Husbandry Manual

for

Eastern Snake-Necked Turtle

Chelodina longicollis

Reptilia: Chelidae

Image Courtesy of Jacki Salkeld

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CONTENTS

1. INTRODUCTION

Eastern Snake-Necked Turtles are a freshwater species native to southeastern parts of Australia and can be recognised by their rather long necks, up to two-thirds of the length of their shell. Being one of Australia's most abundant species of turtle, both in captivity and in the wild, these animals make an intriguing pet or exhibit animal due to their inquisitive nature and reasonably attractive appearance.

These chelonians are primarily carnivorous being known to consume crickets, mosquito larvae, cockroaches, freshwater yabbies, fish, shrimp, tadpoles, snails and slugs. Although not entirely accepted it is believed that this species also consumes limited amounts of plant matter such as duckweed and water lilies.

In the wild if this species is startled it releases a pungent odour secreted from scent glands on the turtles' side. This is thought to persuade potential predators to lose interest in the foul smelling prey. It is because of this adaptation that the Eastern Snake-Necked Turtle has also adopted the humorous nickname 'stinker'. This in not a problem in captivity however as this species quickly settles and is quite amiable towards being handled.

Being a reptile this means the species is ectothermic and so relies on its ambient temperature to maintain a constant body temperature. Due to this most turtles are active during the warmth of the day and can be seen sun-basking on the side of riverbanks. Because of this behaviour it is a suitable exhibit animal that is easy to cater for in a day operating zoo, requiring little funding for initial set-up and ongoing maintenance (especially it is placed in an outdoor pond exhibit). Alternatively they can be incorporated into an already existing exhibit as an additional species.

OH&S Category: Harmless

CARRIER OF SALMONELLOSIS

ENSURE YOU WASH YOUR HANDS WITH AN ANTI-BACTERIAL SOAP FOLLOWING ANY DIRECT/INDIRECT CONTACT WITH THIS SPECIES

- See **7.2 Capture and Restraint Techniques** for appropriate methods of handling and associated precautions as freshwater turtles have sharp claws that can inflict minor/moderate scratches
- Ensure closed shoes with good grip are worn as you may be dealing with slippery surfaces due to turtles being an aquatic species and as a precaution in the event you drop the turtle on your foot
- Turn off all electrical equipment such as water heaters during any maintenance activity
- Hold individuals to your side pointing away from you if they are not yet accustomed to a captive lifestyle as they may spray a pungent defensive odour

2. TAXONOMY

2.1 Nomenclature

Class:	Reptilia
Order:	Testudines
Family:	Chelidae
Genus/Species:	*Chelodina longicollis*

2.2 Subspecies

None

2.3 Synonyms

Testudo longicollis (Shaw, 1794)
Chelodina longicollis (Shaw); Gray 1831
Chelodina novae-hollandiae (Dumeril & Bibron, 1835)
Chelodina sulcifera (Gray, 1855)
Chelodina sulcata (Gray, 1856)
Chelodina longicollis (Shaw); Gray 1857

2.4 Other Common Names

Snake-Necked Turtle
Long-Necked Turtle
Eastern Long-Necked Turtle
Stinker (Encyclopedia of Australian Wildlife 1997)
Chélodine à longcou (French)
Gewöhnlicher schlangenhalsschildkröte (Deutsch)
Australische slangenhalsschildpad (Netherlands)

3. NATURAL HISTORY

3.1 Morphometrics

3.1.1 Mass and Basic Body Measurements

In general female Eastern Snake-Neck Turtles grow to a larger size than that of males; females can typically reach a carapace size of 260mm and males 210mm (Darren Green 2000). Contrary to this, the largest Eastern Snake-Neck captured and recorded by John Cann (1998) was 238mm and weighed 1.47kg, although he acknowledges he has seen larger. John Goode (1967) claims the largest he has recorded is 254mm.

