (2006) also lists green beans, snow peas, romaine lettuce, and fruits such as apple and pear (if finely grated) and oranges and banana.

There is some variation in the suggested frequency of feeding. Haggett (2009) suggests that adult veiled chameleons should only be fed ‘every other day’, with the exception of gravid females. Other keepers and authors, though, recommend daily feeds.
Note: When feeding insects to insectivorous animals, it is important to ensure the insect is of the highest nutritional value. This is most easily achieved if the insects are bred within the facility and the food supplied is monitored and nutrient rich. Giving the feeder insects a good nutritious meal shortly before being fed out is called ‘gut loading’.

Haggett (2013) lists foods that should be fed to the insects (particularly crickets) to ensure they receive, and therefore contain, all the essential nutrients such as protein, carbohydrates, fats, vitamins & minerals etc.

- Fish flakes
- Pumpkin
- Squash
- Potato
- Sweet potato
- Tomato
- Carrot
- Apple
- Oranges
- Cherries
- Watermelon
- Wheat germ
- Dry dog or cat food (high quality)
- Leafy greens (cabbage, mustard greens, kale, celery)

For further reading on insects as feeder food and their breeding see Haggett (2013) from the references list.

### 6.3 Supplements

Supplements are necessary to ensure a well-rounded nutritional intake for most captive reptiles. The foods offered in captivity, while somewhat similar to the wild diet, rarely meet all the nutritional needs of the animal. Crickets, which are probably the most commonly fed insect to captive insectivores, are not particularly good at providing the best nutrition, particularly in regard to their Calcium:Phosphorus (Ca:P) ratio.

Food items should be dusted with supplements prior to feeding to ensure good nutrient intake for the chameleon.

Two suitable supplements include ‘Wombaroo Reptile Supplement’ which is a general vitamin/mineral mix and ‘Reptical’ which is a phosphorus free calcium and D3 supplement (see appendices 5 & 6). It is advised to always follow the directions when using products such as these as the use of too little will have negligible effects while the
use of too much can cause problems such as hypervitaminosis which can be just as serious as nutrient deficiencies.

Supplements may only need to be used once or twice a week, however, for gravid females, daily supplementation with calcium and a general vitamin/mineral supplement is recommended (de Vosjoli, 2004).

6.4 Presentation of Food

Insects should be of a size appropriate to the individual being fed. As a general guide, the insects should be nearly as long as the chameleon’s head-width (de Vosjoli, 2004). Insects can be fed out one at a time using feeding tongs. It is a good idea to use tongs with a rubber coating so as not to damage the tongue of the chameleon. The tongs should be positioned 10-20cm in front of the animal. You will see the chameleon focus both of its eyes on the insect to determine distance and it will then shoot its tongue out and retract it into its mouth.

Insects can also be placed within a small plastic container with an open top that the insects cannot escape from. This should be positioned off the floor of the enclosure as arboreal chameleons often don’t look for food near the ground. Rather, they look for food up in the branches. This is probably the best method, as the number of insects taken can be monitored and the container can be left in the enclosure over several hours for the chameleon to eat as it wants, instead of having time constraints when feeding individually with tongs.

![Fig 6.2: Plastic cup used to contain live insects for the chameleon to feed upon](image)
Alternatively, insects can be released into the enclosure to free range and allow the chameleon to hunt for its food. In doing this, it can be tricky to monitor the intake of food by the chameleon if the insects are able to escape the enclosure.

Greens, fruit and vegetables can be presented in a small bowl, again raised off the floor of the enclosure. Alternatively, the greens, fruit and vegetables could be spread around the enclosure amongst the foliage to encourage foraging behaviour. If live plants are used in the enclosure, then the veiled chameleon may browse upon these at leisure.

Water can be presented in a water bowl on the floor of the enclosure, though many chameleon keepers find that chameleons prefer to drink drops of water from foliage than from a standing water source. There are several commercial products available or a ‘homemade’ apparatus can be installed into the enclosure to provide adequate water for the chameleon. The Exo Terra ‘Dripper Plant’ is one such product as already mentioned in section 4.1. This product consists of a pump that sits within a regular water bowl that pumps water through a pipe up the stem of a fake plant and then drips down the leaves back into the water bowl (see figure 6.1).

![Exo Terra Dripper Plant product](image)

Chameleons tend to drink water over a long period of time (roughly half an hour). It is important that the drip system provides enough water to keep the chameleon sufficiently
hydrated but at a rate slow enough to satisfy the animal’s natural behaviour (Davison, 1997).

Alternatively, the enclosure can be misted with a spray bottle several times daily, ensuring moisture build up on foliage, to ensure there is adequate water supplied.

**Method of Feeding**
Chameleons have a very unique method of feeding that should be addressed here. When catching insects, the chameleon shoots its incredibly long tongue out of its mouth and catches the insect with the bulbous end. When contracted the muscles of the tongue are folded back on themselves like an accordion. Disc-like structures in the tongue named ‘Z-discs’ contract on to each other. The shape of the ‘Z’ illustrates how the discs are arranged (Le Berre et al, 2000).

When feeding upon vegetation, fruits and flowers, the chameleon eats in the same manner as any other herbivorous lizard, by biting off pieces and chewing several times before swallowing (Le Berre et al, 2000).

The anatomy and process behind how the tongue works is quite complex and it is not necessary to discuss it here. The following diagrams, though, are provided to give an overview.

![Diagram showing stages of tongue projection](image)

**Fig 6.4** Diagram showing stages of tongue projection
Fig 6.5: Sequence of tongue projection
7 Handling and Transport

7.1 Timing of Capture and Handling

The ideal time to capture reptiles is in the morning when it is cool and before the animal has had the chance to warm up and become active. As stated in section 4.6 Temperature Requirements, night-time heating is not required (unless in an area of cold climate where low temp heating may be provided overnight) and so the chameleon would have cooled overnight and so not be as active as later in the day.

7.2 Catching Bags

The initial capture of a chameleon is performed using just the hands. Once captured, the chameleon can be placed within any type of bag made of a soft and breathable material. The bag should be large enough for the individual to fit comfortably and sit in a natural position. Crumpled paper could be placed within the bag to give the chameleon something to grab onto. Pillow cases or other soft cotton bags are ideal. It is important to remember here that bags should be turned inside out to prevent parts of the seam or loose threads entangling the animal. Small plastic tubs of a sufficient size fitted with a couple of branches for the chameleon to grab a hold of can be used in place of bags.

7.3 Capture and Restraint Techniques

Capturing a veiled chameleon for the purposes of weighing/examination or moving to a transport container does not require much restraint. For these purposes, it is best to limit the amount of handling to reduce stress and keep the animal calm by placing it in a bag or small container. For detailed method of restraint for more rigorous examination or medical treatment see section 8.2 Detailed Physical Examination.

To capture a chameleon from its enclosure it is best to use both hands. Ideally, it would be good if the chameleon would climb onto the capturer’s hands with a little bit of encouragement, though this rarely happens with chameleons as they are known to be slow to condition to handling (Davison, 1997).

To pick up the chameleon it should be approached slowly and deliberately. One hand should be placed under the front legs of the chameleon while the other hand unwinds the prehensile tail. When the weight of the chameleon is supported, both hands should be raised simultaneously to lift it off its perch. The chameleon should grab onto your hand.
with its front feet and once feeling secure should let go of the perch with its back feet to grab onto your hand.

![Fig 7.1: Ideal capture method](image1.jpg)

![Fig 7.2: Guiding the chameleon onto your hand](image2.jpg)
It is important to note here that the chameleon should not be forcefully removed from a perch when it is gripping on as this could injure the animal’s legs by pulling muscles or breaking delicate bones (Davison, 1997).

Once removed from the enclosure and in the capturer’s hands it is best to hold the chameleon loosely, just supporting its weight and allow it to grip onto your fingers (Figure 7.3). From here the chameleon can then be placed inside a soft material bag or holding container. The animal should be grasping onto a perch in the container or crumpled paper in the bag and sitting normally before the support of your hands is removed.

### 7.4 Weighing and Examination

To weigh the veiled chameleon, the bag or container holding the chameleon can be placed on the scales. It is important to weigh the empty bag/container first so that this weight can be subtracted from the total weight (bag/container + chameleon) to determine the weight of the animal.

An examination can be performed while the chameleon is in the hands or while in a small transparent plastic container. A general examination would include checking the eyes, mouth, nostrils, cloaca, skin and body condition for any abnormalities, as well as checking the animal’s movement for signs of pain or discomfort or difficulty in moving normally.


7.5 Release

To release the chameleon it should be removed from the bag/holding container following the same instructions as in section 7.3 and then placed back onto a perch in its enclosure. The chameleon should reach out to a perch in front of it with its front legs and then follow through with the back legs. Again, the support of your hands should not be removed until you are sure the chameleon is grasping onto a perch and supporting itself.

7.6 Transport Requirements

The IATA Live Animal Regulations (2013) outlines the following requirements for transporting chameleons:

For the purposes of measuring lizards for transport:

“Lizards (including chameleons) and tuatars should be measured by snout-to-vent length (SVL), tail length (TL) and in body width (BW).”

“All species with the exception of young and small specimens must be packed individually.”

“Chameleons 10cm or greater in SVL need to be packed in adequate space to rest naturally. The enclosure needs to conform to the body shape and size. Specimens should be packed one per inner enclosure. The inner enclosure may be cloth, woven material, or rigid container. Crushed or crumpled paper must fill at least 25% of inner enclosure.”

7.6.1 Box Design

Long-term transportation (IATA Standards)

There is no explicit reference to an outer enclosure in the IATA Regulations, though it is implied. It is assumed that the outer enclosure should be made from a strong and rigid material such as wood, metal or strong plastic.

Following general guidelines commonly stated within The IATA Live Animal Regulations (2013), the box should have ventilation sufficient to allow air through the box and also allow air to escape through the roof, i.e. ventilation holes should be located on all sides of the box as well as the roof.

The door could be located on any side of the box or the roof. This needs to be designed in a way that makes it secure and allows a locking device.

The floor should be lined with a non-slip material such as rubber matting, or alternatively, the floor could be divided into sections for the inner enclosures to nestle into, to prevent movement of the inner enclosures containing the animals.

The size of the box should allow sufficient room for the number of animals to be contained, including their inner enclosures.
Inner enclosures could simply be a cloth bag or solid container made from wood or plastic made to a size just large enough to fit the chameleon perching on crumpled paper or small branches in a natural position. If a solid material is used for the inner enclosure then ventilation needs to be provided in these also.

![Fig 7.4: The preferred transport container type (solid thick plastic container with clip-lid, ventilation holes, a bamboo lattice as furnishing and crumpled newspaper as cushioning). This could then be shipped within a larger plastic or wooden crate either singularly or along with several other identical containers.](image)

**Short-term transportation**

If the chameleon is being transported only within the captive animal facility (e.g. from its enclosure to a vet clinic) or a short distance external to the facility, then the IATA standards discussed above are not necessary. A cloth bag or small plastic container would be sufficient options for short-term transportation. Crumpled paper or some form of perch should still be provided, however, to allow the chameleon to sit in a natural position. Ventilation is also required.

**7.6.2 Furnishings**

As stated above, crushed or crumpled paper must fill at least 25% of the inner enclosure. The purpose of the paper is so that the chameleon has something to grasp on to, as well as to provide some cushioning. The natural behaviour and positioning of the animal needs to be considered. *C. calyptratus*, being an arboreal species, rarely comes to ground and walks on flat hard surfaces. They instead spend most of their time gripping onto branches and other vegetation. The crumpled paper aims to simulate this to keep their feet in a natural position to prevent injury. As *C. calyptratus* is one of the larger chameleon species, a thick and strong paper/cardboard is recommended to support the animal’s weight.
Paper should be provided if a cloth bag is used to hold the chameleon during transport. However, the preferred transport container (see Figure 7.4) is a rigid plastic container in which branches would be supplied for perching as well as some crumpled paper for cushioning.

### 7.6.3 Water and Food

In general, food should be withheld from insectivorous lizards in the 24 hours leading up to transport. Food does not need to be supplied within the transport container. Food can be offered as soon as the individual is settled into its new environment after release. Water, similarly, does not need to be offered within the transport container. It is a good idea to offer water through a drip system/misting prior to capture and water provided as normal after release. In the event of delay causing the total transport time to exceed 24 hours, water can be offered via misting with a spray bottle.

### 7.6.4 Animals per Box

Adult specimens must be transported individually within inner enclosures. Juvenile specimens may be transported together within an inner enclosure, ensuring there is enough room and enough paper/branches to hold on to for each individual. There is no indication of the number of specimens that can be transported together in one outer enclosure in the IATA Regulations (2013). Reasonable judgement would suggest, however, that multiple individuals could be transported together in an outer enclosure of an appropriate size, so that each individual has its own space that doesn’t overlap with others.

To maximise ease of transport and prevent too much heavy lifting, it is suggested that no more than 12 specimens be transported in one outer enclosure. The individuals can be arranged within the outer enclosure in rows of 3x4.

### 7.6.5 Timing of Transportation

Reptiles should be transported at a time that is neither too hot nor too cold to prevent exposure to thermal extremes. Timing of transportation should be well planned prior to the event to limit, as much as possible, the risk of delays. All personnel involved with the transportation should be clear on the schedule to ensure that events run smoothly and on time.

### 7.6.6 Release from Box

Release after transport is the same as release discussed in section 7.5 above.
8 Health Requirements

8.1 Daily Health Checks

Any animal in a captive environment relies solely upon the keeper to provide the best possible care. It is necessary to be aware of what is ‘normal’ for a species/individual so that any abnormalities can be readily identified. Animal keepers require excellent observational skills to pick up potential health problems while they are manageable and before they become too serious. This can often be difficult as many species (particularly reptiles) can hide the signs of illness for quite some time before they start to show. At this stage the illness may already be well developed and difficult to treat.

To be able to detect any potential illness as soon as possible daily health checks are essential. This can be done as a distant examination during the routine daily cleaning/feeding tasks. It is not necessary to physically handle the animal every day, rather just observing the animal without disturbing it.

For the veiled chameleon a healthy specimen should:
- Have free movement in its limbs and joints
- Be alert during day-time hours
- Have good body condition (i.e. not over weight, not too skinny – bones should not be clearly visible particularly the ribs, shoulders and pelvis)
- Be clear of any cuts, abrasions
- Be free of any deformation – kinked bone structure, misaligned jaw, crooked or bumpy casque
- Be free of any swelling
- Have free moving eyes – eye turrets plump, not sunken, pupil opening should be round and free of encrustations or foreign objects
- Not be gasping or open mouth breathing
- Be able to grip firmly with its feet
- Be free of any mucus around mouth, nostrils and eyes
- Have solid faeces of normal colour and free of blood
- Have supple skin – i.e. not dehydrated
- Be free of lumps under the skin
- Have a clean and clear cloaca
- Be of a normal colour (not always an indicator of ill health, but darker colouration can indicate stress or inadequate temperatures)
- Be eating normally – have proper use of tongue
- If shedding, skin should come off in large pieces over a few days

(Davison, 1997; Haggett, 2009; de Vosjoli, 2004; Bartlett & Bartlett, 2005)
8.2 Detailed Physical Examination

8.2.1 Chemical Restraint
A suggested anaesthetic is the inhalable gas Halothane (Fluothane I.C.I.) (Le Berre et al, 2000) though others suggest that Isoflurane is a better option (J. Salkeld, pers. comm). These anaesthetics could be administered via a face mask of a suitable size and shape to fit the chameleon’s head, or by gas chamber. Any anaesthetic should only be administered by a veterinarian, vet nurse or other person trained in the administration of general anaesthetics.

