HUSBANDRY GUIDELINES:

RHINOCEROS IGUANA

Cyclura cornuta cornuta (Bonnaterre 1789)

REPTILIA: IGUANIDAE

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OHS WARNING

RHINOCEROS IGUANA *Cyclura c. cornuta*

RISK CLASSIFICATION: INNOCUOUS

NOTE: Adult *C. c. cornuta* can be reclassified as a relatively HAZARDOUS species on an individual basis. This may include breeding or territorial animals.

POTENTIAL PHYSICAL HAZARDS:

Bites, scratches, tail-whips: Rhinoceros Iguanas will defend themselves when threatened using bites, scratches and whipping with the tail. Generally innocuous, however, bites from adults can be severe resulting in deep lacerations.

RISK MANAGEMENT:

To reduce the risk of injury from these lizards the following steps should be followed:

- Keep animal away from face and eyes at all times
- Use of correct PPE such as thick gloves and employing correct and safe handling techniques when close contact is required. Conditioning animals to handling is also generally beneficial.
- Collection Management; If breeding is not desired institutions can house all female or all male groups to reduce aggression
- If aggressive animals are maintained protective instrument such as a broom can be used to deflect an attack

OTHER HAZARDS:

Zoonosis: Rhinoceros Iguanas can potentially carry the bacteria *Salmonella* on the surface of the skin. It can be passed to humans through contact with infected faeces or from scratches. Infection is most likely to occur when cleaning the enclosure.

RISK MANAGEMENT:

To reduce the risk of infection from these lizards the following steps should be followed:

- ***ALWAYS*** wash hands with an antiseptic solution and maintain the highest standards of hygiene
- It is also advisable that *Tetanus* vaccination is up to date in the event of a severe bite or scratch

DISCLAIMER

These husbandry guidelines were produced by the compiler/author at TAFE NSW – Western Sydney Institute, Richmond College, N.S.W. Australia as part of an assessment for completion of Certificate III in Captive Animals, Course number 1068, RUV30204. Since the husbandry guidelines are the result of student project work, care should be taken in the interpretation of information therein, - in effect, all care taken but no responsibility is assumed for any loss or damage that may result from the use of these guidelines. It is offered to the ASZK Husbandry Manuals Register for the benefit of animal welfare and care. Husbandry guidelines are utility documents and are 'works in progress', so enhancements to these guidelines are invited.

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1 Introduction

Rhinoceros Iguanas *Cyclura cornuta cornuta* belong to the Iguanidae family consisting of as many as nine hundred species. Rhino Iguanas are the only member of the *Cyclura* genus to posses the horn after which they are named. Iguanas are unique as they are the only large primarily herbivorous group of lizards.

The genus *Cyclura* is restricted to the islands of the Caribbean. Found on some of these islands are the most endangered lizards on the planet. Rhinoceros Iguanas are listed as a vulnerable species and in captivity they can play a critical role in educating visitors on the crisis that the West Indian iguana species are facing.

"Today 12 of the 40 recognised species of iguanas – 30 percent – are ranked Critically Endangered by the IUCN Red List, meaning that their risk of extinction is very high without urgent conservation intervention and assistance..."

- Rick Hudson, Executive Director International Iguana Foundation IIF

(http://www.iguanafoundation.org/ Accessed: Monday, 4 August 2008).

(Cover image: Cameron Candy 2008).

1.1 ASMP Category

Cyclura c. c. is not currently part of an Australasian Species Management Program.

Management Level: 3.

1.2 IUCN Category

IUCN STATUS: VULNERABLE

Defined as: *"**VULNERABLE (VU)** - A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future* (www.redlist.org/info/categories 2008).

1.3 EA Category

This does not apply to this species.

1.4 NZ and PNG Categories and Legislation

This does not apply to this species.

1.5 Wild Population Management

Rhinoceros Iguanas in the Dominican Republic have full or in some cases partial protection inside national parks and reserves, however, the species enjoys less protection in Haiti. Management of wild populations is not intensive and poaching for food and the pet trade still occurs even with national protection by the Dominican wildlife regulations.

Malone and Davis consider the Rhinoceros Iguana to have strong potential for preventative conservation efforts as it is not under immediate threat of extinction. *C. c. cornuta* may be used as an analogue species to gain relevant field data to apply to conservation strategies of other critically endangered iguanid species (Alberts 2004).

1.6 Species Coordinator

There is no Species Coordinator for *Cyclura c. c.* at present (ARAZPA Species Contact: Vacant, ARAZPA, Scope of data: Australasia. Data current to: 1/01/2008. Census of Reptilia in ARAZPA institutions as at 31 December 2007).

1.7 Studbook Holder

There is no Studbook Holder for *Cyclura c. c.* at present (ARAZPA Species Contact: Vacant, ARAZPA, Scope of data: Australasia. Data current to: 1/01/2008. Census of Reptilia in ARAZPA institutions as at 31 December 2007).

2 TAXONOMY

2.1 Nomenclature

Class: Reptilia

Order: Squamata

Suborder: Sauria

Family: Iguanidae

Genus: *Cyclura*

Species: *cornuta cornuta*

- *Cyclura* meaning "round tail" and *cornuta* meaning "horn"

2.2 Subspecies

There are two subspecies recognised for *Cyclura cornuta.* The nominate race, *cornuta* occurs on the island of Hispaniola (Haiti and the Dominican Republic). The remaining subspecies, *stejnegeri* is confined to Mona Island; however, subspecies status for *stejnegeri* is contentious as it is morphologically identical to *cornuta*. It could possibly be an introduced population (www.cites.org 2008).
There is also described the Navassa Island Iguana *Cyclura cornuta onchiopsis*, although this species is believed to be extinct in the wild.

2.3 Recent Synonyms

Recent synonyms for this species include Horned Ground Iguana and *Cyclura cychlura cornuta* – (Alberts 2004).

2.4 Other Common Names

The common name known for *Cyclura c. c.* is generally the Rhino or Rhinoceros Iguana, but can also include Horned Ground Iguana.

Cyclura c. stejnegeri is commonly known as the Mona Island Iguana and Mona Ground Iguana.

The *Cyclura* genus can be referred to as Rock Iguanas, West Indian Rock Iguanas and Ground Iguanas.

3 NATURAL HISTORY

Most aspects of the natural history of *Cyclura* have not been well studied because of their remote locations, small and highly disturbed populations, and the problems associated with studying such large and long-lived reptiles (Alberts 2004).

Rhinoceros Iguanas *C. c. cornuta*, belong to the Iguanid family, a massive and diverse group of lizards which is facing regular taxonomic updates. Up to eight subfamilies have been recognized consisting of fifty genera and nine hundred species (Ackerman 1997).

The Iguanidae family includes the following genera:

Amblyrhyncus, Brachylophus, Conolophus, Ctenosaura, Cyclura, Dipsosaurus, Iguana, Sauromalus.

Iguanids in this group are referred to as “True Iguanas”. They all inhabit tropical regions and all posses pleurodont dentition (teeth on inside of jaw bone). The species range from a few Fijian islands and Madagascar, while the majority is found in the Americas and West Indies. They differ in several ways including carnivorous and herbivorous species to arboreal and terrestrial species.

3.1 Morphometrics

Rhino Iguanas are a large and robust lizard. They have a somewhat rotund appearance with massive head, limbs and a very solid tail. They are characteristic of the *Cyclura* group, however, they are the only species to posses the horns from which their name is derived.

3.1.1 Mass and Basic Body Measurements

Adult Male mass: 6-10kg. A 10kg animal would be considered very large.

Adult Male snout-to-vent length: 560mm

Total length: up to 1200mm

Adult Female mass: 5.4kg

Adult Female snout-to-vent length: 510mm

Total length: up to 1150mm

3.1.2 Sexual Dimorphism

Male Rhinoceros Iguanas are distinguished from females by attaining greater size (see above measurements). The male also develops larger horns, jowls and fat pads or parietal bulges, which are situated towards the back on top of the head (see Fig. 1)

Figure 1: Male Rhinoceros Iguana in foreground on left.
Note larger fat pads on head and overall body mass
compared to female, behind on the right (Image: Cameron Candy 2008).

3.1.3 Distinguishing Features

Cyclura iguanas are all similar, however, the Rhinoceros Iguana is the only member of the *Cyclura* genus to posses an actual horn, hence their common and Latin name; *cornuta* meaning “horn” (See Fig. 2). They can be distinguished from other iguanid lizards by their dull grey colour, characteristic stocky build and their isolation to the islands of the West Indies.

Figure 2: Note cluster of three horns above nostril
(Image: P. Morris / www.ardea.com, www.arkive.org 2008).

3.2 Distribution and Habitat

The entire genus *Cyclura* is confined to islands of the West Indies (See Fig. 3, 4).

Figure 3: West Indies (Microsoft Map Point 2008).

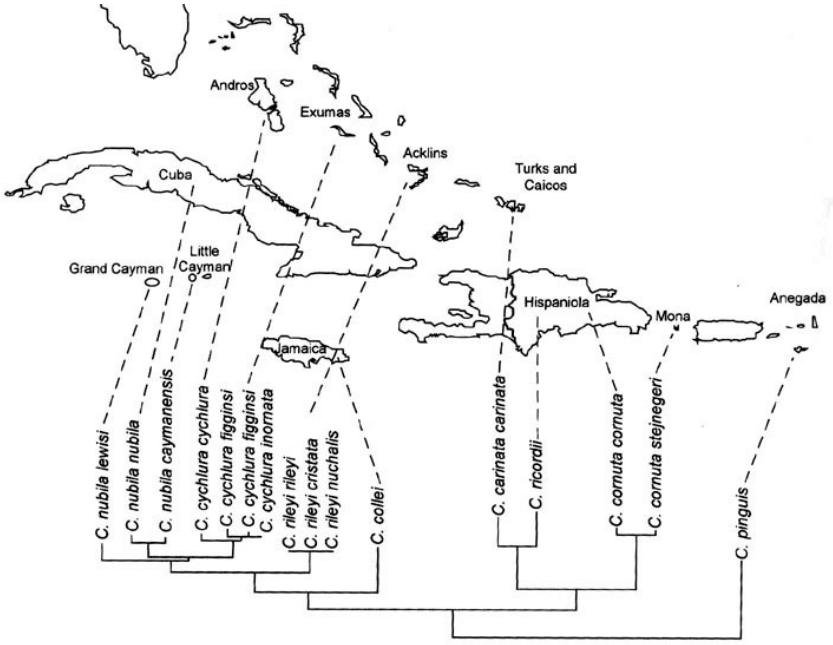

Figure 4: Distribution of the genus *Cyclura* (Alberts 2004).

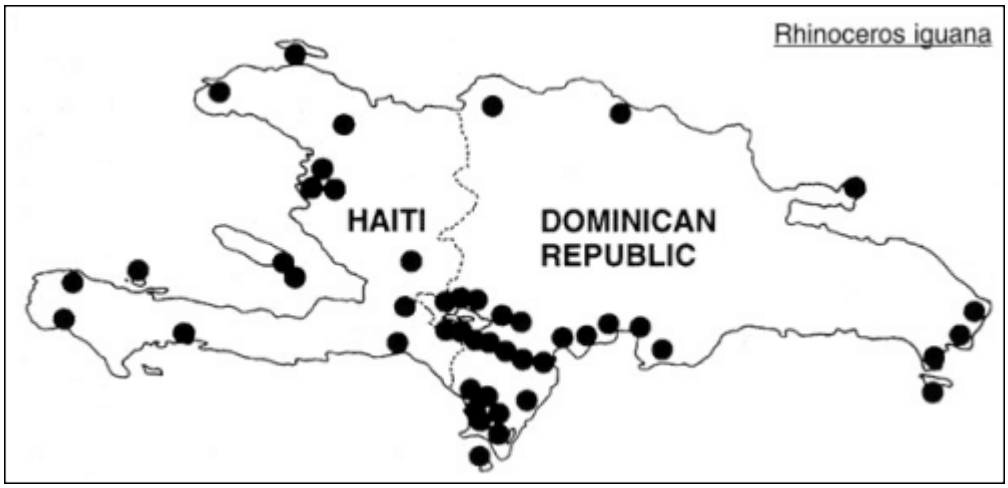

Figure 5: Distribution of *Cyclura c. cornuta* (iucn-isg.org/actionplan/ch2/rhinocerous.ph 2008).

Rhinoceros Iguanas inhabit Hispaniola which is an island in the Caribbean, West Indies area. Hispaniola is divided into two halves; The Dominican Republic and Haiti (See Fig. 5).

Rhinoceros Iguana wild populations are fragmented but they inhabit most offshore islands around Hispaniola. The majority of colonies are found along the southern side of Hispaniola, with the highest numbers in south-southwestern Dominican Republic.

Rhino Iguanas most commonly inhabit dry tropical forest, with the majority of the landscape being characterised by rocky outcrops and terraces (See Fig. 6). These iguanas are perhaps the most adaptable of the extant *Cyclura* species and are not necessarily restricted to these habitats.

Figure 6: Dry, rocky tropical forest (Image: Alberts 1999).

3.3 Conservation Status

IUCN STATUS: VULNERABLE – see section 1.2

CITES STATUS: All *Cyclura* spp. are included in Appendix I and protected.

3.4 Longevity

Accurate records of hatching dates should be kept in accordance with all births and acquisitions from other collections. This is probably the most reliable way to determine age in captivity and can be used in association with capture/recapture marking techniques in wild populations.

Some researchers suggest the *Cyclura* iguanids may live closer to eighty years of age (Blair 2000).

3.4.1 In the Wild

Most sources suggest this species can reach twenty years of age and possibly much longer in the wild.

In a study on wild populations of Allen Cays Iguanas *Cyclura cychlura inornata*, using a long term capture and recapture over twenty one years, Iverson estimated that some individuals attained ages of 53.7 and

60.7 years of age, although admits this could be an exaggeration. An average of thirty-two years can be determined from the twenty one specimens ages (Alberts 2004).

3.4.2 In Captivity

As above, most sources suggest a maximum life span in captivity of up to twenty years with an average of sixteen years, seven months (Animal Diversity Web online 2008).

