Husbandry Manual For

Central Netted Dragon
Ctenophorus nuchalis
Reptilia : Agamidae

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1 Introduction

Agamidae:	Meaning "Dragon Lizard"
Classification:	Harmless
Appearance:	A small dragon with intricate reticulated or netlike patterns of dark lines over a pale grey/brown background.
Activity:	An active species which is diurnal

There are 64 species of dragon lizard in Australia.

The genus *Ctenophorus* consists of a group of at least 22 species of small to medium sized dragons, with representatives inhabiting most semi-arid and arid regions of Australia (Wilson and Swan 2003). The genus is quite diverse, with a range of species adapted to specialised habitats, including rocky outcrops, sandy plains and dunes, shrublands or salt lakes (Greer 1989). These agamids are typically known for their relatively short lifespan and high reproductive output, being capable of producing multiple clutches in a year (Bradshaw 1981).

Ctenophorus nuchalis was once known as *Amphibolorus nuchalis.*

All possess moveable eyelids, 5 clawed digits, developed spines, ruffs and decorative frills.

The Agamidae are mainly insectivorous with well-developed dentition and a broad fleshy tongue.

They are egg layers.

They are characterized by their juxtaposed body scales, often with greatly enlarged tubercles and spines. The limbs are well developed, while the tongue is broad, flat and fleshy.

Unlike most reptiles, the Central Netted Dragon is fairly short lived. To date various studies have been conducted on the biology of the Central Netted Dragon, Ctenophorus nuchalis including; distribution; habitats (Bradshaw, 1981; Dell & Chapman, 1981b; Readman & Bradman, 1990: Valentic & Turner, 1998) and diet (Bradshaw, 1965; Heatwole, 1970; Pianka, 1971).

Little research or notes have been made on their captive status and situation.

2 Taxonomy

2.1 Nomenclature

Kingdom:	Animalia
Phylum:	Chordata
Sub Phylum:	Vertebrata
Class:	Reptilia
Order:	Squamata
Sub Order:	Sauria
Family:	Agamidae
Genus:	Ctenophorus
Species:	nuchalis
Common Name:	Central Netted Dragon

2.2 Subspecies

N/A

2.3 Recent Synonyms

N/A

2.4 Other Common Names

N/A

3 Natural History

3.1 Morphometrics

3.1.1 Mass and Basic Body Measurements

The largest snout-vent length reported for males was 115mm and for females 98mm (Storr, 1966).

A predictive equation relating to body mass to snout-vent length is Body Mass (g) = 3.178 in snout-vent length (mm) – 11.8 (Bradshaw, 1970).

Adult dragons reach overall size of 26-28cm in length; 16-18cm of this is tail. As with most dragons males grow larger than females.

See Appendix for a Key to Agamidae's from Reptiles and Amphibians of Australia – Family Agamadae Key Page.

3.1.2 Sexual Dimorphism

Males can be recognized from their more rounded and larger head compared to body size.

The head and throat of breeding males becomes red or orange.

3.1.3 Distinguishing Features

These dragons have got their name netted from their net like pattern throughout their body, often red brick colours to greys and browns.

The head is rounded and the legs and toes are strong to enable them to run at great speeds and dig burrows.

The scales of their lower eyelid are long and spiny forming a conspicuous fringe.

3.2 Distribution and Habitat

The species is widespread throughout the arid interior of Australia, from the Western Australia coast to Western NSW and Queensland.

The species occurs in halophytic herb lands (Bradshaw, 1981) and in shrub lands (Dell & Chapman, 1981b: Read & Badman, 1990; Valentic & Turner, 1998), manly in substrates of sand (Bradshaw, 1981; Dell & Chapman, 1981b). Most of the habitats in which the species occurs are relatively open.

The species numbers seem to increase substantially in areas artificially cleared of vegetation by humans and then decline as succession restores a denser vegetation. This ability to take advantage of artificial clearings suggests that it may also be able to take similar advantage of natural clearings, such as those due to fires. (Bradshaw, 1981)

3.3 Conservation Status

The Central Netted Dragon is not a threatened species according to the 2006 IUCN red list.

3.4 Diet in the Wild

In the wild, the dragon eats a variety of arthropods (Bradshaw, 1965; Pianka, 1971). It also eats some plant material, (Bradshaw, 1965; Heatwole, 1970; Pianka, 1971). In one study covering all seasons, arthropod prey comprised 71.9% of total prey volume while plant material comprised 24.3% (Pianka, 1971). The dragon also occasionally eats other lizards (Pianka, 1971).

3.5 Longevity

3.5.1 In the Wild

It is fairly short lived, approximately 2-3 years. Annual, less than 2% live past one year (Bradshaw, 1986).

The genus *Ctenophorus* is noted for having a relatively short lifespan, often encompassing only one to two years (Pianka 1971b; Cogger 1978; Dickman 1999). In a marked population of over 1000 animals, Bradshaw (1986) found that *C.nuchalis* is an annual species, with less than two per cent of individuals living beyond 12 months and no individuals ever reaching three years of age. These dragons typically die during the hot, dry, late summer after breeding has ceased (Bradshaw 1986).

3.5.2 In Captivity

Life expectancy seems to be doubled in captivity around 5-6 years and even up to 8 years.

The longevity of *C.nuchalis* in captivity at Taronga Zoo is much longer than has been recorded in wild populations. The longest-lived *C.nuchalis* was a male, wild-collected as an adult, which lived for 8 years and 3 months in captivity. The eldest female, also wild-collected as an adult, lived for 7 years. Both of these individuals produced fertile clutches of eggs up to 5 years after collection. This lifespan in captivity is at least 4 times that noted for maximum age in wild populations (Bradshaw 1986). (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted)

The reason behind this extended longevity in captivity is presumably due to unlimited food and the absence of parasites, competition, predation and drought. Bradshaw (1986) indicated that the ultimate cause of death in wild *C.nuchalis* was chronic dehydration during late summer, and

starvation to a lesser degree in females, after the stresses of producing multiple clutches. In captivity, water is always available and food is provided *ad libitum* to rapidly replenish depleted energy reserves after reproduction, allowing dragons to quickly regain condition. This can be seen by the high reproductive output of the captive dragons. The longest-lived *C.decresii* and *C.nuchalis* females produced six and eleven clutches, totalling 27 and 54 eggs, respectively during their lifetime. (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted)

3.5.3 Techniques Used to Determine Age in Adults

In the wild, as it is an annual species, those found in spring/early summer can be assumed to be from last seasons young, and to be 10-12 months of age. Otherwise there isn't a way to determine age of 1 year. (McFadden, M Taronga Zoo Pers.comm).

In captivity there is no method of determining age other than knowing the actual date of birth.

4 Housing Requirements

4.1 Exhibit/Enclosure Design

It should be kept in mind the fact that captive reptiles will not perceive its world in such neatly defined parameters, but rather as a whole, finding it either acceptable or unacceptable (Care of Australian Reptiles in Captivity).

The exhibit at Taronga Zoo that holds the Central Netted Dragons has a glass-fronted display measuring at 69 x 63 cm. The substrate consists of red desert sand over an artificial irregular red mock-rock floor. Cage furnishings included dead branches for basking and a clump of Spinifex grass (*Triodia sp*.) to shelter beneath.

4.2 Holding Area Design

A simple short term holding area for the dragon could be a plastic garbage bin. This could be used when accessing or cleaning their exhibit enclosure.

A more long term holding cage would be a basic enclosure as this would be an off exhibit enclosure. This enclosure should consist of a hide box, water and newspaper for a substrate for cleanliness and quick and easy cleaning.

4.3 Spatial Requirements

The species is thought to be territorial (Heatwole, 1970; Pianka, 1971). This supposition is suggested by the observation that males rarely occur close together in the wild (Heatwole, 1970) and that the males sometimes fight (Heatwole, 1970; Pianka, 1971).

In captivity, males may fight to such an extent that they must be separated (Klages, 1982).

4.4 Position of Enclosures

The lizards colour patterns and behaviour suggest that it can influence the rate of heating and cooling when on the land. In the morning and evening lizards are cool and they tend to be dark, which facilitates heating. But during the day when they are warm, they tend to be pale, which retards the heat (Bradshaw & Main, 1968).

Behaviourally, newly emerged lizards tend to turn their dark (above) backs at right angles to the sun, a posture that presumably enhances heating. However, as they warm, they may move more to the shaded side of their perch where they are not only partially shaded but also now have their pale ventral surfaces turned toward the sun, a posture that presumably minimises hearing (Heatwole, 1970). As the ambient temperatures rise, the lizards may move higher on their perches in order to get away from the heat radiating from the hot ground. But during the early to mid-afternoon when ambient temperatures at their highest, the lizards may retreat to their burrows (Bradshaw and Main, 1968; Heatwole, 1970). And late in the afternoon or early evening as temperatures are cooling, the lizards may press themselves against the ground, presumably to absorb the heat of the substrate, which is now the warmest part of the environment (Heatwole, 1970). Finally, at sunset, the lizards

enter their burrows, which can remain warmer that the air temperature far into the night (Heatwole, 1970).

The efficacy of the burrow as a heat shelter is shown by one animal, which was excavated from its burrow during the day and found to have a body temperature of "only" 39.2º C while the air temperature was 45.0º C and the substrate temperature in excess of 60º C (Bradshaw and Main, 1968).

An indoor enclosure would be preferential so positioning of the enclosure wouldn't be necessary to consider.

4.5 Weather Protection

The Central Netted Dragon is most suited to an indoor enclosure when on exhibit, due to its size being quite small.

4.6 Temperature Requirements

In the wild, the lizards emege from their burrows shortly after sunrise and enter again about sunset. During the day, they let their body temperature rise no higher than about 43.8˚C (Bradshaw & Main, 1968) to 44˚C (Heatwole, 1970).

The body temperatures chosen by animals in laboratories thermal gradient has been studied on 2 occasions. One study found a mean of 36.4˚C (Licht, Dawson, Shoemaker & Main, 1966) and another study found a mean of 38.6˚C (Pianka, 1971).

When rising temperatures enter the critical zone, the lizards behaviour and mobility is affected in various ways. For example, in one laboratory study, panting began at body temperatures as low as 40.8º C in some large individuals; vigorous (shelter seeking?) activity began at 42º C and was continuous above 44º C, and loss of coordination began at approximately 47.8º C (Heatwole, 1970: fig. 20). In another laboratory study, the lizards became immobile at a temperature of 46.5º C (Warburg, 1965). These data suggest that 44º C may be the point at which the lizards may begin to feel seriously stressed and begin to make strenuous efforts to seek shelter. At higher body temperatures, the lizards may be only a few minutes from effectively perishing.

Mean body temperatures have been provided in a number of studies (Licht, Dawson, Shoemaker and Main, 1966; Bradshaw and Main, 1968; Heatwole, 1970; Pianka, 1971). However, the significance of these temperatures to the animals' biology is unclear as they are all well below the maximum tolerated by the species and hence may have involved no apparent critical choices for the lizards.

Only one aspect of the species' thermal biology is known to be affected by size. There is a significant negative correlation between the body temperature at the on-set of panting and the mass of the lizard. That is, larger lizards tend to begin panting at a lower body temperature than do smaller lizards (Heatwole, 1970: fig. 20). However, there is no significant relationship between the body temperature either at either the on-set of loss of coordination or at death and body mass (Heatwole, 1970: fig. 20).

At any one time in any one geographic area, there appears to be no significant difference between the mean body temperatures of males and females (Heatwole, 1970).

Ambient temperatures within an exhibit can be maintained using thermostatically controlled radiant heaters, set at approximately 28°C during the warmer months and 25-26°C throughout the cooler months. Between October and March, the ambient temperature in exhibits can be set at 28°C during the daytime, falling to ambient Sydney temperatures at night. Between April and September, the daytime temperature is set at 28°C, falling to 24-25°C at night. (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted.)

In a reptile enclosure, 4 components are commonly used:

1. Light

Lighting is an important factor; it provides a basking site and vitamin D3.

Light are also used to see our animals, and to mimic the real world situation in which there is day and night.

The two standard forms of this lighting is by either a fluorescent tube, or by incandescent or halogen bulbs.

If you choose a fluorescent tube, you can either use a standard "office" tube (either white, or daylight), or a UV tube.