8.2.2 Physical Examination
To reduce stress of the animal being examined it is best to perform physical examinations and invasive procedures quickly to minimise the time the individual is subjected to the stressful situation. It is therefore important that these procedures are undertaken by confident keepers with a clear plan of what is to be done before the procedure begins. The correct way of handling and restraining should be well known to the keepers involved to avoid clumsy or careless handling that could cause injury or undue stress to the animal.
The method for a simple capture has already been discussed in section 7.3. The following describes how best to capture a veiled chameleon for physical restraint (as outlined by Le Berre et al, 2000).

- Before picking up a chameleon it is important to know that grasping by its nape, neck, spine or tail will be interpreted by the chameleon as aggressive and will cause stress
- It is best to encourage the chameleon to climb and hold on to you rather than grabbing at and pulling the chameleon off its perch
- This is done by putting your hand under the neck and belly and slowly and gently raising your hand to lift the chameleon which will encourage it to climb onto your hand
- At this point, the chameleon is holding onto you rather than you holding onto it which is the least stressful for the animal. A close external examination of the animal can be performed here including the entire skin, the feet, claws and legs, the cloaca, the head, eyes, nostrils, the jaw and external mouth area
- To restrain for a more invasive examination your free hand should grip around the body making sure to envelop the front legs to prevent movement. The front legs should be made to lie backwards along the side of the body. Two hands may be needed for large specimens – a towel wrapped around the chameleon may allow a more comfortable restraint for the animal (Figure 8.2)
- Your grip should be firm enough to prevent movement but gentle so as not to injure the chameleon
- While restrained the inside of the mouth can be examined and a variety of procedures can be performed such as medicating orally, medicating via injection, force feeding, taking blood samples, taking swabs, applying ID (microchip), palpating of body parts
- This type of examination and these procedures are best performed by 2 keepers – one to restrain and one to perform the examination/procedure

Fig 8.2: Restraining a veiled chameleon for administering oral medication
To open the mouth
Gently pinch the chameleon’s lips between the eyes and nostrils and maintain pressure for a few seconds. The chameleon should open its mouth (Figure 8.3). If not, the gular flap (skin under the chin) can be pinched between the thumb and forefinger and gently pulled down (Le Berre et al., 2000).
If it is difficult to keep the mouth open then a paddle-pop stick (or similar soft item that won’t damage the teeth or jaw) can be used to prise open the mouth. Use the above method to open the mouth enough to fit the flat stick in between the jaws, then gently twist 90° to open the mouth wide enough to see inside or perform the desired procedure.
With the mouth open a syringe can then be used to administer oral medications, food items can be gently pushed down the throat, swabs can be taken, mucus membranes can be examined and the inside of the mouth checked for normal colouration and any cuts or swelling.

![Fig 8.3: Opening the mouth for taking a swab](image)

While restrained, the animal should be checked all over for any abnormalities.
- The entire body should be gently palpated to check for any lumps or tender areas, paying particular attention to joints and the abdominal area
- Limbs should be moved/rotated to ensure proper movement
- If shedding, any excess skin can be gently removed. If any skin is retained and has not shed after some time, the chameleon could be soaked in tepid water at this time
For this species, the examinations that can be performed under anaesthetic and those that can be performed while conscious/restrained, are the same as chameleons are innocuous animals and easy to handle and restrain.

8.3 Routine Treatments

Subcutaneous injections (SC) – should be made in the chameleon’s flank by gently pinching and lifting a section of the skin to form a ‘tent’. The needle is then inserted between the epidermis and the dermis being careful not to penetrate too deep or protrude out the other side of the ‘tent’.

Intramuscular injections (IM) – made in the muscle mass preferably on the hind legs though the forelegs are also fine (Figure 8.4) (Le Berre et al, 2000)

Oral medication
Most treatments potentially required by the veiled chameleon will be given orally. To eliminate stress of the chameleon it is a good idea, where possible, to inject the oral medication required in to a feeder insect and then feed as normal as part of its daily diet. This, however, may not be possible with an ill chameleon as it may not be willing to take food items. In this case the method described above should be utilised to restrain and open the mouth of the chameleon. A syringe can then be inserted into the mouth and directed toward the back of the throat and the medication slowly administered (Figure 8.5). Having the head tilted back will assist in the medication going down the throat.
Keeping hold of the head until all the medication has been visibly swallowed will prevent the chameleon expelling the medication from its mouth (Chameleon Forums, 2014).

![Fig 8.5: Oral injection of medication](image)

**Common medications** (most require prescriptions; all should only be administered in consultation with a vet)

- **Albon (Sulfadimethoxine)** – an oral antibiotic used to treat bacterial infections and enteritis from coccidial infections
- **Baytril (Enrofloxacin)** – an antibiotic most commonly prescribed as an oral medication. Injectable Baytril can cause muscle necrosis
- **Ceftaz/Tazicef (Ceftazidime)** – an injectable broad spectrum antibiotic
- **Flagyl (Metronidazole)** – an oral antibiotic and antiprotozoal medication used to treat anaerobic infections and protozoan parasites
- **Ivomec (Ivermectin)** – a parasiticide for both endoparasites and ectoparasites. Can be given orally or as an injection depending on formulation
- **Metacam (Meloxicam)** – an oral Non-Steroidal Anti-Inflammatory Drug (NSAID) for treating pain and inflammation
- **Panacur (Fenbandazole)** – an oral broad spectrum parasiticide, largely used for intestinal parasites
- Ponazuril – an oral anti/protozoal medication used to treat coccidial infections (Chameleon Forums, 2014)

For treatment of wounds, Betadine is a commonly used antiseptic to prevent bacterial and fungal infections. It is available in a number of forms including a liquid spray, a cream and an ointment (see Appendix 8 for product details).

### 8.4 Known Health Problems

There are a number of commonly found health problems amongst captive chameleons. Most can be prevented simply through following best practice in husbandry techniques. Health problems may be due to:
- Poor nutrition
- Poor husbandry
- Trauma
- Parasites
- Bacterial infection
- Fungal infection
- Interestingly, Le Berre (2000) states that no virus has been found to affect chameleons (no publication since that date that was reviewed for this document has mentioned any viral infections of chameleons)

#### Dehydration

A common problem seen in new acquisitions is that of dehydration (Bartlett & Bartlett, 2005). Since it is not a requirement to supply water in the transport container (IATA LAR, 2013) the specimens may be denied water for an extended period of time should there be any delay during transportation. Specimens should be offered water after a period of 24 hours though this is not always possible. Unless you personally were accompanying the chameleon during its transportation it is not possible to know that it has been adequately hydrated. New acquisitions, then, should always be checked immediately for signs of dehydration. Look for the following:
- Dry, wrinkled skin (when pinched the skin should be well elasticised and snap back to its normal position. If it hangs loose after letting go this is a clear sign of severe dehydration – called skin tenting)
- Sunken eyes
- Dry mucus membranes (inside mouth)
- Listlessness
- Weakness
- Weight loss (records arriving with the animal should include a weight just prior to shipment)
(de Vosjoli, 2004; Fowler, 2007))

Even if the chameleon shows no signs of dehydration water should be offered as soon as possible upon arrival.
The new animal should be put into its holding/quarantine enclosure and the automatic misting/dripping system turned on (if one is used). Alternatively, the enclosure should be heavily misted by hand so that there is a good stream of water dripping from the fake and/or live plants supplied. It is also a good idea to observe the animal until it is witnessed to drink to ensure it is actually taking in a sufficient amount of water.

In severe cases of dehydration fluid therapy may have to be utilised. Fluids can be administered either orally or subcutaneously. Fluids would only be administered orally if the chameleon was responsive and able to swallow normally. This is done via a syringe or ‘eye dropper’ inserted into the patient’s mouth. It is important to go slowly and not give too much water at once to avoid choking, asphyxiation or flooding of the nasal passages.

If dehydration is severe the subcutaneous method is most likely required. Fluid is applied via a syringe under the skin on the flank of the chameleon (le Berre et al, 2000). The amount of fluid provided should be 10% of the animal’s body weight daily until the animal is fully hydrated. The full 10% should not be administered all at once but divided in to 3-4 smaller amounts a few hours apart (Fowler, 2007).

An isotonic saline solution of 0.9% should be used for rehydration as this equals the salt concentration of cells and blood (Fowler, 2007).

**Respiratory infection**

Respiratory infections are common among many captive reptiles and are mostly caused by poor husbandry practices. The most common causal factors are prolonged periods of humidity levels too high for the species or prolonged periods of temperatures too low. Proper maintenance of temperature and humidity appropriate to the species while maintaining adequate ventilation will do a lot to eliminate respiratory infections.

Other things that can cause respiratory infection, however, can include stress and underlying bacterial infections (Dorval, 2006).

Signs of respiratory infection can include:

- Wheezing
- Mouth breathing
- Drooling
- Large quantities of mucus in the mouth
- Nasal/mouth bubbling
- Sneezing
- Lethargy/weakness
- Shallow and rapid panting
- Loss of appetite
- Closed or puffy eyes

(Dorval, 2006; Bartlett & Bartlett, 2005; de Vosjoli, 2004; Haggett, 2009)
Treatment of respiratory infection can be as simple as raising the basking temperature by a few degrees (maximum of 36-38°C) for mild cases (Bartlett & Bartlett, 2005; Dorval, 2006). Note that a temperature gradient still needs to be maintained within the enclosure. It is important to be familiar with the required humidity levels of the species and providing these as well as allowing enough ventilation but without creating an area that is too draughty. Stabilising these elements at a level appropriate for the species can often be enough to fix a respiratory problem.

For more severe cases caused by bacterial infection, antibiotic treatment should be administered in consultation with a veterinarian.

**Metabolic Bone Disease (MBD)**

This is usually a nutritional disease from a lack of usable calcium in the diet (Davison, 1997). The importance of the calcium/phosphorus ratio needs to be emphasised here. Foods provided should have a calcium/phosphorus ratio of 2:1. The dietary provision of calcium must be accompanied by the provision of UVB so that the animal can produce vitamin D3 in the skin which helps to absorb the calcium (Kaplan, 2014).

Signs of MBD can include:
- Shaky and jittery movements
- Bowed legs
- Anorexia
- Spinal kinking
- Loss of coordination (especially in back legs)
- Weak grip
- Lethargy
- Rubbery jaw bone
- Spongy casque
- Inability to feed or use tongue properly

(Dorval, 2006; de Vosjoli, 2004)

Treatment of MBD is usually by amending the husbandry practices to ensure that dietary and environmental factors required by the animal are met. If MBD is caught in the early stages then proper provision of calcium/phosphorus and UVB is usually enough to get the animal to good health. Food items can be dusted with calcium supplements such as discussed in section 6.3 and the chameleon can be put into an outdoor enclosure during the day to get natural sunlight or a good quality UVB lamp can be installed in the normal enclosure. It is important that the UVB lamp is positioned in a way to maximise its benefit as UV radiation diminishes greatly with distance. A distance of 15-30cm from the basking spot is recommended. Also, the effectiveness of these lamps diminishes with age so they need to be replaced at regular intervals.

Severe cases would require veterinary consultation. There can be underlying issues causing MBD such as hormonal imbalances or kidney, liver or intestinal diseases that
would need to be diagnosed by a veterinarian. A vet would also be able to perform a series of calcium injections to ensure the animal is getting sufficient calcium.

Haggett (2009) recommends that a female that has MBD or has previously suffered from the disorder should not be bred. This is due to the high calcium requirement of egg production.

Fig 8.6: MBD showing by weakened legs

Fig 8.7: MBD showing by malformed casque
**Dystocia (egg binding)**
This is the retention of eggs inside the female – an inability to lay either a whole clutch or a few eggs.

Dystocia can be caused by inadequate provision of UVB, inadequate provision of laying sites, old age, high stress, physical blockage or deformity of canal, underlying illness like MBD, inappropriate temperatures or a female being ‘over-bred’ (Dorval, 2006; Haggett, 2009).

Females that are over-fed, dehydrated, sick, or over-supplemented have a predisposition to dystocia (de Vosjoli, 2004). Only females in prime health with a history of good husbandry should be used for breeding.

Dystocia should be suspected if a female thought to be gravid doesn’t lay within an appropriate time frame (30-40 days after mating) (Necas, 1999). Also if after an apparent successful laying the female becomes weak. This could signify a few eggs remaining inside. Palpation of the lower abdomen just in front of the rear legs may result in feeling of remaining eggs. An x-ray of the female is the most reliable method of confirming dystocia (Haggett, 2009).

Sometimes allowing an egg bound lizard to sit in tepid water helps to stimulate laying. A small plastic container can be used to fill with water at about 24-26˚C to a height that will cover the abdomen of the chameleon but allows it to keep its head out of water comfortably.
If soaking doesn’t work there are 2 options for treatment of a confirmed egg-bound female. The first is the use of oxytocin shots to stimulate laying. This should only be performed by a veterinarian as dosages need to be precise. The second option is surgical removal which will also leave the female sterile. Neither option has a great success rate and the surgical option can prove fatal as the female would already be in a weakened state making recovery unlikely (Haggett, 2009).

Renal or Hepatic (kidney or liver) Failure
Both the kidneys and the liver help to cleanse the body of toxins and so are very important for the overall health of any animal. Failure of these organs can be caused by dehydration, underlying bacterial infections, or vitamin deficiencies or hypervitaminosis, particularly of vitamins A and D3 (Dorval, 2006).

Signs of the kidneys or liver not functioning at full capacity include:
- Jaundice (yellowing of mouth tissues)
- Development of edemas (swellings around the throat)

Treatment of these conditions requires the underlying issue to be identified and addressed. See section above for treating dehydration, bacterial infections need to be treated with antibiotics and vitamin intake needs to be at a suitable level with any supplementation amended as required (de Vosjoli, 2004; Bartlett & Bartlett, 2005).

Stomatitis (mouth rot)
This can be caused by bacterial, viral or fungal infection and is usually secondary to other conditions. The condition can be exacerbated by, or the infection may occur due to stressors such as sub optimal temperatures or humidity, parasites, trauma, poor nutrition. In extreme cases the infection can spread throughout the head and cranial cavity causing loss of teeth and weakening of the jaw (Le Berre et al, 2000; Carmel & Johnson, 2014).
Signs include:
- Loss of appetite
- Weight loss
- Salivation
- Swelling or scabbing of the lips
- Inability to close mouth
- Red sores
- Discolouration and sensitivity inside the mouth
- White/yellow mucus in the mouth

Treatment of stomatitis involves identifying the infectious agent, whether bacterial, viral or fungal and treating accordingly. Husbandry techniques should also be examined to ensure optimal conditions. Things to check include temperatures, humidity, nutrition, anything in the enclosure that could cause trauma, any other potential stressors (Carmel & Johnson, 2014).