3.1.2 Sexual Dimorphism

Sexual dimorphism is apparent, although difficult to determine. Differences between sexes include:

- Plastron curvature: Males plastron has a tendency to be more concave whilst a females' plastron has a tendency to be more convex (Darren Green 2000).
- Anal scute shape: Males anal scutes are predominately more 'V' shaped whilst females are predominately more 'U' shaped (Darren Green 2000).
- Tail length: By comparison a male has a longer tail than a female with the cloaca situated further down the appendage (Adam Skidmore.pers.comm).

Figure 1:

Comparison between female *Chelodina longicollis* on left with 'U' shaped anal scutes to male on right with 'V' shaped anal scutes.

Image by Brendan Host

Figure 2:

Comparison between male *Chelodina rugosa* (Northern-Snake Necked Turtle) on left with longer tail to female on right with noticeably shorter tail. Used this species to illustrate, as it is rather hard to determine in *C.longicollis* and is more evident here. Also when handled tails usually retract in *C.longicollis*.

Image by Brendan Host

When completely developed females are generally larger than males (usually only obvious in the presence of others of the same species). When trying to distinguish sex using tail length it is best to observe them whilst still in the water if possible as tails retract when handled (Adam Skidmore.pers.comm).

If you cannot determine the sex of an individual by means of sexual dimorphism other sexing techniques include:

- Probing: a larger hemipene pocket is indicative of a male (Aleyshia Manning 2001).
- Stimulation: gently rock the specimen from side to side. Sometimes the hemipene will pop out (Adam Skidmore.pers.comm).

3.1.3 Distinguishing Features

The family Chelidae, of which the Eastern Snake-Necked Turtle belongs to, is characterised by the fact it is pleurodirous. This means the head and neck of animals within this family can retract into the front component of their carapace by a series of folds (H.G.Cogger 1975). When extended this can add a further two-thirds in length. It is also evident that the limbs of this species are jointed and webbed with four claws (H.G.Cogger 1975). The plastron differs in colour from white to shades of cream or tan and the carapace is brown. Dorsally the turtles' skin is dark grey and ventrally either pale grey to white (John Cann 1998). A characteristic 'V' shape in the anal shields (Darren Green 2000) and a plastron occasionally rimmed in black help to identify this particular species of turtle (Encyclopedia of Australian Wildlife 1997). Juveniles are brighter in colour (red/orange) on their plastron with this colour rimming both plastron and carapace. Upon reaching maturity the carapace curves slightly upwards (John Cann 1998).

See Appendix I for 'Key To The Australian Species Of Chelodina'.

3.2 Distribution and Habitat

The Eastern Snake-Necked Turtle is found only in the eastern coastal areas of Australia ranging from as far south as the Adelaide region of the Murray-Darling river system to as far north as the Burdekin River south of Townsville. It has been sighted in all eastern river systems of New South Wales and Victoria (John Cann 1998).

This species generally lives in weedy and slow moving rivers, swamps and creeks, however is known to inhabit a diverse array of freshwater aquatic environments. It prefers a temperate climate with winter dominant rainfall patterns typical to southeastern Australia. It can also to some extent survive under Mediterranean or sub-tropical conditions (Darren Green 2000).

During summer months this species has been known to travel up to 2km over land in search for food/shelter and research into the gut contents of turtles has revealed significantly high levels of terrestrial insect species indicating the species is semi-terrestrial (Scott Thomson 2003).

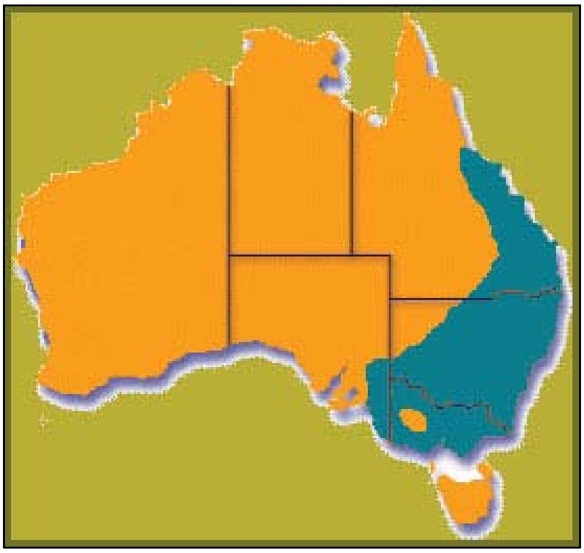

Figure 3:

Distribution of *Chelodina longicollis* in the wild.