Longevity in captivity recorded for Exuma Island Iguana *Cyclura cychlura figginsi*, is at twenty-three years, six months and for the closely related Lesser Cayman Islands Iguana *Cyclura nubile caymanensis*, is at thirty-three years (Alberts 2004).

It appears possible that with correct husbandry procedures this species has the potential to exceed 20 years of age by decades.

3.4.3 Techniques Used to Determine Age in Adults

This area of reptile husbandry is still in its infancy; however, there are several techniques which may be utilised.

Skeletochronology: A toe clipped from an amphibian or reptile may be used for Skeletochronology. Transverse histological sections taken through the midpoint of the toe phalanx are stained with hematoxylin. Circumferential annual layers are present in the sections, and are counted to determine age.

Ages estimated by skeletochronology may give useful approximations of the population's age structure. However, aging errors are expected to be common and researchers should take every opportunity to test precision, with duplicate specimens, and accuracy, with known age individuals. (Matson's Laboratory LLC 2008). This process still needs extensive study to refine the technique in reptiles and amphibians.

Using snout – vent and total length sizes in Rhinoceros Iguanas can be helpful in determining an estimate of age but this can be vague. The growth of an Iguana is determined by diet, heat and activity, as well as by the population characteristics in the population from which the iguana was taken or bred (Kaplan 1997), (See Fig. 7).

End of Year:	SVL (inches):	STL (inches):	Wgt/Lbs:
Hatchling	2.5-3.5	6-9	~90 gm
1	8-9	20-27	1-1.5
2	11-12	28-36	2-4
3	12-14	30-42	4-6
4	14-16	35-48	5-8
5	18-20	45-60	10-15
6	20-22	50-66	14-18
7	20-24	50-72	15-20

SVL = snout-vent length
STL = snout-tail length
Iguana tails range from 2.5-3 x the SVL.

Figure 7: Above; this table refers to the Green Iguana *Iguana iguana*, but may be useful as a guide for the Rhino Iguana (Kaplan 1997).

4 HOUSING REQUIREMENTS

4.1 Exhibit/Enclosure Design

Although reptiles often require less space than a mammal of similar size the space must be large enough to permit a proper temperature gradient to be set up and maintained. Adequate room must also be available for the animal to move around, thermo-regulate, feed, drink, bask, and sleep (Kaplan 1997).

Adult Rhinoceros Iguanas should be housed in outdoor enclosures where possible and the animal should be offered as much room as possible (See Fig. 8), (See Appendices for more images).

Figure 8: *C. c. cornuta* exhibit at Taronga Conservation Society (Image: Cameron Candy 2008).

It is usually preferable that juveniles be housed indoors in terrarium or similar arrangements. These may be glass, timber, plastic or combinations but must conform to the previously mentioned requirements (See Fig. 9).

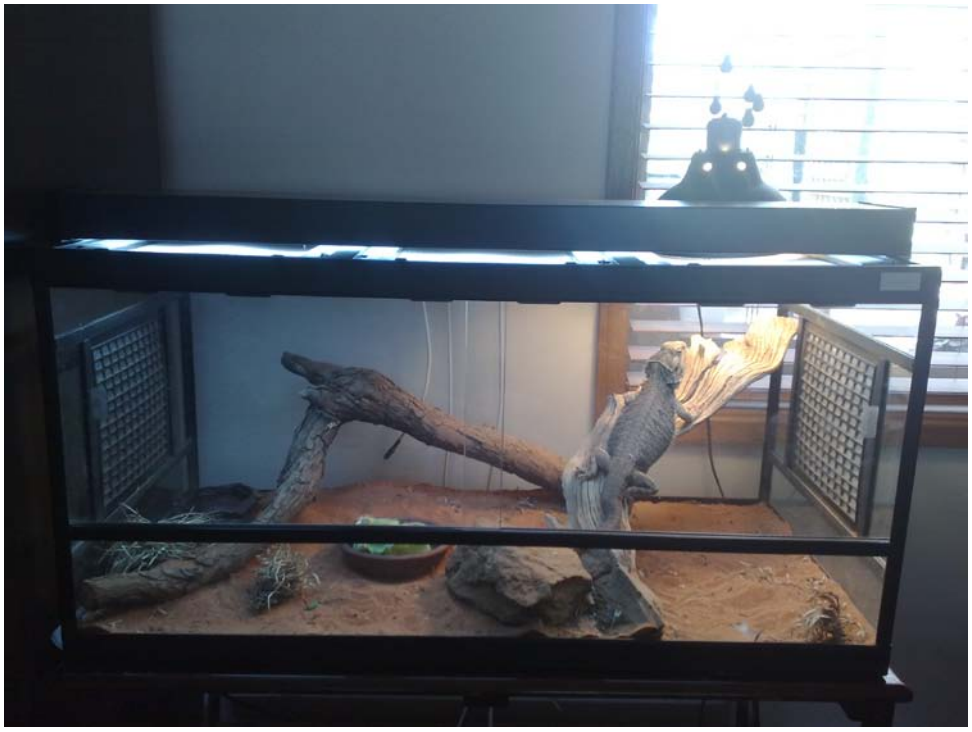

Figure 9: Indoor glass tank suitable for juvenile *C. c. cornuta* (Image: Cameron Candy 2008).

4.2 Holding Area Design

Holding areas should be simple and easy to clean as there function should be to temporarily house an animal for transport, construction, cleaning or medical reasons. All aspects of the animal's natural history and basic requirements must still be met; however, the enclosure does not necessarily have to be as aesthetically pleasing as a display exhibit (See Fig. 10).

Figure 10: Off exhibit holding area (Image: Cameron Candy 2008).

The General Standards for Exhibiting Animals in NSW describes standards for *Off-exhibit Holding Enclosures*;

Short term holding (24-32 hours), of animals may not need to conform to minimum spatial requirements for the species but all attempts should be made to comply with the requirements where possible.

Medium term holding enclosures (less than 90 days), must be at least 1/3 the minimum floor measurements of the prescribed standards for the species and must comply with height measurements.

The standards describe reasons for holding areas and requirements for these enclosures:

- The animal can freely stand up, stretch and turn around

- The length is at least three times the animal's length and the breadth of the enclosure is at least one and a half times its length

- It has adequate protection from the weather

- It allows safe access for the keepers and does not include blind spots

Juvenile Rhino Iguanas can be housed indoors in standard reptile banks (See Fig. 9). News or butcher's paper should be used as substrate as a high level of hygiene can be maintained by replacing the paper daily or when soiled. Thermal gradients and access to ultraviolet lighting must be available.

4.3 Spatial Requirements

Considerations for spatial requirements should be based on the larger sex and/or the largest individual specimen. Adult male *C. c. cornuta* can reach a total length of up to 1200mm and this measurement should be used as a guide.
Christie recommends a minimum of $10m^2$ for an adult pair of *Cyclura* iguanas including visual barriers such as large rocks and logs (Christie 2008).
The Code of practice for the welfare of animals - Private keeping of reptiles (Victoria) describes housing for lizards; Minimum floor area for 2 adult specimens = 2.5L x 2.0L (L = length of longest specimen); for each additional specimen add 20% to the area (DPI Victoria 2003).

Based on these measurements enclosures should be at least 3000mm x 2400mm.
The Lace Monitor *Varanus varius*, is a similar sized lizard to the Rhinoceros Iguana and for *V. varius* Weigel recommends minimum spatial requirements on the ground of 3m x 3m and 180cm high walls. Alternatively an aviary style enclosure of equal floor dimensions can be employed (Weigel 1988).

Juveniles generally have a fast growth rate and provision should be made for this accelerated increase in size. As a guide, up to six hatchling Bearded Dragons *Pogona spp*., can be maintained in an enclosure measuring 60cm long x 30cm wide x 30cm high, provided that these numbers are gradually reduced as the lizards grow and/or as soon as any signs of dominance-related stress become apparent.
Signs may include excessive hiding, in-appetence, abnormal and/or dark colouration and slow growth rate. Overcrowding must be avoided at all times (DPI Victoria 2003).

4.4 Position of Enclosures

Rhinoceros Iguanas can be housed outdoors throughout most of Australia perhaps with the exception of Tasmania and the far south of the Australian continent where snow and frosts occur. During winter supplementary heating may be necessary and in southern states it may be necessary year round.

For an outdoor enclosure Weigel recommends for the similar sized *V. varius* that the enclosure be positioned where it will receive more than 8 hours of sun a day, but should also provide some shaded

and dry areas (Weigel 1988). To best achieve this desirable position the enclosure should face north to take full advantage of sun.

Rhinoceros Iguanas generally become accustomed to human presence therefore the exhibit should allow easy viewing for the visitor and keeper. This can be achieved by using an open "pit" style but fencing should be at least 180cm high (Weigel 1988), to prevent visitors entering exhibit and animals escaping.

The Victorian DPI recommends the following requirements for outdoor reptile enclosures:

- provide access to direct sunlight throughout the day;

- provide adequate hiding facilities for all reptiles housed within;

- provide adequate shade at all times of the day;

- be well drained to prevent the accumulation of water and facilitate dehydration of the substrate;

- provide areas which are permanently covered and dry.

Indoor exhibits can be constructed within a reptile house with climate control. Reptile houses can have a greater degree of control over temperature and humidity and in southern areas of Australia this may be necessary even for adult *C. c. cornuta*. Adequate ventilation must be provided to avoid overly moist environment which may encourage pathogens. Ventilation can be achieved through air conditioning, mesh partitions or open tops in the exhibit. This must not compromise the animal's ability to escape or visitor's ability to enter exhibit.

Viewing ease should also be included for the staff and visitor. This may be done indoors using the "pit" approach; however, the use of reinforced glass or plastics is often used.

4.5 Weather Protection

Weather protection is only applicable to outdoor exhibits which will be dealt with in this section. The General Standards for Exhibiting Animals in NSW (EAPA 2004) describe weather protection;

Sufficient shelter must be provided to allow protection from wind, rain and extremes in temperature and allow sufficient access to shade during the hot periods of the day (EAPA 2004).

As mentioned previously, the Victorian dpi recommends the following requirements for outdoor reptile enclosures:

- provide access to direct sunlight throughout the day;
- provide adequate hiding facilities for all reptiles housed within;
- provide adequate shade at all times of the day;
- be well drained to prevent the accumulation of water and facilitate dehydration of the substrate;
- provide areas which are permanently covered and dry.

Shelters may be in the form of large hollow logs, artificial or natural rock caves, purpose-built dens and by roofing. Weather protection from southerly winds must be provided in particular as they can be exceedingly cold.

4.6 Temperature Requirements

The Rhinoceros Iguana is a tropical species and therefore the animal's temperature requirements must be paid close attention. Although *C. c. cornuta* is found in the tropics it inhabits relatively dry scrubland, it is therefore critical that they are not allowed to be exposed to environments of high humidity as is the case with the Green Iguana *Iguana iguana*, which is a tropical species inhabiting areas of very high humidity in rainforest.

To combat humidity a high level of ventilation must be provided if housed indoors. This may be done by limiting the size of the water body provided, mesh partitions or open tops and air conditioning.

If housed outdoors; areas that are permanently dry must be provided, such as an elevated mound to allow drainage or hide den.

To provide adequate heating for individuals housed in outdoor exhibits it may be necessary to offer supplementary heat sources, particularly in winter and potentially year round in southern parts of Australia. This may be done by installing large 150W heat globes in sheltered areas, small mounted heating units or heat mats. Sufficient heated areas and basking spots must be available for every individual as dominant lizards may drive others away from basking sites.

David Blair of the Cyclura Research Centre states that supplementary heating should be provided when night temperatures drop below 12.5C. If temperatures drop below 10C then the animals must be housed in an indoor heated facility or must be placed in a heated area of the enclosure. Blair describes the use of heat pads inside specifically designed timber hide boxes that the lizards can sleep in.

Juveniles housed indoors should be allowed access to night temperatures of 21-27C, rising to 32-35C during the day (Blair 2000). Basking spots may be higher than this but should not exceed 50C for long periods.

The Victorian DPI describes temperature requirements for captive reptiles;

- Reptiles are ectothermic and maintain their preferred body temperature (PBT) through a set of behaviours, such as selecting microclimates so that heat gain or loss occurs as required

Reptile activity, physiological functions and feeding occur within a narrow range of the species' PBT. Therefore it is critically important that optimal body temperatures are provided by the creation of a thermal gradient allowing the animal to select PBT

- Heating devices must be designed and positioned so that parts of the enclosure are not heated, thereby providing a range of temperatures and ultimately a working thermal gradient

Daytime temperature gradients of 25-30C will accommodate the thermal requirements for most species. Natural daily and seasonal variations should be provided

- Temperature readings must be taken regularly at the site where the reptile basks. Heating sources must be thermostatically control to eliminate dangerous extremes in temperature

- Light globes, exposed heat mats and other heat sources must be designed and constructed to prevent access by the animal to eliminate the risk of thermal burns

4.7 Substrate

Substrate for *C. c. cornuta* can be relatively simple while still reflecting the natural environment. Rhinoceros Iguanas inhabit dry, rocky scrubland and this should be used as a guide when choosing substrate for a display exhibit.

Sandy substrates are probably the preferred option as it drains well, looks aesthetically pleasing, echoes the animal's natural environment and is relatively easy to clean or replace.
Nepean River Sand can be used to satisfactory effect and Washed Sydney Sand mixed with soil also produces a good result. The substrate should be mixed with at least some rock or pebble substrate to allow the animal's different terrain to move on and prevent monotony.
Sand may also be the most beneficial substrate as it allows for burrowing behavior and nest construction.

The Victorian DPI describes guidelines for substrate use in the captive care of reptiles;

- The substrate must keep the reptiles dry, and therefore must be deep enough to achieve this.
- A variety of substrates may be used, including gravel, sand, peat, exfoliated bark and leaf litter. When choosing the substrate, consideration should be made of the possibility that small particulate substrate may be consumed with the diet and cause serious internal problems. Materials that swell when they are swallowed should not be used.
- Natural substrates may be chosen which reflect the known habitat of the species in the wild. However, the collection of rocks and logs from protected natural areas is not recommended.