**Tongue Hyperextension**
This is when the chameleon is unable to retract its tongue after shooting it out to catch prey. There is no known cause for this but it has been observed to happen more often in chameleons with a calcium deficiency. Thankfully the problem is most often easily amended.
To prevent damage to the tongue while it is hanging out it is best to move the chameleon to a smaller holding area with minimal furnishings for it to be dragged or caught on. When moving the chameleon it is important to support the tongue. There should be just a single perch for the chameleon to sit on in the holding area. This holding enclosure should have sufficient heat so that the chameleon is comfortable but not at the regular basking temperature, 24°C is recommended. The bottom of the enclosure should have layers of moist paper towel to create some humidity to prevent the tongue from drying out. To keep the chameleon calm, the holding enclosure should be in a quiet and dark area away from excessive noise and activity. The tongue usually retracts by itself within 24 hours and is back to normal function (de Vosjoli, 2004).
In the event that the tongue does not retract of its own accord after 24 hours then a vet should be consulted.

**Prolapse**
A prolapse in females is the oviduct protruding from the cloaca and can be caused by nutritional imbalance, constipation or egg binding.
In the male, it is the hemipene that prolapses and can be caused by nutritional imbalance or physical trauma.
Some home remedies that have been utilised to fix a prolapse include soaking the affected area in sugar water or a corn starch solution. Also, just applying a slight pressure to the prolapse may encourage it to retract.
If the prolapse does not retract within a couple of hours then a vet should be consulted. A prolapsed hemipene or oviduct will begin to dry out and cause damage to the organ that will affect the reproductive potential of the animal (Dorval, 2006).

![Fig 8.10: A cloacal prolapse in a female chameleon](image)

**Shedding Problems (Dysecydysis)**

Chameleons, like other lizards, shed their skin in pieces. The shedding process should take a few days and there should be rough furnishings such as branches provided for the chameleon to rub itself against to aid in removing the old skin. Difficulty in removing the skin could be indicative of underlying health issues or suboptimal environmental conditions, particularly humidity. The chameleon should be given a detailed examination to identify any signs of other health issues and the environmental conditions should be checked and adjusted if necessary. Leaving parts of the skin on the animal can lead to constriction of body parts. Lizards in captivity are prone to losing toes and the ends of their tail due to retained skin constricting the body part (Carmel & Johnson, 2014). The chameleon can be soaked in tepid water to assist in loosening the skin before trying to carefully peel the old skin off. If there is resistance then the skin should not be forcibly torn off as this can cause injury.
Fig 8.11: Severe dysecdysis causing amputation of a foot

Endoparasites
Most of the time animals can live with endoparasites with no ill effect. Endoparasites only become a problem when the load becomes too great. If endoparasites become a problem then the chameleon can be treated in consultation with a veterinarian with the medications mentioned above, Ivomec or Panacur. Faecal tests for endoparasites are recommended to be performed biannually. This will allow regular monitoring of the presence of endoparasites and allow quick action to be taken should the load be identified as too great.

Ectoparasites
There are two ectoparasites that commonly affect reptiles – ticks and mites. They are both arachnids that feed on the internal fluids of their host and are visible to the naked eye.

Ticks are the larger of the two. When not engorged they are small and look much like a seed with legs. When engorged, they are several times larger with a swollen bladder-like abdomen. They bury their mouthparts deep into the skin of the animal to feed so it can be difficult to remove them without breaking these parts off and leaving them in the host. It is best to dab the tick with rubbing alcohol on a cotton ball prior to pulling them off to kill the tick and loosen its grip. They can usually be pulled off easily with tweezers (Bartlett & Bartlett, 2005).

Mites are smaller and harder to remove as they can hide in any fold of skin or under the eyelids or, in the case of chameleons, the eye turret. The best way to eliminate mites is by
using the product ‘Top of Descent’ as it is very effective and harmless to reptiles (see Appendix 9 for product details). The enclosure can be sprayed with the product with the infected animal still inside. It is, however, best not to spray directly on to the chameleon.

8.5 Quarantine Requirements

The General Standards of Exhibiting Animals in NSW (DPI, 2004) Clause 48 states that:

“A newly acquired animal must be kept in isolation for as long as may be necessary to provide for its examination, acclimatisation and, if necessary, restoration to good health before being placed in the company of other animals.”

The Zoo and Aquarium Association General Standards and Guidelines (ZAA, 2011) states that:

S5.4 “The operator must ensure species appropriate quarantine procedures are implemented.”

G5.7 “Appropriate quarantine procedures and guidelines should be written, maintained and readily available to staff.”

G5.8 “Quarantine procedures and guidelines should consider:

i. isolation of newly acquired animals to provide for examination, treatment, monitoring, acclimatisation and, if necessary, restoration to good health;

ii. physical examination of all animals on arrival, including performance of appropriate clinical and laboratory diagnostic tests;

iii. veterinary treatment for existing illness, disease, injury;

iv. adaptation to diet, including supplemental feedings, if necessary, to meet nutritional requirements;

v. appropriate time periods for quarantine to ensure animals are clear from communicable disease and injury;

vi. veterinary care and treatment as necessary to protect against communicable diseases.

Woodford (2000) published the following concerning suggestions for quarantine of reptiles:

“Quarantine for reptiles should last for 90 days. Quarantine facilities should be adequate for the thermal requirements of the species under quarantine and allow for thermo-regulatory behaviour.”
1. Faecal examination, direct and flotation, for protozoan (especially Cryptosporidia sp. and Amoeba sp.) and metazoan parasites. Three or more consecutive tests should be negative.

2. Culture faeces for Salmonella sp.

3. Carry out complete Blood Count and PCV (Packed Cell Volume)

4. Examine blood smears for haemoparasites

5. Swab/nasal wash and examination for Mycoplasma sp. and Mycobacteria sp.

(6. omitted as not relevant to lizards)

7. Check for tick infestation, especially Amblyomma sp. that can be vectors of cowdriosis-heartwater. If present, treat with an acaricide.”

General recommendations for any quarantined animal include:

- Housing in a separate facility to that of the general collection
- Housing all quarantined animals singularly
- Servicing that animal last, after the general collection animals have been serviced
- Washing hands thoroughly with antibacterial soap before and after handling or contacting its enclosure, food etc.
- Wearing disposable gloves while servicing the animal
- Using separate tools and equipment from the rest of the collection and disinfecting between each use
- Using food and water bowls separate to that of the general collection and washed/disinfected daily
- Having a single person responsible for the quarantined animal to limit the risk of contamination

Any new acquisition should be quarantined as well as any individual that is known or suspected to be affected by a transmissible disease.
9 Behaviour

9.1 Activity

Veiled chameleons are diurnal and spend a large portion of their time basking as they tend to like high temperatures (Dorval, 2006). Chameleons tend to be very secretive animals and prefer to be hidden rather than out in the open. They have a number of ways to assist them in concealing themselves, the most obvious of course being their ability to change colours and patterns. They also have very malleable bodies and a soft bone structure that allows them to greatly change the size and shape of their bodies. Their ribs, particularly, are very flexible as they are part bone and part cartilage (Tolley & Herrel, 2014). To help conceal themselves amongst the branches they are able to suck their bodies’ right in to a narrow tube shape and lay flat against the branch they are perched on.

![Fig 9.1: A male veiled chameleon reducing its body size in an attempt to hide](image)

Failing this, they are also able to expand their bodies dorso-ventrally so that the surface area of their sides is greatly increased, resulting in them appearing much larger to deter potential predators or competing chameleons. They may also use this ability to assist them in camouflaging amongst the foliage. They will also sway on a branch to imitate leaves blowing in the wind (Dorval, 2006). Various chameleon species have also been observed to allow themselves to fall from a branch to the ground as a last effort to evade a predator or some perceived danger. Again, their malleable bodies and flexible bone structure allows them to do this without injury (Dorval, 2006).
9.2 Social Behaviour

The veiled chameleon is not a social animal preferring to live a solitary life, though groups of individuals can live communally within a reasonably small area without much conflict, though this is dependent on the dynamics. Groups of females will most often tolerate each other, each individual ignoring the presence of other females. A single male will often live amongst a group of females where they will ignore and be ignored by the females until a female becomes receptive. There is very rarely aggression displayed between males and females in the wild. It is only when they are paired up in captivity in a confined space where one can’t get away from the other that any serious aggression is displayed (Necas, 1999).

Males will not tolerate the presence of other males. In densely populated areas there may be a single male per tree and they will not tolerate another male invading their territory. Aggression between males is usually displayed with the males facing each other with mouth agape, throat pouch extended and hissing. They will then lunge at each other to hit the flanks of the opponent or to grab the legs or head casque of the opponent in the mouth. One animal will submit and retreat to another branch leaving the winner to his area. The winner rarely follows to chase the weaker male further off (Necas, 1999).

Although solitary as adults, studies have shown that growing up in groups as juveniles can greatly benefit chameleons in their adult life (Salleh, 2014). It has been shown that chameleons reared in isolation are less colourful and more submissive than those who grow up together. Chameleons are known to hatch together and disperse slowly so they may well spend time with their siblings in the wild which benefits their social abilities later in life. Excerpts from Salleh (2014) follows:

“Animals reared in groups showed signs of aggression. They chased the other animal, curled and uncurled their tail, compressed their body and extended their throat. Those animals reared in isolation, on the other hand, were more submissive in their encounters with others - fleeing or curling into a ball”. This indicates that veiled chameleons raised in groups are more dominant than those raised individually and therefore are more likely to reproduce as adults.

“Those reared in a group would become brighter and more saturated in colour [in social situations] whereas isolated individuals tended to become darker and duller in colour”. Again indicating greater reproductive success as adults due to the increased display ability (especially for males).

Chameleons raised in groups were also found to be better foragers than those raised individually. Those raised in groups were found to catch their prey much quicker than those raised in isolation, possibly due to the competition between individuals when raised in groups. If they can’t catch food quickly then they miss out.
**Colour Communication**

Chameleons, of course, are known for their ability to change colour. It is now known that colour is an indication of mood more than for camouflage as previously believed. Colour is used among chameleons to communicate to each other in regards to things like aggression and sexual receptivity. The following figures outline the veiled chameleons colour zones (Figure 9.2) and what different colour combinations could potentially indicate (Figure 9.3).

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**Tab. 1: Coloration on the skin zones (1–14 = skin zones; s. above):**

|   | W°♂ | B|l°♂ | Bw°♂ | G|n°♂ | Y°♂ | O°♂ | G|y°♂ |
|---|-----|---|-----|-----|---|-----|-----|-----|---|
| 1 | ++  | ++ | ++  | --  | -- | --  | ++  | --  | -- |
| 2 | ++  | ++ | ++  | --  | -- | --  | ++  | --  | -- |
| 3 | --  | ++ | ++  | ++  | ++ | ++  | --  | ++  | -- |
| 4 | --  | ++ | ++  | --  | ++ | --  | ++  | --  | -- |
| 5 | --  | ++ | ++  | ++  | ++ | --  | ++  | --  | -- |
| 6 | --  | ++ | ++  | ++  | ++ | --  | ++  | --  | -- |
| 7 | --  | ++ | ++  | ++  | ++ | --  | ++  | --  | -- |
| 8 | --  | ++ | ++  | ++  | ++ | --  | ++  | --  | -- |
| 9 | --  | ++ | ++  | ++  | ++ | --  | ++  | --  | -- |
| 10 | -- | ++ | ++  | ++  | ++ | --  | ++  | --  | -- |
| 11 | -- | ++ | ++  | ++  | ++ | --  | ++  | --  | -- |
| 12 | ++ | ++ | ++  | ++  | ++ | --  | ++  | --  | ++ |
| 13 | ++ | ++ | --  | --  | -- | --  | --  | --  | -- |
| 14 | ++ | ++ | --  | --  | -- | --  | --  | --  | -- |

*Fig 9.2: Colour scheme of Chamaeleo calyptratus*
9.3 Reproductive Behaviour

Both male and female veiled chameleons signal their breeding receptivity via colouration. The female adds flashes of sky blue to her normal pale green colour along the back and tail and on the casque.

The male will brighten in colour, laterally flatten his body to appear larger, expand his gular pouch and nod his head. The first sign of a male being ready to mate may be regular rolling and unrolling of the tail (Figure 9.4). He approaches the female with a side-to-side swinging walk, tail tightly curled, and can be quite aggressive toward her, sometimes striking at her with significant force that can potentially injure the female (Bartlett & Bartlett, 2005).

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Tab. 2: Characteristic patterns and their meanings:  
1–14 = skin zones, W, Bl, Bw, Gn, Y, O, Gy = colors, see Tab. 1, v = or, + = and,  
b = bright, d = dark, l = turquoise, f = spot, bf = big spot, lf = little spot, p = emargination  
. = interpunction.  
Example: 4Y+GnLf+O.p = In males the transversal stripes (4) are yellow (Y) with little (l) green (Gn) spots (f) and have an orange (O) emargination (p).

Fig 9.3: Reading the colour of a veiled chameleon
If the female is receptive she will maintain her receptive colouration and turn and start walking away. The male will then pursue her, often butting her on the back and tail with closed mouth, before mounting her (Figure 9.5).

The act of copulation lasts a few minutes and can be repeated several times a day (Bartlett & Bartlett, 2005).

If a female is not receptive to a male her colour will darken to an olive-green or even black with bright neon green or yellow stripes or spots. She will stand erect, flatten her body laterally, rock back and forth and expand her gular area (Figure 9.6). If the male approaches too close the female will then open her mouth and hiss and strike at the male with mouth open (Bartlett & Bartlett, 2005).
A rejected male will give up trying to court the female after a few minutes and retreat to a far corner of the enclosure. His colours will become dull and he will suck in his body to appear smaller in size (personal observations).

A successfully mated female will reject males after 18 hours to 3 days after copulation by displaying her non-receptive colouration of dark green to black with neon green/yellow stripes/spots to any chameleon she sees. If left alone the female should display her normal relaxed colouration of pale green with white/yellow spots, though sometimes a female will retain her gravid colouration for extended periods.

Coming up to laying the female will go off food and come to ground often to look for nesting sites. She may dig several holes before deciding on one to complete to lay her eggs in. The completed hole can be up to 30cm deep/long and wide enough for her to turn around. She will lay her eggs at the very bottom of the hole and partly fill it in (Bartlett & Bartlett, 2005).

Gravid females often exhibit increased basking behaviour just prior to laying of the eggs (Bartlett & Bartlett, 2005).