A standard household globe will do fine. You can also use a reflector bulb which gives more intense light, and allows you to use the lamp for both lighting and providing a warm basking spot.

2. Heat

Reptiles are ectothermic, which means they don't generate enough heat to keep themselves at a stable temperature. In order for them to stay active, they need to find an external.

There are 4 main types heat source:

- a standard incandescent bulb, either coloured party or standard household globes.
- An infrared globe.
- A ceramic heat globe.
- A heat mat

The use of a thermostat and/or thermometers will assist with the heating of the enclosure:

Thermostats are essential for controlling the temperature of an enclosure. A thermostat simply turns the heat source on when the temperature drops below a certain point, and off when the temperature rises above a certain point. This means that you can set the temperature of the enclosure to whatever best suits the animals.

A thermometer is used to monitor the temperature of the enclosure. It is best if you have at least two thermometers for each enclosure, so you can measure the temperature in different places within the enclosure.

3. UV – ultraviolet light

UV light is required all lizards from the Agamid Family – Dragons. UV light is usually added to an enclosure.

Taronga Zoo currently use one 300 watt Osram Ultra-Vitalux globe for eight hours per day in each enclosure. In the *C.nuchalis* enclosure, the globe was situated 35 cm above the highest available basking area, providing a basking temperature of greater than 44 °C. (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted.)

- **UVB** is a non-visible wavelength, and allows the synthesis of vitamin D3, which helps to process calcium and prevent metabolic bone disease.

  UVB light sources are either UV fluorescent tubes or mercury vapour (MV) lamps. UV fluorescent tubes usually have much lower UV output so need to be mounted much closer to the basking site than MV lamps, or be on for more hours each day. (P.Harlow, TZ UV Light Requirements for Captive Reptiles Held Indoors).

  You should aim to give them UV equivalent of one hour's exposure per day at 300 - 500 $\mu W/cm^2$ UVB. Different brands of globes give off different UV exposure, take note of this when purchasing globes.

  Note: In Sydney at midday on a clear mid-December day the sun produces about 400 $\mu W/cm^2$ UVB and in mid-winter it's about 30 $\mu W/cm^2$ UVB. (P.Harlow, TZ UV Light Requirements for Captive Reptiles Held Indoors).

Things to Remember (P.Harlow, TZ UV Light Requirements for Captive Reptiles Held Indoors):

- Even if fed calcium to excess, dietary calcium cannot be properly synthesised (for bone, blood and other metabolic requirements) in the absence of UVB radiation.
- UVB light does not pass through glass (up to 99% absorbed), most clear plastics or water (~ 50 % loss every 1 cm depth).
- Young, fast growing reptiles require much more UVB than slow-growing adults.
- UVB is not utilized until the reptile is within its normal 'preferred body temperature' range, so it's of little benefit having UV lights on in an unheated cage and before a reptile has had a chance to 'warm up'.
- Although we measure UVB at the closest basking site, we usually do not know how long each day an individual is actually at that site.
- The actual amount of UVB emitted by a light source decreases with usage, even though visible light does not. Need to check UV output of all globes at least annually.
- Social hierarchies among cage mates may mean that subordinate individuals are always kept away from the basking site, and thus may get no UV exposure.
- UVB radiation drops off rapidly as distance from the light source increases. See table below;

Distance from globe	Average UVB from a 300W Osram 'Ultra-Vitalux' UV globe
25 cm	400 µW/cm^2
50 cm	120 " "
75 cm	60 " "
100 cm	30 " "
150 cm	5 " "

- **UVA** is in the visible range, and is responsible for normal behaviors such as feeding, diurnal movement, mating and others.

4. Humidity

Humidity is the function of temperature, ventilation and the amount of water contained in the cage. These 3 factors together are important in the husbandry of lizards.

4.7 Substrate

Substrate is the general name for the material placed on the floor of reptile enclosures. Consideration the ease of cleaning, availability, looks and what occurs in the animals' natural environment.

If you choose to use a loose substrate (e.g. recycled paper pellets, gravel, sand etc.) it is suggested by most keepers that you do not feed your animal in the cage with the substrate present. The accidental ingestion of substrate particles has the potential to cause health problems in your animals.

No Substrate

This is the easiest type of substrate to have in your enclosure. It doesn't necessarily look great, but is easy to clean just by washing/wiping out the enclosure. Without substrate, it is important to clean frequently to avoid urine and faeces smeared around the enclosure and themselves.

Newspaper

Paper is easy to use as a substrate. It costs little or nothing and is easily available. It's placed on the bottom of the enclosure, with the enclosure's furnishings on top, and, when soiled, it is easily removed, thrown away and completely replaced. Newspaper is absorbent especially if placed in layers.

Newspaper is also often used with other substrates, being placed underneath to protect the enclosure floor, and enabling easy removal of substrates by just picking up the entire sheet of paper and throwing it all away.

A disadvantage of paper is that the lizards are unable to burrow and can wear down their claws from digging on a smooth surface.

Breeders Choice

Breeders Choice is recycled paper pellets, which are made for use as kitty litter. It is reasonably cheap. It is highly absorbent, and while they don't look completely natural, they can look quite good in an enclosure, and are easy to change.

Breeders Choice can allow the lizards a textured surface to run on and allows them to forage and dig.
The dirty pellets can easily be removed and replaced with new ones - a full substrate change is suggested every few months that a full substrate change (and enclosure clean) is conducted every 1 - 3 months.

Sand

Sand is another commonly used substrate that looks very natural and allows for digging. Sand is quite absorbent and can be used as to control humidity in an enclosure.

Red sand would resemble the dragon’s natural environment.

Sand can be spot cleaned daily, but a complete substrate change is required every few months, this can be time consuming and messy. You need to be careful and aware about feeding your animals on sand, as it can be eaten consumed accidentally, and cause problems

There are other types of substrates that can be utilised such as gravel and leaves/bark. These are commonly used for reptiles. They are not a typically natural substrate of the Central Netted Dragon.

Experimentation of substrates is advised to find what is suitable for your dragons and suitable for you as the keeper. Remember to consider:

- Their natural habitat and environment.
- Ease of cleaning and changing.
- Aesthetically pleasing enclosures that depict the dragon, especially when displaying them.

4.8 Nestboxes and/or Bedding Material

The species is said to dig its own burrow (Storr, 1966; Pianka, 1971) and while this seems to be true due to the "perfect" fit and position of burrows, the only apparent direct observation of an animal digging its burrow is one in captivity (Rankin, 1977).

The burrow usually has only one entrance (Heatwole, 1970; Pianka, 1971), which faces no particular direction (Heatwole, 1970) and usually consists of a single straight, slightly curved or L-shaped passageway (Heatwole, 1970). The burrows usually extend for lengths of 20-40 cm (Warburg, 1965; Storr, 1966; Heatwole, 1970; Henle, 1996), although they may be as long as at least 50 cm (Heatwole, 1970). They usually extend to depths of no more than
about 25 cm (Warburg, 1965).

Most individuals have only one burrow (Pianka, 1971), although some may have as many as eight (Storr, 1966; Heatwole, 1970; Pianka, 1971).

Usually only one lizard is found occupying a burrow at a time, but juveniles are sometimes found with adults and occasionally a female is found with a male. Rarely do two males occupy the same burrow (Heatwole, 1970).

The burrows are usually close to where the lizards are perching during the day. For example, in one field study, 74 percent of the burrows examined were within one metre of the perch (Heatwole, 1970).

The burrows are sometimes plugged with earth (Rankin, 1977), perhaps more in association with inclement conditions than at other times. The plug is not at the entrance, but toward the end of the tunnel, the earth from the plug coming from loose soil at the end of the tunnel (Rankin, 1977). The fact that the tunnel is plugged toward the end instead of near the
entrance may be the reason burrow plugging was over-looked by earlier workers (Heatwole, 1970; Pianka, 1971). Adults of both sexes as well as juveniles plug their burrows (Rankin, 1977).

In addition to providing shelter from predators and inclement weather, the burrows may also provide thermoregulation benefits).

The addition of a mock rock or reptile cave into the enclosure could be used as a hide. Nesting material isn't required as such. Spinifex grass also can be used a hide for lizard to retreat.

4.9 Enclosure Furnishings

Cage furniture is used to make an enclosure more interesting for both keeper and animal. A variety of different types of cage furniture is used.

Water Bowl

Water bowls are very important, as all animals require water. Water should be changed regularly, every 3 - 5 days bowls should also be scrubbed.

When choosing a water bowl, you need to take into consideration the size of the animal, as a number of species will immerse themselves to soak fully within the bowl. You will need to consider the size of the enclosure as well for a suitable sized bowl.

It is important to make sure that the dragon can get out of the bowl, so you they don't drown. This can be a problem for juvenile animals. Just use a small bowl, or place rocks in the water bowl to act as stepping stones for the animal to get out. The bowl should be stable so as not to tip over.

The placement of the water bowl should also be considered, because if the water is under a heat source, the water will evaporate quickly and could affect the humidity.

Hide Box

Hide boxes are very important, as reptiles are generally solitary, which spend most of their time hidden. If you place this type of animal in plain view with no means of escape, most, if not all animals, will eventually end up getting stressed, and which can result in many illnesses, such as parasitic infection, food refusal, inactivity, respiratory infections, etc. Juvenile animals are especially prone to becoming stressed in the manner.

Hide boxes are easy to make, and can be as simple or as fancy as you like. For juvenile animals, a small box such as a light bulb box with a hole cut in the side serves the purpose well. These have the advantage that they are just tossed out as soon as they are dirty.

Larger animals require a larger hide box, and obviously a larger hole in the front! The simplest type is just a wooden box (similar to a bird breeding box) which has a large hole cut in the front, and an easily-removed lid.
Remember to have an easy to remove lid - otherwise you will find it hard to get to your animal when you want/have to.

More complex (and some would say better looking) are fake hide rocks. These can be made from a standard wooden hide box, and then covered with fibreglass, plaster or mortar mix, and painted in rock colours. These can look quite good, and serve a double purpose of both a hide box and a basking platform.

Whatever option you choose, be sure to allow a large enough space for the animal (or animals!) to get into, and ensure that the opening is large enough for the animal to get in and out. If there are two or more animals kept in the same enclosure, the opening needs to be able to cope with multiple animals trying to enter/exit at the same time without a blockage occurring.

It also is worthwhile having a hide box in a number of locations around the enclosure, to allow your animal to choose a hide box which is at the right temperature for it.

Branches
Branches provide both vertical space in the enclosure for climbing (and hence exercise), a place to provide a basking platform, and a means for the animal to regulate its temperature by moving up or down in the enclosure's temperature range.

Rocks
Rocks not only make your enclosure look good, but they also provide hiding places and basking spots for your animal. When you get your rocks, be sure they are solid. Sandstone sometimes gets brittle or dissolves when wet, falling to pieces in the enclosure. Also, make sure the rocks do not have large amount of mineral ore either in or on the rock, as this can be toxic for both you and your animal.

Plants
While plants can make an enclosure look very natural, you must be careful about what you bring into your enclosure, as plants can be toxic, or carry parasites or diseases.

Spinifex grass (*Triodia sp*.) for shelter is a natural plant to select for enclosures.

5 General Husbandry

5.1 Hygiene and Cleaning

Enclosure hygiene is extremely important - the health of your reptile depends on good husbandry.

Most cleaning of the enclosure involves the use of some liquid to clean surfaces. If you have lights/bulbs in the enclosure, make sure you give them time to cool down before allowing water near them, as water on a hot bulb can cause the bulb to explode.

F10 is a cleaning agent that is effective in cleaning agent and disinfectant enclosures and safe to the animals it is the best product for disease prevention control and care of your reptiles.

The enclosure should be regularly cleaned. Enclosures should be spot cleaned daily.

The substrate should be regularly removed and replaced/washed, and all sides of the enclosure should be cleaned.

Water Changing/Cleaning

The water bowl should be emptied and cleaned every 3-5 days, or as needed if dirty. When emptying the water, check for mites on the bottom of the bowl - often this is the first place you will see them if your animal is infested, as it tries to get rid of them by soaking.

Substrate Washing

If you are using a washable substrate such as gravel, sand or leaves/bark, the substrate should be removed regularly, washed, dried and replaced. The substrate should be washed until the water coming off is clear and clear of any foreign particles. To dry the substrate, place it in the sun.