Image Courtesy of Sean-Paul Smith

3.3 Conservation Status

The Eastern Snake-Necked Turtles conservation status is currently secure with the turtle in actuality being Australia's most commonly kept captive turtle (John Weigel 1988).

3.4 Diet in the Wild

Eastern Snake-Necked Turtles have been described as opportunistic carnivores consuming either aquatic specimens or terrestrial invertebrates as they fall into the water (Georges, Norris and Wensing 1986). They will mainly consume available insects such as crickets, dragonflies and grasshoppers as well as small fish, molluscs, shrimp, yabbies and tadpoles (Darren Green 2000) and use their claws to tear the food apart. Carrion also comprises a part of this species diet, hence its 'opportunistic' title (John Cann 1998). It is suspected that chelonians will consume plant material in the wild to supplement their diets. Such species include duckweed, azolla, nardoo, hyacinths and water lilies (Craig Latta 2005). When considering diet a slower flowing habitat would appear to be of greater benefit to the species.

3.5 Longevity

3.5.1 In the Wild

36.2 years – Male [acquired 11/09/61 - Wild Bred] (Frank and Kate Slavens 2003)

3.5.2 In Captivity

35.1 years – Unknown sex (Max-Planck-Gesellschaft 2002)
37.0 years – Unknown sex (Max-Planck-Gesellschaft 2002)

Michael Frith however believes *C.longicollis* may possibly live up to over eighty years, based on his own observations. Craig Latta supports this (pers.comm).

3.5.3 Techniques Used to Determine Age in Adults

It is possible to approximate the age of an immature individual by counting the growth rings on the scutes of the shell. This can be rather complicated with some individuals as they can be born already with one or two sets of rings (Aquariums Online 2006).

Other factors contribute to the growth rate and size of an individual such as enclosure size and diet. Limited space will place stress on an individual and hence limit its growth rate. Excessive feeding will cause accelerated growth rates resulting in larger and mature specimens faster. This is not always healthy and can place undue stress on the animal (Michael McFadden.pers.comm). Aging a turtle is generally best done by someone with experience and will still only be an approximation.

Below is data collected to determine the predicted size of *Emydura macquarii* (Murray River Short-Necked Turtle) at specified ages, *Emydura macquarii* being a small breed of short-necked freshwater turtle. Although not specific to Eastern Snake-Necked Turtles it gives an indication of the relative size turtle specimens should be at the ages listed.

Age	Predicted Size - Plastron Length (mm)
1	68.3
2	94.3
3	114
4	130
5	143
6	155
7	165
8	174
9	182
10	189

(Unknown)

4. HOUSING REQUIREMENTS

4.1 Exhibit/Enclosure Design

Glass aquariums are the standard means by which to house an Eastern Snaked-Necked Turtle indoors. They need to be kept in filtered, clean, fresh water of a depth at least the width of the turtles shell so it can right itself if it falls onto its back (Scott Thomson 2003). Other items may be added to decorate the enclosure and simulate a natural environment, however, care must be taken to ensure that this will not result in the turtles' lodging themselves in place and hence death by drowning (Darren Green 2000). A shelf or accessible land area must be provided to allow the turtle to completely dry itself and bask (Darren Green 2000).

If outside a pond is used to house turtles all year round (Darren Green 2000). Pond liners are quite effective as the bare minimum however a concreted or fibreglass pond is more aesthetic. If practical a drainage system should be installed for easier maintenance of the enclosure. A wall should also be installed around the parameter of the pond high enough to prevent turtles from escaping and deep enough into the ground to prevent pests from entering (Darren Green 2000). A land area either around the pond or in the middle of the pond is required, as is access to it (Craig Latta 2005).