9.4 Bathing
Chameleons do not naturally bathe themselves. Veiled chameleons, however, do often seem to enjoy sitting under misting or drip systems in captivity.
9.5 Behavioural Problems
Chameleons generally do not display behavioural problems in captivity. However, possible behavioural problems could include:

- aggression
- abnormal feeding behaviour – going off food (could be a sign of a gravid female coming close to laying)

9.6 Signs of Stress
Stress on an animal can lead to immunosuppression and cause illness in an animal that would normally be able to overcome disease. It is important to be able to identify stress in captive animals under your care. Signs of stress in chameleons may include:

- Abnormal behaviour – unusual amounts of activity or inactivity for that individual
- Sitting with eyes closed during the day
- Dark or dull colouration for extended periods of time
- Not eating
- Constant hiding
- Aggressive behaviour

(Haggett, 2009)

Stress may be caused by:

- Illness
- Overcrowding of an enclosure / being forced to co-inhabit with others
- Temperatures outside of preferred range
- Exposure/insufficient hiding places
- Over handling – chameleons generally don’t enjoy handling though certain species or individuals may handle better than others

(Haggett, 2009)

9.7 Behavioural Enrichment
Providing enrichment for any captive animal is important to keep the animal occupied and stimulated. Providing enrichment can assist in maintaining the health of captive animals as it keeps them active both physically and psychologically. Providing enrichment to encourage natural behaviours is particularly important in a zoo facility where the focus is often on education of visitors regarding the species and its natural history.

There are 5 areas of enrichment commonly identified. They are:

- Sensory (visual, olfactory, auditory, tactile)
- Feeding (food items, presentation, frequency)
- Environmental/Physical (furnishings, substrates, water bodies, visual barriers)
• Manipulative/Cognitive (toys, problem solving)
• Social (solitary v gregarious)
(Hawkins, 2003; Irwin et al, 2013)

**Sensory enrichment ideas**
• Adding a mirror to the enclosure for the chameleon to see its reflection (this has however been observed to have negative effects in some instances)
• Herb spray - many authors state that chameleons virtually lack smell but will ‘taste’ things with the end of their tongue which they then touch to the Jacobson’s organ (Le Berre et al, 2000; Dorval, 2006)
• Place faeces of another chameleon or different species in enclosure (only if faeces is known to be free of parasites and infectious disease)
• Swap enclosures with another chameleon (could also be considered social enrichment)

**Feeding enrichment ideas**
• Release of live insects into enclosure to encourage hunting behaviour
• Feeding via tongs
• Providing a variety of insect species
• Including some fruits and vegetation in the diet
• Feeding the occasional pinkie mouse
• Using a slow release insect feeder
• Allowing natural drinking behaviour via a drip system
• Changing the presentation of food
  o For fruit – in bowl, hidden in foliage, on ‘fruit tree’ (a stick with ‘branches’ upon which pieces of fruit are spiked)

**Environmental/Physical enrichment ideas**
• Providing plenty of branches that cross each other and allow multiple routes of movement – allows climbing and normal movement, also acts as sloughing aids as chameleons will rub against surfaces to assist in shedding (Dorval, 2006)
• Adding extra branches or furnishings
• Subtracting branches or furnishings
• Blocking the chameleon’s normal route of movement forcing it to take a different route and explore other areas
• Rearranging the branches and furnishings
• Provision of basking spot – veiled chameleons in particular are known to be ‘sun loving’ and will spend a large amount of time in their optimal basking spot
• Provision of misting/drip system
• Providing a natural substrate that females can dig in
• Using live plants

**Manipulative/Cognitive enrichment ideas**
• Providing damp soil or other similar substrate for a gravid female to dig nest burrows could be considered ‘manipulative’ behaviour
Social enrichment ideas

- Veiled chameleons are largely solitary though there are some social activities that could be considered.
- Handling by keepers – captive veiled chameleons tend to condition to handling quite readily.
- Pairing males and females for breeding.
- Small groups of females have been known to tolerate inhabiting the same area. Having multiple females together for a short period of time would encourage them to establish their own mini territories. This would mirror the wild behaviour of females inhabiting the one tree each having their own area of that tree. It should be stressed, though, that multiple chameleons should not be housed together permanently.
- Male to male pairing may be possible to encourage competitive behaviour. This would only be done, however, under constant supervision and for a short period of time.
- Adding a mirror to an enclosure could be considered social enrichment as the chameleon would identify its reflection as another chameleon.
- Swap enclosures with another chameleon.

Included in the appendices are some forms that may come in useful regarding enrichment. The first (Appendix 10) is an Enrichment Rating Scale which allows you to rate the effectiveness of any enrichment provided. The second (Appendix 11) is an Enrichment Data Transfer Form which should accompany any animal that is being transported from one institution to another. This form outlines the typical behaviour of an individual and the history of enrichment provided to it.

### 9.8 Introductions and Removals

Most keepers won’t house veiled chameleons together due to their solitary nature so introductions and removals will only take place when pairing males and females for breeding.

Bartlett & Bartlett (2005) recommend having a planned pair in adjacent enclosures where they can see each other for a few hours before putting them in the same enclosure. This will reduce the risk of rejection or aggression as the pair has time to recognise that there is another animal nearby instead of suddenly having another animal invading territory without any prior warning.

When pairing a male and female together they should always be closely observed to prevent serious injury to the female from an overly aggressive male or to the male from a non-receptive female.

Males should always be introduced to the female’s enclosure and not vice versa. Males are very territorial and may become aggressive toward a female entering his enclosure (Ferguson et al, 2007).

If the pairing is successful they should be left to mate for an entire day before removal of one to maximise the potential for successful copulation and fertilisation.

Husbandry Guidelines for Veiled Chameleon (Chamaeleo calyptratus) Stuart Daniel (2015)
9.9 Intraspecific Compatibility

Though in the wild veiled chameleons can inhabit areas with others of their species, it is not recommended to house veiled chameleons together in captivity. The smaller area and the competition for food and resources create a stressful environment that is not encountered in the wild. Individuals are not able to escape each other and dominating behaviour would ensue causing stress to the non-dominant animal.

9.10 Interspecific Compatibility

I don’t know of any facility that houses veiled chameleons with other species though it may be possible. It would not be recommended to house with other arboreal species as this would cause competition and aggression. It may be possible to house with purely terrestrial species as the two would very rarely interact if the enclosure design was large enough to accommodate it. There are a number of Uromastyx sp from the Arabian Peninsula that could potentially be housed with veiled chameleons in an exhibit showcasing species of that region. If these species were to be housed together you would have to be wary of the chameleon potentially coming to ground, particularly a female to dig a nest. Direct interaction could very well result in aggression so while it may be possible to house the veiled chameleon with terrestrial lizards such as Uromastyx sp, it is not recommended.

9.11 Suitability to Captivity

The veiled chameleon does very well in captivity. This species is one of the most commonly kept chameleons amongst private keepers worldwide due to its adaptability, tolerance of a range of temperatures and climates, and its relative ease of care and husbandry (Ferguson et al, 2007).
10 Breeding

10.1 Mating System

Veiled chameleons are polygamous – both males and females will reproduce with several mates throughout their life. Females tend to mate with only one male per receptive period and refuse other males after successfully mating. Males may mate with several females within the peak reproductive period (Tolley & Herrel, 2014). Males and females form short-term pairings only when breeding, they are otherwise largely solitary. Pairings may last up to 4 days during the female’s receptive period after which she will become aggressive toward the male and he will move on. During their pairing a male and female may mate several times (Necas, 1999).

Breeding of wild veiled chameleons can be seasonal or a-seasonal, depending on the population and the climate of the region they inhabit. In captivity though, with constant favourable conditions, this species can breed year round.

It is not believed that females actively exhibit mate choice behaviour. If receptive, the female is likely to accept any male presented to her (Tolley & Herrel, 2014).

Fig 10.1: Pair of C. calyptratus in the act of mating
10.2  **Ease of Breeding**

Veiled chameleons are considered relatively easy to breed. They can reproduce year round if some very easily maintained conditions are provided, such as optimal temperatures and diet (Le Berre et al, 2000). They are the most commonly kept chameleon species among hobbyists in the U.S.A. due to their ability to tolerate a range of conditions and for their ease of breeding.

10.3  **Reproductive Condition**

Sexually mature at 6 months (Le Berre et al, 2000) though earliest breeding of a female was at 4 months with successful laying of fertile eggs at 5 months (Necas, 1999).

10.3.1  **Females**

Despite being sexually mature at 6 months, or potentially earlier, it is recommended that females not be mated until at least 9 months of age as the resultant offspring of earlier matings have often been found to be weak and susceptible to many problems. Additionally, breeding a female too young can result in complications for that female later in life, particularly in regard to future breeding attempts (Haggett, 2009). In the weeks leading up to a planned mating the female should be offered a highly nutritional diet to ensure she is in good reproductive condition. The provision of adequate calcium is particularly important for egg production.

The average breeding size of a female is between 30.5cm and 40.6cm total length (TL) (Ferguson et al, 2007).

Over breeding of females can severely shorten their lifespan. In captivity where optimal conditions can be constantly maintained, females tend to produce more and larger clutches. This puts a lot of strain on the females so they should be allowed time to recover. Over worked females tend not to live past their 5th or 6th clutch (Ferguson et al, 2007).

10.3.2  **Males**

Male body condition isn’t as important as that of the female as the male only plays a very small part in the reproductive process and doesn’t require much energy or resources. It is recommended, though, that the male be allowed to reach full adult size before breeding is attempted (Ferguson et al, 2007). The male should have good overall condition with no sign of ill health.
10.4 Techniques Used to Control Breeding

The best way to prevent breeding in this species is simply separation of the sexes. As discussed in Section 9, veiled chameleons are a largely solitary species and so it is recommended to house them separately anyway.

In the event that a planned mating has resulted in a larger clutch than desired (can range from 12-93 eggs, see 10.13 Clutch Size below), any unwanted eggs can be removed and frozen to maintain the collection at a more manageable size.

It is important to note here that females that are not used for breeding can still produce eggs, though infertile. In the past it was quite common that un-bred females would become egg-bound, posing a serious health risk. This was most likely due to the fact that keepers would not suspect that the female would produce eggs. It is important to remain vigilant and be aware that these females may suffer from dystocia (Fife, 1999). If managed correctly and treated like a regularly gravid female, by providing the required diet and nesting substrate, egg producing un-bred females should not be adversely affected (Haggett, 2009).

10.5 Occurrence of Hybrids

Wild populations of a hybrid between the two very closely related species of *C. calyptratus* (veiled chameleon) and *C. arabicus* (Arabian chameleon) have been found where their respective ranges overlap (Necas, 1999). This hybrid was previously believed to be a sub-species, *C. calyptratus calcarifer*. There are no hybrids existing in Australian collections.

10.6 Timing of Breeding

In the wild the timing of breeding can vary greatly depending on the location and climate of a particular population. In dry climates breeding is limited to a single season in autumn (September/October, northern hemisphere) though in more suitable conditions and a wetter climate breeding can occur year round independent of seasonal factors (Necas, 1999).

A female will be receptive for 3-4 consecutive days and a couple will mate several times a day, more frequently in the beginning (5-6 times on day 1) and reducing with each consecutive day (1-2 times on day 4). The duration of coitus also decreases with each consecutive day from around 20 minutes on the first day down to 1.5 minutes on the last (Necas, 1999). Coitus, though, has been observed to last close to an hour in this species (Tolley & Herrel, 2014).

If mating is successful females will signal their gravidity with aggression towards others, particularly males, and through their gravid colouration (Necas, 1999).
10.7 **Age at First Breeding and Last Breeding**

Both males and females are sexually mature by 6 months of age. The earliest recorded mating of a female veiled chameleon is 4 months of age (Necas, 1999).

Although females may be able to breed as early as 4 months it is not advised to attempt breeding until around 9 months of age (Haggett, 2009). Some keepers recommend waiting until the female is 14 months old (Ferguson et al, 2007). A young female that is, herself, still growing will struggle to develop healthy eggs while still maintaining her own growth and condition (Ferguson et al, 2007).

Generally chameleons have a peak period for reproductive success, with young chameleons (in their first season) laying fewer eggs than older females.

This species, however, can breed right up until the end of its life.

10.8 **Ability to Breed Every Year**

*C. calyptratus* is able to breed annually, in those populations that breed seasonally; or continuously throughout its life for those populations that breed a-seasonally (Necas, 1999).

In captivity, provided with favourable conditions, year round breeding can be achieved.
10.9 Ability to Breed More than Once Per Year

If conditions are good this species can breed year round with potential to produce up to 3 clutches a year (Le Berre et al, 2000). Each clutch, though, takes a toll on the female so it is advised to monitor the condition of the female closely. So while it is possible that a female may breed 3 times in a single year it is recommended that a single female not be bred more than once per year.

Veiled chameleons are capable of *amphigonia retardata* (delayed fertilisation). Additional clutches have been observed in the absence of a male as females are able to retain living sperm in an epithelial pouch, the *receptaculum seminis*, in the oviducts. Therefore, several clutches can be produced from a single copulation (Necas, 1999; Haggett, 2009).

In the instance of double clutching, the second clutch is generally laid 90-120 days after oviposition of the first clutch (Ferguson et al, 2007).

Optimal captive conditions tend to maximise the potential for several clutches per year as well as the average size of each clutch.

Females can be receptive to mating again 60 days after laying a clutch of eggs (Bartlett & Bartlett, 2005).

10.10 Nesting, Hollow or Other Requirements

In the wild increased rainfall is a known trigger for breeding of this species (Bartlett & Bartlett, 2005). This could be replicated by misting the enclosure more often or increasing the time an automatic drip system runs, depending on the chosen method.

Oviposition often correlates with increased moisture in the substrate and is performed mostly in the night. Several days before laying, the female will start digging holes, often many, before choosing one in which to lay. Moisture in the substrate is very important as the eggs absorb the water surrounding them. There is also a transfer of moisture between eggs so that moisture levels are balanced among the whole clutch. For example, if in a large clutch the substrate surrounding the eggs at one end of the nest hole is wetter than the substrate surrounding the eggs at the other end, all eggs will contain the same level of moisture through this transfer between eggs (Necas, 1999).

In captivity a suitable substrate needs to be introduced to the female’s enclosure when it is suspected that she is gravid. It is also important to ensure that the substrate is deep enough. Generally the depth should be at least equal to the length of the female. More often than not, the female will dig to the very bottom of the provided substrate before laying her eggs.

A common practice in captivity is to provide a bucket full of potting mix or river sand (or combination of both) at a depth of about 30cm and ensuring the moisture level is enough for the substrate to hold when a burrow is dug out (Dorval, 2006).

The process of laying the eggs and then covering over with soil may take up to 24 hours. It is important not to interrupt this process and to allow the female to finish in her own
time. Only when the female climbs back up the branches and appears to be resting after the exhausting effort of laying should the nest be disturbed to check the eggs (Ferguson et al, 2007).

![Fig 10.3: A female in gravid colouration digging a nesting burrow](image)

Some breeders also recommend adding a small plant (the genus *Ficus* is often recommended to include in chameleon enclosures) to the substrate as females tend to make a nest at the base of small trees and shrubs (de Vosjoli, 2004).

![Fig 10.4: Female digging nesting burrow at base of plant](image)
10.11 Breeding Diet

In the wild the food intake of the female will increase significantly when gravid and her weight will increase rapidly (Necas, 1999). This should be mirrored in a captive setting. A general guide is to offer the gravid female 50-100% more food than her normal diet. Increasing the application of supplements to a gravid female’s food from once or twice a week to daily is recommended (de Vosjoli, 2004).