4.8 Nest Boxes and/or Bedding Material

It is important that permanently dry nesting and bedding materials are provided for *C. c. cornuta*.

The most critical aspect of nesting areas for this species is a sandy substrate as described in section 4.7. Rhinoceros Iguanas dig burrows to lay their eggs so exhibit substrate must be of a depth of at least 1500-2000mm if breeding is desired, to allow the lizard sufficient scope for the construction of nest burrows.

Blair describes the female Rhinoceros Iguanas' habit of moving huge amounts of sand from around the enclosure to make a mound over the nest burrow once she has filled it in.

Timber boxes may also be used in an effort to encourage oviposition in a site easy to access. The box would have to be quite large and at least partially sunk into the ground (See Fig. 11).

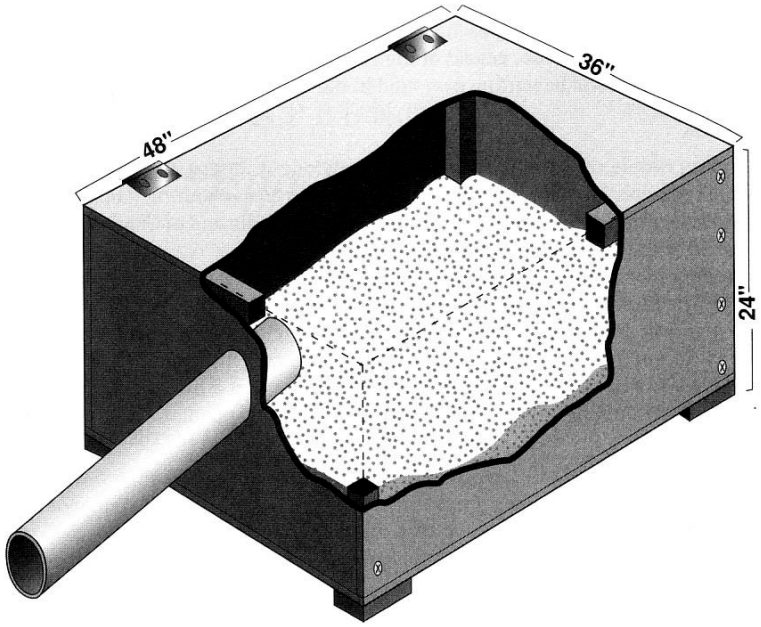

Figure 11: Green Iguana (*Iguana iguana*), nest box suitable for *C. c. cornuta*.
Cut-away view reveals sand substrate (Hatfield 2005).

It is critically important that Rhinoceros Iguanas have access to permanently dry hide areas especially during the night and winter months. These hide areas should be heated via large heat globes or similar, or heat mats within the box. Bedding material can be sand and/or soil, vegetation, newspaper or

sawdust if necessary. Sawdust is only recommended for a very short period if nothing else is available due to the dust that may irritate the lizard.

4.9 Enclosure Furnishings

The General Standards for Exhibiting Animals NSW (EAPA 2004) states in relation to enclosure furniture;

An enclosure must:
- include naturalistic furniture; and
- include, where appropriate, such items as bedding material, branch work, burrows, nesting boxes and pools to aid and encourage normal behavior.
- Objects, furniture, apparatus, decoration, plants or other items that could interfere with the welfare of the animals or with efficient husbandry must not be kept in, or allowed to remain in, the enclosure.

For example; (See Fig. 12)

Figure 12: Artificial rock wall, terracotta pot and branch (Image: Cameron Candy 2008).

Blair recommends for *Cyclura* species that large logs and rocks be provided to stimulate natural behavior and offer visual barriers. This can be particularly important as Rhinoceros Iguanas can be dominant and occasionally aggressive towards each other.

Abrasive objects such as rocks or bark must be provided to aid the animal during the sloughing process.

Although Rhinoceros Iguanas are generally described as a terrestrial species provision should still be made to allow the lizards' access to climbing opportunities in order to provide enrichment as they are known to climb on occasion (See Fig. 13).

Figure 13: Adult *C. c. cornuta* resting on elevated branches (Image: Lafebre 2006).

5 GENERAL HUSBANDRY

5.1 Hygiene and Cleaning

The EAPA (2004), details specific hygiene and cleaning requirements that must be complied with in order to provide adequate housing for reptilian species.

At Symbio Wildlife Park outdoor enclosures for large lizards are spot-cleaned daily for faeces and uneaten food. Pond water is changed as necessary with a weekly change and scrub regardless.

Indoor enclosures for juveniles are provided with 'butcher's paper' substrate and changed as necessary with a twice weekly change regardless. The enclosures are made of sealed timber with glass sliding doors, when cleaning takes place all surfaces are swept for debris and then sprayed with F10 disinfectant (See Appendices). Following contact time of up to five minutes the surfaces are then thoroughly wiped down with paper towel. Water bowls are replaced daily and containers are scrubbed,

rinsed, sprayed with F10 and left for up to five minutes then thoroughly rinsed. Food bowls are replaced daily with fresh food and container or the container is cleaned as per the water bowls.

Keepers should where gloves to aid in protection from zoonotic disease.

5.2 Record Keeping

The maintenance of accurate record keeping is of the utmost importance in the captive animal industry. Legal, ethical and husbandry requirements dictate that all relevant aspects of an animal's history within the captive institution are properly recorded. This information can be invaluable for treating sick or injured animals, breeding plans and enclosure design.

The EAPA (2004) lists the requirements necessary for keeping records for all reptiles:

a) Feeding records including the feed date, amount and type of food offered and eaten;

b) occurrence of skin shedding;

c) measurements of weight and length and date on which taken;

d) any adverse health conditions and treatments;

e) breeding details and offspring details; ***should all be recorded and kept as permanent records.***

At Symbio Wildlife Park all relevant information are recorded on Daily Record documents that are completed daily for all exhibits. This document provides space to record the following information:

- Date, Day
- Food
- Water
- Clean
- Behaviour; Normal, Abnormal, Observation
- Completed by:
- Signed
- Keys returned, radios returned, park secured
- Maintenance issues
- Keeper Approved

- Comments/Notations - Extra Task/Enrichment

Reptiles in are also provided with individual record cards that are formatted to include an entire year. These cards are marked with codes to indicate all the above information and codes are also used for information specific to reptile husbandry such as skin sloughing, prey item and defecation (See Fig. 14).

SPECIES: **SEX:** **SPECIMEN #:**

ORIGIN: **CAGE #:**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Jan																														
Feb																														
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May																														
Jun																														

Figure 14: Individual Record Card (Symbio Wildlife Park 2008).

5.3 Methods of Identification

Being able to accurately identify individual animals within a collection can be very important and should be a matter of routine in correctly maintaining a captive animal institution.

Correct identification can be important in reducing aggression between cohabitants, streamline the transfer of animals, determining sex and age and a number of other reasons.

Methods of identification in Rhino Iguanas can include a number of techniques, some more accurate than others. In general it can be difficult to individually identify large numbers of lizards as their differences are often very subtle. Fortunately, Rhinoceros Iguanas are generally not held in large colony style groups and due to their large size they can usually be readily identified using individual patterns,

scars, anatomical differences and behavioural nuances. As mentioned previously adults display obvious sexual dimorphism.

There are several more permanent and accurate methods of identifying Rhinoceros Iguanas.
- Unique Micro-chipping is probably the most current method.
- Digit clipping is a potential method, but is not recommended anymore.
- Photographs of individual specimens may also be used but these must be updated as the animals' age.

5.4 Routine Data Collection

Routine data collection must be a requirement for all captive animal institutions in conjunction with accurate record keeping as outlined above.

Rhinoceros Iguanas are seen as an ambassador species an excellent analogue species for conservation efforts involving Iguanas from the West Indies. Basic information such as growth rates, diets, behavior, reproductive biology and veterinary procedures can all potentially be used in the field to help further knowledge and the conservation of critically endangered Iguanas.

6 FEEDING REQUIREMENTS

6.1 Diet in the Wild

The wild diet of *C. c. cornuta* consists primarily of vegetation and this is a defining feature of the iguanids. Detailed studies of a number of *Cyclura* species suggest that at least 95% of the diet through all ages during all seasons consists of plant material (Alberts/Hayes et al 2004).

Blair describes the genus *Cyclura* as chiefly herbivorous, ingesting the leaves, flowers and fruits of as many as 58 different native plants on a single island. They also consume small amounts of animal matter such as insects, land crabs and carrion, which can include dead seabirds, fish and occasionally other iguanas (Blair 2000). It appears that the consumption of protein is highly opportunistic and Rhinoceros Iguanas, similarly to other iguanids, are not designed for eating large amounts of animal material. Iguanas and a few other herbivorous lizards all have an obvious enlarged colon, which holds bacteria capable of digesting cellulose in plant matter. This morphological adaptation is known as the

hindgut and the process; hindgut fermentation (Hatfield 2005). Some research suggests that Rhinoceros Iguanas undergo an ontogenetic shift in diet where juvenile animals will consume insects and as they mature this habit diminishes (http://animaldiversity.ummz.umich.edu/site/index.html 2008).

6.2 Captive Diet

There is a vast amount of information available on the captive diet of iguanids including the Rhinoceros Iguana. They are often very long and complex, and these guidelines will attempt to simplify the array of sources to a manageable set of instructions without compromising the welfare of the animal (sources will be provided for further information). Revision of the EAPA guidelines describes that food for animals must be fresh, hygienically prepared and suitable for the specific species and age. It may be helpful to revise these guidelines.

It is critically important that we observe research of wild diets for these lizards to provide them with a nutritional captive diet. As described previously the wild diet of the genus *Cyclura* is made up of at least 95% plant material and this should be replicated in captivity. The majority of this should be leafy greens. Making up the rest of the diet is selected vegetables and then small amounts of fruit and insects can be offered.

Table 1: Captive diet suitable for Rhinoceros Iguanas as used at Symbio Wildlife Park, Cameron Candy, 2008.

HERBIVOROUS LIZARD MIX

Symbio Wildlife Park

Fresh Greens 70%	**Frozen Vegetables (included in 15%)**
*Pak Choy leaves, use some stalk	Peas (frozen)
*Choy Sum leaves, use stalk + flowers	Corn kernels (frozen)
*Bok Choy leaves, use some stalk	**Fresh Fruit 10%**
*Endive	Apple

*Asian greens mixed	Pear
*Parsley	Rockmelon
*Italian Lettuce, Dark Lettuce	Grape

Fresh Vegetables 15%	**Treats + Supplements + Insects 5%**
Parsnip	Mealworms, Crickets, Cockroaches
Carrot	Various Tropical Fruits instead of those above
Pumpkin	Flowers; Rose, Hibiscus, Nasturtium, Dandelion, Clover
Squash	Calcium, Multivitamins
Sweet Potato	Dog Kibble and jams
Corn	
Mung Beans, Alfalfa Sprouts, Snow Pea Sprouts	

*When the green leafy vegetables above are out of season or expensive (those marked with a *), substitute with mixed Lettuces *but do not use Iceberg Lettuces as they are nutritionally low.*

Preparation:

Greens: Leafy greens are to be roughly chopped or shredded, more finely chopped for neonates

Vegetables + Fruit: Vegetables and Fruit are to be finely diced into 5mm x 5mm cubes for neonates/juveniles and up to 20mm x 20mm for adults. *Note: The author prefers not to grate food as it can become soggy*

Supplements: Dog Kibble should only be offered occasionally and pre-soaked in water, insects can be offered to neonates/juveniles weekly. Flowers can be offered at every opportunity.

Table 2: Captive diet suitable for Rhinoceros Iguanas as used at Taronga Conservation Society, courtesy of Peter Harlow, 2006.

Serpentaria Iguana and Tortoise Basic Mix:

Taronga Zoo

Fresh Vegetables		**Frozen Vegetables**	
Alfalfa sprouts - 1 Punnet		Peas (frozen)	200g
Apples	200g	Beans (frozen)	200g
Carrot	200g	Corn kernels (frozen)	200g

Escarole* - 1 bunch (about 500g)

Kale* - 1 bunch (about 500g)

Mung bean sprouts - 1 Punnet

Parsley* - 1 bunch (about 500g)

Pears	400g
Pumpkin	400g
Rockmelon	400g
Tomatoes	200g

Endive* - 1 bunch (about 500g)

Paw Paw	400g
Sweet potato	200g
Squash	400g

When the green leafy vegetables above are out of season or expensive (those marked with a *), we try to substitute with other greens such as bok choy, broccoli leaves, water cress, etc.

How to prepare:

(1) Cut the apples, pears, rockmelon, tomatoes, paw paw and squash into bite size chunks. Leave the skins on, but remove the seeds from the apples, pears, rock melon and paw paw.

(2) Dice the greens into small, bite size pieces (Escarole, kale, endive, parsley)

(3) Grate the hard vegetables (Sweet potato, carrots and pumpkin)

(4) Add in the frozen peas, beans and corn then add the alfalfa and mung bean sprouts. One day per week we add about two teaspoons of 'Rep-Cal' Calcium with Vit.D_3 as well. Finally, mix everything together well.

For herbivorous lizards additionally add:

(5) Mix in a handful (approx 150 g dry weight) of low fat dog kibble pre-soaked in water. We use "Pedigree" brand "Mini Meaty Bites", a 'Light' dog kibble designed for adult dogs (23 % protein and 7% fat).

The above instructions can be used to make a bulk amount of mix. However, the food must be prepared from fresh ingredients and then stored in a fridge inside a sealed container. If the mix becomes wet it should be discarded. The amounts and percentages are guides and it will not be detrimental to deviate

slightly. David Blair of the Cyclura Research Centre recommends a mix of similar ingredients in the following ratios; “about 70% leafy greens, 15% mixed vegetables, 10% fruit and flowers, and less than 5% animal protein based products” (Blair 2000).

Most sources suggest that daily feeding is required for neonates and juveniles and 2 to 3 times a week for adults. Adults may be fed more often certainly during the summer, the author recommends at least offering food daily and removing if not eaten after several hours. The lizards may refuse food during the winter months and food should not be offered unless constant supplementary heating is available to the animals. It is normal for the lizards to go through a period of reduced feeding and activity, often referred to as brumation (Ackerman 1997).