Rocks and Branches

Rocks and branches should be thoroughly cleaned before adding to the enclosure, and also regularly as part of the enclosure cleaning process As part of the regular cleaning process, branches and rocks should be removed and cleaned thoroughly.

5.2 Record Keeping

Records are an important step in the husbandry process of reptiles. Notes can be taken daily or as needed. Records can be made in different ways, on a cage card or a daily report sheet.

Records that should be noted:

- Date of feedings and what was consumed,
- Substrate changes,
- Weights and measurements,
- Deaths,
- Vet Visits,
- Medications,
- Any abnormal activities.

5.3 Methods of Identification

The common methods used to identify individual Central Netted Dragons are:

- Photography of individuals to identify individual variation in colour patterns and other distinguishing characteristics,
- Recording old wounds or scars on individuals,
- The application of a coloured spot to the individual either temporarily or permanently,
- Using individual micro chips that can be read by a scanner,

Trovan Scanner

- Toe Clipping (This method has long been favoured as a convenient and permanent method for identifying small lizards, but its continued use is controversial because it may be cruel and disfiguring) and,
- Labeling the enclosure

5.4 Routine Data Collection

Weights and measurements – it is advisable to weigh and take snout vent lengths monthly. This ensures that there is no weight loss and that the dragons are healthy and maintaining a desirable weigh. It is particularly useful when breeding them so as to monitor the female's weight.

Faeces – a faecal sample should be taken and tested twice a year. This is to ensure that you animals are healthy and parasite free.

6 Feeding Requirements

6.1 Captive Diet

During the day, perched individuals will descend from their vantage points in order to catch a passing insect (Heatwole, 1970). This behaviour suggests that the lizards are sit and wait predators.

A diet for *C.nuchalis* can include both invertebrates and vegetation three times a week.

Dragons can be offered invertebrates, which consist mostly of crickets, but occasionally can include moths, fly maggots or small locusts. Invertebrates should be dusted with Rep-cal calcium powder or Herptivite multivitamin powder on every second feed. Dragons can also be offered a vegetable mix, comprising of an assortment of finely- chopped green, leafy vegetables and fruit, with a small amount of soaked low-fat dog kibble or cat food (approx 1 teaspoon) mixed through it. (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted.)

Feeding hand raised insects in captivity such as crickets or woodies are a good dietary foundation for most, but when time and opportunity permits, it is a good idea to supplement these cultured insects with a selection of wild caught ones (Care of Australian Reptiles in Captivity).

The quality of the diet is essential to the animal's health. Vegetables and fruit must be free from fungal infection, spoilage or other signs of decay.

Animal prey should be free from any infectious disease or evidence of gross pathology and, if possible, should be tested periodically for the presence of bacterial infection and parasitic infectation.

ADULT DRAGONS: can be feed a diet of crickets every 2 – 3 day. Once a week a meal of iguana mix*, as well as crickets on this day. (D.Purcell, TZ pers.comm.).

JUVENILE DRAGONS: can be feed a diet of small crickets one to two times a day, juveniles should be feed everyday. (D.Purcell, TZ pers.comm.).

Pinky mice can be offered occasionally to adult dragons as well as good quality canned cat food such as whiskas, hills canned food. (Care of Australian Reptiles in Captivity).

* Iguana Mix (as per Taronga Zoo)

Alfalfa Sprouts	Mung Bean Sprouts	Escarole
Apples	Kale	Parsley
Carrot	Pears	Pumpkin
Rockmelon	Tomatoes	Endive
Paw Paw	Sweet Potato	Squash

6.2 Supplements

Rep-Cal or Herptavite can be used fortnightly/monthly. Crickets are to be coated in this calcium and vitamin D supplement. Calcium supplements can be purchased from pet stores or order through reptile suppliers.

The routine use of supplementary vitamins and calcium is often advised for amphibians and reptiles (Campbell and Busack, 1979; Allen et al., 1986; de Vosjoli, 1990a; Staton et al., 1990), but generalisations about the quantities needed are difficult to formulate. Studies of lizards have revealed substantial interspecific and geographic variation in vitamin and mineral requirements, and the symptoms of vitamin deficiency or excess are similarly variable (Larry Talent, personal communication). Many multivitamin supplements don't state nutrient levels on their labels. Using a product without knowing whether it has, for example, 5000 or 50,000 IU of vitamin A per gram is dangerous (Mary Allen, personal communication).

As with UVB supplementation, we remain largely at a trial and error stage, and a conservative approach to vitamin supplementation is probably the best starting point for a species with unknown requirements. Selective supplementation of particular nutrients is preferable to a shotgun approach. For example, a calcium : phosphorus ratio of 1.5:1
promotes normal bone growth.

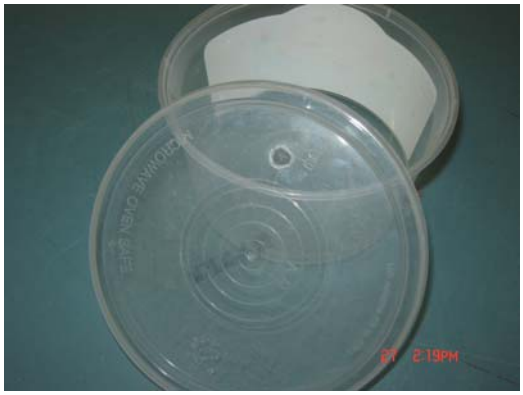
Food items can be dusted or 'gut-loaded' with a vitamin and mineral mixture just before they are offered to the animals; uneaten items should be removed from the cage. Most insects have low levels of calcium, and dusting them with calcium/phosphorous mixture that adjusts the ratio is desirable. Beta carotene and vitamins C and E may also be beneficial, but excessive vitamin and mineral supplementation can cause problems (de Vosjoli 1990).

Feeding a balanced diet is preferable to supplementing an inadequate one.

6.3 Presentation of Food

- Offering pinky mice as a food alternative can be used as enrichment. This provides stimulation and different eating techniques. It is also providing them with alternative nutritional values that are required within a captive situation

- Utilising a container such as a takeaway container and placing holes in the lid large enough for a fly to get through. Placing Fly Pupae in the containers, eventually the flies will hatch and find there way out of the container, they are slowing released and the dragons are able to catch these at will once they have emerged. The dragons may also become accustom to what goes on after some time of doing this procedure and sit and wait in anticipation of the fly's emerging. These procedures enhance the dragons sit and wait predatory approach to capturing their meals in the wild.



- Similarly a bamboo pole or pole of any material can be used, holes are drilled along the length of the pole large enough for a cricket to get out of but not large enough that they all fall out of the pole at one time. The crickets are placed inside the pole and suspended from the top of the dragon's enclosure. Once again there should be a slow release of the food item and the dragons are able to hunt and wait for their prey.

- Simply leaving crickets in the enclosure for the dragons to hunt and catch at their leisure.

NOTE: When leaving food items in the enclosure central netted dragons may not eat them instantly and the crickets may be left in the cage for some time. There is a risk of the crickets starting to eat off the dragons. They may be a need to ensure the crickets have food items of their own. Placing a small bowl of the iguana mix will help combat this problem. The central netted dragons can also feed from this.

7 Handling and Transport

7.1 Timing of Capture and Handling

Body support and a firm but gentle grip is needed to handle lizards. Unfortunately lizards are often difficult to handle as there are no tools specifically designed for the purpose. So the handler must grasp the lizard directly. Lizards move swiftly and have an inclination not to be picked up. They have claws, tails and mouths to contend with.

Often a cloth dropped over the lizards will afford the handler a vital few extra seconds with which to affect a firm grip. A smothering grip initially will prevent movement and allows a more safe and secure hold to be achieved.
It is easier to handle the dragons when they are cold and their environment is cool and they haven't heated up. This timing would be dependant on your heating system. Handling them when they are warm is a little more difficult they tend to be more active and wiggle around making restraint a little harder.

7.2 Catching Bags

A small calico catching bag could be useful to carry the Central Netted Dragon in. The catching bag must be of a fabric that allows the lizard to breathe. The catching bag provides them with a dark environment which allows movement/travel a little less stressful for them.

Reptiles should not remain in a catching bag for more than about 2 hours.

Ensure that the catching bag is turned inside out to stop the lizard from catching on any loose threads that are on the inside seems of the bag.

7.3 Capture and Restraint Techniques

The head of an agamid should be held with one hand so that the handler can affect safety for both the handler and the held. The other hand should grasp the body and the rear legs. This technique should

prevent any scratches to the handler and, although difficult, it is perfected with practice. The grip should be safe, both for the animal and the handler, and it should be comfortable.

7.4 Weighing and Examination

The simplest and easiest way to way the Central Netted Dragon would be to place inside a small catching bag, weighing on a small set of kitchen scales. This ensures that the dragon is safe and secure, with minimal worries of him escaping.

Calico Catching Bag

Scales suitable for weighing

The bag should be weighed first and subtracted from the overall weight of the bag and the lizard.

7.5 Release

Once reptiles are in captivity, it is usually unwise to release them to the wild for several reasons;

- The former captive may not be able to compete successfully when released to fend for itself,
- The former captive may compete for an ecological niche already occupied by a resident native reptile which is well established in its habitat,
- The former captive may be infected with pathogenic microorganisms against which the wild population is ill equipped to mount an immune response.

7.6 Transport Requirements

7.6.1 Box Design

See Appendix for IATA container requirements

7.6.2 Furnishings

Furnishings are not required when transporting the Central Netted Dragon.

7.6.3 Water and Food

Water and food are not a requirement when transporting Central Netted Dragons.

Do not feed for approximately 3 days prior to transportation to avoid defecating in the transport bag. Also, if transport temperature becomes cool the lizard won't be able to digest its food. (McFadden, M, Taronga Zoo, Pers comm.)

7.6.4 Animals per Box

Animals in the same container or bag 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.

Snout-Vent-Length (SVL)	Body-With (BW)	Max No. of Animals per Bag	Max Bag Size
≥ 20cm (8 in)	≥ 5cm (2 in)	1	Depending on the size of the animal.
≥ 15cm < 20cm (6< 8 in)	≥ 2.5cm < 5cm (1< 2 in)	15 10	45 x 60 cm (18 x 24 in) 30 x 45 cm (12 x 18 in)
≥ 10cm < 15cm (4< 6 in)	< 2.5cm (1 in)	30 20	45 x 60 cm (18 x 24 in) 30 x 45 cm (12 x 18 in)
< 10cm (4 in)	< 2.5cm (1 in)	30	30 x 45 cm (12 x 18 in)

7.6.5 Timing of Transportation

The lizards should not be transported in extreme weather; they should not be transported in hot weather. (McFadden, M, Taronga Zoo, Pers comm.). Try to avoid temperatures of 30°C - 35°C, also this is dependant on your transportation container.

7.6.6 Release from Box

The lizards can be released from their transportation box as soon as they have made it to their required destination. Water should be supplied to the lizards as soon as possible.

8 Health Requirements

8.1 Daily Health Checks

Reptiles are creatures of habit. If there is a noticeable change in their behaviour then this can indicate that there may be stress or disease.

The signs that indicate disease in reptiles include;

- Anorexia,
- Weight Loss,
- Dehydration,
- Lethargy,
- Abnormal Behaviour,
- Abnormal Posture,
- Swellings,
- Discharges,
- Abnormal Urine and Faeces,
- Abnormal Odours, and
- Changes in the skin and mucous membranes.

Because they are ectothermic, reptiles do not develop a fever in response to infections. However, they may seek higher environmental temperatures in certain disease states. This is called 'behavioural fever'. Inspection of a reptile is best carried out in its environment.

Ecdysis, the sloughing of skin, occurs in all reptiles. It is not an annual event but occurs as the reptile out grows its skin. The frequency varies between species and individuals. Other factors, such as injury and parasitism of the skin also stimulate shedding. If a reptile suddenly begins to slough more frequently, it may indicate a mite infestation.

When a reptile is beginning to show signs of sloughing its behaviour changes, usually becoming less active, disinclined to feed and more aggressive if handled.

8.2 Detailed Physical Examination

8.2.1 Chemical Restraint

Chemical restraint can be injectable or inhalant anesthetics. Inhalants are preferred for lizards and isoflurane is the usual choice for short sedation.