Davison (1997) recommends feeding egg-bearing female crickets as the cricket eggs contain concentrated lipids, protein and other important nutrients for egg production.

A few days to up to 2 weeks prior to laying, the female often goes off food (Fife, 1999). This is a good sign of imminent laying.

After digging the nest/s and then laying, the female will be significantly weakened. It is recommended to have plenty of food and water available to the female upon completion of laying (Ferguson et al, 2007).

Haggett (2009) suggests that a generously fed female is likely to produce more clutches and larger clutches per year. While more eggs may be desired to grow a collection quickly, it is important to be aware that each clutch puts a large strain on the female in regard to condition and nutritional resources, particularly calcium. To maintain healthy females it is recommended that they are not over worked in terms of breeding, so once per year is recommended.

10.12 Incubation Period

After copulation the females are gravid for 20-30 days (Necas, 1999). A gravid female becomes obvious due to her gravid colouration as well as her sudden weight gain and plumpness of the abdomen. Toward the end of her gravid period the outline of the eggs inside the female are clearly visible.
Haggett (2009) has observed gravid females start to dig nests at the expected time and go off food suggesting imminent laying of eggs, only to stop digging and resume eating as normal and not lay the eggs until several weeks after the expected date. This would indicate that gravid period can vary greatly and that withheld eggs do not always indicate dystocia.

Once laid the eggs generally take 6-8 months to hatch if maintained at 27°C though the incubation period can vary depending on temperature and humidity (Le Berre et al, 2000).

There are 2 stages of embryonic development: a ‘latent period’ where the egg increases in size but embryo development is at rest and a ‘rapid growth’ period where the embryo inside the eggs grows at an increased rate. The rapid growth period, at least in the wild, is possibly triggered by increased moisture and substrate temperatures at the beginning of the rainy season (Necas, 1999).

### 10.13 Clutch Size

An average clutch size for this species is 30-40 white eggs but the range can vary from this greatly (Necas, 1999; Le Berre et al, 2000). The fewest eggs in a clutch recorded for this species is 12 while the largest clutch size recorded is 93, which also happens to be the largest clutch size recorded for any chameleon species (Necas, 1999).
The eggs are like most other lizard species and oval in shape with average dimensions of 1.1cm x 1.7cm (Necas, 1999).

Generally the sex ratio of hatchlings is 1:1. However, there is a reported instance (unpublished) of *C. calyptratus* eggs incubated at a low temperature resulting in a majority of males. There are other anecdotal accounts of possible Temperature-dependent Sex Determination (TSD) and this is supported by the fact that chameleons generally do not possess heterochromosomes (sex-specific chromosomes); therefore sex of the embryo is not fixed after fertilisation (Necas, 1999). However a study published in the Journal of Herpetology concluded that this species has Genetic Sex Determination (GSD) (Andrews, 2005). More study needs to be conducted to ascertain whether this species is subject to GSD, TSD or a combination of both.

### 10.14 Age at Weaning
Chameleons do not provide parental care to their young as they hatch out in a precocial form, at least in oviparous species. Some breeders have observed apparent nest guarding after depositing of the eggs though this is short-lived. Generally, once the eggs are laid and the nest is covered over, the female leaves the eggs not to return. Females can be receptive to mating again 60 days after laying a clutch of eggs (Bartlett & Bartlett, 2005).

### 10.15 Age of Removal from Parents
Most often in a captive environment the eggs will be removed from the burrow created by the female immediately after being laid and the female has left the nesting site. The eggs will then be placed into an incubator to better control conditions such as temperature and humidity and increase the chances of a high hatching rate. This will be discussed in the following section: 11 Artificial Rearing.

### 10.16 Growth and Development
**Hatching**
A few days or just hours before hatching the eggs darken in colour and collapse and droplets emerge on the surface of the egg.
To hatch, the juvenile inside the egg jerks its head back and forth to slit the egg membrane with the egg tooth located on the tip of the nose. Once split the liquid inside the egg begins to spill out which is thought to act as a catalyst for the other juveniles to begin hatching. The split in the egg membrane made by the emerging hatchling is typically in a star shape, as shown in figure 10.7 (Necas, 1999; Haggett, 2009). Once the egg membrane is split the emerging hatchling will stick its head out and most often rest in this position for several minutes, hours or even a couple of days. Exposed to the air, the nostrils will dry out and the hatchling can take its first breath. The hatchling will then resume emerging from the egg, sometimes with the yolk sac still attached though most often it will have detached in the egg. If it is still attached it will fall off shortly after while the hatchling begins moving around (Necas, 1999).
Most often, eggs from the same clutch will hatch within 2-3 days of each other, though occasionally some eggs can take much longer, up to a few weeks after the first egg has hatched (Haggett, 2009). It is important, then, to not be too quick to discard eggs that you think should have hatched already.

In the wild, digging out of the nest can be long and exhausting and the mortality rate at this stage is high. It is believed that heat and light detection by the parietal eye plays a role in orientating the hatchling to the surface of the substrate (Necas, 1999).

Within any clutch of eggs there are most often a few that are infertile and will start to go off. Indications of this are severe discolouration (often going dull yellow, brown, green), severe dehydration or mould growth on the egg. It is important to monitor the clutch to identify any off eggs because if left with the rest of the clutch, the off eggs can affect the health of the fertile eggs. Particularly, rotting eggs can attract insects or maggots. If any rotten eggs are identified they should be removed from the clutch and discarded (Haggett, 2009). Sometimes healthy eggs can appear to be going off due to some discolouration or slight dehydration causing a shrivelled shell. If you are unsure about the health of any eggs it would be possible to remove them from the rest of the clutch though keep them in a separate container to see if they survive. Though if the eggs are off, separating them will ensure that they don’t affect the health of the rest of the clutch.

**Development of young**
Due to their rapid growth rate it is important to provide sufficient food and nutrients, particularly calcium, to juveniles during this period to avoid developmental disorders.
such as MBD (metabolic bone disease). To assist in the absorption of calcium it is also important to provide full spectrum light in the way of UV lamps (Fife, 1999).

Hatchlings generally measure 5.5-7.5cm total length (TL) and as with most other chameleon species growth is at a rapid rate reaching sexual maturity at 6 months (Le Berre et al, 2000).

Fife (1999) states that by 4 months of age juveniles can reach 30cm.

![Juvenile Chamaeleo calyptratus](image)

**Fig 10.9:** Juvenile *C. calyptratus*.

Hatchlings may eat immediately once they are completely out of the egg or wait up to 2 days to begin eating (Ferguson et al, 2007).
11 Artificial Rearing

11.1 Incubator Type

There are various methods used to incubate reptile eggs. Incubators can be self-made relatively cheaply, or commercially produced incubators can be purchased from pet shops and other suppliers.

A simple but very effective incubator consists of a simple plastic container with the eggs slightly depressed into a moist substrate. The container should have a secure lid but with several holes in the sides to allow some ventilation. This container could be maintained at the correct temperature by sitting on a thermostatically controlled heat mat or by having the ambient temperature around the container thermostatically controlled. To achieve the correct ambient temperature many breeders will use converted refrigerators or some other insulated box with a heat source such as a lamp or heat cord controlled by a thermostat.

Fig 11.1: Eggs incubating in plastic containers in a thermostatically controlled refrigerator
Many different incubator substrates have been used to incubate the eggs of this species including:

- Sand
- Soil
- Sand/peat moss mix
- Peat
- Perlite
- Vermiculite
- Crushed coconut shells

(Necas, 1999)

The preferred substrate for incubating reptile eggs, for most authors, is moistened vermiculite (Swan, 2008; de Vosjoli, 2004; Bartlett & Bartlett, 2005; Hagget, 2009; Davison, 1997). The vermiculite/water mix should be roughly 1:1 by weight. It is however best to judge by the texture of the mix. The vermiculite should be moist enough to clump together when squeezed but not too moist that water drips from the mix (Ferguson et al, 2007).

![Veiled chameleon eggs incubating](image)

**Fig 11.2:** Veiled chameleon eggs incubating in a plastic tub with ventilation holes around the sides. Moist vermiculite is the preferred substrate. The tub is sitting on a thermostatically controlled heat mat.

To prevent a build-up of carbon dioxide and to allow oxygen to circulate it is recommended that the lid of the plastic container be removed and fanned over the eggs about once a week (Swan, 2008).
11.2 **Incubation Temperature and Humidity**

There has been great variation in temperatures trialled for incubation of the eggs of this species. Some breeders prefer to maintain constant temperatures up to a maximum of 32˚C (Necas, 1999) and down to a minimum of 22-23˚C (Ferguson et al, 2007). Haggett (2009) suggests that constant 26˚C results in a high hatching rate of healthy juveniles. Other breeders prefer to allow variable temperatures with some dropping temperatures down to 16˚C at night and raising the temperature to 32˚C during the day.

Necas (1999) suggests that the best results were obtained using moist vermiculite as the substrate and having variable temperatures from 20˚C at night and raising to 30˚C during the day. This method resulted in an incubation time of 200 days, 100% hatching rate and minimal mortality during the first 2 months.

Breeders have found that a substrate that is too moist is not conducive to embryo development (Necas, 1999).

Andrews (2008) tested 3 different incubation temperatures: 25˚C, 28˚C and 30˚C, and found that a constant 28˚C resulted in the highest hatch rate and survival of hatchlings. She reasons that a constant incubation temperature is better than a variable one because of the fact that in the wild, the eggs would be buried about 30cm beneath the soil surface where the range of temperature fluctuation would only be 1-2˚C.

Though there have been varying success rates with varying incubation temperatures according to several different authors, it could be concluded that a constant temperature of 25-28˚C should result in a high success rate in incubating the eggs of this species.

There was no published data found stating an optimal humidity range for this species. Though, just like the incubation of most other reptile eggs the preferred medium being vermiculite should maintain a suitable moisture level so that it clumps together but does not drip when squeezed. The vermiculite should not be allowed to dry out too much in case of desiccation of the eggs. Likewise, it should not be too wet that large droplets form on the lid of the incubator that will drip onto the eggs. The moisture of the vermiculite, therefore, should be monitored regularly.

11.3 **Desired % Egg Mass Loss**

This is not applicable to reptilian eggs. During incubation there is likely to be regular fluctuation in egg mass due to water exchange, dependent on the moisture levels surrounding the eggs. The soft shell of reptilian eggs allows for greater water exchange than the hard shell of avian eggs (Deeming & Ferguson, 1991).

To ensure that the moisture levels don’t fluctuate too much and either cause desiccation or ‘drowning’ of the egg it is important to maintain the correct moisture and humidity levels within the incubator.

For veiled chameleons (and other Chamaeleonids) moisture in the substrate is very important as the eggs absorb the water surrounding them. There is also a transfer of moisture between eggs so that moisture levels are balanced among the whole clutch. For
example, if in a large clutch the substrate surrounding the eggs at one end of the nest hole is wetter than the substrate surrounding the eggs at the other end, all eggs will contain the same level of moisture through this transfer between eggs (Necas, 1999). It should therefore be expected that eggs within a single clutch should be very close to equal in mass.

11.4 **Hatching Temperature and Humidity**
Temperature and humidity conditions should remain constant throughout the entire incubation period right up to the point of hatching (Andrews, 2008).

11.5 **Normal Pip to Hatch Interval**
The period from pipping to hatching in veiled chameleons is relatively short compared to other chameleon species commonly held in captivity (Haggett, 2009). The hatchlings begin to slit the shell using the temporary egg tooth usually in a cross or star shape (Fig 11.3).
The hatching juvenile may then remain in the egg for 10-15 hours while it absorbs any remaining yolk before fully emerging from the shell (Ferguson et al, 2007).

![Fig 11.3: Star shape slit of a hatching veiled chameleon](image)
11.6 Diet and Feeding Routine

Sufficient food supplemented with vitamins and minerals as well as provision of plenty of water is essential for juveniles in captivity (Necas, 1999). This is to provide the best chance for growth and development in the early stages. Food items should be dusted with mineral and vitamin supplements at least twice weekly before being fed out (Haggett, 2009; Necas, 1999). Veiled chameleons, being one of the larger chameleon species, are usually able to eat pinhead crickets as hatchlings, though it is a good idea to also have some smaller insects readily available such as:

- fruit flies
- aphids
- woodlice
- mantis nymphs

(Haggett, 2009)

It is important to never feed a juvenile a food item with a length greater than that of the juveniles own head (de Vosjoli, 2004).

New hatchlings may begin to eat immediately or it may take up to 2 days. Once they do start eating it is recommended to try get the hatchling to eat about a dozen suitably sized insects a day (Ferguson et al, 2007). Haggett (2009) suggests providing a starve day for juveniles one day a week but doesn’t back this up with a reason why.

Some vegetation and fruit can be introduced to the diet early on. Items like alfalfa sprouts can be offered or pureed fruit and veg can be spread onto the foliage in the enclosure to allow the juvenile to lick it up (Ferguson et al, 2007).
A trick used to assist the hatchlings to be able to catch fruit flies initially is to mash some banana in a dish and place a paddle pop stick (or similar) in the banana so that it is standing vertically. The fruit flies will congregate on the paddle pop stick and allow the hatchling chameleons an easily caught meal (Haggett, 2009).

When feeding pinhead crickets or any other item that will grow in size, it is important to only feed what will be eaten and to look out for any that hide amongst foliage or in the substrate. If uneaten they will grow to a size that could pose a threat to the hatchlings. There are instances recorded where large crickets have attacked and injured juvenile reptiles (Haggett, 2009).

It has been found that chameleons that have had a poor start nutritionally are less likely to reproduce successfully with the females more likely to suffer from dystocia. It is therefore important to ensure that all juveniles are getting enough high quality food, and if several are kept together in one enclosure to observe them all feeding so that no individuals miss out.

### 11.7 Specific Requirements

There is no rush to move the new hatchlings into an enclosure immediately after hatching. It is fine to leave the hatchlings in the incubator for the first 24 hours before moving them to an enclosure (Haggett, 2009). This is good to know if it is not possible to monitor the eggs constantly therefore missing the hatching or if hatching occurs prior to the expected date and an enclosure has not yet been prepared.

A temperature of 25°C should be maintained in the juvenile enclosures. Young chameleons are not as tolerant of high heat as adults and can suffer in temperatures above 28°C (Haggett, 2009). Humidity is more important for juveniles than adults and so enclosures should be misted at least twice a day if not several times a day (Necas, 1999; Haggett, 2009).

It is important that all juveniles have access to a basking spot and that there are enough perches for the number of individuals in any enclosure to exist comfortably without overcrowding.

Enclosures for juveniles can be very simple and inexpensive. Plastic storage tubs with branches and foliage (real or fake) are suitable to house small groups of juveniles. Paper towel or newspaper/butcher’s paper is sufficient for a substrate. The tubs should be misted several times a day to maintain high humidity.
Fig 11.5: Plastic tub setup for juvenile veiled chameleons. Lamps emitting heat and UV are suspended over the top and thermostatically controlled to maintain optimal temperature.