In addition to avoiding certain food items it is very important that the lizards are offered as much variety as possible to reduce the risk of any nutritional deficiencies. See the Appendices for further information and sources on diets.

Table 3: Foods to avoid

Spinach	Beets	Rhubarb	Cabbage	Broccoli	Brussels Sprouts
Cauliflower	Banana	Meats	Pinky Mice or similar		

*It is also important not to over-supplement with vitamins. Once or twice a week is sufficient

Figure: Selection of un-chopped Asian Greens (Image: Cameron Candy 2008).

The iguanas' herbivorous diet can provide an explanation for when the lizards appear to "sneeze". The lizards are actually excreting excess salt due to the high potassium levels in vegetation. The excretion of salt becomes very obvious when keeping captive iguanas as it presents on glass or plastic exhibit fronts as a white coating.

Water should be permanently available for lizards of all ages in easily cleaned receptacles or ponds (EAPA 2004). Water should ideally be some distance away from the heat source if indoors to avoid excess humidity.

6.3 Supplements

Supplements for Rhinoceros Iguanas can be divided into two main groups; dietary and environmental.

Dietary:

Research on the use of Calcium and Multivitamin supplements in reptiles is still in its infancy. In the past it has been suggested that the supplements be used daily through to weekly (Hatfield 2005). For a complete and reliable guide from Kaplan see the Appendices.

Calcium in the form of powder should be provided to neonates and juveniles daily for at least the first year of life. It should be mixed in well with the basic diet so it is barely visible; 2 to 3 pinches should be sufficient. It can also be dusted on live insects in addition to providing insects with a calcium rich diet. It may be beneficial to offer to adults up to once a week.

Multivitamins in powder form should be used as for Calcium, however, it should only be offered 2 to 3 times a week for juveniles and neonates and no more than once weekly for adults.

It is also critically important that the correct diet is provided to the lizards as much of the absorption of essential calcium, vitamins and minerals comes from the food. A well balanced Calcium to Phosphorus ratio (Ca:P), is also essential and can be achieved by avoiding the foods in Table 3 and varying the diet as much as possible.

Environmental:

Environmental supplements should be provided in conjunction with the dietary supplements.

They include providing a correct basking spot, temperature gradient, and access to UVA and UVB light sources if access to natural sunlight is not available.

6.4 Presentation of Food

Presentation of food for Rhinoceros Iguanas is straightforward but the importance can be underestimated. Most importantly; presentation of food must be appropriate to the age and/or size of the iguana.

Vegetables, fruits and greens must be finely chopped for young iguanas of around one year or younger. Presentation for adults can be roughly chopped cubes of around 2mm x 2mm in size.

Food for neonates and juveniles should be presented in shallow bowls to minimize the contents being spilt. Food for adults can be offered in large shallow dishes in an attempt to avoid spilling food. Other options include palm barks that can be discarded when soiled or rotten. They provide a more natural and appealing look for the presentation of food, however, care must be taken to ensure high standards of hygiene are still maintained (EAPA 2004).

It is also beneficial to present food in different ways to provide enrichment for the animal. This may include offering live insects that the lizards can chase, offering whole leaves or vegetables including stalks, fruit halves attached to branches and hanging leaves from safe hooks to allow the lizards to browse.

Figure : Aesthetically appealing water/food bowl – from URS see Appendices (Image: Cameron Candy 2008).

7 HANDLING AND TRANSPORT

7.1 Timing of Capture and Handling

Timing of capture and handling for most reptile species is generally best done in the morning so the animal is less active and therefore safer to handle. This would be effective for lizards housed in outdoor exhibits however, if the animals are housed in an indoor enclosure their body temperature may not drop significantly overnight. To combat this it may be beneficial to restrict the amount of heat provided to the lizard during the night before the capture is planned. This must be done safely so as not to cause the animal undue stress, the temperature should not be allowed to drop below around 15 degrees. Reducing the overnight temperature during winter would likely be unnecessary.

In accordance with EAPA guidelines the capture and handling of the animal must be done safely to minimise risk to handlers and animals.

7.2 Catching Bags

The use of catching bags may be necessary for individuals that are not accustomed to handling. Catching bags with handles may be useful when catching fast and unconditioned individuals as the bag can be flung over the animal so that it is flush with the ground. Care must be taken not to injure the animal if employing this technique.

For juveniles; soft cotton or calico bags should be used with the seams on the outside and rounded corners to avoid the lizards' claws becoming tangled. The bags can be secured with cable ties or shoelace.

If catching bags are necessary for adult lizards, due to their large size and strength canvas bags may need to be used. They should be secured as stated above.

7.3 Capture and Restraint Techniques

If the lizard required for capture and restraint is an unconditioned animal the most important aspect of safe capture and restraint is to ensure the head is secured as Rhinoceros Iguanas can inflict serious bites. The grip restraining the head must not put excess pressure on the animal's throat. The claws, limbs and tail should also be secure and the animal should be supported by having either a hand or solid surface under the ventral surface. The tail of the iguana should *never* be held onto, particularly in neonates and juveniles, as it can break.

Some sources suggest the use of thick gloves to minimize the risk of serious bites or scratches. The author does not recommend this especially with neonates and juveniles as it increases the risk of injuring the lizard through the loss of sensitivity in the handler's touch. Gloves may be necessary if the lizard is required to be restrained for an extended period of time to reduce the amount of scratching (Hatfield 2005).

For particularly aggressive animals equipment such as a firm broom may be used to pin the head. A second handler can then grip the animal behind the head to restraint it. This should be done quickly and use of a catch bag may be beneficial although it can limit visibility of the animal's movements.

See Figure 15, 16, 17 for images demonstrating correct handling techniques.

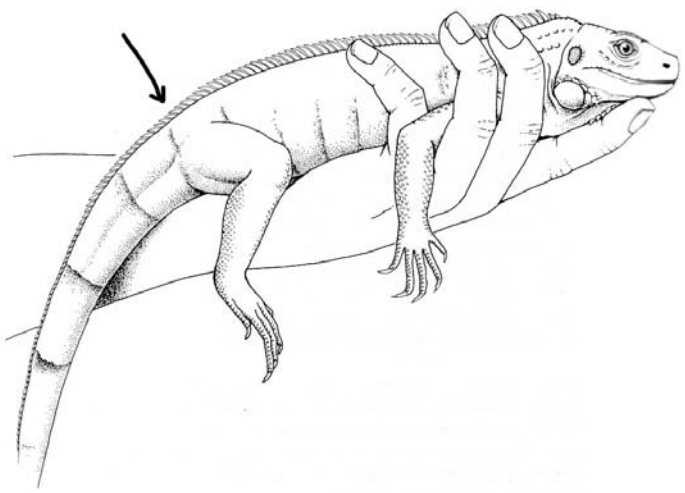

Figure 8.1: One way to hold your small iguana is in your hand, as shown here.
Illustration by: Kendal Morris

Figure 15: The arrow indicates where a second hand may grip the hind legs if the animal struggles. The hand pictured can be arranged to better secure the head (Hatfield 2005).

Figure 8.2: Large iguanas need more surface area to feel settled when they are being held; using a forearm (shown here from both sides) is one good option.
Illustration by: Kendal Morris

Figure 16: Arrow indicates where to hold the animal's head, behind the eyes, if it is aggressive (Hatfield 2005).

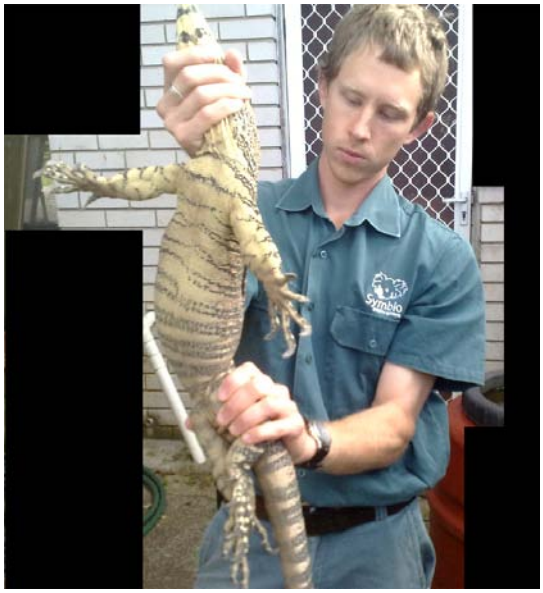

Figure 17: This image shows the author restraining a Lace Monitor, the same technique could be used to restrain an aggressive adult Rhinoceros Iguana. Note the hind legs are secured with the tail (Image: Cameron Candy 2008).

As a general rule it is preferable to have the animal's eyes covered to reduce stress. It is also very beneficial for the animal and the handler if the lizard has been conditioned to be amenable to handling as it decreases the stress levels in both animal and handler. This makes capture and restraint a streamlined process. If this is to be achieved with Rhinoceros Iguanas it is recommended that training commence as soon as possible when the animal is young (Hatfield 2005).

7.4 Weighing and Examination

To safely conduct examination of a Rhinoceros Iguana, the capture and restraint techniques described in 7.3 should be adhered to. Two people should be involved in the capture and restraint of large or aggressive individuals.

To safely and effectively weigh the animal it must first be captured and restrained, as above, and then depending on the size of the animal will have to be contained.

Juvenile animals may be secured in bags as described in 7.2, the bag can be weighed separately to ascertain its weight, which can then be subtracted from the weight of the animal. Digital scales may have a tare function which delivers the same result. Weights should be double checked to ensure a correct result.

Larger animals may need to be weighed in suspended scales or large bench top scales. Large animals may need to be restrained in a bag which should then be placed in a container to ensure the animal does not cause injury to itself or the handler.

7.5 Release

When releasing *C. c. cornuta* back into the enclosure, the animal will need to be restrained according to the animal's temperament and age described in section 7.3.

Animals being released back into an indoor bank exhibit should be placed into the exhibit facing away from the keeper and preferably directed towards a hide box or similar. Release of the animal should be executed once the animal is correctly placed inside the exhibit and has stopped struggling.

Release of animals into an outdoor exhibit should be similar to the above procedure particularly directing the animal towards an area of refuge. If the animal is an aggressive individual, then a second keeper should be involved as a 'spotter' and be equipped with an item such as a firm, long handled broom to fend off an attack. Release of an aggressive animal should be quick and deliberate followed by backward steps to give the animal reassurance. The animal should be released during the morning to allow the opportunity to reach a preferred body temperature.

7.6 Transport Requirements

7.6.1 Box Design

Box design for transporting Rhinoceros Iguanas will vary depending upon size of the animal, duration of transport and destination. According to IATA Live Animals Regulations containers for reptile transport must be adequately ventilated, rigid enough to prevent damage or escape, protect the handler from bites or other injury, clean and leak proof (IATA 2006).

The container must be labeled with consignee's name, address and phone numbers. The Shipper's name, address, phone numbers, the species common and scientific names and the quantity must all be present on box. "LIVE ANIMAL", "KEEP OUT OF EXTREME TEMPERATURE AREAS", "THIS WAY UP" labels must also be used (IATA 2006).

As reptiles rely on temperature for healthy biological functions they must be removed from areas of extreme temperature, not below 7 degrees Celsius and not above 29 degrees Celsius. The preferred temperature range should be 15-25 degrees Celsius (IATA 2006).

See Figure 18 for IATA container designs.

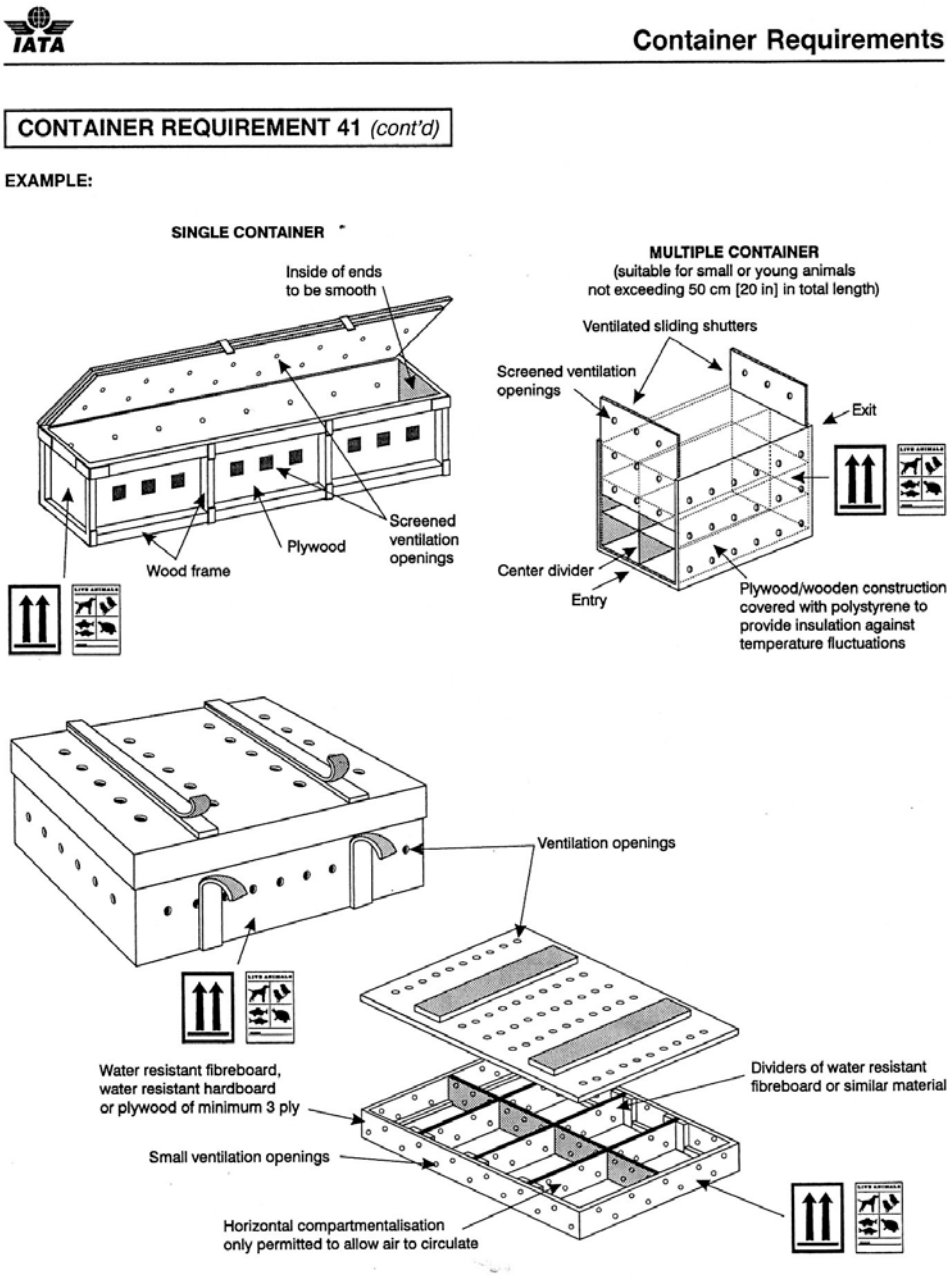

Figure 18: IATA container designs for Lizards (IATA 2006).