Isoflurane has a rapid onset and rapid recovery, it is a good muscle relaxant.

Small dragons can be either mask down with 5% isoflurane in oxygen (face mask) or put them in an induction chamber with 5% isoflurane in oxygen. Sometimes they breathe hold if manually restrained, and these often go down faster in the chamber. (VQC, Taronga Zoo)

Injectables can be used but it is harder to give them in small lizards and the gas is very safe and effective. (VQC, Taronga Zoo)

8.2.2 Physical Examination

See 7.1 and 7.3 for capture, handling and restraining techniques, these should be applied for physical examinations.

Skin: The condition of the skin provides a lot of information about its well being and its state of hydration. The skin may often be infested with parasites such as mites and ticks. The skin can be palpated for masses or swellings under the skin.

Posture: head should be generally held up and erect, the lizard should be alert.


Example of a healthy lizard with good posture.

Body Condition: there should be good muscle mass, no emaciation present, eyes should not be sunken, skin should be free of missing scales or abnormal skin imperfections.

Oral Cavity: is often diseased and should be examined closely. The mucous membrane of the mouth and the teeth are delicate and are easily damaged. Hard objects should not be used to pry open the jaws. If a probe is used to open the mouth it should be covered with rubber or plastic tubing. The mucous membrane of the mouth should be glistening and moist and the saliva should not be sticky and tenacious.

Heart: Auscultation of the heart and lungs is not much use in reptiles. The heart beat may be visible in the armpit of lizard. The internal organs may be gently palpated for abnormalities, especially if emaciated.

Respiration: there should be no gasping or open mouth breathing.

8.3 Routine Treatments

Faecal Samples: It is advised to take faecal samples for testing twice a year.

Worming: All lizards should be wormed once a year.

8.4 Known Health Problems

Common Name	Scientific Name	Type of Pathogen	Zoonotic	Symptoms
External Parasites (Ecotoparasites)				
Mites	*Ophionyssus natricis*	N/A	Yes	• Restlessness • Immersing in water • Unusual Digging • White Specs • Loss of appetite
Ticks	*Amblyomma Aponomma*	N/A	Yes	• Evidence of ticks is upon visual inspection, around eyes, ears
Internal Parasites (Endoparasites)				
Roundworm	*Strongyllurus paronai*	Protozoa Nemotodes	Yes	• Adult worm may be seen; otherwise a faecal sample is required for tests.
Tapeworm	-	Protozoa Cestodes	Yes	• Adult worm may be seen; otherwise a faecal sample is required for tests.
Flukes	-	Protozoa Tremotodes		-
Microsporidia	-	Protozoa		• Necrotising Lesions
Coccidia	*Cryptosporidia* spp	Protozoa	Yes	• Weight Loss • Regurgitation • Diarrhoea • Death
Amoebae	*Entamoeba invadens*	Protozoa	Yes	• Loss of appetite • Regurgitation • Bloating • Endless thirst
Flagellates	-	Protozoa		• Poor appetite • Weight lose • Regurgitation • Abnormal faeces • Lethargy
				•
Bacterial Diseases				
Respiratory Infections/Pneumonia	-	N/A	No	• Listlessness • Weight loss • Swollen or bloated • Gaping, open mouth • Wheezing, bubbling

Canker or 'Mouth Rot'	Necrotic Stematosis	N/A	No	• Gums swell • Yellow-white cheesy matter in mouth • Swelling • Anorexia
Scale Rot	-	N/A	No	• Abnormal skin condition/scales
Abscesses	-	N/A	No	• Lumps/masses on the skin
Salmonella/ Salmonellosis	*Salmonella spp*	N/A	Yes	
Non Infectious – Stress & Captive Reptile Diseases				
Sloughing Difficulties	Dysecdysis	N/A	No	• Dehydration • Stress • Rubbing body continuously
Metobolic Bone Disease (MBD)	-	N/A	No	• Hard knobs in leg bones • Bumps along vertebrae
Egg Binding	Dystocia	N/A	No	• Eggs not being laid at the correct time.
NOTE: ZOONOSIS: (zo"o-no'sis) pl. zoono'ses - a disease of animals that may be transmitted to man under natural condition				

For more on common health problems refer to 13 Appendix. For more diseases and health problems in reptile Manual of Exotic Pets by Peter H Beynon & John E Cooper or Exotic Animal Medicine for the Veterinary Technician are both useful and comprehensive on lizard medicine.

8.5 Quarantine Requirements

A newly acquired reptile should be quarantined to allow time for the development of any disease it may be incubating before it is introduced to the rest of a reptile collection. In this way disease outbreaks in a collection of reptiles can be prevented. Similarly, if a reptile in a collection is observed to be showing signs of an infectious and potentially contagious disease, then it should be isolated.

There is always a lapse of time between when a reptile becomes infected with a disease causing (pathogenic) organism and the time the clinical signs of disease are observed. This period is called the incubation period of the disease. Reptiles have long incubation periods for many of their diseases because their metabolic rate is slow, and their body temperature is low.

Quarantine is necessary for both wild and captive bred reptiles for a period of approximately 30-40 days.

The period of time is dependant on the institution/place that the animals are kept and the policies that are put into place.

A routine faecal sample is advisable at the end of the quarantine period before the release of the lizard to clear them of all diseases before being added to a collection.

9 Behaviour

9.1 Activity

The species is diurnal. However, adults of both sexes have been found on roads after dark (G. Fyfe, in Valentic and Turner, 1998). Some of these animals have been heavily gravid females, seemingly asleep, on warm bitumen roads (Valentic and Turner, 1998).

It is primarily ground dwelling, although it climbs on short sticks and stems in order to bask and keep watch (Storr, 1966).

These lizards dig several shallow dead-end burrows near favoured basking sites, to which they retreat when threatened. If disturbed in their burrows, they dash off and hide in another nearby burrow.

9.2 Social Behaviour

They are very territorial and even females will fight each other. (Rex Neindorf, Director Alice Springs Reptile Centre pers comm.). Males fight to such an extent they must be separated.

They are very talkative and head bob and arm wave, and stamp to each other.

Hatchlings are initially raised together but quickly need to be separated due to aggression and establishment of dominance. Dominated animals tend not to feed so need to be separated out. (Greg Fyfe, Acting Curator (Zoology) Alice Springs Desert Park pers comm.)

9.3 Reproductive Behaviour

The males will come up from their winter rest and establish their territories. Mating behaviour of the male consists of head bobbing. The female will show her readiness by arm waving. The male will approach her and the female will show submissive behaviour by laying flat on the ground. The male grasps the female in the nape (back of neck) and will mate. Mating only lasts for a few seconds generally. (Jochem van der Reijden Specialist Keeper Reptiles and Invertebrates pers comm.)

9.4 Bathing

They are a desert species so they really shouldn't need to bath for any behavioural reasons.

The only time they would enter water is if their skin was really dry or if they were dehydrated.

9.5 Behavioural Problems

There are no apparent behavioral problems of the Central Netted Dragon.

9.6 Signs of Stress

Studies have demonstrated that stress due to a combination of reproductive activity and extreme climatic conditions actually lead to death (Bradshaw, 1986).

There are some signs in lizards that may alert you stress of your animal:

- Unusual Postures, to identify these postures you must in the first instance know and recognise their normal postures.
- Constant digging is usually a sign that they are not happy with their environment and you should check to make sure that their habitat is properly set up.
- Eating habits have changed, usually when an animal experiences a loss in appetite or willingness to eat, it may be stressed and its health may be compromised.

9.7 Behavioural Enrichment

Environmental or behavioural enrichment is achieved by adding to a captive animla's environment or by modifying that environment to stimulate behaviours resembling those of a healthy animal (Shepherdson, 1992a). An enriched environment should offer a captive animal some sense of control, resulting in its ability to make choices for itself.

Food

A majority of behavioural enrichment that is provided for a Central Netted Dragon is food based. These food based enrichment ideas are in 6.3 Presentation of Food of this manual also, they are:

- Offering pinky mice as a food alternative can be used as enrichment. This provides stimulation and different eating techniques. It is also providing them with alternative nutritional values that are required within a captive situation

- Utilising a container such as a takeaway container and placing holes in the lid large enough for a fly to get through. Placing Fly Pupae (approx 5-10) in the containers, eventually the flies will hatch and find there way out of the container, they are slowing released and the dragons are able to catch these at will once they have emerged. The dragons may also become accustom to what goes on after some time of doing this procedure and sit and wait in anticipation of the fly's emerging. These procedures enhance the dragons sit and wait predatory approach to capturing their meals in the wild. (Adam Skidmore, Taronga Zoo, pers comm.)

- Similarly a bamboo pole or pole of any material can be used, holes are drilled along the length of the pole large enough for a cricket to get out of but not large enough that they all fall out of the pole at one time. The crickets are placed inside the pole and suspended from the top of the dragon's enclosure. Once again there should be a slow release of the food item and the dragons are able to hunt and wait for their prey. (Michael McFadden, Taronga Zoo, pers comm.)

- Simply leaving crickets in the enclosure for the dragons to hunt and catch at their leisure.

- NOTE: When leaving food items in the enclosure central netted dragons may not eat them instantly and the crickets may be left in the cage for some time. There is a risk of the crickets starting to eat off the dragons. They may be a need to ensure the crickets have food items of their own. Placing a small bowl of the iguana mix will help combat this problem. The central netted dragons can also feed from this. (Michael McFadden, Taronga Zoo, pers comm.)

Burrowing
This species is said to dig its own burrows. The burrows are usually under or near their perch. Provision of a suitable digging substrate such as sand or soil will allow the dragon to dig its own burrow allowing it a daily task and to provide itself with a greater choice for thermal gradient and fleeing. There is a downside to this enrichment activity if the dragons are on display; they may not be visible at all times if they choose to seek solace in their burrows.

Perches
Although it is primarily ground dwelling, the dragon does climb onto perches to bask and keep watch. Providing branches or perches would allow the dragon to do this. It would be necessary to provide suitable basking lights in conjunction to the branches so that it could utilize them for basking.

9.8 Introductions and Removals

Social behavior can be apparent in certain individuals within a few hours after lizards are released in their enclosure. Aggression can appear in the form of displays and chases. Within two days a dominant (male) can establish himself on a central position in which he can display frequently, directing his displays and chases at other males which came close to the area. Introductions should be monitored.

9.9 Intraspecific Compatibility

It is not advisable to keep adult male dragons together because they may fight causing injuries to each other. Aggression or bullying between different dragons may occur. If this happens it may be necessary to separate smaller dragons from larger ones.

9.10 Interspecific Compatibility

The Central Netted Dragon could be housed with other species if there is enough enclosure space so they could keep out of each others way. It wouldn't be advisable to put it with a dragon from the same genus.

Or anything large that could possibly eat them. A small ground dwelling desert skink, like a night skink or one of the Ctenotus genus (moderately large skinks with well developed limbs and long tails), would be suitable. (Michael McFadden, Taronga Zoo, pers comm.)

9.11 Suitability to Captivity

Initially this species will be nervous, but if given ample quiet and privacy, will adjust readily to captivity and eventually become trusting of their keeper. In time some individuals become amenable to being handled and appear happy to just sit on a hand.

10 Breeding

10.1 Mating System

Breeding is improved by allowing a cooling off period for a month or so in winter.

Timing of reproduction in these species is attuned to the period of maximum food supply (Bradshaw, 1981).

The rate of growth is necessary to achieve sexual maturity in one year. It is measured in C. nuchalis at a maximum rate of 25mm/month (Bradshaw 1981). There maybe a positive relationship between age at maturity and the average life span (Bradshaw 1981).

The Central Netted Dragon is oviparous.

10.2 Ease of Breeding

Female Central Netted Dragons lay as many as three clutches in a season, from late spring to mid-summer, the onset of spring.

Mating behaviour of the male consists of head bobbing. The female will show her readiness by arm waving. The male will approach her and the female will show submissive behaviour by laying flat on the ground. The male grasps the female in the nape(back of neck) and will mate. Mating only lasts for a few seconds generally. (J. Van Der Reijden, Alice Springs Desert Park)

10.3 Reproductive Condition

Triggers in captivity that will provide optimum conditions are:

- Increase in their diet.
- Cool them down during the winter months and increase their temperature to simulate the spring months.
- Introduce the females into an enclosure if males and females have been separated.