Water quality is a crucial factor to control when keeping Eastern Snake-Necked Turtles captive and should be monitored regularly. Turtles produce much more waste product than other species (i.e. fish) due to the high levels of ammonia and nitrate they excrete and the skin fragments and scutes they shed (Darren Green 2000). In order to maintain excellent water quality a filter should be installed accompanied by regular water changes. Testing pH should also be done using a standard pH testing kit (purchased from any pet shop) and adjusted to keep pH stable at approximately 7 (Darren Green 2000).

Eastern Snake-Necked Turtles also need to be exposed to light to ensure they receive essential UV waves that promote healthy conditions and growth. The photoperiod they are exposed to should reflect the current seasonal conditions. A standard UV light (timed or manual) ensures this and should be replaced annually due to diminishing effectiveness over time (Darren Green 2000). Position the UV tube no more than 30cm above the enclosure or it won't be effective. Craig Latta (2005) also recommends removing any glass/plastic mediums positioned under the lamp as these will filter out the UV potential. If outside access to both the sun and shade is required.

An indoor set-up is only recommended for the first few years when housing a turtle, after which it should be transferred into an outdoor pond (Michael Frith.pers.comm).

4.2 Holding Area Design

A plastic tub with a considerable depth (to prevent climbing out) is sufficient to hold a turtle for whatever reason. It is flexible enough to provide a turtle with all its essential needs temporarily and can easily be stored between uses. If left outside a mesh covering may be utilised to provide protection from predators/tormentors.

Figure 4:

An example of an outdoor pond enclosure constructed for turtles at Taronga Zoo. Note the cover provided by logs and shrubs as well as access to land. Also note multiple submerged areas for basking.

Image by Brendan Host

4.3 Spatial Requirements

An aquarium with dimensions 120cm x 60cm x 60cm is adequate to house two mature Eastern Snake-Necked Turtles and should allow them to easily swim past each other within the confinements of the space provided. If bumping does occur this is a sign of overcrowding and a larger tank or outside pond will be required.

If a pond is utilised it should be as large as possible and at least 50cm deep (Scott Thomson 2003). The minimum requirements of water area however are 100cm x 150cm for two adult specimens. An extra 100cm x 100cm is required per addition (John Weigel 1988).

The basking area should be large enough to accommodate for all specimens within the enclosure to be out of the water and sit comfortably on it at the same time (Darren Green 2000).

4.4 Position of Enclosures

Indoors the position of the enclosure isn't too important however if it can be placed in an area exposed to natural light it would be of benefit. It should not be placed in any area with regular loud noises, which would stress the animal and should also provide easy access to all aspects of animal/enclosure maintenance in accordance with OH&S.

If outside the enclosure should be positioned to face the northeast. This will expose the inhabitants to the early morning sun and thus the greatest photoperiod possible. It will also allow the turtles to warm up and become active sooner (Craig Latta 2005).

4.5 Weather Protection

Enclosure can be completely open with the following protective measures:

- Furniture must be implemented to provide shading from the sun and a dry area if shelter from rain is desired.
- An installed drainage system to remove excess water during periods of rain.

4.6 Temperature Requirements

As Eastern Snake-Necked Turtles are ectothermic heating both the air and water is essential. A submersible heater should be used to heat the water maintaining a constant temperature of between 24-26^{o}C (Darren Green 2000). The heater should also be protected to prevent burns, electrocution, abrasion and breakages (Darren Green 2000). If the water temperature drops too low (below 12^{o}C) the specimens will not be able to digest their food efficiently or stop eating all together.

A basking lamp ensures the air temperature is slightly warmer than that of the water and should radiate across the expanse of the tank providing varying degrees of warmth. This provides a suitable environment for the turtle to dry off and bask (Scott Thomson 2003). The globe should be between 40-150 watts and be positioned at least 30cm out of reach of the turtle to prevent burns (Darren Green 2000). It is a good idea to use a red or blue lamp for heating as these are essentially used for heating and will not interrupt with the turtles' day length cycle (reptiles do not pick up these colours in their visual spectrum so it appears dark).

4.7 Substrate

Clean aquarium gravel or **small** pond pebbles are suitable substrate for keeping this species in an indoor aquarium. It is not abrasive to the plastron and is manoeuvrable enough to allow the turtle to forage through it for food. These forms of substrate are easily removed for cleaning and hygiene purposes.