7.6.2 Furnishings

Furnishings should be kept simple as excess items may move during transport. If furnishings are included they should be very lightweight and or adequately secured. The container should be packed with scrunched or shredded newspaper to provided padding.

7.6.3 Water and Food

According to IATA Live Animals Regulations food and water should not need to be provided for reptiles during transport. Under special circumstances water may need to be provided if transport is delayed (IATA 2006). The animals must be well fed and provided with water constantly in the days prior to transport.

7.6.4 Animals per Box

The animals per box will be dependant on size of the animal and the transport box itself. It is not recommended that any lizards be kept together in the same bag or box where they have contact with each other as aggression, injury and cannibalism is a possibility. The IATA regulations do not list *Cyclura* spp. as being either cannibalistic or delicate, however the author recommends that Rhinoceros Iguanas are not packed together as a precaution (See Tab 4)

Table 4: IATA regulations packing lizards for transport (IATA 2006).

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)

7.6.5 Timing of Transportation

Timing of transport must be designed to minimise the amount of time the animal spends in a container. This should be done by liaising with the receiving institution and being familiar with the timetable of relevant airports and companies such as Australian Air Express (Radnidge 2008).

As Rhinoceros Iguanas are reptiles they are dependant on temperature to become active. It may therefore be beneficial to transport the lizards in the early morning so the animal doesn't heat up and become too active.

7.6.6 Release from Box

When releasing the animal from the transport box the enclosure should already be prepared for the animal. This may include removing other inhabitants or creating a temporary exclusion zone for the new occupant. The animal should ideally be released in the direction of a suitable hide area to minimize stress to lizard. The iguana must not be released in the direction of a wall or any other object they may cause it injury.

8 HEALTH REQUIREMENTS

8.1 Daily Health Checks

To conduct daily health checks for Rhinoceros Iguanas it is generally most efficient to do this during the morning when feeding and cleaning is done. Visual checks should be conducted throughout the day in addition to the initial morning check.

Observations of the animal must be made everyday to ensure that the following biological functions are correct:

- All the animals' limbs and tail should move freely

- The animal should be consuming regular amounts of food, taking into account

seasonal shifts in food consumption

- Overall appearance – scales should look clean, sloughing should be recorded, body condition must be good; hips should not be prominent, tail should be firm and full
- Eyes should be clear, open and not recessed into the head
- Any discharges from nostrils, eyes and cloaca must be recorded. Note that *Cyclura* expel excess salt from the nose which creates a white crust at times
- Changes in behaviour – is the animal "sulking", hiding when it's not normal, sitting in the water bowl
- Faecal matter must be observed for texture; it must be dark brown in colour with a trace of white indicating uric acid. It is not solid but should still hold a pellet-like shape

It is vitally important that heating in the enclosure is checked at least twice daily – morning and afternoon, to ensure correct temperatures are provided to the lizard. Significant fluctuations in temperature must be rectified *immediately* as suitable temperature regimes are essential for maintaining optimum health in reptilians.

Every opportunity should be taken to examine the animal closer when performing tasks such as demonstrations, capture and transport. Testing the animals' strength, skin tension/condition and a closer look at the eyes, nose, mouth and cloaca are tests that can be done.

8.2 Detailed Physical Examinations

The process of detailed physical examination may require the animal to be restrained. This is generally achieved by using physical or chemical restraint. According to Mader a physical examination should be approached systematically and thoroughly. Start at the cranial end and work to the caudal end observing inside the mouth, nares and eyes. Palpate musculature and carefully examine skin. Any swellings, discolouration in the mouth or faeces and abnormal discharges may indicate a problem and a veterinarian should be contacted (Mader 2006).

In hatchling and small juvenile Rhinoceros Iguanas a detailed physical exam can be simple as the lizards are small but not so small that handling becomes complicated. Individuals over an SVL of approximately 500mm will generally require two people to adequately restrain, examine the animal and perform procedures such as blood extraction.

8.2.1 Chemical Restraint

There are a number of chemical restraints available for use in reptilians, but it is generally advisable that an experience veterinarian administers the drug. It is also very important that the lizard be allowed to acclimate to the procedure room and allowed to reach its' preferred body temperature (PBT). This should be in the high 20's.

Large *C. c. cornuta* can potentially injure a handler during examination so chemical immobilisation may be required. Tiletamine-zolazepam (4 to 6 mg/kg IM) can be administered and Butorphanol (1 to 4 mg/kg IM) can be administered 30 minutes prior to induction as a preanesthetic. The preferred access sites for injection are the ventral coccygeal vein and the ventral abdominal vein. Facemasks can be useful to administer isoflurane (4% to 5%) or sevoflurane (7% to 8%) (Mader 2006).

8.2.2 Physical Examination Restraint

Chapter 7 provides details on handling including images, however, find images below of more physical restraint techniques

Clockwise from left: Handling juvenile lizard being cautious not to depress the stomach. Handling adult iguana in two hands; restraining head and forelimbs in one hand and restraining hind limbs and tail. Handling aggressive adult iguana wrapped in towel. (Mader 2006).

8.3 Routine Treatments

As *Cyclura c. cornuta* herbivorous they are not as prone to the many endoparasites that carnivorous reptiles such as snakes may be exposed to, however, this is probably the primary issue that the lizards should be routinely treated for. Routine faecal analysis should be carried out every 6 to 12 months or immediately upon observing abnormal faeces (Mader 2006). Due to their herbivorous diet Iguanids have a complex array of gut flora and treating the lizards with worming drugs unnecessarily may be harmful. Ivermectin is generally used to worm lizards (Mader 2006).

It is essential that basic hygiene is a priority in captivity to prevent parasite infection. This includes regularly cleaning water receptacles, not allowing a build up of faecal matter and disinfecting cages thoroughly.

Table 5: Lizard Formulary (Swan 2006).

Anaesthesia/Analgesia	**Dose**	**Comment**
Alfaxalone	9-20 mg/kg IV	rapid induction/recovery, preferred choice for Anaesthetic
Butorphanol	1.5 mg/kg	opioid analgesic
Carprofen	1-4 mg/kg PO, IM, IV	Analgesia
Isoflurane	1.0-3.0% maintenance	inhalation anaesthetic for maintenance of anaesthesia Pre-anaesthetize with injectable agent
Meloxicam	0.1-0.2 mg/kg IM, IV, PO	Analgesia
Morphine	1.5 mg/kg IM	preferred opioid analgesic in reptiles
Propofol	10 mg/kg IV	Rapid, smooth induction

Antibiotics	**Dose**	**Comment**
Ceftazidime	20 mg/kg IM, IV q 72hrs	highly effective against Gram-ve bacteria
Enrofloxacin	5-10 mg/kg PO, IM q 24 hrs	painful, can cause tissue necrosis when injected
Metronidazole	20 mg/kg PO q 24 hrs	anaerobic bacteria
Piperacillin	100 mg/kg q 24 hrs	broad-spectrum, effective against Gram-ve bacteria

Antiparasitic	Dose	Comment
Fenbendazole	50 mg/kg PO, q 24 hrs x 3 treatments	Nematodes
Fipronil	spray/wipe over q 7 days	mites/ticks
Ivermectin/Moxidectin	0.2 mg/kg PO, IM, repeat 2 weeks	nematodes/mites
Metronidazole	100 mg/kg PO q 7 days x 3 treatments	Protozoa
Phenothrin	topical spray	pyrethroid "Top of Descent", mites
Ponazuril	30 mg/kg PO repeat in 3 days	Protozoa
Toltrazuril	50 mg/kg PO repeat in 3 days	Protozoa
Praziquantel	10 mg/kg PO, IM repeat in 2 weeks	cestodes, trematodes

8.4 Known Health Problems

Most of the known health problems in Rhinoceros Iguanas can be avoided by following basic husbandry guidelines, specifically; a varied diet, access to UVA/UVB light, access to PBT, clean water, adequate cage furniture to reduce stress and daily observations to enable the keeper to treat health issues before they become dangerous.

Nutritional Health Issues

Metabolic Bone Disease (MBD) is a disorder that more often affects juvenile lizards but can be seen in adults and it is generally caused by a lack of calcium. This can be attributed to an unbalanced diet and or a lack of adequate exposure to UVA/UVB light. It can cause lameness, limb fractures, tetany and occasional paralysis (Swan 2008). To avoid the risk of MBD a correct diet must be provided in addition to access to UVA/UVB light and the provision of powdered calcium/multivitamin supplements can be beneficial (Mader 2006).

Environmental Health Issues

Captive iguanas can occasionally suffer from dysecdysis (abnormal shedding) and usually it presents as partial failure to shed the skin. It is often observed at the end of the tail and around the limbs and digits. To combat this the animal can be sprayed with a water bottle to raise humidity, providing adequately sized water bowl or by providing a 'humidity box' which can be a plastic container with a lid, an entry hole and a handful of damp sphagnum moss inside.

Bacterial Disease

Bacterial pathogens have been historically blamed for most reptile disease (Mader 2006). It is important that bacteria is not blamed prematurely for ill health, standard tests such as faecal and blood analysis should always be carried out and a culture made to achieve the most suitable treatment. The best prevention is to maintain high levels of hygiene (Mader 2006).

Bacterial diseases that may affect *Cyclura* include: *Salmonella* spp., *E. coli, Pseudomonas* spp., *Aeromonas* spp., *Citrobater* spp., *Pasteurella* spp., *Alcaligenes* spp., and *Klebsiella* spp.

Fungal Disease

Fungal disease in reptiles is generally cutaneous or systemic. Major factors in fungal disease are incorrect environment such as high humidity or dampness, excessive dryness, poor husbandry and sanitation. In *Cyclura,* because of their small gauge scales and periodic sloughing of the skin, they don't usually suffer from dermatitis infections (Mader 2006). Fungal infections can be treated with povidone iodine and 5% chlorehexidine gluconate diluted with water (Radnidge 2009).

Table 6: Potential diseases, clinical signs and treatments (Mader 2006).

Viruses	**Signs**	**Treatment**
Herpesviruses	anorexia, colour change lymphocytosis, lethargy spontaneous hemorrhage	supportive care; antibiotics, fluids, quarantine, correct husbandry issues
Adenoviruses	anorexia, lethargy, depression	supportive care; antibiotics, fluids, quarantine, correct husbandry issues
Paramyxoviruses	Ascites	supportive care; antibiotics, fluids, quarantine, correct husbandry issues, euthanize confirmed cases
Poxviruses	dermatitis	debridement/cleaning of wound, topical/systemic antibiotics, quarantine, correct husbandry issues
Iridoviruses (from previous page)	nasal discharge, stomatitis, conjunctivitis	supportive care; antibiotics, fluids, quarantine, correct husbandry issues

Ectoparasites	**Signs**	**Treatment**
Ticks	axillae, around joints, cloaca, nostrils, eyes,	physical removal, Permethrin, ivermectin
Mites	around eyes, nostrils, cloaca	correct husbandry issues, Permethrin, ivermectin, 'Top of Descent', quarantine
Flies, Mosquitoes and similar	gathering around wounds, attracted by unhygienic conditions	ensure wounds are properly cleaned/covered, correct husbandry issues

Endoparasites	**Signs**	**Treatment**
Amoebiasis	hematogenous spread to liver and	Metronidazole, increase

	kidneys	temperature, quarantine
Coccidiosis	anorexia, dehydration, regurgitation, hemorrhagic enteritis	Trimethoprim/sulphonamides, sulfa drugs, hygiene, quarantine
Cryptosporidiosis	intestinal causing weight loss, anorexia, diarrhea, lethargy	No 100% effective treatment; sulfa drugs, paromomycin, spiramycin, high level disinfection; ammonia, F10
Hemoprotozoa	usually asymptomatic	No known treatments
Sarcosporidia	usually asymptomatic, weight loss, lethargy, anorexia, swollen muscles	No known treatments
Ciliated *Protozoa*	usually asymptomatic	rarely required, Metronidazole
Flagellated *Protozoa*	usually asymptomatic, weight loss, anorexia	rarely required, Metronidazole
Digenea	anorexia, listlessness	Praziquantel, albendazole, manual removal
Cestodes ***(Mesocestoidea)***	internal signs only	surgical removal, Praziquantel, Tetrathyridium
Nematodes ***(Rhabdiasidea, Oxyuridea, Trichuridea)***	respiratory distress; open mouth breathing, few signs reported	Benzimidazoles Ivermectin, Ievamisole,
Pentastomiasis	usually asymptomatic	surgical removal, Ivermectin

8.5 Quarantine Requirements

It is recommended that newly acquired reptiles are isolated for a minimum of 3 months before being introduced to the permanent collection. If individuals are not thriving they should be quarantined for 90 days or until faecal and blood tests are negative for pathogens. Animals must be observed to demonstrate normal appetite, activity and shedding. Mader recommends that 5% Carbaryl powder be used topically on the animal and the cage and repeated in 7 days, it must be used in a well ventilated container.