Refer to 4.1 Temperature Requirements for heating requirements.

10.3.1 Females

In Western Australia, females carry yolking follicles between late winter and early summer (September-end of February) (Bradshaw, 1965).

They also can carry oviducal eggs in this same period (Bradshaw, 1981). Other studies have found females to be "gravid" between early spring and mid-summer (early October through February) (Pianka, 1971; Valentic and Turner, 1998).

Oviducal eggs are present from September until late February and there appears to be peaks of laying in September, October, January and February with the most important of these being October. (Bradshaw, 1981).

10.3.2 Males

It is not advisable to keep adult male dragons together because they may fight causing injuries to each other. Aggression or bullying between different dragons may occur. If this happens it may be necessary to separate smaller dragons from larger ones.

The head and throat of breeding males becomes red or orange in colour.

10.4 Techniques Used to Control Breeding

Separate enclosures for males and females. Only introduce when wanting to breed them.

10.5 Occurrence of Hybrids

There has been no occurrence of hybrid *C.Nuchalis* recorded to date.

10.6 Timing of Breeding

Ctenophorus nuchalis breeds regularly in spring (September-October in the southern hemisphere) in, following reliable winter rainfall which stimulates insect abundance sufficient to sustain their reproductive effort.

In years where adequate winter rainfall has been followed by early cyclonic rains, the population breeds continuously for a 6-month period between October and March of the following year.

They appear to be an opportunistic vernal breeder, limited only by the availability of resources. Although environmental temperature has often been seen as the primary factor determining reproductive cycles in reptiles, it is suggested that temperature is a necessary but not a sufficient condition for successful reproduction in Central Netted Dragons and that the availability of adequate resources may assume an overriding importance, especially in arid habitats where annual rainfall may be highly unpredictable.

These Dragons are spring breeders. The males will come up from their winter rest and establish their territories. (J. Van Der Reijden, Alice Springs Desert Park)

10.7 Age at First Breeding and Last Breeding

They appear to grow rapidly and reach maturity in their first year. (Bradshaw, 1981). Average age is 0.75.

The attainment of precocious sexual maturity may represent an important adaptation in desert lizards whish are associated with low seral state environments loiable to destruction by fire and necessitating a rapid population response on the part of the animal. (Bradshaw, 1981)

Age-specific fecundity:

Age Years	No. Clutches Laid/Year	No. Eggs/ Clutch	Total No. Eggs Laid/ Year/Female	Source of Data
1	2	4	8	Bradshaw (1965)
2	3	4	12	Pianka (1971a)
3	3	4	12	Bradshaw

10.8 Ability to Breed Every Year

Dependant on food availability and warmth. In captivity if reproductive conditions are correct the Central Netted Dragon should be able to breed each year assuming they are at sexual maturity.

Between 1995 and 2001, thirteen clutches of eggs were laid at Taronga Zoo, with one female responsible for eleven of these. Eggs were typically laid in moistened red sand when provided. Clutch size ranged from 3-6 eggs, which is within the range of 2-6 previously stated for this species (Pianka 1971a; Bradshaw 1981). However, the average clutch size of 4.9 eggs in captivity was higher than the average clutch of 3.4 eggs recorded in the wild (Bradshaw 1981). This may be due to the abundance of food in captivity. Average egg weight from a clutch of six eggs was 1.58 g (range 1.45-1.69 g). (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted.)

10.9 Ability to Breed More than Once Per Year

Individual females can carry both yolking follicles and shelled oviducal eggs at the same time, suggesting that individuals can lay more than one clutch in a season (Pianka, 1971).

In captivity the dragons can lay multiple clutches but in the wild this might be restricted to just one clutch.

Recorded in captivity, one female laid three clutches in one “season”. The clutches were separated by 32-44 days (mean = 38 days) (Klages, 1982).

Double clutching occurred on three occasions at Taronga Zoo, with inter-clutch intervals of 37, 70 and 112 days. In the case of the 37 day inter-clutch interval, the second clutch of eggs was not fertile. Double clutching has previously been reported in captivity for this species, with an inter-clutch interval as short as 32 days (Klages 1982). Pianka (1971b) found that second clutches in this species average nearly one egg more than the first clutch. In two of the three double clutches recorded here, the second clutch was one egg larger than the first, whilst clutch size was equal in the remaining clutch.

Eggs were deposited at various times throughout the year, with clutches laid in May, July, August, September, November, December and February. Peak laying period was in November and December, with five of the thirteen clutches laid in this period. This pattern of breeding behaviour

indicates that *C.nuchalis* may breed at any time of the year under our captive set-up. Wild data indicates that *C.nuchalis* is highly seasonal with a long breeding season, between September and March that is largely determined by the availability of resources (Bradshaw 1991). By late summer, most wild adult *C.nuchalis* die (Bradshaw 1986). (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted.)

10.10 Nesting, Hollow or Other Requirements

Eggs are deposited in a shallow excavation of sand. Gravid females should be provided with a laying box of damp sand into which they burrow to lay their eggs. (Fyfe, G Alice Springs Desert Park).

This should be introduced into the enclosure around the time that the gravid female will begin to lay her eggs. This will reduce the eggs from being damaged and also allows for easy removal of the eggs from the enclosure to the incubator.

10.11 Breeding Diet

After the mating the female will increase in weight and food intake is increased. The female could be feed every 1-2 days until she regains her weight, approx 10g of the iguana mix per feed and 2-3 crickets.

10.12 Incubation Period

The incubation period at one temperature is given in the following table:

Incubation Temp (ºC)	Incubation Period Days	Reference
27	75-79	Klages, 1982

Two clutches of eggs were incubated at Taronga Zoo. Eggs from these clutches were incubated at 30°C and 26.4°C, using a refrigerated incubator. These were set up in one-litre plastic food containers in a medium-grade vermiculite mixed with water at an equal weight ratio. Clear plastic sandwich wrap covered the top of the container to maintain humidity. Data are available for incubation of seven of the clutches, incubated at temperatures of between 27°C and 30°C (Table 1). Average incubation period for the seven clutches was 73 days (range 57-85 days). Hatchling measurement data is only available for one clutch. The average snout-vent length of four hatchlings was 34.3 mm (range 32-36 mm), average total length was 71.8 mm (range 69-80 mm) and average mass was 1.46 g (range 1.23-1.60 g). This may be due to the larger size reached by the dragons in captivity and the abundance of high-quality food available. (Harlow 2000). (McFadden, M. and Harlow, P. 2007. Captive reproduction and longevity in Tawny Crevice (*Ctenophorus decresii*) and Central Netted Dragons (*C.nuchalis*). *Herpetofauna,* submitted.)

Table 1. - Egg incubation data for seven clutches of *C.nuchalis* laid at Taronga Zoo between 1995 and 1999.

Date Laid	No. of eggs (No. hatched)	Incubation period (days)
04/12/1995	5 (3)	78
09/12/1996	6 (6)	57
06/07/1997	6 (3)	85
23/02/1998	4 (3)	70
04/05/1998	5 (5)	69
24/12/1998	5 (2)	78
27/11/1999	5 (5)	73

10.13 Clutch Size

Clutches are usually 2-6 eggs. Average clutch size is 5 eggs. (J. Van Der Reijden, Alice Springs Desert Park)

There is a positive relationship between clutch size and female snout-vent length

10.14 Age at Weaning

Weaning is not required in the Central Netted Dragons as they are altricial.

10.15 Age of Removal from Parents

Hatchlings are initially raised together but quickly need to be separated due to aggression and establishment of dominance. Dominated animals tend not to feed so need to be separated out. (Fyfe, G, Alice Springs Desert Park)

10.16 Growth and Development

Measurements and weights for hatchlings are:

Snout-Vent Length:	30mm
Total Length:	70mm
Mass;	1.3 - 1.5g

In captivity, hatchlings may not eat up until nine days after hatching (Klages, 1982).

11 Artificial Rearing

11.1 Incubator Type

An incubator is an apparatus for incubating eggs, where the temperature and the air humidity can be regulated, such that it is possible to incubate the eggs.

The size of the incubator would depend on the amount of eggs to be hatched. The incubator should be constructed from material that can withstand the humidity that is required for incubation.

A source of heat and a reliable thermostat are basic requirements for a good incubator. The heat distribution inside the incubator should be as even as possible. The thermostat must be sensitive and accurate enough to control temperature fluctuations of less than 0.5˚C.

The incubator must be constructed in such away that the hatchlings will not escape or be harmed from the incubator.

The incubator should be placed in a room that never rises the desired incubation temperature; an ideal room should remain constant at a temperature of 20˚C - 23˚C.

There are 3 most commonly used incubators are The Aquarium Method, Still-Air Incubators & the Forced-Air Incubator.

The Aquarium Method
One of the oldest methods for incubating reptile eggs. An aquarium is filled with 10-15 cm of water and heated with an aquarium or a heating pad. The warm water creates an even temperature and high humidity in the tank. The top of the aquarium is covered with a lid. To prevent the water that condensates under the lid from dripping onto the eggs, a slanted sheet of glass is placed under the lid. The condensation can then drip onto the glass and run off without harming the eggs. Since glass conducts heat well, the inside of the aquarium may be sensitive to temperature fluctuations in the surroundings of the aquarium. It is advised that the outside be isolated with Styrofoam sheets. The eggs are placed in containers that stand above the water line on a pedestal.

An advantage of this method is it is simple and cost effective to make. The disadvantage however is that there is lack of control over the precise temperature and the drops in temperature and humidity every time that the lid is opened.

You could alter the aquarium method to reach the required incubation temperature by adding a flat heat source at the top of the incubator.

Still Air Incubators
In a still air incubator the eggs are arranged on a tray and heated from above with a fan to circulate the air. A heating element is built into the lid to warm the air. Still air incubators must be flat as the heat provides a vertical temperature. The temperature is controlled by a thermostat. The humidity is controlled by containers of water that are placed in the incubator.

An advantage of still air incubators is that temperature and humidity can be controlled more accurately. The disadvantage once again is the loss of air temperature and humidity when the lid is opened due to its flat construction.

Forced Air Incubators
These incubators have a fan that circulates the air to create an eve temperature. A fan sucks air from the inner chamber, moves it over the heating element and brings it back into the inner chamber through ventilation shafts. A water tray sits on the bottom of the chamber size and water amount determine the level of humidity.

There are advantages to the forced air incubator, the temperature can be set and regulated accurately. The air temperature and humidity are quite even inside and there is no condensation.

11.2 Incubation Temperature and Humidity

Incubation temperature should be between 28 – 32^0C, higher temperatures produce more males.(van der Reijden, J, Alice Springs Desert Park)

Humidity between 80 -100%. (van der Reijden, R, Alice Springs Desert Park). This can be achieved usually a 1:1 ratio of vermiculite to water for the incubation substrate.

11.3 Desired % Egg Mass Loss

To date there is recorded information for a desired eggs mass loss for *C.nuchalis.*

It would be assumed that the eggs wouldn't have a desired egg mass loss as soft shelled eggs absorb significant amounts of water during incubation, which increases their volume and mass.

11.4 Hatching Temperature and Humidity

The temperature and humidity would remain the same as it would for incubation.

11.5 Normal Pip to Hatch Interval

Pip to hatch time: 3 - 12 hours. (J. van der Reijden, Alice Springs Desert Park)

11.6 Diet and Feeding Routine

Refer to 6.1 Captive Diet.

It can take up to 9 days before the newly hatched Central Netted Dragon will begin to eat.

11.7 Specific Requirements

11.8 Data Recording

During the incubation process eggs could be weighed once a week. Care should be taken when handling the eggs so as not to damage them. Handling the eggs can affect the development of the egg. It can also change the temperature of the eggs and cool them down too much.

The juveniles could also be weighed weekly, refer to 7.4 Weighing and examination.

Recording weights can assist with any future breeding of the species or it could also be used to improve on the process if required.

11.9 Identification Methods

Individual distinguishing features could be used as a method to indentify one baby from another, this data would have to be recorded.

Liquid paper could be used on the lizards back in different formations to indentify each individual. The markings would have to be monitored so as not to wear off.

11.10 Hygiene

Sterility is not required when you handle eggs, but some hygiene is required. You should be in the habit of washing your hands with warm water and soap before and after handling the eggs. Oils and creams could interfere with the pores on the eggshells, your hand should be clean and substance free.