11.8 Data Recording

As this species can have quite large clutches it is important to keep accurate records to be able to keep track of each individual.

Things recorded during the incubation stage should include:
- Number of eggs initially, each assigned a unique number
- Any discarded eggs throughout the process due to poor development of the embryo
- Regular temperature readings

Things recorded after hatching should include:
- Individual identification
- Date of hatching
- Parentage
- Weights and measurements taken at regular intervals
- Food offered and taken
- Which enclosure each hatchling is in
- Husbandry tasks such as cleaning, misting, feeding
- Regular temperature readings
- Observations regarding health, behaviour etc.
11.9 Identification Methods
Since veiled chameleons are so small when first hatched it may be difficult to permanently ID them immediately after hatching. When they are of a suitable size the preferred ID method is microchipping.
As hatchlings, however, it may be possible to ID individuals by their markings though these can change quite dramatically as they age. It may also be possible to mark them with an easily washable non-toxic marker/ink.
Another way to ID them would be to use bird leg bands. A very small size would be required. Bands designed for use on small bird species like finches would be needed. It is important to be aware, though, that growth can be quite rapid in chameleon species so it may be necessary to increase size of the band after only a short period.
The method of ID chosen would depend on whether the juveniles were on display or not. It would be preferable to not have any visible marking or leg band on displayed juveniles.

11.10 Hygiene
Regular cleaning should be conducted the same as for adults. Daily spot cleaning should be done to remove any faecal matter and food waste. To make things easier for the keeper, at this stage the substrate can just be newspaper/butcher’s paper or paper towel. Depending on how many juveniles are in each tub, and therefore how much waste is produced, this substrate may need to be replaced daily or however often is required at the keeper’s discretion.
Before handling the juveniles or their food it is important to wash hands thoroughly to ensure pathogens are not passed to the juveniles, particularly if other animals have been handled prior. Use of disposable gloves is recommended.
Cleaning products such as F10 or other proven products to be safe for use with reptiles can be used to clean water/food dishes as well as furnishings in the enclosures.

11.11 Behavioural Considerations
Juvenile veiled chameleons can be housed together for the first few months. Necas (1999) recommends groups of 5-7 individuals.
There may be dominance or hogging of food observed amongst individuals housed in the one enclosure. A well designed enclosure would reduce this by providing enough basking spots for the number of individuals and providing several feeding stations.
Research has shown that keeping juveniles in small groups is very beneficial to their development (Salleh, 2014). Juveniles reared in groups are generally more capable of communicating via colour than those raised individually. Those raised in groups are able to achieve brighter and more diverse colouration than those raised individually which are generally duller and darker in colour. Juveniles raised individually also tend to be more submissive in encounters with others of their species by fleeing or curling into a ball. Juveniles raised in groups also tend to be more efficient and effective at catching prey.
Healthy competition between individuals stimulates feed intake and, therefore, a good growth rate (Necas, 1999). By the time the chameleons reach 3 months of age they should be housed individually (Haggett, 2009).

11.12 Weaning

Weaning is not applicable to this species. Chameleonids are precocial when hatched and need no parental rearing. When raised in captivity, their diet as juveniles is very much the same as when adults. Only the size of the insects fed will change as they grow. Any vegetation or fruit in the diet may need to be introduced gradually as the juveniles grow.
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13 References


ASMP (2015) Regional Census & Plan, ZAA, Mosman NSW.


Davison, LJ (1997) Chameleons: their care and breeding, Hancock House Publishers, USA.


Haggett, D (2013) *Breeding insects as feeder food*, Mantis Press, UK.


Irwin, MD, Stoner, JB, Cobaugh, AM (2013) *Zookeeping: an introduction to the science and technology*, University of Chicago Press, Chicago, USA.


Tolley, KA, Herrell, A (2014) *The biology of chameleons*, University of California Press, Los Angeles, CA, USA.


Woodford, M.H. (2000) *Quarantine and health screening protocols for wildlife prior to translocation and release into the wild*, Published jointly by the IUCN Species Survival Commission’s Veterinary Specialist Group, Gland, Switzerland, the Office International des Epizooties (OIE), Paris, France, Care for the Wild, U.K., and the European Association of Zoo and Wildlife Veterinarians, Switzerland.


Image Credits

**Fig 3.1:** Female (left) and male (right) veiled chameleons, both in relaxed state. (S. Daniel, 2014)

**Fig 3.2:** The ventral crest is visible in this photo (http://www.chameleonforums.com/tommys-happy-again-39149/)

**Fig 3.3:** Two closely related species - the Arabian chameleon (*Chamaeleo arabicus*) and the Indian chameleon (*Chamaeleo zeylanicus*)

(http://www.inaturalist.org/taxa/32876-Chamaeleo-arabicus


**Fig 3.4:** Colour scheme of *Chamaeleo calyptratus* (Necas, 1999)

**Fig 3.5:** Distribution range of the veiled chameleon (Wilms et al, 2012)

**Fig 4.1:** ExoTerra Dripper Plant product


**Fig 4.2:** Diagram showing product assembly


**Fig 4.3:** Veiled chameleon exhibit at The Australian Reptile Park (S. Daniel, 2014)

**Fig 4.4:** An example of a ceramic heat emitter


**Fig 4.5:** Enclosure with ideal furnishings (http://animal-kid.com/panther-chameleon-cage.html)

**Fig 6.1:** Catching a live cricket (Ferguson et al, 2007)

**Fig 6.2:** Plastic cup used to contain live insects for the chameleon to feed upon (de Vosjoli, 2004)

**Fig 6.3:** Exo Terra Dripper Plant product


**Fig 6.4** Diagram showing stages of tongue projection (Necas, 1999)

**Fig 6.5:** Sequence of tongue projection (Necas, 1999)

**Fig 7.1:** Ideal capture method (Davison, 1997)

**Fig 7.2:** Guiding the chameleon onto your hand (Davison, 1997)

**Fig 7.3:** Loose hold of a chameleon (S. Daniel, 2014)

**Fig 7.4:** The preferred transport container type (S. Daniel 2014)

**Fig 8.1:** Abnormal colouration indicating an ill chameleon (Necas, 1999)

**Fig 8.2:** Restraining a veiled chameleon for administering oral medication

(http://www.chameleonforums.com/care/images/vet3.jpg)

**Fig 8.3:** Opening the mouth for taking a swab (Davison, 1997)

**Fig 8.4:** Intramuscular injection in the muscle of the upper leg (Davison, 1997)

**Fig 8.5:** Oral injection of medication (Davison, 1997)

**Fig 8.6:** MBD showing by weakened legs (Davison, 1997)

**Fig 8.7:** MBD showing by malformed casque (Haggett, 2009)

**Fig 8.8:** MBD showing by disproportional growth of jaw and skull (Haggett, 2009)

**Fig 8.9:** X-ray showing 2 eggs remaining within an egg bound female (Haggett, 2009)

**Fig 8.10:** A cloacal prolapse in a female chameleon (Davison, 1997)

**Fig 8.11:** Severe dysecdysis causing amputation of a foot (Davison, 1997)

**Fig 9.1:** A male veiled chameleon reducing its body size in an attempt to hide

(http://lllreptile.com/load-image/StoreInventoryImage/image/9617)
Fig 9.2: Colour scheme of *Chamaeleo calyptratus* (Necas, 1999)
Fig 9.3: Reading the colour of a veiled chameleon (Necas, 1999)
Fig 9.4: A male in the act of rolling and unrolling his tail (S. Daniel, 2014)
Fig 9.5: A male pursuing a female (S. Daniel, 2014)
Fig 9.6: Typical non-receptive colouration of a female (Ferguson et al, 2007)
Fig 10.1: Pair of *C. calyptratus* in the act of mating (Le Berre et al, 2000)
Fig 10.2: A typical gravid female showing aggression with open mouth and gravid colouration (Ferguson et al, 2007)
Fig 10.3: A female in gravid colouration digging a nesting burrow (Bartlett & Bartlett, 2005)
Fig 10.4: Female digging nesting burrow at base of plant (Dorval, 2006)
Fig 10.5: Female in gravid colouration with very obvious egg outline (Necas, 1999)
Fig 10.6: Egg with water droplets forming on outside, suggesting imminent hatching (Necas, 1999)
Fig 10.7: Typical star shaped slit of hatching chameleons (Haggett, 2009)
Fig 10.8: Hatching veiled chameleons (Ferguson et al, 2007)
Fig 10.9: Juvenile *C. calyptratus* (Ferguson et al, 2007)
Fig 11.1: Eggs incubating in plastic containers in a thermostatically controlled refrigerator
Fig 11.2: Veiled chameleon eggs incubating in a plastic tub (Haggett, 2009)
Fig 11.3: Star shape slit of a hatching veiled chameleon (Haggett, 2009)
Fig 11.4: Having a rest (Haggett, 2009)
Fig 11.5: Plastic tub setup for juvenile veiled chameleons
(http://www.chameleonforums.com/baby-bins-enclosures-56164/)
14 Bibliography


Biotropics – Veiled Chameleon

Chameleons Online <http://www.chameleonsonline.com/index.php>


Jones, E, Veiled Chameleon,
<http://nationalzoo.si.edu/animals/reptilesamphibians/facts/factsheets/veiledchameleon.cfm>


Lizard Lounge (2014) Veiled Chameleon care sheet,
<http://www.the-lizard-lounge.com/content/species/veiled-chameleon.asp>


McLeod, L (2014) Veiled Chameleon
<http://exoticpets.about.com/od/chameleons/p/veiledcham.htm>

Petco (2012) Veiled Chameleon Care Sheet,


Husbandry Guidelines for Veiled Chameleon (Chamaeleo calyptratus) Stuart Daniel (2015)
UK Chameleons (2002) *Veiled Chameleon care sheet*  
<http://www.martinsreptiles.co.uk/ukchams/calytratus_caresheet.htm>

Veiled Chameleon Care Sheet <http://www.veiledchameleontcaresheet.com/>
15 Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arboreal</td>
<td>living or spending a large amount of time in trees</td>
</tr>
<tr>
<td>Caudal</td>
<td>pertaining to the tail or posterior end of the body</td>
</tr>
<tr>
<td>Copulation</td>
<td>mating, sexual intercourse resulting in fertilisation of Eggs</td>
</tr>
<tr>
<td>Dorsal</td>
<td>pertaining to the back</td>
</tr>
<tr>
<td>Dorso-ventral</td>
<td>extending from the dorsal area (back) to the ventral area (belly)</td>
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<tr>
<td>Dysecdysis</td>
<td>difficulty in shedding – retaining skin</td>
</tr>
<tr>
<td>Gregarious</td>
<td>social; living in groups</td>
</tr>
<tr>
<td>Gular pouch</td>
<td>throat sac</td>
</tr>
<tr>
<td>Hepatic</td>
<td>pertaining to the liver</td>
</tr>
<tr>
<td>Hypervitaminosis</td>
<td>excessive concentrations of vitamins causing toxicity</td>
</tr>
<tr>
<td>Inguinal</td>
<td>around the groin</td>
</tr>
<tr>
<td>Laterally</td>
<td>from the side</td>
</tr>
<tr>
<td>Oviposition</td>
<td>laying of eggs</td>
</tr>
<tr>
<td>Precocial</td>
<td>born/hatched in an advanced stage of development – need minimal to no parental care</td>
</tr>
<tr>
<td>Renal</td>
<td>pertaining to the kidneys</td>
</tr>
<tr>
<td>Saurian</td>
<td>pertaining to the group of reptiles commonly known as lizards</td>
</tr>
<tr>
<td>Solitary</td>
<td>living alone or individually</td>
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<tr>
<td>Subcutaneous</td>
<td>underneath the skin (when giving injections for medication or rehydration – between the dermis and epidermis in chameleons)</td>
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<tr>
<td>TAG</td>
<td>Taxonomic Advisory Group</td>
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<tr>
<td>Ventral</td>
<td>pertaining to the belly or under-side</td>
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</table>
16 Appendices

Appendix 1: Exo Terra Dripper Plant


DRIPPER PLANT / DRIP WATERING SYSTEM
The Exo Terra Dripper Plant is a realistic plant that was designed to meet the watering needs of tree dwelling reptiles and amphibians like e.g. Chameleons. Arboreal reptiles generally do not recognize motionless sources of water; instead they drink from moving dewdrops and raindrops while foraging in the forest canopy. The Exo Terra Dripper Plant supplies a continual supply of cascading water droplets, attracting even the most reluctant reptile to drink. Regular access to a recognizable source of drinking water helps prevent illnesses related to dehydration, and will improve your animal’s overall health.

**Installation**

1. Place pump inside a water reservoir, like an Exo Terra Water Dish Large or X-Large (A).
2. Attach water-tube to Dripper Plant (B).
3. Position Dripper Plant above water reservoir to prevent spilling (D).
4. Attach water-tube with connector to pump (B).
5. Dry hands, then connect plug to power source.
6. Adjust dripping speed by turning valve (C).

Water Dish (PT2803) NOT included.
Appendix 2: F10 Product Information & MSDS


F10SC is a total spectrum disinfectant that, unlike other strong disinfectants on the market, has no adverse side effects on people, animals, or on equipment and surfaces. It is ecologically friendly and biodegradable, and carries a wide range of registrations and approvals from around the world.

In Australia, F10SC is registered by the APVMA for use in animal production and housing facilities, approved by AQIS for use in food export processing as a non-rinse disinfectant, and is also listed by the TGA as a Hospital Grade Disinfectant.

The benefits of using F10SC include:
Kills all types of pathogen – F10SC is bactericidal, virucidal, fungicidal, sporicidal.
Minimal chance of microbial resistance due to F10SC’s unique benzalkonium chloride and polyhexamethylene biguanide combination of actives and mode of action.
*Rapid kill times – less than 30 secs for gram positive bacteria, 60 secs for gram negative bacteria, Canine Parvovirus 20 mins.
Successfully tested against avian influenza (bird flu) viruses at a concentration of 1:500 in 10 mins.
Non-corrosive, non-toxic, non-tainting, non-irritating, aldehyde-free.
Highly cost effective.
Biodegradable & ecologically friendly.
Tried, tested, independently verified and documented, and approved around the world.

How to dilute F10Sc:
High level disinfection: dilute 1:250
For the most resistant viruses (e.g. parvovirus): dilute 1: 125.

How long will 200ml of F10SC disinfectant last?
If you use 2L of a workable solution per day for High Level Disinfection, you will have enough F10SC for 25 days.
# Husbandry Guidelines for Veiled Chameleon (*Chamaeleo calyptratus*)

Stuart Daniel (2015)

<table>
<thead>
<tr>
<th>COMPANY DETAILS</th>
<th>MANUFACTURER:</th>
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<tr>
<td>AUSTRALIAN DISTRIBUTOR:</td>
<td>Health and Hygiene (Pty) Ltd</td>
</tr>
<tr>
<td>COMPANY: Chemical Essentials (Pty) Ltd</td>
<td>P O Box 347. Sunninghill 2157, South Africa.</td>
</tr>
<tr>
<td>Address: 13 Abelha Str, Doncaster East, Victoria 3111</td>
<td>Tel:+27 11 474-1668</td>
</tr>
<tr>
<td>Emergency Telephone number:+03 8821 0025</td>
<td>Fax:+03 8648 0835</td>
</tr>
<tr>
<td>Fax: +03 8648 0835</td>
<td>e-mail: <a href="mailto:info@healthandhygiene.co.za">info@healthandhygiene.co.za</a></td>
</tr>
</tbody>
</table>

## IDENTIFICATION

| PRODUCT NAME: **F10SC VETERINARY DISINFECTANT** | UN Number: None |
| OTHER NAMES: **F10 SUPER CONCENTRATE DISINFECTANT** | 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 airspaces.