It is recommended that isolation is achieved through separate rooms that do not exchange air. Healthy, established animals must be serviced, treated before the new arrivals and quarantined animals. Keepers who service quarantined animals should not enter the regular collection until the next working day. It is beneficial to employ footbaths outside of any building, room housing reptiles. Footbaths can be diluted chlorhexidine or chlorine mixes.

9 BEHAVIOUR

9.1 Activity

Rhinoceros Iguanas are heliothermic reptiles, meaning they spend much of their time in the heat and light of the sun. In addition to this behaviour they are ectothermic and require heat to provide the energy they need for biological functions. The majority of documented activity in *C. c. cornuta* relates to mating behaviour which will be discussed in section 9.3.

Activity in foraging and browsing for food is another major component in Rhinoceros Iguana behaviour. As 95% of the diet is made up of vegetation the lizards will spend a relatively large amount of time eating.

9.2 Social Behaviour

The majority of lizard species are terrestrial and/or solitary, with social behaviours being primarily aggressive. Iguanas are an exception in that several species will congregate in groups, although these are sometimes for short periods in areas where food is plentiful. Iguanas can recognise and behave differently toward individuals of differing dominance and therefore may be able to form social groups (Alberts 2004).

Iguanas have complex behaviours similar in complexity to many bird and mammal species. They have large brains and multi-faceted social and foraging behaviours (Alberts 2004).

Like most lizards Rhinoceros Iguanas use “head-bobbing” in a series of ritualised up and down motions. These movements identify individual lizards conveying information such as sex and rank. Mature males tend to display the most whereas females and young males will display far less to avoid aggressive males (Alberts 2004).

Rapid head-bobs are generally an indication of excitement or aggression most often in dominant lizards and slower head-bobs are usually indicative of submission more often in females.

9.3 Reproductive Behaviour

The breeding season for Rhinoceros Iguanas occurs every year during a 2 – 3 week period, between May and June. This demonstrates that breeding activity is possibly triggered by seasonal changes in photo period. Females often move outside of their regular activity ranges to areas that provide adequate nest sites. Several exploratory nests are often begun prior to completing one (Blair 2000).

The activity level in females will increase and her appetite decrease in the two weeks prior to laying. In some cases females may demonstrate aggressive behaviour in defending the nest for several weeks (Blair 2000).

David Blair has observed mating behaviour describing that the males will head-bob then circle behind the female and bite the nape. Copulation rarely lasts longer than 90 seconds and usually only occurs once during the day (Blair 2000).

Mate guarding has been documented in several closely related *Cyclura* species. This involves large dominant males who defend the females they have mated with inside their territory. They defend the females against rival males and smaller males who attempt to “steal” females (Alberts 2004).

For this reason it is unadvisable to house more than one male together in the presence of females.

9.4 Bathing

C. c. cornuta inhabits dry scrubland where water bodies are not plentiful. In captivity they do not appear to have a great fondness for water, however, certain individuals may be eager to enter water and others may not. A small pond or water bowl should nonetheless always be available.

9.5 Behavioural Problems

The majority of behavioural problems are likely to stem from breeding behaviour particularly large dominant males being aggressive toward other males or behaving too roughly with females.

In some cases captive lizards may become aggressive because of an internal health problem. Kaplan has described aggressive behaviour as being caused by gall stones, tumours and abscesses in Green Iguanas (Kaplan 2007).

The other major cause for behavioural problems arises when the iguana becomes used to human presence and may be aggressive toward a keeper in an effort to obtain food or defend territory. It is advisable to condition Rhinoceros Iguanas to become familiar with as many keepers as possible to reduce the risk of behavioural problems involving humans as large aggressive iguanas can become difficult to handle.

9.6 Signs of Stress

Mader describes signs of stress as including lowered food intake, fewer breeding displays and other suppressed behavioural changes (Mader 2006).

Hatfield describes the following signs of stress regarding captive Green Iguanas which can be followed for Rhinoceros Iguanas; - Skin changes to dark, muddy colour

- Reduced or zero food intake

- Defecating more than usual or not at all

- Hiding more than usual

- “Sleeps” all the time or by contrast behaves frantically unable to stay still

(Hatfield 2005).

In the event of observing any of these signs they must be recorded in diary or cage card to judge duration of any abnormal behaviour or appearance. If any of these signs continue for over several days a thorough examination of husbandry and the enclosure must be completed and if necessary a veterinarian consulted.

9.7 Behavioural Enrichment

As iguanas are intelligent reptiles, behavioural enrichment must not be overlooked.

At Symbio Wildlife Park a number of enrichment techniques are employed for Rhinoceros and Green Iguanas including;

- Natural browse such as palm fronds, fig branches

- Natural rocks, logs, ropes and branches for climbing

- Large water bowls are offered to allow swimming

- Coloured panels are erected in the exhibits as visual stimulus

- Jam or Honey smeared on browse

- Food is varied as much as possible not only ingredients but presentation

  (Leafy greens are offered whole and chopped by varying amounts)

- Variety of insects are eagerly accepted

- Misting with water to simulate rain

- Audio of predators such as bird of prey

In addition to this the iguanas are allowed the chance to interact with humans and other animals. This is only done with conditioned animals as it is stressful to individuals that are not conditioned to handling and human interaction. Under supervision the lizards are able to move around different rooms and people also gaining valuable exercise.

Kaplan and Hatfield describe similar activities including the provision of objects. Hatfield describes how some iguanas relish the opportunity to investigate large soft objects such as pillows and seem to enjoy laying on them. Also described is the opportunity to view other live animals such as fish which the lizards appear to enjoy (Hatfield 2005).

It is important when trialling enrichment activities to record in a diary or similar what the activity is, the duration of sessions and the outcomes whether they are positive, negative or indifferent.

9.8 Introductions and Removals

When introducing Rhino Iguanas the enclosure must be fitted with adequate hide areas and visual barriers to minimise aggression between lizards. It is not advisable to house more than one mature male together as they will invariably combat and can injure each other (Christie 2008).

Introductions and removals should be closely monitored throughout the day and timing should be mid morning to allow the reptile to reach preferred body temperature and begin displaying natural behavior.

Details in section 7 Handling and Transport will aid in streamlined introductions and removals.

9.9 Intraspecific Interaction

David Blair describes housing Rhinoceros Iguanas in pairs, trios and groups of four and notes that pair groupings are the most successful. More than one mature male can rarely be kept together unless the enclosure is over 200 square meters which is generally impractical. The aggression between females must also not be overlooked as they are often aggressive towards each other and usually develop a hierarchy. Submissive females usually display inhibited growth rate and in some cases compatible groups can have serious fights ending in injuries. David Blair recommends that the most successful grouping of *Cyclura c. cornuta* is pairs but if possible it may be beneficial to allow males eye contact through fence or similar to stimulate breeding behaviour (Blair 2000).

9.10 Interspecific Interaction

There is not a large source of reliable information on housing Rhinoceros Iguanas in mixed species exhibits; however, Hatfield has described several cases of Green Iguanas being housed with other lizards, tortoises and turtles, hardly with positive results (Hatfield 2005). In relation to Rhinoceros Iguanas this would be more than likely be just as problematic as they are similarly territorial and can consume significant amounts of animal matter. This would make it potentially dangerous keeping Rhino Iguanas with other species. It may be possible to trial keeping with some large tortoise species but this would have to be closely monitored for competition for food and territory.

9.11 Suitability to Captivity

This species appears to settle in captivity very well. Rhinoceros Iguanas are the most widely kept member of the *Cyclura* genus with several hundred specimens kept in zoological institutions around the world. In recent years it has become more common to acquire them as pets in the United States and there are several successful commercial breeders (Blair 2009).

In Australia, Taronga Zoo Rhinoceros Iguanas have successfully bred almost every year for the past decade (McFadden 2009).

Rhino Iguanas represent an exceptional ambassador not only to their own species but to the plight of the entire *Cyclura* genus of the West Indies which constitute the most endangered group of lizards in the world (Alberts 2004).

10 BREEDING

10.1 Mating system

The mating system of Rhinoceros Iguanas consists of several courtship displays and behaviours by males.

Evidence for a polygynous mating system with social rank determining breeding rights has been published. This corresponds to the fact that *C. c. cornuta* appears to be extremely territorial and males especially will attempt to dominate and intimidate conspecifics with head movements and body gyrations. They use similar motions to attract females (Egnatios-Beene, J 2002).

David Blair describes observation of mating Rhinoceros Iguanas;

"Copulation is usually preceded by numerous head bobs by the male, who then circles around behind the female grasping the nape of her neck in typical iguanid fashion. He then attempts to restrain her and to manoeuvre his tail under hers to position himself for intromission. Copulation generally lasts from 30 to 90 seconds (rarely longer) and a pair is rarely observed mating more than once or twice per day" (Blair 2000).

Combat behaviour could be an important stimulus for reluctant males, and if space allows, *Cyclura* can be housed in colony environments to enable pair bonding and male combat. Sexually mature males can

be very aggressive and defend their territory vigorously (www.waza.org 2008). Care must be taken that males do not injure each other and may have to be separated.

In captivity, *Cyclura* are annual, seasonal breeders. Breeding activity appears to be triggered by seasonal changes in the day length, or photo period. Depending upon the species of *Cyclura*, mating occurs from late May until mid June, with ovipositing occurring approximately forty days later, usually in early August (Blair, 2000. Egnatios-Beene, J 2002).

10.2 Ease of Breeding

Rhinoceros Iguanas have been regularly bred in captivity for over ten years. Rhinoceros Iguanas are the most extensively bred *Cyclura* iguanas.

The Iguana Specialist Group (ISG) comments that several species of *Cyclura* have successfully bred in captivity, particularly Rhinoceros Iguanas. Successful reproduction can occur with single, adult pairs and combat behaviour could be an important stimulus for reluctant males (ISG 2009).

In Australia, Taronga Zoo has had success in captive breeding of *Cyclura c. cornuta* with copulation and eggs laid in 1995, 1997, 2000, 2001, 2002, 2003, 2004, 2005 and 2006. Clutch sizes ranged from 12 - 25 (McFadden 2008).

Provided the animals have a temperature cycling program which mimics the drop in temperature in the natural range breeding should be achieved.

10.3 Reproductive Condition

Reproductive condition primarily centres on the diet for iguanas in captivity and the different approach to males and females. The animals must also be sexually mature, in captivity this can be achieved faster than in the wild due to constant access to high quality food. The iguanas can potentially breed at 3 years of age (Blair 2000).

10.3.1 Females

It has been observed that Rhinoceros Iguana eggs are among the largest produced by any lizard. This highlights the importance of reproductive females having enough body mass and energy levels to cope with such large eggs. Mader suggests that without sufficient energy levels female reptiles with often forego reproduction that year, therefore sufficient food must be available to females leading up to the breeding season, during and prior as ovipositing will deplete energy and fat reserves (Mader 2006).

Critically important is the female lizard's access to calcium which may need to be increased during the breeding season to ensure successful egg formation. It is recommended that the female's protein intake is increased; this may include insects such as cockroaches and crickets which can be a good medium for offering calcium by dusting the insects in calcium powder. Also of benefit may be soaked dog kibble and small amounts of juvenile rodents or chickens.

Dystocia (abnormal birth) can occur in females for a number of reasons including nutritional imbalances, inadequate lighting and temperature or inappropriate nesting sites (Swan 2008). Dystocia in Rhino Iguanas generally results in the retention of a clutch eggs which, if untreated, can be fatal. It is critical that all basic husbandry requirements are met at all times particularly in gravid females to avoid reproductive disorders.

10.3.2 Males

It may be beneficial for males to not have food intake increased in the same way as the females to allow for more lean and active males. However, if male combat is to be used it is important that the lizards still have access to sufficient food to ensure their energy levels are maintained (Mader 2006).

10.4 Techniques Used to Control Breeding

The most practical way to eliminate reproduction in *Cyclura* is to house males and females separately.

Permanent surgical procedures and contraceptives are not widely used in reptiles and it due the vulnerable status of this animal in the wild it would be beneficial to have as many reproductively active animals as possible for future programs.

These lizards can be kept as bachelor groups as male combat will generally only occur if females are present. Females can also be kept together with generally no issue.

10.5 Occurrence of Hybrids

Ricord's Iguana (*C. ricordi*) and *C. c. cornuta* are the only sympatric forms of *Cyclura*, both species occurring on the island of Hispaniola. However, the existing natural range of Ricord's Iguana is more restricted than Rhinoceros Iguanas. The two populations are separated by 2000 metre high mountains so rarely do they come into contact with each other (Blair 2000). With Rhino Iguanas vulnerable in the wild and Ricord's critically endangered, all efforts are made to avoid hybrids.

There are two subspecies recognised for *Cyclura cornuta.* The nominate race, *cornuta* occurs on the island of Hispaniola (Haiti and the Dominican Republic). The remaining subspecies, *stejnegeri* is confined to Mona Island (www.cites.org 2008). Some sources do not recognise the subspecies as they are virtually identical.
Due to the isolation of the two potential subspecies it is unlikely that they would hybridise in the wild.

There is, however, a documented case of Galapagos Land Iguanas breeding with Galapagos Marine Iguanas producing viable hybrid offspring. Hybridisation of Grand Cayman (*Cyclura nubila lewisi*) and Lesser Caymans (*C. l. caymanensis*) has also been recorded (Alberts 2004).
It is therefore highly possible that Rhinoceros Iguanas could be hybridised with other *Cyclura* species and every effort must be made to ensure this is avoided and accurate records are always maintained. The potential result of this is; captive animals and animals released into the wild may be hybrids and if allowed to breed will eventually result in the extinction of at least one species.

10.6 Timing of Breeding

Rhinoceros Iguanas can breed at various times throughout the year in captivity, particularly when iguanas are introduced to each other for the first time. In most cases breeding takes place for several weeks during May and June (Blair 2000).