In an outside exhibit a mixture of sand and soil should be provided, and leaf litter if possible, around the pond. These serve as mediums to lay eggs in and hibernate (John Weigel 1988). Large pebbles and stones are not recommended as a substrate in this enclosure as they can cause abrasions (Craig Latta 2005).

4.8 Nest Boxes and/or Bedding Material

Nest boxes are not required. All that is necessary is an area of land filled with a mixture of sand and soil to lay eggs in.

4.9 Enclosure Furnishings

Besides heating/lighting equipment relating to the well being of the species, other furnishings can be implemented to make the enclosure more visually aesthetic and provide the turtles somewhere to retreat from public view. This can include plants, driftwood/logs, rocks or even terracotta pots/scenery. I personally use a terracotta log as a retreat area as it won't rot or promote growths within the enclosure (pers.obs). It is also important to be careful when using second hand terracotta pots or items due to substance build up i.e. salts/nitrates that could be harmful or affect the species health (Darren Green 2000). If implementing plants they must be non-toxic. Even though Eastern Snake-Necked Turtles are strictly carnivorous in striking to catch their prey they may consume some plant matter that may have an adverse affect their health (Darren Green 2000).

5. GENERAL HUSBANDRY

5.1 Hygiene and Cleaning

Filtration is the major means by which waste products are removed from the enclosure. This should also be accompanied by regular water changes as required with caution taken not to expose the turtle to rapid changes in water temperature. Depending on the substrate it should either be routinely changed (leaf litter) or simply washed routinely (gravel/pebbles). Enclosure furniture should be cleaned regularly and care should be taken when removing and reinstalling to ensure exhibit animals are not harmed. Chemicals are not required in this cleaning process however conditioning the water with algicides is encouraged. Ensure all electrical devices are turned off before any maintenance procedures are begun.

See Appendix VIII for 'Annual Cycle Of Maintenance Roster'

5.2 Record Keeping

Any daily observations should be recorded on a daily report that will later be collated and transferred into the institutions computer record system and ISIS (ARKS). This allows all zookeepers access to this information as required.

Any observations that are made regarding the turtles are marked on a cage card, which is situated close to the animal's enclosure and allows instant access to recent information without having to resort to the institutions database.

Whiteboards are utilised for data likely to change and are an effective communication tool between staff members regarding the upkeep of both exhibited animals and the institution.

See Appendix II for 'Daily Record Sheet' and relevant record criteria and codes

5.3 Methods of Identification

The most humane method to identify individual Eastern Snake-Necked Turtles is to become familiar with characteristics that distinguish the specimens in an enclosure from one another (Adam Skidmore.pers.comm). These should be recorded on the cage cards (and institutions database) for reference in the event of a casual keeper or someone inexperienced with the enclosures inhabitants. Installing a transponder chip is another method employed by institutions (Adam Skidmore.pers.comm). Scute notching is a possibility however is deemed cruel (Darren Green 2000).

5.4 Routine Data Collection

- Weight and measurements (carapace length/carapace width/head width)
- Faecal sample every six months for testing
- Egg mass periodically during incubation (possible study)
- pH weekly

6. FEEDING REQUIREMENTS

6.1 Captive Diet

A varied diet is essential to the well being of a turtle as many heath problems relating to Chelonians stems from a poor diet. For adults a typical feeding at Taronga Zoo usually consists of two fish (whitebait) per turtle of about head size. The point at which the specimen starts to slow up on its eating is a good indicator to stop feeding (Michael McFadden.pers.comm). This is substituted with pinkies, small yabbies, earthworms, molluscs, crickets, freshwater prawns with heads removed, mealworms, grasshoppers and cockroaches to ensure a balanced diet of vitamins/minerals (Michael McFadden.pers.comm). Feeding should occur 2-3 times a week and should not exceed 20 minutes in length with excess removed to maintain water quality (Darren Green 2000). Due to the suspicion that plant matter comprises a component of their wild diet it is recommended that species such as duckweed, azolla, nardoo, ribbonweed and water lilies are included in the make-up of the turtles enclosure (Craig Latta 2005).