### 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

| Benzalkonium Chloride | CAS Number | 68424-85-1 | 5.4% |
| Bifuramine | 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 degreassant 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
Husbandry Guidelines for Veiled Chameleon (*Chamaeleo calyptratus*)

Stuart Daniel (2015)
Appendix 3: Roccal D Product Information

<http://www.drugs.com/vet/roccal-d-plus.html>

Roccal-D Plus

This page contains information on Roccal-D Plus for veterinary use. The information provided typically includes the following:

- Roccal-D Plus Indications
- Warnings and cautions for Roccal-D Plus
- Direction and dosage information for Roccal-D Plus
- Manufacturer: Zoetis
- Veterinary and Animal Care Disinfectant
- EPA Reg. No.: 65020-12-1023
- Active Ingredient(s):

Didecyl dimethyl ammonium chloride 9.2%
Alkyl (C12, 61%; C14, 23%; C16, 11%; C18, 2.5%; C8 & C10, 2.5%) dimethyl benzyl 9.2%
ammonium chloride
Alkyl (C12, 40%; C14, 50%; C16, 10%) dimethyl benzyl ammonium chloride 4.6%
bis-n-tributyltin oxide 1.0%
Inert Ingredients: 76.0%

- Roccal-D Plus Indications
  - Bactericide, fungicide, virucide for veterinary, laboratory animal, kennel and animal breeder facilities.
  - Effective in 400 ppm hard water as (CaCO3). Disinfects in 5% organic soil load.
  - ROCCAL®-D PLUS is a complete, chemically balanced disinfectant providing clear use solutions even in hard water.
  - It is also a residual bacteriostat and inhibits bacterial growth on moist surfaces and contains rust corrosion inhibitors.
  - It deodorizes by killing most microorganisms that cause offensive odors.

- Directions For Use
  - In veterinary clinics, animal care facilities, animal research centers, animal breeding facilities, kennels and animal quarantine areas.
  - It is a violation of Federal Law to use this product in a manner inconsistent with its labeling. ROCCAL®-D Plus is a one-step germicide, fungicide, soapless cleaner and
deodorant effective in the presence of organic soil (5% serum). It is non-selective and when used as directed, will not harm tile, terrazo, resilient flooring, concrete, painted or varnished wood, glass or metals.

- To clean and disinfect hard surfaces, use 1/2 fluid ounce of ROCCAL®-D Plus per gallon of water. Apply by immersion, flushing solution over treated surfaces with a mop, sponge, cloth or bowl mop to thoroughly wet surfaces. Prepare fresh solutions daily or when solution becomes visibly dirty.

- To clean badly soiled areas, use up to 1 1/2 fluid ounce per gallon of water.

- To disinfect, allow treated surfaces to remain moist for at least 10 minutes before wiping or rinsing.

- To control mold and mildew growth on previously cleaned, hard nonporous surfaces, use 1/2 fluid ounce per gallon. Allow to dry without wiping. Reapply as new growth appears.

- Boot Bath: Use 1 fluid ounce per gallon in boot baths. Change solution daily and anytime it becomes visibly soiled. Use a nylon bristled brush to clean soils from boots.

- Disinfecting Vans, Trucks and Farm Vehicles: Clean and rinse vehicles and disinfect with 1/2 fluid ounce per gallon ROCCAL®-D Plus. If desired, rinse after 10 minutes contact or leave unrinised.

- Do not use ROCCAL®-D Plus on vaccination equipment, needles or diluent bottles as the residual germicide may render the vaccines ineffective.

- ROCCAL®-D Plus should not be mixed with other cleaning or disinfecting compounds or products. Broad spectrum germicidal action in hard water and under soil load conditions: At 1/2 fluid ounce per gallon (1:256) in official AOAC Use Dilution and Fungicidal Tests, ROCCAL®-D Plus is effective in water up to 400 ppm hardness (as CaCO₃) and an organic soil load of 5% serum against the following organisms.

- Bacteria: Pseudomonas aeruginosa ATCC 15442, Salmonella choleraesuis ATCC 10708, Enterobacter aerogenes ATCC 63809, Pasteurella multocida ATCC 7707, Shigella dysenteriae ATCC 13313, Klebsiella pneumoniae ATCC 4352, Enterococcus faecium ATCC 6569, Salmonella gallinarum ATCC 9184, Serratia marcescens ATCC 264, Bordetella avium ATCC 35086, Streptococcus agalactiae ATCC 27916, Mycoplasma gallisepticum ATCC 15302, Mycoplasma gallinarum ATCC 19708, Actinomyces pyogenes ATCC 19411, Actinobacillus pleuropneumoniae ATCC 27088, Corynebacterium pseudotuberculosis ATCC 19410, Rhodococcus equi ATCC 6939, Streptococcus equi var. zooepidemicus ATCC 43079, Staphylococcus aureus ATCC 6538, Salmonella enteritidis ATCC 4931, Streptococcus pyogenes ATCC 9547, Salmonella pullorum ATCC 9120, Escherichia coli ATCC 11229, Alcaligenes faecalis ATCC 8748, Shigella sonnei ATCC 29930, Salmonella typhosa ATCC 6539, Proteus morganii ATCC 25830, Proteus mirabilis ATCC 25933, Mycoplasma iners ATCC 19705, Mycoplasma hypopneumoniae ATCC 25934, Bordetella bronchiseptica ATCC 19395, Streptococcus equi var. equi ATCC 33398.

- Fungi: Aspergillus fumigatus ATCC 10894, Trichophyton mentagrophytes var. interdigitale ATCC 9533, Candida albicans ATCC 18804.

- **Precautionary Statements:** Hazards to Humans and Domestic Animals: Corrosive: Causes severe eye and skin damage. Do not get into eyes, on skin or clothing. Wear goggles or face shield and rubber gloves when handling the concentrate. Harmful or fatal if swallowed. Avoid contamination of food. Wash thoroughly with soap and water after handling.

- Environmental Hazards: This product is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NPDES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA.

- Physical and Chemical Hazards: Do not use or store near heat or open flame.

- Statement of Practical Treatment: In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes. For eyes, call a physician. Remove and wash contaminated clothing before reuse. If ingested, drink promptly a large quantity of raw egg whites, gelatin solution, or if these are not available, drink a large quantity of water. Avoid alcohol. Call a physician immediately.

- Note to Physician: Probable mucosal damage may contraindicate the use of gastric lavage.

- **Storage and Disposal:** Store only in tightly closed original container in a secure area inaccessible to children. Do not contaminate water, food or feed by storage and disposal. Disposal: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide spray mixture, or rinsate is a violation of Federal Law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the hazardous waste representative at the nearest EPA Regional Office for guidance.

- Do not reuse empty container. Rinse container thoroughly before discarding in trash.

**Warning(s):** Danger. Keep out of reach of children
Appendix 4: Nolvasan Product Information

< http://www.drugs.com/vet/nolvasan-solution.html>

Nolvasan Solution

This page contains information on Nolvasan Solution for veterinary use. The information provided typically includes the following:
- Nolvasan Solution Indications
- Warnings and cautions for Nolvasan Solution
- Direction and dosage information for Nolvasan Solution
- Manufacturer: Zoetis
- Chlorhexidine diacetate
- Disinfectant
- Bactericide, Virucide
- For Animal Premises Use Only

Active Ingredient
Chlorhexidine (1,1’-Hexamethylenebis [5-(p-chlorophenyl) biguanide]) diacetate 2%
Other Ingredients
- The product contains the active ingredient at 0.168 pounds per gallon.
- KEEP OUT OF REACH OF CHILDREN
- DANGER

Directions For Use
- It is a violation of federal law to use this product in a manner inconsistent with its labeling.
- Nolvasan Solution final use dilutions may be applied by wiping, mopping, or spraying on the inanimate surface. It may also be used in fogging (wet misting) operations as an adjunct either preceding or following regular cleaning and disinfecting procedures. Fog (wet mist) until the area is moist using automatic foggers according to manufacturer’s directions.
- When applying by wiping, mopping, or spraying: Applicators or other handlers must wear long-sleeve shirt and long pants, socks plus shoes, and rubber gloves.
- When applying by wet-mist fogging: Applicators and other handlers exposed to the fog during wet-mist fogging applications and until the fog has dissipated and the enclosed area has been thoroughly ventilated must wear: Long-sleeve shirt and long pants, rubber gloves, socks plus shoes, and a full face respirator with a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14-G).
• Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application.

• **Entry Restrictions:** Thoroughly ventilate buildings, vehicles, and closed spaces following application. Do not enter, allow other persons to enter, house livestock, or use equipment in the treated area until ventilation is complete and the liquid chlorhexidine diacetate has been absorbed, set or dried.

• For entry into fogged areas before ventilation is complete and the fog has completely dissipated, absorbed, set, or dried, all persons must wear: Long-sleeve shirt and long pants, rubber gloves, socks plus shoes and a full face respirator with a canister approved for pesticides (MSHA/NIOSH approval number prefix TC-14-G).

• **User Safety:** Follow manufacturer’s instructions for cleaning/maintaining personal protective equipment. If there are no such instructions for washables, use detergent and hot water. Keep and wash personal protective equipment separately from other laundry.

• Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet. Users should remove clothing immediately if pesticide gets on or inside it, then wash both skin and clothing thoroughly and put on clean clothes. Users should remove personal protective equipment immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash skin and clothing thoroughly and change into clean clothes.

• **Veterinary or Farm Premises**
  1. Remove all animals and feed from premises, vehicles and other equipment.
  2. Remove all litter and manure from floors, walls and surfaces of barns, pens, stalls, chutes and other facilities and fixtures occupied or traversed by animals.
  3. Empty all troughs, racks and other feeding and watering appliances.
  4. Thoroughly clean all surfaces with soap or detergent and rinse with water.
  5. Saturate all surfaces with the recommended disinfecting solution for a period of 10 minutes.
  6. Immerse all halters, ropes and other types of equipment used in handling and restraining animals, as well as forks, shovels and scrapers used for removing litter and manure.
  7. Thoroughly scrub all treated feed racks, mangers, troughs, automatic feeders, fountains and waterers with soap or detergent, and rinse with potable water before reuse.

• **Precautionary Statements**
  • HAZARDS TO HUMANS (AND DOMESTIC ANIMALS)
    • Prolonged or frequently repeated skin contact may cause allergic reaction in some individuals.
    • Remove contaminated clothing and wash before reuse.
• Danger
  • Corrosive: Causes irreversible eye damage. Wear protective eyewear (Goggles, face shield or safety glasses). Harmful if swallowed or absorbed through skin or inhaled. May be fatal if inhaled. Avoid breathing spray mist.
  • Avoid contact with skin or clothing and do not swallow. Wear rubber gloves when handling or applying.

• First Aid
  • IF IN EYES: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing. Call a poison control center or doctor for treatment advice.
  • IF SWALLOWED: Call a poison control center or doctor immediately for treatment advice. Have person sip a glass of water if able to swallow. Do not induce vomiting unless told to by a poison control center or doctor.
  • IF ON SKIN: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15-20 minutes. Call a poison control center or doctor for treatment.
  • IF INHALED: Move person to fresh air. If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth, if possible. Call a poison control center or doctor for further treatment.

• Environmental Hazards
  • Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollutant Discharge Elimination System (NDPES) permit and the permitting authority has been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA. Do not contaminate water by cleaning of equipment or disposal of waste.

• Storage And Disposal
  • Do not contaminate water, food or feed by storage or disposal. Open dumping is prohibited. Do not reuse empty container. Protect from freezing.
  • STORAGE DISPOSAL: Store the product in a dry and cool place, where it is not reachable by children.
  • PESTICIDE DISPOSAL: Wastes resulting from use of this product may be disposed of on site or at an approved waste disposal facility.
  • CONTAINER DISPOSAL: Do not reuse containers. Rinse thoroughly with water and discard in trash.
  • GENERAL: Consult federal, state or local disposal authorities for approved alternative procedures such as limited open burning.
Appendix 5: Wombaroo Reptile Supplement

WOMBAROO

REPTILE SUPPLEMENT

A versatile high protein supplement which can be added to fruits and vegetables, insects, meat or made as soft pellets. Can be fed to all reptiles including tortoises, dragons, lizards and snakes.

Available in 250g, 1kg and 5kg packs

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min Crude Protein  55%</td>
<td>Whey protein, soy protein, meat meal, fish meal, blood meal, cereal bran, lysine, methionine, vegetable oils, omega-3 and omega-6 fatty acids, vitamins A, B1, B2, B6, B12, C, D3, E, K, nicotinamide, pantothenic acid, biotin, folic acid, choline, inositol, calcium, phosphorus, potassium, sodium, magnesium, zinc, iron, manganese, copper, iodine, selenium.</td>
</tr>
<tr>
<td>Min Crude Fat  14%</td>
<td></td>
</tr>
<tr>
<td>Max Fibre  6%</td>
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<tr>
<td>Max Salt  0.8%</td>
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</tbody>
</table>
Appendix 6: Repti-Cal - Calcium & Vitamin Supplement for Reptiles & Amphibians

Repti-Cal Description

Repti-Cal is a natural phosphorus free, calcium and vitamin D3 supplement for all reptiles and amphibians. Calcium deficiency is a major dietary problem with captive reptiles and amphibians. Maintaining a correct calcium:phosphorous (Ca:P) ratio in the diet of 1:1 to 1.5:1 is equally important nutritionally as adequate calcium intake. Commonly used food sources such as Crickets, Meal Worms and Mice contain high levels of Phosphorous and low levels of calcium. Repti-Cal assists in balancing the Ca:P ratio by providing a natural phosphorous free calcium source together with vitamin D3 to assist in absorption from the intestinal tract. Repti-Cal is manufactured from natural oyster shell ground to a ultrafine powder with added vitamin D3.

Ingredients
350mg/g Calcium (as Calcium Carbonate); 70iu/g Cholecalciferol (Vitamin D3)

Direction of Use
Mix with vegetables, fruits and pastes at approximately 1/2 Tablespoon (9g) per 500g of food. Before feeding with insects: Place Repti-Cal in a plastic bag, add insects and shake slowly until insects are completely coated.

Size
220gram
Appendix 7: IATA Live Animal Regulations for shipping lizards

CONTAINER REQUIREMENT 41

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

Applicable to:
Lizards and Tuataras

STATE VARIATIONS: GGG-01/02/04, USG-Variations

△OPERATOR VARIATIONS: DL-07, GF-07, UA-01

The following instructions must be compiled with in addition to the principles laid down in the General Container Requirements for Reptiles and Amphibians.