11.11 Behavioural Considerations

Refer to 9.9 Intraspecific Compatibility

11.12 Weaning

Weaning isn't required in the Central Netted Dragon

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GLOSSARY

ALTRICIAL	helpless at birth or hatching and requiring parental care for a period of time
AMENABLE	willing to be guided or controlled by some influence
AMBIENT	surroundings, ambient temperature
ARBOREAL	dwelling at least part of the time in trees
AUSCULATION	listening to movement of heart and lungs with a stethoscope
ECDYSIS	sloughing of skin
ECTOTHERMIC	descriptive of those animals, such as reptiles, which regulate body temperature using outside heat sources.
EMACIATED	make or become abnormally thin
FECUNDITY	the quality of being fecund; capacity, esp. in female animals, of producing young in great numbers, fertility
GRADIENT	gradual increase or decrease of temperature over a given distance or slope
GRAVID	pregnant
GUT LOAD	feeding up invertebrates to increase their nutritional value before feeding out to animals
HALOPHYTIC	the ability to deal with high concentrations of salt
HYBRID	the offspring of two different species
OVIDUCAL	Of or pertaining to oviducts; as, oviducal glands
PALPATED	examined by touch
PRECOCIOUS	unusually advanced or mature in development
SERAL	Of or relating to an ecological sere: *a seral stage; a seral community.*
SLOUGH	shedding of skin
SVL	Snout Vent Length – the distance between the tip of the snout and the anterior opening of the vent measured along the vertebral line or its equivalent
TENACIOUS	holding fast, stubborn
THERMAL	
VERMICULITE	hydrous silicate mineral used as a moisture holding medium
VERNAL	occurring in spring

13 Appendix

Annual Cycle of Maintenance Activities

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Substrate Change												
Cage Furniture Change												
UV Light Bulb Change												
Worming												
Health Check												
Faecal Sample												
Weight Check - Juvenile												
Weight Check - Adult												
Breeding Triggers												
Breeding Season												

Common Diseases

Mites ***Ophionyssus natricis***

Infestations by mites are known as Acariasis. Reptile mites (*Ophionyssus natricis*) are without doubt one of the greatest killers of captive reptiles.

A mite infestation is usually indicated by one or more of the following:

- Unusual restlessness in the reptile (usually in the early stages of infestation)
- The reptile seeking to immerse itself in water
- Unusual digging activity
- White specs of dust (mite droppings on the scales)
- Scales taking on a raised appearance
- A loss of appetite
- A rapid loss in condition (as infestation advances)
- General listlessness (usually in advanced cases)

If you have good records, you'll also notice an increase in shedding frequency and/or a shedding brought on prematurely as a result of the mite infestation.

These tiny arachnids live under scales. They are usually hard to see, except where they congregate around the eyes, under the anal plate and similar places.

Mites, if present can often be found drowned in the water bowl, where they take on the appearance of flecks of pepper. They may also be found hiding under scales in the places just indicated and as opaque flecks under scales elsewhere on the body, but particularly under the larger ventral scales. With care, one or more mites can be removed and you will see them move.

When in large numbers they kill the reptile by removal of blood and poisoning what's left. Post mortem's usually reveal death by septicaemia.

Ophionyssus natricis which is the species most commonly seen on reptiles is usually brown in colour, although when filled with blood may take on a reddish hue. They breed very rapidly (a 30-90 day lifecycle in most cases) and there are five stages in the life-history. The younger stages are microscopic and hence it's generally only the adults that are seen by the reptile keepers. As already mentioned, the white droppings from mites are usually visible on the scales as white dots. In particularly bad cases mites themselves will be seen walking over the reptile.

Infected reptiles commonly soak themselves in a bid to drown the mites. This works well in the wild situation, but in captivity any relief is only temporary at best.

Another indicator of mites is when a non-digging reptile starts to dig excessively or becomes unusually active. This may be the reptile trying to literally scrape the mites off the head or hoping that the mites will fall off. In the wild state these methods work well, as the likelihood of the mite climbing back onto the moving reptile are remote. However in captivity, where both are confined to a cage, the mites are soon able to find the reptile again and continue their attack.

Amoeba *Entamoeba invadens*.
There are a variety of different types of protozoa that can be found in the intestinal system of reptiles. Amoeba and trichomonas are the most common.

The general signs of protozoa gut infections are;

- Loss of appetite
- Endless thirst for water

- Droppings soiling the cloaca and tail,
- Regurgitation and,
- Occasionally, bloating of the stomach region.

A vet can make a diagnosis from a fresh faecal sample or cloacal swab.

These protozoa can cause serious illness in snakes, particularly captive snakes. This condition is highly infectious. Enclosures, bags used to hold reptiles and any equipment used on these reptiles should be thoroughly cleaned before being used on another reptile.

Some animals can be asymptomatic (not displaying symptoms) carriers.

The most common way that this disease enters a collection is through the practise of feeding infected but apparently healthy food items. There is a real danger of spreading disease to cage mates through direct or in direct contact with faeces or regurgitated food. The amoeba generally does not occur in all snakes or lizards in the 'benign' state, as it does in some of their food items.

Vets can dispense Metronidazole (Emtryl) or Flagyl to treat this condition. It is an oral drug that is best given via a tube. If the animal seems healthy and is feeding well, inject the drug into the animal's prey.

The disease is highly contagious in a reptile collection, and good cage hygiene, as well as complete isolation of infected individuals.

Maintaining proper environmental temperatures, exercising proper hygiene and quarantine procedures, and ensuring the infected reptiles are adequately hydrated will help increase survival rates.

Flagellates
Various types of flagellates can cause diseases such as necrotic enteritis in captive snakes and lizards. They are so named because they propel themselves through their fluid environments by waving their whip-like appendages called flagella.

Signs and Symptoms:

- Poor to no appetite (anorexia),
- weight lose,
- or no weight gain or growth seen in an animal that appears to be eating well,
- regurgitation following feeds
- diarrhoea or loose and frequent bowel movements
- presence of remnants of faeces around the cloaca
- extremely smelly stools,
- poor colour (darker or duller colouration),
- and lethargy (inactivity, sleepiness, not very alert, dull eyes).

A combination of several of the above symptoms is usually seen, and symptoms can range from being fairly mild- slight decrease in appetite and loose stools, to quite severe- extreme lethargy and dehydration caused by frequent diarrhoea.

Outbreaks of intestinal infections of flagellates are often prompted by inadequate caging conditions or undue stress such as overcrowding of species. Some flagellates (eg trichomonads) are so contagious that they can spread regardless of conditions.

There are several drugs that are frequently used to treat parasitic infections in reptiles. Treatment is usually given orally. This could be inserting liquid or tablet in the middle of food items or in their pythons drinking water. If these do not work they may need to be mixed with water and tube fed to the snake.

Flagyl (Metronidazole) and Emtryl can be prescribed by your veterinarian. The vet will be able to identify this parasite by microscopic inspection of a faecal sample.

Infectious Stomatitis (Mouth Rot)

Stomatitis refers to an inflammation of the mouth, "stoma" indicating an opening, cavity or mouth and "itis" being the Latin suffix for inflammation. Most often referred to with regard to snakes, stomatitis is seen in all reptiles. Stomatitis is one of the conditions included in the group, "Upper Alimentary Tract Disease (UATD)," which includes any pathologic condition that affects the oral cavity, pharynx, or oesophagus.

Infectious stomatitis usually occurs as a response to stress such as an inappropriately temperature-regulated environment, overcrowding, internal or external parasites, trauma, or especially, poor nutrition. Vitamin C deficiency and inappropriate calcium/phosphorous levels in the diet have been implicated. Any of these stresses suppress the immune system of the reptile and make it much more susceptible to infections. Many pathogens can cause infectious stomatitis including bacteria, viruses, and fungi. *Pseudomonas*, *Aeromonas*, *Salmonella*, *Klebsiella*, and *Mycobacterium* are bacterial causes.

Signs can vary in number and degree, depending on the stage of infection

- Anorexia,
- Purulent discharge from the mouth,
- Excessive mucous (salivation) in the mouth,
- Swelling or reddening around or in the mouth,
- Inability to close the mouth,
- Reduced or absent tongue flicking,

The lining of the mouth can become eroded and often develops a "cottage cheese" appearance that is either yellow- or whitish-Gray in colour. In severe cases, it may look very much like the mouth is rotting away, hence the common name for this condition - mouth rot.

In extremely advanced cases, the head may be swollen; the infection may spread to the jaw and/or cranium (skull); teeth may become loose; and pneumonia may develop from aspiration of bacteria. Bacteria may also travel up what is called the hardarian duct, a pathway connecting the inside of the

mouth to a sinus near the eye. In this case, the eye may become infected and swell. If not treated quickly and aggressively, the eye may be lost to infection.

The intestinal lining may become inflamed (enteritis) as a result of the ingestion of necrotic material that has broken off from an area of plaque in the mouth. In areas where necrosis and ulceration is especially deep, a thrombus may form that is loaded with bacteria and released into the bloodstream with a resultant septicemia (when bacteria multiply in the bloodstream).

Where the stomatitis is diagnosed in its earliest stages, addressing husbandry and/or nutrition issues is often the first step. Sometimes something as simple as warming the environment will assist in the recovery of a mild case. The lesions are debrided (dead or dying tissue is removed), any abscesses are opened and drained, the area is repeatedly flushed with an antiseptic solution, and topical antibiotics or silvadene cream may then be applied. These procedures need to be repeated daily until the lesions are healed.

Supportive care may include supplemental heat and respiratory support by way of humidification. Nutritional supplements may be injected into prey foods that are offered. Tube feeding is generally used as a last resort.

The importance of proper nutrition and husbandry is vital. Under proper husbandry condition, with proper attention to nutrition and environment, infectious stomatitis will not be a problem.

Respiratory Tract Infection

In reptiles, respiratory tract infection (RTI) is caused by a bacterial infection in the lungs. RTI is generally related to improper environmental conditions (being kept too cold, too wet, prolonged stress due to enclosure being kept at a single temperature rather than the species' required thermal gradient, prolonged psychosocial stress, etc.). If the reptile is not otherwise being cared for properly (dirty enclosure, inadequate feedings, etc.), this can exacerbate the condition, making it more severe and prolonging recovery.

Symptoms include;

- Listlessness,
- Weight loss due to decreased appetite,
- Swollen or bloated body,
- Gaping, open mouth breathing,
- Often with audible exhalations when in an advanced state.
- Wheezing may be heard, or clicking noises when breathing.
- Bubbly, stringy or sheeting mucous appears in the mouth.
- The head may be held in a raised position to facilitate breathing. In snakes, the tines of the forked tongue may be stuck together.

A common posture adopted by lizards and snakes with respiratory infections is an elevated head, often supported in a corner of the cage or on a water dish, presumably to aid breathing.

Treating a respiratory infection requires two things: an immediate evaluation of the day and night temperatures in the reptile's enclosure, with additional heat sources added or broken/malfunctioning

equipment replaced, and the attention of a reptile vet who will evaluate the reptile for systemic antibiotics and fluid replacement. In addition, if the reptile has cage mates or lives in a room where he is in line-of-site of other reptiles or household pets, an overall psychosocial evaluation needs to be made.

Reptile with respiratory infections should be kept in draft-free but well-ventilated enclosures maintained at the species' day time temperature gradient both during the day and at night. For reptiles that require a hotter basking area, the basking area temperatures do not need to be provided at night, but the higher overall gradient does. This will not only enable the reptile's own immune system to function better, but increases the efficacy of the antibiotics.

Metobolic Bone Disease

Metabolic bone disease (MBD) is an umbrella term that covers a number of disorders related to the weakening of the bone or impaired systems function caused by an imbalance in vitamin D3, calcium and phosphorus. This imbalance may be caused by a lack of or too much of one of these three essential elements or the failure to provide one or more of them in a bio available form. Many foods highly touted for their calcium content, such as spinach, carrots, collards, chards and other thick leafy greens, contain calcium oxalates that bind calcium. This renders most or all dietary calcium, both that contained in the foods and that added to the foods as supplements, unavailable for maintenance and growth, depending on the quantities ingested.