10.7 Age at First Breeding and Last Breeding

Most sources suggest that Rhinoceros Iguanas are sexually mature at 5 – 9 years of age, with some instances of breeding occurring with 3 year old animals. In the *Cyclura* genus it appears the youngest age at first breeding is 2 years of age. All members of this genus are long-lived with records of individuals reaching 30 years old and still reproducing. Sources suggest that Rhinoceros Iguanas may possibly live up to 80 years, therefore, more research will be required to accurately ascertain age at last breeding and this highlights the need for accurate record keeping (Blair 2000).

10.8 Ability to Breed Every Year

Sources recommend that *C. c. cornuta* can reliably breed every year when maintained at optimal condition from as young as 2 years but more commonly 4 – 5 years of age.

Taronga Zoo successfully bred *Cyclura c. cornuta* in 1995, 1997 and every year from 2000 – 2006. Clutch sizes ranged from 12 - 25 (McFadden 2008).

10.9 Ability to Breed More Than Once Per Year

In captivity, *Cyclura* are annual, seasonal breeders. Breeding usually takes place during a 2 – 3 week period. A fluctuating photoperiod seems to have a dominating influence on the reproductive cycle (Blair 2000).

Taronga Zoo Australia, has only ever recorded one clutch per year (McFadden 2009).

10.10 Nesting, Hollow or Other Requirements

In the wild females dig burrows up to a meter and a half long in sandy soil (Animal Diversity Web online 2008). David Blair comments that several days before actual egg laying, females begin to dig all over the cage, excavating many shallow depressions. With this information the animals should be provided with a sandy substrate with some large rocks or logs embedded in the soil to allow for the construction of a burrow. Adequate floor space with the sandy substrate should be available to give the lizard the opportunity to mimic natural behaviour by digging test holes. See section 4.8 for more details and diagrams on suitable nest site for *C. c. cornuta*.

10.11 Breeding Diet

Kaplan recommends that pre-breeding and gravid females should have calcium supplements increased. Because Rhino Iguanas produce such large eggs and potentially large clutches it is very important that they have sufficient condition to cope with this process. It is likely to be beneficial for the diet offered to females be increased as well and a close observation program followed to ensure the animals are not under undue pressure from reproduction. As Rhinoceros Iguanas are known eat carrion it may be beneficial to provide females in particular with increased access to small amounts of protein and or insects during the breeding season. See section 6 for more details on diet.

10.12 Incubation Period

Sources vary on incubation period for this species, however, the average period is 80 – 100 days with some sources suggesting as low as 65 and as high as 165. Higher incubation temperature will result in shorter incubation periods. It would be good management to closely observe the condition of eggs from 65 days.

10.13 Clutch Size

Clutch size in Rhinoceros Iguanas can vary significantly with sources suggesting as low as 5 and as high as 30 with an average of 15 – 20 (Blair 2000), (www.waza.org 2008).

10.14 Age at Weaning

Reptiles in general do not wean offspring; however, Blair has observed some female iguanas defending their nests after oviposition for several weeks to protect from egg predation. Hatchling Rhinoceros Iguanas are fully independent from birth.

10.15 Age of Removal from Parents

Adult Rhinoceros Iguanas do not provide any parental care for the offspring; the young are fully independent from birth. In a captive situation where eggs are incubated artificially in containers it is standard practice to leave the hatchlings together in the container for several days until all the viable eggs have hatched. Depending on the size of the clutch the young may need to be separated into small groups of 3 – 4 to avoid overcrowding and resultant aggression and injuries such as loss of digits, tails and lacerations.

10.16 Growth and Development

Hatchling Rhinoceros Iguanas are relatively large which corresponds with the large eggs (See Fig. 19). Rhinoceros Iguana eggs are among the largest of all lizards (Blair 2000). This gives the hatchling lizards a positive head start which may be an adaptation to the high infant mortality rate on the Caribbean islands *Cyclura* iguanas inhabit, on some islands the mortality rate approaches 100% (Blair 2000).


Figure 19: Rhinoceros Iguana at full term (Image: Cameron Candy 2008)

The hatchlings will emerge from the eggs after piercing it with the egg tooth. They will generally remain in the egg for up to two days and every effort must be made not to disturb the lizards at this stage as they will continue to absorb vital egg yolk during this time. After the hatchlings have completely left the egg they should be left undisturbed for up to a further five days to allow the umbilical opening to close. It may take up to ten days for all hatchlings to fully emerge from the eggs. Once all lizards have exited the egg the ventilation must be increased to allow sufficient oxygen to penetrate. Care must be taken that the lizards cannot escape from any openings (Blair 2000).

If individual eggs have not hatched after a week it may be necessary to open the egg. This can be done with a pair of small surgical scissors with curved tips. The top of the egg can be gently pinched with forceps and a very small “v” shaped cut made with the scissors (Radnidge 2009).

After all hatchlings have been completely out of the egg for approximately four days they can be removed into holding containers in groups of 3 – 4. It is important to closely observe the young together to ensure individuals are not becoming stressed or bullied.

The young iguanas will slough the skin in the days after hatching and slough again in approximately two weeks. After 7 – 10 days the hatchlings will begin to accept food. There is evidence suggesting that *C. c. cornuta* hatchlings undergo an ontogenetic shift from consuming large amounts of insects and reducing

this intake as they mature. Hatchlings and juveniles will generally relish mealworms, cockroaches and crickets which are important in the early development. Provision of insect food almost certainly increases growth rate, however, Rhino Iguanas have been raised with no access to insects successfully (Blair 2000). Blair has recorded significant growth in the first year of over 500 mm.

11 ARTIFICIAL REARING

11.1 Incubator Type

There are a number of incubator types suitable for Rhinoceros Iguana eggs. Very technical incubators can be purchased but are often quite expensive. At Symbio Wildlife Park an unused drinks fridge has been converted into an incubator. As the fridge is air-tight and insulated in holds a very steady temperature, a length of heat cord, small computer fans and thermostat have been installed to make a highly functional incubator. An even simpler method is to use a Styrofoam box or aquarium and place a thermostatically controlled aquarium heater inside, cover with water, and place something for the egg container to stand on so that it sits just above the water level. Then a ventilated lid or Glad Wrap should be placed over the container (Ackerman 1997).

It is important to note that reptile eggs unlike bird eggs do not have a chalazae which is a ligament that holds the yolk in the centre of the albumen so that the embryo does not drown. This is why bird eggs can be turned and reptile eggs *must not be turned* otherwise the embryo may suffocate. It is good practice to mark the top of the egg a pencil so that it can be transferred to the incubation container without turning the egg (Swan 2008).

The preferred incubation medium for lizard eggs is Vermiculite mixed with an equal part of water by weight (50:50). This generally provides enough moisture for the incubation period, however, the container can be lightly misted with water if necessary. Care should be taken not to directly spray the eggs but spray the inside of the container. The eggs should be partially buried in the same position they were in when removed from the animal (Swan 2008), (See Fig. 20).

Also important to the incubation process is gas exchange. This can be achieved by lifting the incubation container lid and lightly fanning the eggs being careful not to spill condensation onto the eggs. This can be done up to every 3 days (Ackerman 1997), (Swan 2008).

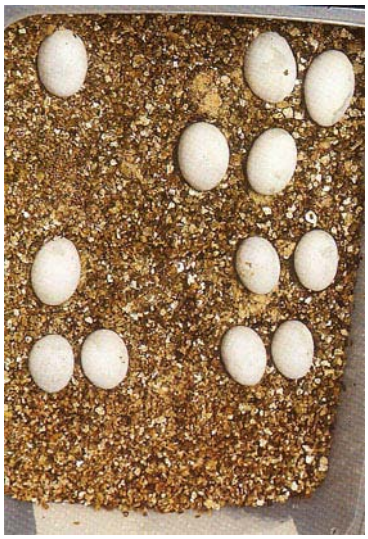

Figure 20: Bearded Dragon eggs in Vermiculite (Image: Cameron Candy 2009).

11.2 Incubation Temperature and Humidity

30 degrees is the recommended temperature for Rhinoceros Iguana eggs (Blair 2000), though a range of 28-31 degrees is adequate for most lizard species (Ackerman 1997). Humidity should be maintained at around 80% and this is usually achieved well by using Vermiculite and water (50:50) and checking that moisture is present inside the container. The inside walls should be covered in a light condensation.

11.3 Desired % Egg Mass Loss

Reptile eggs do not lose mass during incubation but actually gain mass through an increase in moisture.

11.4 Hatching Temperature and Humidity

Hatching temperature will remain the same for several days after hatching, at around 30 degrees. It is critically important to monitor humidity as a hatchling iguana can become dehydrated quickly. It can be beneficial to add some wet paper towel to ensure there is adequate humidity (Swan 2008).

The lizards will usually hatch over a period of 2-3 days. If there are a small number of eggs that do not hatch with the other eggs they may need to be opened by using a scalpel to ensure the lizard can exit the egg.

11.5 Normal Pip to Hatch Interval

It is normal for the lizards to stay inside the egg for up to 24 hours after they have pipped the shell. They will be building strength to fully emerge from the egg and often they will still have yolk attached to their abdomens which they will absorb within 12-24 hours (Swan 2008). Rhinoceros Iguanas can have a highly variable incubation period with an average of around 100 days, it is therefore important to monitor the eggs closely for the collapsed appearance which will mean hatching is imminent. If the majority of the eggs are hatching and an egg fails to hatch with the others within 1-2 days it may have to be opened carefully using a scalpel and tweezers.

11.6 Diet and Feeding Routine

Juvenile Rhinoceros Iguanas appear to undergo an ontogenetic shift as they grow. When young; they will include a higher percentage of insect and protein in their diet whereas when they mature this will decrease perhaps as the adults become slower and they include more plant material in the diet. It is important in this case that hatchling *Cyclura* are offered insects dusted with calcium and multivitamin powder every 2-3 days. Because of their large size at birth the iguanas should be able to accept medium sized crickets or cockroaches. The insects should be refrigerated first so they do not escape the lizards and build up in the enclosure.

The young iguanas can also be offered the same diet as the adults every day, however, the items should be diced finely to ensure the young lizards can consume enough food. Iguanas will forage through the night so food should be left so the young lizards can eat at their leisure.

11.7 Specific Requirements

There are a number of specific requirements for hatchling iguanas that are simple but important; Very important is that the lizards can all escape and hide from each other as over-crowding will lead to aggression and the lizards can cause significant injury to each other. In some cases several enclosures may need to be set up if you have a large number of animals. The same is true for basking spots of around 32 degrees, access to food and water, access to UVA/B light. At Symbio the NEC T10 Blacklight is used for young lizards, the lights are inexpensive and produce a high range of UVA/B.

11.8 Data Recording

Data recording has been detailed previously. Here will be stated data that should be recorded specifically for hatchling iguanas.

Data should be recorded once the eggs have been laid. Once the eggs have been removed they must be place into an incubator immediately, on appropriate medium such as the vermiculite mix mentioned in section 11.1.

The weight, length and width of each egg should be taken and recorded upon being laid, then each week after (Priam Psittaculture 2009). This allows there to be an accurate record of all the eggs and helps keepers determine important statistics such as the average weight and size of iguana eggs; by how much the weight of the embryo increases during the incubation; the percentage of egg mass lost during incubation; and the weights and lengths of the hatchlings upon hatching.

11.9 Identification Methods

The ability to individually identify the juvenile lizards is important to give the keeper an accurate vision of growth and development for each animal. There are several methods including; keeping individuals separated, using Liquid Paper markers, photographs can be used but should be updated.

Microchips are another preferred method (Taronga Zoo 2008).

11.10 Hygiene

Hygiene has been covered previously but should be reiterated here in relation to the care of hatchling and juvenile animals. The young animals will not have the ability to fight of infection or disease as well as an adult animal so it is very important that high standards of hygiene are maintained.

The lizards should be kept in simple enclosures with newspaper or similar substrate, disposable cardboard or plastic hides and easy to clean food and water bowls. Enclosures should be cleaned daily or at least every second day. At Symbio the preferred cleaning agent is F10 due to its broad safety range and effectiveness against most bacteria and disease.

11.11 Behavioural Considerations

The primary behavioural consideration for hatchling Rhinoceros Iguanas is aggression between individuals. When the lizards have first hatched they can be housed together provided there are more hide areas than individual animals to ensure they can escape confrontations. As the lizards begin to grow they can develop territorial behaviours and will attack each other if there is not adequate space. Where possible the lizards should be housed separately or in small groups of 2-3 individuals with adequate hide areas.

11.12 Weaning

Like most reptiles Rhinoceros Iguanas do not wean their young, however, in captivity it is important that the juveniles are not allowed to become “addicted” to certain food items. Kaplan advises that young iguanas not be given large amounts of lettuce as the lizards appear to become increasingly fussy and will refuse other foods if allowed.