Measurement
Lizards (including Chameleons) and tuataras should be measured by snout-to-vent length (SVL), tail length (TL) and in body width (BW).

Specific Requirements
All containers and bags should have some kind of packing material (i.e. crumpled paper). Animals in the same containers or bags should belong to the same size class to avoid damage to smaller individuals.

The maximum number of animals per bag or container must not be increased even when larger bags or containers are used.

Packing Density for Lizards and Tuataras (not including Chameleons and farmed Iguana iguana):

<table>
<thead>
<tr>
<th>Snout-vent length (SVL)</th>
<th>Body-width (BW)</th>
<th>Maximum no. of animals per bag</th>
<th>Minimum bag size</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 25 cm (9.8 in)</td>
<td>≥ 5 cm (2 in)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>≥ 15 x 20 cm (6 x 7.8 in)</td>
<td>≥ 2.5 x 5 cm (1 x 2 in)</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>10 x 15 cm (4 x 6 in)</td>
<td>&lt; 2.5 cm (1 in)</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>&lt; 10 cm (4 in)</td>
<td>&lt; 2.5 cm (1 in)</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

If the bag is suspended the bag must be suspended horizontally from opposite ends of the bag the maximum number of animals per bag should be divided by two.

For lizards, rigid containers can be used instead of bags with a maximum of 25 animals, up to 30 cm (12 in) total length. The length of the container should be at least the snout vent length plus half the tail length (TL).

These containers must be rigid and able to support the entire weight of all the other containers when stacked upright and if turned upside down, without failing structurally (without bending, cracking or collapsing). The size of these containers must enable the animals to have contact with their whole ventral surface to the floor of the container.

Arboreal geckos will be provided the use of the surface area of the floor and wall space of rigid containers.

Large Animals
Lizards whose length range from 90-120 cm (36-48 in) SVL require double bags for shipping.

Lizards of 120 cm (48 in) or more in length must follow the same primary enclosure requirements as crocodiles excluding the taping or banding of the mouth.

The direction of the head should be indicated on the outer enclosure.
Lizard species that should be packed singly because they are either aggressive, cannibalistic or delicate:
- Malagasy leaf geckoes (Uroplatus spp.)
- New Caledonian giant geckoes (Rhacodactylus spp.)
- Asian gliding agamid (Draco spp.)
- Sail-finned lizard (Hydrosaurus spp.)
- Angle-headed dragon (Gonocephalus spp.)
- Helmeted basilisks (Corytophanes spp.: basilicus spp.) (except hatchlings and juveniles)
- Caiman lizard (Dracaena spp.)
- Emerald tree monitor lizard (Varanus prasinus)
- Black tree monitor lizard (Varanus beccari)
- Solomon Island pre-hersile tailed skink (Corucia zebrata)

Venomous lizards that must be handled and packed like venomous snakes (see Container Requirement 44), these are:
- Gila monster, beaded lizard (Heloderma spp.)

Specific Requirements for Chameleons including African Dwarf Chameleons (Rhamphothela) and Malagasy Dwarf Chameleons (Brookesia)

All species with the exception of young and small specimens (see below) must be packed individually.

Chameleons 10 cm (4 in) or greater in SVL need to be packed in adequate space to rest naturally. The enclosure needs to conform to the body shape and size. The inner enclosure may be cloth, woven material or rigid container. Crushed or crumpled paper must fill at least 25% of inner enclosure.

Chameleons of 2.5–10 cm (1–4 in) in SVL must be packed one per inner enclosure. Inner enclosures may be fibrous woven tubes with each open end of tube securely enclosed in a manner that can be resealed, cloth, rigid container, or heavy gauge paper enclosures.

Heavy gauge paper should be defined as a container that is sufficient to hold specimens without escape.

Inner enclosures must be easily opened and closed, if heavy gauge paper enclosures are used as inner enclosures, they must be secured to a frame of support bars in the primary or outer enclosure with tacks or nails with head diameter of at least 0.6 cm (¼ in). No burlap (hessian) bags as inner enclosures are permitted.

Chameleons less than 2.5 cm (1 in) SVL can be packed with a maximum of 10 per 0.5 liter rigid enclosure. At all times, the specimens must be able to have full contact with the container floor. At least 50% of the inner enclosure must be filled with loosely crumpled paper.

Crushed or crumpled paper must be provided to ensure a foothold for the animal.

Since farmed Green Iguanas (Iguana iguana) are usually in good condition, free of diseases and used to handling, the use of following special packing density is allowed.

### Packing Density for Farmed Green Iguanas (Iguana iguana)

<table>
<thead>
<tr>
<th>Snout-vent length (SVL)</th>
<th>Maximum no. of animals per bag</th>
<th>Minimum box size (cm)</th>
<th>Minimum bag size</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 25 cm (10 in)</td>
<td>1</td>
<td>Depends on the size of the animal</td>
<td>—</td>
</tr>
<tr>
<td>&gt; 20 cm (8 in)</td>
<td>6</td>
<td>45 x 40 x 9 cm (18 x 16 x 3 7/8”)</td>
<td>—</td>
</tr>
<tr>
<td>&gt; 17.5 cm (7 in)</td>
<td>6</td>
<td>30 x 45 cm (12 x 18 in)</td>
<td>20 x 40 x 9 cm (8 x 16 x 3 3/4”)</td>
</tr>
<tr>
<td>&gt; 12.5 cm (5 in)</td>
<td>20</td>
<td>30 x 45 cm (12 x 18 in)</td>
<td>20 x 40 x 6.5 cm (8 x 16 x 2 3/4”)</td>
</tr>
<tr>
<td>&gt; 10 cm (4 in)</td>
<td>30</td>
<td>30 x 45 cm (12 x 18 in)</td>
<td>20 x 40 x 4.5 cm (8 x 16 x 1 1/2”)</td>
</tr>
<tr>
<td>&gt; 8.75 cm (3 1/4 in)</td>
<td>40</td>
<td>30 x 45 cm (12 x 18 in)</td>
<td>20 x 42 x 4.5 cm (8 x 16 x 1 1/2”)</td>
</tr>
<tr>
<td>0-8.75 cm (3 1/4 in)</td>
<td>50</td>
<td>30 x 45 cm (12 x 18 in)</td>
<td>20 x 40 x 4.5 cm (8 x 16 x 1 1/2”)</td>
</tr>
</tbody>
</table>
Appendix 8: Betadine Product Details


Betadine® antiseptics are among the most effective antiseptics available, inactivating infecting organisms including bacteria and fungi. Povidone-iodine solutions are a golden-brown colour because of the iodine content. This colour shows the area that has been treated and also denotes the activity of the product. As the iodine is depleted from the solution, the colour fades. When the colour fades to a light yellow, Betadine® should be reapplied. In most cases Betadine® antiseptics are non-irritating and non-stinging to the skin. They do not permanently stain the skin or natural fabrics and the treated areas may be bandaged, taped or otherwise covered.

**Antiseptic Spray**

Betadine® Antiseptic Liquid rapidly kills bacteria and fungi commonly responsible for wound and skin infections. This spray pack makes application convenient and not messy.

**Antiseptic Cream**

Betadine® First Aid Cream is recommended for grazes, minor burns and scalds and the treatment of minor infections.

**Antiseptic Ointment**

Betadine® Antiseptic Ointment is recommended for the treatment of common skin infections such as infected skin around the nails and toes, as well as preventing infection in minor burns, cuts and abrasions. It is a bactericidal, sporicidal and fungicidal antiseptic.

**Antiseptic Liquid**

Used in both hospitals and households around the country, this antiseptic is recommended for the treatment of minor cuts and abrasions and is also effective against school sores, thrush and ringworm.

Betadine® Antiseptic Liquid rapidly kills all bacteria and fungi commonly responsible for wound and skin infections. It is essentially non-irritating to skin and will not permanently stain skin and natural fabrics.
Appendix 9: ‘Top of Descent’ Product Details

Appendix 10: Enrichment Rating Scales

ENRICHMENT RATING SCALES

HTTP://WWW.ANIMALENRICHMENT.ORG/

1) Direct Evidence (keeper observes animal and assess its level of interaction with enrichment initiative):

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>no observed interaction with enrichment;</td>
</tr>
<tr>
<td>2</td>
<td>animal orients towards enrichment, but does not physically contact enrichment;</td>
</tr>
<tr>
<td>3</td>
<td>1-5 visits/minutes of interaction;</td>
</tr>
<tr>
<td>4</td>
<td>5-10 visits/minutes of interaction;</td>
</tr>
<tr>
<td>5</td>
<td>greater than 10 visits/minutes of interaction.</td>
</tr>
</tbody>
</table>

This 1-5 scale is useful for assessing the degree to which an animal interacts with an enrichment initiative (either novel or familiar) for a specific period of time. This scale can be used to assess how an animal’s interest in a particular enrichment changes over time. Important points to note will be that the animals’ response to the enrichment may vary depending on the time of day that the animals are observed and the scale used, as well as how long the observation period is. Both of these factors should be made as consistent as possible. For example, all keepers assessing a gorilla’s use of a puzzle feeder should come to an agreement as to when and for how long their observations should take place (e.g., 15 minutes when the gorillas are first let out on exhibit).

2) Indirect Evidence (keeper is unable to observe animal’s response to enrichment, and so uses indirect evidence of the animal’s use of enrichment, e.g., cardboard box all ripped up versus untouched):

<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>no evidence of interaction (e.g., pristine, untouched cardboard box);</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>moderate evidence of interaction (e.g., box moved and urine marked);</td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>significant evidence of interaction (e.g., box ripped into pieces, and scattered around holding area).</td>
</tr>
</tbody>
</table>

The indirect scale is especially useful for assessing enrichment use that occurred during the night, or when the animals cannot be directly observed during the day. Only three criteria are defined for
this 1-5 scale since it is difficult to specifically define what categories 2 and 4 will look like without taking into account the individual characteristics of the various enrichment initiatives provided. When using the indirect scale it is important clearly define what 2 and 4 would look like for specific enrichment initiatives, where this is possible. This scale can be used to answer the question of whether or not any of the animals use the enrichment (for group housed species), or which animal uses the enrichment (for individual housed species – e.g., at night).

3) Goal Scale (keeper assesses whether the animal uses the enrichment for the intended goal):

1 = actively avoids enrichment item;

2 = interacts inappropriately (e.g., dangerously, aggressively);

3 = interacts tentatively with item (e.g., brief contact with no specific behavioral response);

4 = interacts appropriately but not with goal behaviors (e.g., uses foraging material for nesting);

5 = interacts appropriately with intended goal behaviors.

This scale is useful to assess any interaction with enrichment that is observed by the keepers. Each enrichment initiative provided to the animals should be provided for a reason, with a goal to promote a certain type of species-appropriate behavior. This scale can help to document how closely the animal’s response to the enrichment meets the intended goal. Certain animals may use the enrichment in a way that is unrelated to the goal of the enrichment, but that is still appropriate, and so the initiative may still be of value as enrichment. In other cases, the animals’ responses may be inappropriate or dangerous, and action should be taken by the team to remove or modify the enrichment initiative. Once again, the consistency with which this 1-5 scale is used will affect the quality of the information collected.

Inter-observer reliability

For all these scales, it is necessary for teams to discuss and clearly define what each of the scale criteria represents for a particular enrichment or subset of enrichment initiatives. It is important that each keeper scores the same behavioral responses in the same way (i.e., with the same numerical value) for the information collected to be useful. Inter-observer reliability should be re-assessed on a frequent basis (e.g., quarterly) to ensure that the team is still in agreement with the specific definitions from the 1-5 scales. A good way to assess inter-observer reliability is to videotape an animal’s use of enrichment, and ‘test’ each keeper on how he/she would score that animal’s use of the enrichment. Group discussions about why each person scored a ‘3’ versus a ‘4’ will likely enhance future inter-observer reliability.
Appendix 11: Enrichment Data Transfer Form

ENRICHMENT DATA TRANSFER FORM

1. Quarantine keeper staff
2. Copy for keepers caring for this animal
3. Copy for zoo files and/or veterinarian

Date: ______________________

Institution __________________________________ Telephone ______________________

Contact person ______________________ Fax/Email _____________________________

Common Name ______________________ Scientific Name ______________________

House Name ______________________ Sex ______ Age ______ I.D. # ______________

Behavioral History: Behavioral and medical problems, general behavior  

__________________________________________________________________________

Reactions to Keepers (shy, likes males vs. females) ____________________________

Stereotypic behavior: List __________________ How Frequent ____________________

How severe _______ Duration _______ Triggers _______ What helps _______

Other relevant information ________________________________________________

__________________________________________________________________________

Trained Behaviors _______________________________________________________

How often __________________ squeeze cage/chute __________________________

General Background Information: (Check or list all that apply)

Social- Housed alone ______ Housed w/same species (#) ______ Housed mixed species ______

species housed with __________

Housed on exhibit _____ off-exhibit _____ access to both ______

Rearing type- mother ______ hand-reared ______ peer ______ family/social ______

Preferred enrichment for this animal _________________________________________

Enrichment offered: daily ______ weekly ______ monthly ______ scheduled ______ other ______

Naturalistic/Exhibit Enrichment: (When offered or provided, please list or check where applicable)

Static: Substrates sand _______ guinite _______ mulch _______ leaf litter _______ soil _______ other ______

Plants/rotten logs/termite mounds/trees in enclosure ____________________________

Streams/Ponds ___________________ Perches-artificial/natural __________________
Husbandry Guidelines for Veiled Chameleon (*Chamaeleo calyptratus*)

Stuart Daniel (2015)

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**Is indoor area holding**

- exhibit
- natural looking
- concrete/chain-link
- has plants
- No indoors

**Rotating:**

- Substrates sand
- mulch
- leaf litter
- soil
- other
- How often enrich given

**Perches:**

- artificial/natural
- Plants/rotten logs

**Olfactory**

- Auditory

**Other (snake sheds, hot rocks/cooling/misting, etc.)**

---

**Food Enrichment:** (variety, presentation, style, please list or check, includes diet and food enrichment)

- # of feedings per day
- varied times
- when
- food scattered
- hidden

**Carcass foods (roadkill, hides, parts, feeder animals, bones)**

- Live foods
- Diet varied
- highly
- moderate
- slightly
- not at all

**Preferred foods**

- Diet
- blended
- dried
- diced
- whole
- cut

**Browse (list types)**

- Browse offered: daily
- weekly
- monthly
- frozen
- fresh

**Other (rawhide, popsicles, blood trails, etc.)**

---

**Artificial Enrichment:** (Check and list)

- PVC feeders
- Tires
- Burlap/towels
- Plastic containers

- Puzzle feeder
- Cardboard boxes/tubes/bags
- Ropes/vines

- Balls/kegs/barrels
- Toys (Kong®, dog chews, etc.)

- Attachments used (chain, rope, bungee)
- How often enrichment given

**Other**

---

**Safety Concerns:** (eats plastic or cardboard, items animals shouldn’t have, bad experiences, failed items)

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**Comments:**

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