Signs of metabolic bone disease include;

- Hard knobs in the long bones of the legs,
- Bumps along the vertebral column of the back and tail,
- Bilateral softening or hard swelling of the lower jaw, and
- Softening of the plastron or carapace.

All of these signs may be felt before they can be seen, making a careful physical exam important. Visible signs of moderate to severe MBD include jerky gait when walking, repeated tremors and twitches in the limbs and muscles of the legs and toes when at rest, and shakiness when being held. (The occasional single myoclonic jerk that happens is not considered indicative of MBD.)

Advanced cases of MBD include all the above signs plus constipation, anorexia and fractured bones. Severely deficient reptiles tend to be lethargic and may only be able to drag themselves along the ground. Arboreal lizards spend all of their time on the ground as they lack the strength to grip and climb.

Moderate to severe cases of MBD require the proper diet, temperatures, and light wavelengths as well as a more powerful calcium supplement than those found in pet stores. Oral administration of calcium glubionate (NeoCalglucon®, 1cc/kg PO bid prn) or injections of calcium lactate (Calphosan®, 250 mg/kg IV/IM, bid) or calcium gluconate (100 mg/kg IM qid prn) are generally prescribed by veterinarians. Mader (1993) reports faster recovery with calcitonin (Calcimar®, Miacalcin®, 50 IU/kg IM in front leg, repeated once a week for two weeks) when it is administered to iguanas who have been returned to normal serum calcium levels. Use of calcitonin before normal levels have been established, however, may cause hypocalcemic tetany and death. Mild cases, cases where the signs are felt or just barely visible, may successfully be treated by providing the proper

environment and diet. In the case of diurnal lizards and chelonians, proper environment includes not only the proper temperature ranges and diet, but daily access to ultraviolet B wavelengths.

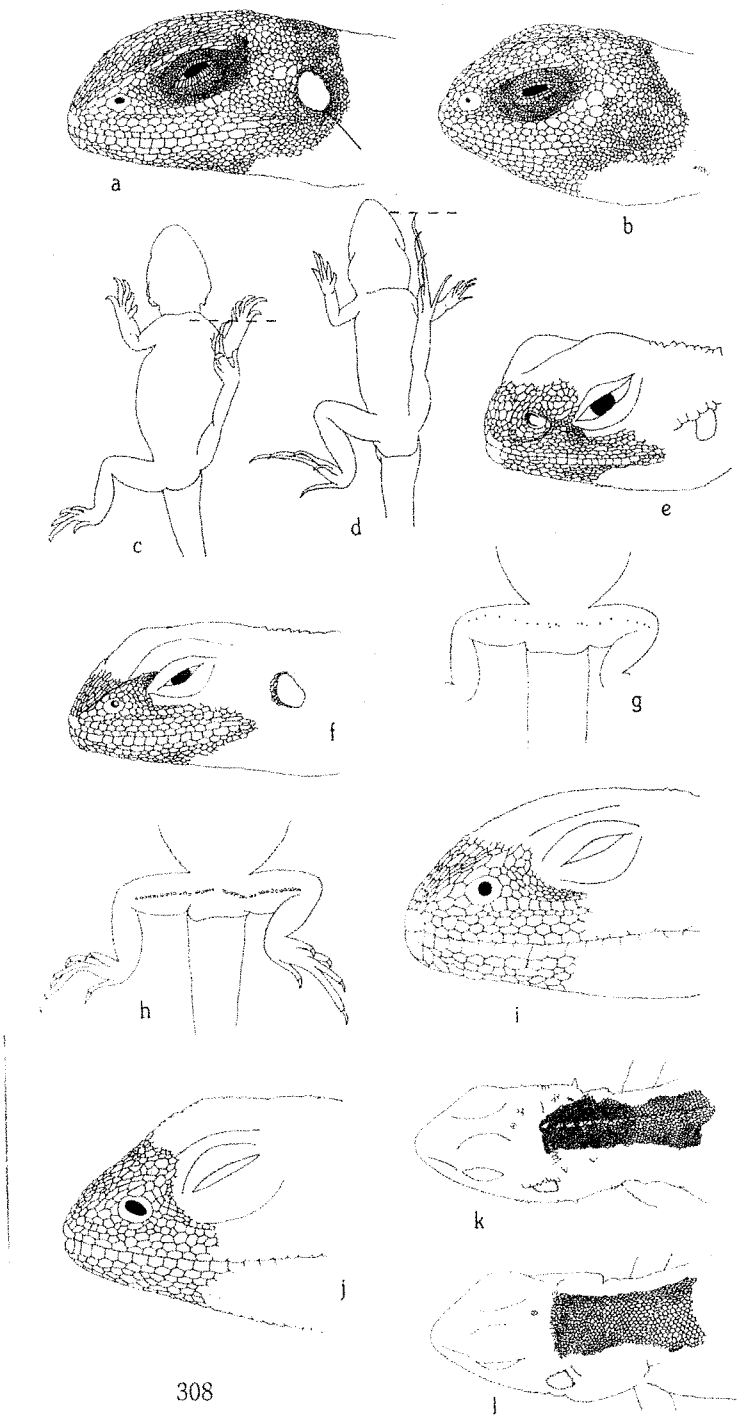
Along with proper day and night temperature gradients and a nighttime dark period of sufficient length (based on native habitat), proper diet is essential to recovery. Herbivores and omnivores should be fed calcium-rich, nutrient dense foods such as squashes, green beans, alfalfa (from alfalfa powder, crushed alfalfa tablets, alfalfa tea, or softened rabbit food pellets or pulverized hay cubes), parsnips, mustard greens, dandelions, escarole, and fruits such as figs, papaya, cantaloupe and berries (Barten, 1993; Frye, 1991). The food should be supplemented with additional calcium and a multivitamin formulated for reptiles or birds, or a crushed Centrum vitamin tablet formulated for humans (Donoghue, 1996). Omnivores and carnivores should be fed whole captive bred prey (to reduce the risk of zoonotic infection from parasites commonly found in wild prey) that have been raised on nutritious foods or have been gut loaded with nutritious foods for several days before being fed out.

Egg Binding
Eggbinding is associated with calcium deficiency or incorrect environment. Diagnosis is required by gentle palpation or an ultrasound. An egg tray is required for the animals to have a suitable area to lay there eggs in. Eggs that are not laid will require a caesarean.

Reptiles and Amphibians of Australia – Family Agamidae Genus Ctenophorus Key page:

Genus ***Ctenophorus*** Fitzinger, 1843

A composite genus of essentially terrestrial lizards found throughout most of continental Australia and characterised by small dorsal scales, homogeneous or with at most slightly enlarged tubercles; absence of distinct rows of paravertebral or dorso-lateral spinose scales; a row of enlarged scales from below the eye to above the ear; tympanum exposed or covered by scales; tail long, slightly to much longer than head and body; femoral and preanal pores present in males; males usually with distinctive black or dark grey markings on throat and/or chest.



Key

TO THE SPECIES OF CTENOPHORUS

1 Tympanum exposed (a)..... **2**

Tympanum hidden, covered by skin (b)..... ***maculosus***

2 Hindlimb usually reaching no further than tympanum when adpressed (c); tail usually less than one and a half times as long as head and body..... **3**

Hindlimb usually reaching to eye or beyond when adpressed (d); tail usually much more than one and a half times as long as head and body..... **8**

3 Nasal region swollen, the nostril lying on or above the curved canthal ridge (e)..... **4**

Nasal region not swollen, the nostril lying below an angular canthal ridge (f)..... **5**

4 Femoral pores widely spaced along a curve which lies along the inner half of the thigh (g)..... ***nuchalis***

Femoral pores closely spaced along a more or less straight line along the outer half of the thigh (h)..... ***reticulatus***

5 Pores more than 25; nostril circular or broadly elliptical (i). **6**

Pores fewer than 15; nostril slit-like or narrowly elliptical (j) ..... ***clayi***

6 No linear series of dark spots or blotches along each side of the tail..... **7**

A series of 20-30 dark spots or blotches along each side of the tail..... ***gibba***

7 Dorsal scalation homogeneous, without scattered enlarged scales on the back and sides..... ***pictus***

Dorsal scalation heterogeneous, with numerous low, enlarged scales on the back and sides..... ***salinarum***

8 Canthus rostralis angular or moderately swollen but nostrils, when viewed from above, face outwards..... **9**

Canthus rostralis swollen, the nostrils when viewed from above face distinctly upwards..... ***caudicinctus***

9 A distinct nuchal crest; a series of enlarged keeled scales form a distinct vertebral series along at least the anterior two-thirds of the body (k)..... **10**

At most a few enlarged keeled scales on the nape; a series of enlarged vertebral scales, if present, forming a distinct linear series only to about the level of the forelimbs (l).. **12**

10 Dorsal, caudal and hindlimb scales homogeneous; a dark brown zigzag dorso-lateral streak along each side of the tail, which is never banded..... **11**

Dorsal, caudal and hindlimb scales heterogeneous, with scattered, enlarged, keeled scales, especially along the dorso-lateral skin-fold; tail without dark dorso-lateral streaks, usually banded distally..... ***cristatus***

11 Fewer than 30 subdigital lamellae under fourth toe; dorsal pattern dark brown with narrow, broken, pale vertebral and dorso-lateral stripes joined by pale, broken transverse bars..... ***mckenziei***

More than 32 subdigital lamellae under fourth toe (m); dorsal pattern of paired dark brown blotches on a pale brown ground colour..... ***scutulatus***

12 Dorsal and even small dorso-lateral scales with distinct sharp central keels forming continuous ridges running obliquely towards vertebral line; scales on the chest strongly keeled..... **13**

Dorsal scales at most with low, irregular keels which do not form distinct continuous ridges; dorso-lateral scales and those on the chest smooth, or with low, blunt ridges... ..... **16**

13 Pores more than 32 and extend to more than halfway along thigh (n); black on throat at least in males..... **14**

Pores 32 or fewer, extending no more than halfway along thigh (o); no black on throat..... ***femoralis***

14 Preanal pores not arching forward in the mid-line (p); black throat markings, when present, not in a single undivided band and black on chest of males not extending to abdomen (q)..... **15**

Preanal pores arching forward to an apex on the mid-line (n); a single, broad undivided throat marking in males and black on chest of males extends back to abdomen (r)..... ..... ***isolepis***

15 Pores extending almost to knee (s); a solid black chevron on throat of males (t)..... ***maculatus***

Pores not extending to distal quarter of thigh (p); throat spotted with black, the spots often arranged in a chevron-shaped zone (q)..... ***fordi***

16 Nostril subcircular, in a normal nasal scale lying below an acute canthal ridge (u); scales on anterior and posterior surfaces of tibial region subequal (v)..... **17**