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15 Glossary

- **Brumation** a period of prolonged cool temperature without actual hibernation. This term replaces the term hibernation which should be used in mammals
- **Copulation** the act of sexual intercourse
- **Cloaca** the common chamber into which the reproductive, urinary and intestinal ducts open
- **Carrion** flesh of dead animal
- **Digit** finger or toe
- **Diurnal** active by day
- **Dorsal** regarding the back
- **Dystocia** Difficult birth
- **Ectothermic** regulation of body temperature primarily through an external heat source

- **Endemic** restricted to a certain region
- **Extant** state of a population or species being alive currently; not extinct
- **Gravid** the term applied to reptilian pregnancy
- **Heliothermic** sun loving, deriving heat from the sun
- **Hemipenes** the pair of sex organs in snakes and lizards
- **Morphology** the study of form and structure of plants and animals
- **Neonate** newborn or newly hatched animal
- **Oviparous** egg laying
- **Oviposition** the act of egg laying at a site
- **Parietal eye** vestigial "third eye". A sensory structure that can detect changes in light
- **Photo-period** hours of light in 24 hour period
- **Terrestrial** land dwelling
- **Tympanum** ear drum
- **Vent** anal opening
- **Ventral** the lower surface or underside

16 Appendix

Diet Information:

Multivitamins/Calcium Frequency of Feeds:

Less than 1yr old:	MV: 4-5x p. week	CA: 7x p. week
1-2yr old:	MV: 3-4x p. week	CA: 5-6x p. week
Over 2yr old:	MV: 2-3x p. week	CA: 4-5x p. week
Pre-breeding/Gravid	MV: 2-3x p. week	CA: 5-6x p. week
Poor condition > 1yr	MV: 3-4x p. week	CA: 5-6x p. week

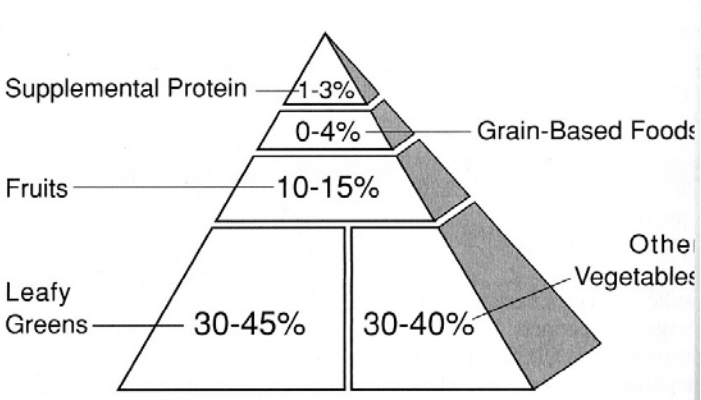

Figure 5.1: Iguana Food Pyramid. Plant percentages (except Grain-Based Food courtesy of Robert Ehrig, President of International Iguana Society. He also ha more than 15 years of experience breeding and raising iguanas in captivity.

Iguana Food Pyramid which can be applied to *C. c. cornuta* (Hatfield 2005).

Contact details

URS (Ultimate Reptile Supplies): www.urswholesale.com.au/ Supplier of water bowls etc.

Herp Shop: www.herpshop.com.au/ Supplier of Multivitamins, Calcium, Lighting and Heating accessories.

ANNUAL CYCLE OF MAINTENANCE TABLE *C. c. cornuta* (2009)

JANUARY	**1**				**5**
FEBRUARY	**1**				**5**
MARCH	**1**	**2**	**3**		**5**
APRIL	**1**			**4**	**5**
MAY	**1**	**2**			**5**
JUNE	**1**				**5**
JULY	**1**				**5**
AUGUST	**1**	**2**			**5**
SEPTEMBER	**1**				**5**
OCTOBER	**1**			**4**	**5**
NOVEMBER	**1**	**2**	**3**		**5**
DECEMBER	**1**				**5**

1 = CLEAN ALL FEEDING/WATER EQUIPMENT + CAPTURE/RESTRAINT EQUIPMENT

2 = PRUNE/SERVICE PLANTS + REARRANGE FURNITURE

3 = REMOVE/REPLACE SUBSTRATE

4 = FAECAL SAMPLE TEST

5 = MONITOR TEMPERATURE READINGS

*Vermiculite and Perlite are available from most Nursery or Garden supply centres

Figure 21: Indoor exhibit at National Zoo, Canberra. (Image: Cameron Candy 2009).

Figure 22: Indoor exhibit at National Zoo, Canberra. (Image: Cameron Candy 2009).

MATERIAL SAFETY DATA SHEET

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

IDENTIFICATION

PRODUCT NAME: **F10 SUPER CONCENTRATE DISINFECTANT** UN Number: None
D G Class: None

Hazchem code: None
Poisons Schedule: 5
HAZARDOUS ACCORDING TO CRITERIA OF WORKSAFE AUSTRALIA IN THE PACK CONCENTRATE ONLY (eyes and skin irritant)
USE: Biodegradable multi purpose Disinfectant for all hard surfaces, equipment and airspaces

PHYSICAL DESCRIPTION/PROPERTIES
Appearance: Clear, colourless liquid, with a slight natural odour.
Boiling Point: 110 ^{0}C
Vapour Pressure: Not known
Specific Gravity: 1.00
Flash Point: Not flammable
Flammability Limits: Not flammable
Solubility in water: Soluble

INGREDIENTS
CAS Number Quantity (w/w)
Benzalkonium Chloride 68424-85-1 5.4%
Biguanide 27083-27-8 0.4%
Ingredients not determined to be hazardous to 100%

HEALTH HAZARD INFORMATION

HEALTH EFFECTS:
Acute
SWALLOWED: Low. Substantial ingestion may cause irritation to mouth, throat and digestive tract.
EYE: Low. Will cause irritation but not serious damage.
SKIN: Low. Concentrate may act as mild degreasant to sensitive skin.
INHALED: Low. No significant hazard.
Chronic
INHALED: Low. No significant hazard

FIRST AID

SWALLOWED: DO NOT induce vomiting. Give milk or water to drink. Seek medical advice where necessary.
EYE: Rinse eyes with water. Seek medical advice where necessary.
SKIN: Wash affected area with soap and water.
INHALED: Non-toxic. Avoid long term inhalation of neat liquid. Remove to fresh air.
FIRST AID FACILITIES: Contact a doctor or Poison Information Centre (phone 131126)
ADVICE TO DOCTOR: Treat symptomatically

F10 SUPER CONCENTRATE DISINFECTANT

PRECAUTIONS FOR USE

EXPOSURE LIMITS: No data found
Engineering controls: None required
PERSONAL PROTECTION: Not required
FLAMMABILITY: Not Flammable

SAFE HANDLING INFORMATION

Storage and Transport: Store below 30 ^{0}C in dry conditions
SPILLS AND DISPOSAL: Soak up on an inert material e.g. dry earth and dispose of in an area approved by local authority by-laws. Flush small spills with copious amounts of water
FIRE/EXPLOSION HAZARD: The product is not flammable or explosive.
OTHER INFORMATION: Ensure good industrial hygiene.
DO NOT mix with soaps or other chemicals.
CONTACT POINT: Managing Director, +03 9841 9901
Chemical Essentials Pty Ltd

KEEP OUT OF THE REACH OF CHILDREN

Issue number: 2
Issue Date: August 2004

Material Safety Data Sheet
Hexawash
Classified as hazardous according to the criteria of NOHSC

Product Name Hexawash
Recommended Use Pre-operative antiseptic scrub for skin and hands.
Supplier Details Apex Laboratories Pty. Ltd.
ACN Number 000 397 240
Street 61 Chivers Road
Suburb Somersby
State NSW
Country Australia
Post Code 2250
Phone +61 2 4372 1661 (Business hours – 8.30am – 5.00pm)
Fax +61 2 4372 1668 (fax)
Website http://www.apexlabs.com.au
Emergency contact As above or Poisons Information Centre 131126 (Australia)
Classification Classified as hazardous according to the criteria of NOHSC
Risk Phrases R22 Harmful if swallowed R41 Risk of serious damage to eyes
Safety Phrases None allocated
ADG Class None allocated
Hazchem Code None allocated
Poisons Schedule Not Scheduled

Ingredients CAS No Proportion TWA mg/m3 STEL mg/m3

Chlorhexidine Gluconate 18472-51-0 10-<30% not set not set
Teric GN9 9016-45-9 30-60% not set not set
Isopropyl alcohol 67-63-0 <10% not set not set
Other non hazardous ingredients NA to 100% NA NA

The TWA exposure value is the average airborne concentration of a particular substance when calculated over a normal 8 hour working day for a 5 day working week over an entire working lifetime. The TWA exposure standard set by Worksafe Australia for dusts not otherwise specified is 10mg/m3. The
STEL (Short Term Exposure Limit) is an exposure value that should not be exceeded for more than 15 minutes and should not be repeated for more than 4
times per day. There should be at least 60 minutes between successive exposures at the STEL.

Ingestion DO NOT INDUCE VOMITING. Rinse mouth with water and give milk and then a raw egg to drink. Seek medical advice immediately.
Eye Irrigate with copious quantities of lukewarm water for at least 15 minutes and seek medical advice.
Skin Wash well with soap and water and if concerned seek medical advice.
Inhalation If concerned remove to fresh air and seek medical advice.
Extinguishing Media Water fog or fine water spray, foam, dry agent. As appropriate for surrounding environment.

MSDS|Hexawash

Apex Laboratories Pty. Ltd. | ACN 000 397 240 | www.apexlabs.com.au | Phone: 02 4372 1661 | Fax: 02 4372 1668 (International +61) | Email: info@apexlabs.com.au

SECTION I Identification of the Material and Supplier
SECTION II Hazard Identification
SECTION III Composition
SECTION IV First Aid Measures
SECTION V Fire Fighting Measures

Combustion Hazards Toxic or irritating fumes may be released including carbon monoxide and carbon dioxide.
Precautions for Firefighters Wear self contained breathing apparatus and protective clothing.
Hazchem Code None allocated
Emergency Procedures In the event of a major spill, protect drains and water courses from

contamination. Ensure good ventilation to avoid inhalation and wear protective clothing to prevent contact with skin and eyes. Take care to avoid slipping.
Materials and Methods Wear protective clothing (overalls, gloves, goggles and boots). Use adsorbent such as sand to mop up spill and collect then dispose after consulting appropriate authorities. Wash area down with detergent and excess water. Take care not to slip.
Precautions Always use good occupational work practices and observe recommendations on the label. Keep exposure to this product to a minimum. Prohibit eating, drinking and smoking in storage and handling areas. Wash hands after handling and remove contaminated clothing and any protective equipment before entering eating areas.
Conditions Store product in original containers as per label instruction (below 30oC or room temperature).
National Exposure Standards No exposure standard has been allocated for this mixture or any significant ingredient within this mixture.
Biological Limit Values No biological limit has been allocated for this mixture.
Engineering Controls No specific engineering controls are required for this mixture.

Personal Protective Equipment

Eye Eye protection is not normally necessary. Wash hands after handling and prior to touching eye and in particular handling contact lenses.
Skin Skin protection is not normally necessary, however it is good practice to avoid contact with chemicals by wearing suitable gloves when handling.
Respiratory Protection from inhalation is not normally necessary. If ventilation is inadequate or dust is likely to build up then use of a suitable dust mask would be appropriate.
Appearance Pink liquid.
Odour Slight alcohol odour.
pH 5-6
Vapour pressure No data available.
Boiling point/range No data available.
Freezing/Melting point No data available.
Solubility Miscible.
Specific gravity/density 1.04.
Flash Points No data available.
Flammable limits (in air) No data available.
Ignition temperature No data available.
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MSDS|Hexawash

SECTION VI Accidental Release Measures

SECTION VII Handling and Storage

SECTION VIII Exposure Controls and Personal Protection

SECTION IX Physical and Chemical Properties

Chemical stability This mixture is stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.
Conditions to avoid No specific conditions to avoid other than extreme heat.
Incompatible materials No data available.
Decomposition products May emit toxic fumes under fire conditions.
Hazardous reactions No data available.
Handling of the formulated product is not expected to cause any adverse affects. The following data pertains

particularly to the active and any hazardous ingredients in the formulation, rather than this specific formulation.

Acute Health Effects

Ingestion

Eye The data available suggests that irritation of the eye is likely and may be severe and cause permanent injury and corneal burns.

Skin The data available suggest that irritation to the skin is likely after contact with some of the hazardous ingredients and burns are possible. However, this formulation is unlikely to cause problems in appropriate quantities. Individuals may have or develop sensitivities.

Inhalation If this material is used in an enclosed, poorly ventilated space, and at elevated temperatures, then inhalation may produce irritation.

Chronic Health Effects

Ingestion There is no data available on the long term effects of ingestion of this product.

Eye There is no data available on the long term effects of eye contamination with this product.

Skin Allergic reactions following skin contact may occur in susceptible people. Chronic skin contact may also defat and dry the skin leading to discomfort and dermatitis.

Inhalation There is no data available on the long term effects of inhalation of this product.

Advice to Doctor Treatment for any adverse effects should be symptomatic and as for chemical burns. If ingestion has occurred, early endoscopy should be performed to assess mucosal lesions in the oesophagus and stomach, and gastric lavage might be considered.

Carcinogenicity No ingredient in this formulation is known to be carcinogenic.

Compounding effects No known effects.

Ecotoxicity No data available.

Persistence and Degradability No data available.

Mobility No data available.

Disposal Methods Empty containers may be recycled or sent to a commercial waste disposal site. Unused product should be suitable for landfill however contact the relevant local Waste Disposal Authority.

Special Precautions Do not dispose into sewers or waterways.

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MSDS|Hexawash

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SECTION IX Physical and Chemical Properties

SECTION XI Toxicological Information

SECTION XII Ecological Information

SECTION XIII Disposal Considerations

UN Number None allocated.

UN Shipping Name None allocated.

ADG Class None allocated

Packing Group None allocated.

Special Precautions None allocated.

Hazchem Code None allocated

Poisons Schedule Not Scheduled

Date This MSDS has been reviewed and updated as required in May 2009.

NOHSC: National Occupational Health and Safety Commission

ADG Class: Australian Dangerous Goods Class

CAS Number: Chemical Abstracts Service Number

TWA: Time Weighted Average
STEL: Short Term Exposure Limit
UN: United Nations

Disclaimer

This Material Safety Data Sheet has been developed according to WORKSAFE Australia, NOHSC Guidelines.
Hazard Classifications have been determined in consultation with the Approved Criteria for Classifying Hazardous Substances [NOHSC:1008(1999)].
However, to the best of our knowledge, the finished product is unlikely to cause harm to humans handling, administering and dispensing as per label instructions.
The data, information and recommendations herein are represented in good faith and are believed to be correct as of the date hereof.
The purpose of this Material Safety Data Sheet is to describe products in terms of their safety requirements.
Apex Laboratories Pty Ltd make no representation of merchantability, fitness for a particular purpose or application, or of any other nature with respect to the
information or the product to which the information refers ("the product").
The information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability prior to use of the product.
The physical data shown herein are typical values based on material tested. These values should not be construed as guaranteed analysis of any specific lot
or as guaranteed specification for the product or specific lots hereof.
Due care should be taken to make sure that the use or disposal of this product and/or its packaging is in compliance with relevant Federal, State and Local
Government Regulations.

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SECTION XIV Transport Information

SECTION XV Regulatory Information

SECTION XVI Other Information

Key to Abbreviations