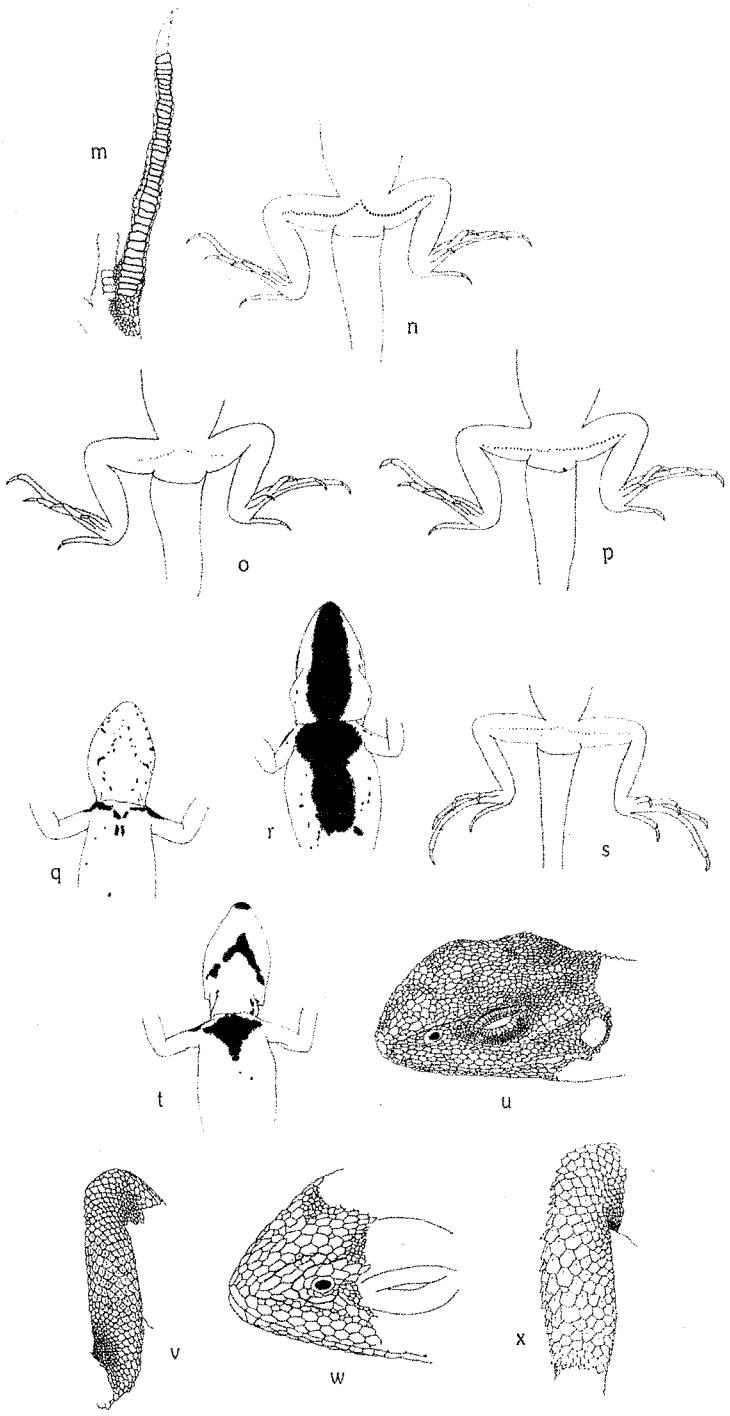
Nostril elliptical in a swollen nasal scale lying on a swollen canthal ridge (w); tibial region with a series of anterior proximal scales which are very much larger than those on posterior surface (x)..... **20**

17 Upper head scales between and in front of eyes rarely coarsely wrinkled, usually with simple longitudinal keels or almost smooth; vertebral row of keeled scales absent or not extending part way down back..... **18**

Upper head scales between and in front of eyes coarsely wrinkled, not simply keeled; vertebral row of keeled scales extending at least part-way along back..... ***vadnappa***

18 Scales on side of body homogeneous, without scattered tubercles..... **19**

Sides of body with few to many scattered, slightly enlarged tubercles, each usually pale in colour and contrasting with the darker ground colour..... ***decresii***



19 Normally 26 or fewer lamellae under fourth toe, between its junction with the third toe and its tip..... ***fionni***

Normally 27 or more lamellae under fourth toe, between its junction with the third toe and its tip..... ***rufescens***

20 Tail banded throughout its length..... ***ornatus***

Tail banded only on posterior portion; basal third unbanded..... ***yinnietharra***

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.

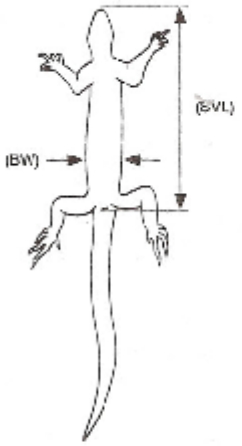
Applicable to Lizards and Tuataras

⚠ *See USG Variations in Chapter 2 and Variations CO-01/04/05/09, and UA-05 in Chapter 3.*

The following instructions must be complied 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) and in body width (BW).



Specific Requirements

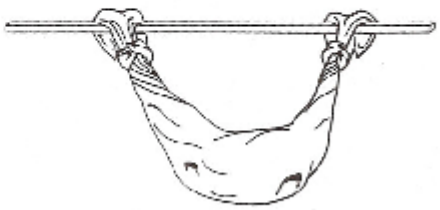
All containers and bags should have some kind of packing material (i.e. crumpled paper). Animals in the same containers or bags should belong to the same size class to avoid damage to smaller individuals.

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):

Snouth-vent-length (SVL)	Body-width (BW)	Maximum no. of animals per bag	Minimum bag size
≥ 20 cm (8 in)	> 5 cm (2 in)	1	Depending on the size of the animal
≥ 15 < 20 cm (6 < 8 in)	≥ 2.5 < 5 cm (1 < 2 in)	15 10	45 × 60 cm (18 × 24 in) 30 × 45 cm (12 × 18 in)
≥ 10 < 15 cm (4 < 6 in)	< 2.5 cm (1 in)	30 20	45 × 60 cm (18 × 24 in) 30 × 45 cm (12 × 18 in)
< 10 cm (4 in)	< 2.5 cm (1 in)	30	30 × 45 cm (12 × 18 in)

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, under the same conditions for the snake containers.

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.

CONTAINER REQUIREMENT 41 *(cont'd)*

Lizard species that should be packed singly because they are either aggressive, cannibalistic or delicate:

Malagasy leaf geckoes (Uroplates spp.)
New Caledonian giant geckoes (Rhacodactylus spp.)
Asian gliding agamid (Draco spp.)
Sail-finned lizard (Hydrosaurus spp.)
Angle-headed dragon (Gonocephalus spp.)
Helmeted basiliscs (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-hensile 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 (Rhamphoelon) 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. 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.

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.

Packing Density for Farmed Green Iguanas (Iguana iguana)

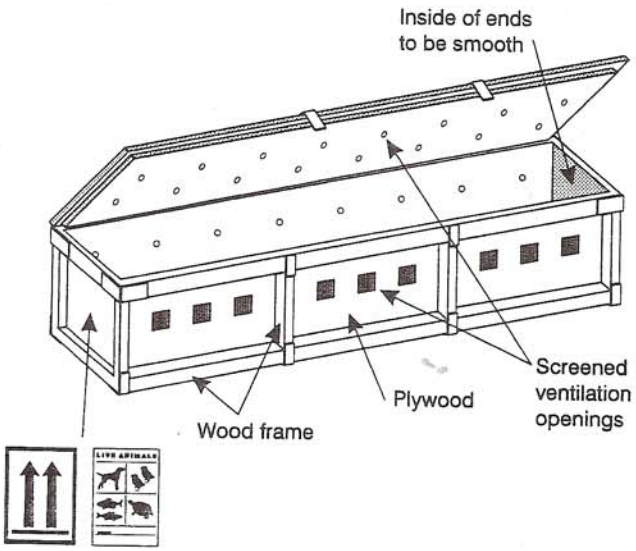
Since farmed Green Iguanas (Iguana iguana) are usually in good condition, free of diseases and used to handling, the use of following special packing density is allowed.

Snout-vent-length (SVL)	Maximum no. of animals per bag/box	Minimum bag size	Minimum box size
> 25 cm (10 in)	1	Depending on the size of the animal	—
> 20 cm (8 in)	6	45 × 85 cm (18 × 34 in)	—
> 17.5 cm (7 in)	6	30 × 60 cm (12 × 24 in)	20 × 40 × 9 cm (8 × 16 × 3⅜ in)
> 12.5 cm (5 in)	20	30 × 45 cm (12 × 18 in)	20 × 40 × 6.5 cm (8 × 16 × 2⅜ in)
> 10 cm (4 in)	30	30 × 45 cm (12 × 18 in)	20 × 40 × 4.5 cm (8 × 16 × 1¾ in)
> 8.75 (3.5 in)	40	30 × 45 cm (12 × 18 in)	20 × 40 × 4.5 cm (8 × 16 × 1¾ in)
0–8.75 cm (3.5 in)	50	30 × 45 cm (12 × 18 in)	20 × 40 × 4.5 cm (8 × 16 × 1¾ in)

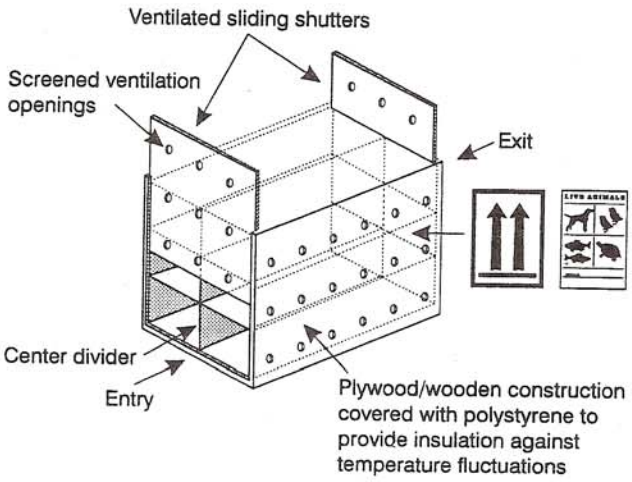
CONTAINER REQUIREMENT 41 *(cont'd)*

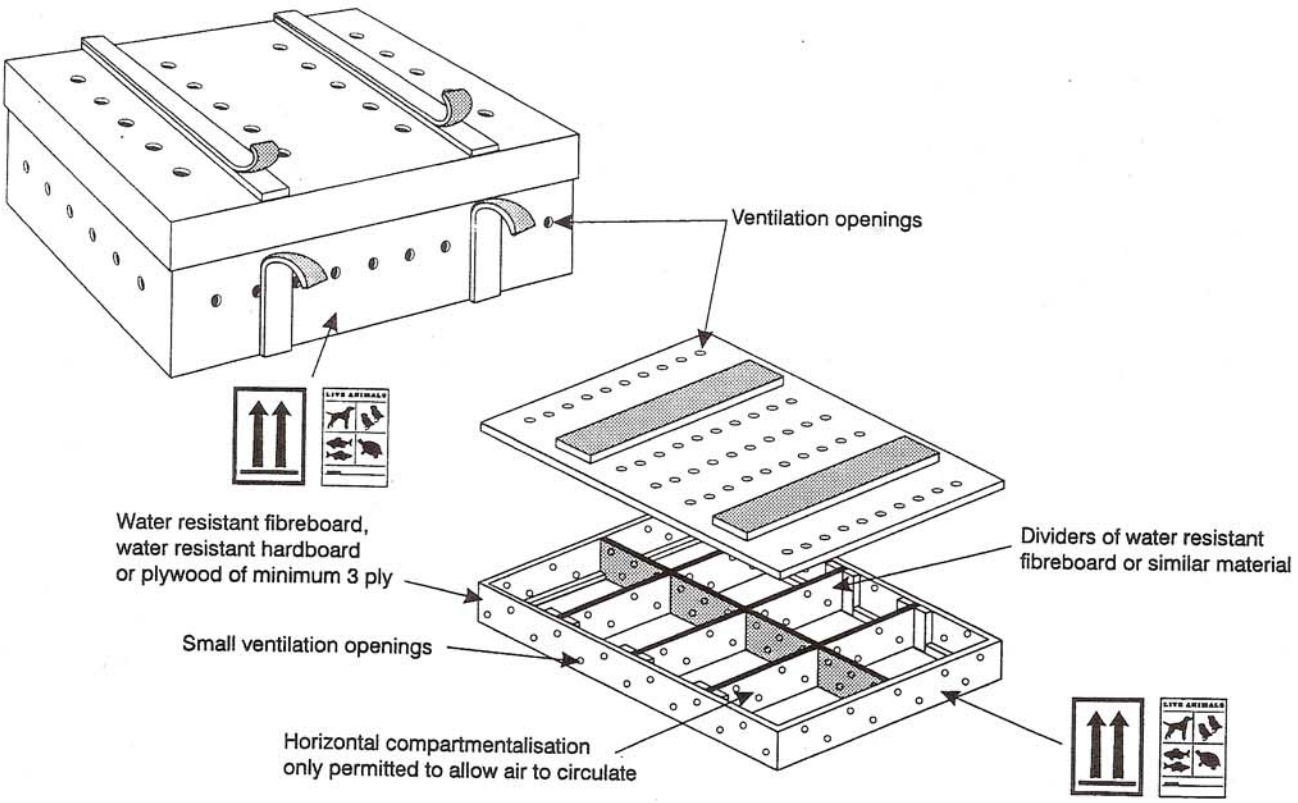
EXAMPLE:

SINGLE CONTAINER



MULTIPLE CONTAINER
(suitable for small or young animals
not exceeding 50 cm [20 in] in total length)





CONTAINER REQUIREMENT 41 *(cont'd)*

MULTICOMPARTMENT CONTAINER