Feeding schedules should be adjusted depending upon how active the turtle is. During their breeding season (September-October) chelonians should be provided with a larger proportion of food (Darren Green 2000). During winter this species tends to hibernate. Feeds should be halved/quartered as the temperature reduces to 16^{o}C and then stopped at 12^{o}C. This is to simulate the natural seasonal cycle the Eastern Snake-Neck would experience in the wild. As spring approaches this should be reversed back to a normal feeding cycle (Darren Green 2000). Observations of the turtles weight should be made over time so that diet can be altered if the turtle appears to be losing or gaining fat stores in an extreme manner (Darren Green 2000).

An emergency diet for Eastern Snaked-Necked Turtles can consist of dog/cat foods however long term use of such a diet can be detrimental to the health of the specimen. This is due to the fatty nature of such foods and incredibly unbalanced calcium to phosphorous ratio (Suzanne J. Hand et al 1995).

See Appendix III for examples of recipes prepared for freshwater turtles

Feeding Days	Monday	Wednesday	Friday

6.2 Supplements

A varied diet is the best way to ensure a chelonian is exposed to the greatest number of nutrients required for good health. Of these calcium, phosphorous and VIT.D_3 are probably the most important, with a 1-1.5:1 Ca to P ratio (Suzanne J. Hand et al 1995). Unfortunately with captive reptiles the calcium to phosphorous ratio is rather inadequate (Rep-Cal Research Labs 1999) and is demonstrated in the table below. For this reason a calcium and multivitamin supplement, such as Rep-Cal, should be mixed into food items prior to presentation. The Rep-Cal product is phosphorous free (to contain phosphorous would defeat the purpose of using the supplement in the first place – see table) and can be purchased from most pet care suppliers. As turtles live in an aquatic environment administering supplements can be quite difficult. Gutloading food items such as crickets a day prior or mixing the supplement into pre-prepared meat mixes are effective ways of ensuring this essential dietary component is administered. Calcium blocks may also be placed in the water as an added measure. Skim milk powder can be used as a substitute for crickets to gutload if supplement powder stocks are exhausted (Jacki Salkeld.pers.comm).

Calcium : Phosphorous ratio for specific food items

Dietary Constituent	Calcium : Phosphorous
Crickets	0.13:1
Meal Worms	0.06:1
Wax Worms	0.08:1
Pinky Mice	0.89:1
Meat	1:30
Liver	1:50

(Rep-Cal Research Labs 1999, Suzanne J. Hand et al 1995)

6.3 Presentation of Food

Food should be presented to the turtles by throwing it into the water in the vicinity of a turtle's head, defrosted and rinsed (Michael McFadden.pers.comm). By throwing it to individual turtles this allows the amount of food consumed by each turtle to be monitored and ensures each turtle receives a relatively equal fill (Michael McFadden.pers.comm). The food **must** be presented to turtles in the water so as to allow more fluent swallowing (Darren Green 2000). Craig Latta (2005) recommends feeding during the mid-morning or mid-afternoon to coincide with the increased activity of the species at these times. It is also possible to condition these animals to except food from forceps and presents another method to monitor food consumption. Due to the extremely messy nature of Chelonians feeding habits it is recommended, if water quality is a concern, to remove them from their enclosure and feed them in separate holding containers (Suzanne J. Hand et al 1995). Scattering small food items such as mealworms is an enrichment that will allow the turtles to forage; subsequently this will require water changes to occur more regularly.

See Appendix IV for live food and aquatic plant supplier details.

7. HANDLING AND TRANSPORT

7.1 Timing of Capture and Handling

When capturing and handling Eastern Snake-Necked Turtles there isn’t really a specific time that is preferred, however since these turtles are diurnal one would suppose that during the day would probably be less stressful for the animal (Michael McFadden.pers.comm). If done during the cool of the day these animals will also be less active. Handle before feeding.

7.2 Capture and Restraint Techniques

Generally chelonians are relatively simple to capture and can be done so easily using ones hands. If an enclosure has a relatively deep pond quite often these turtles have been conditioned to expect food. Once they realise the doors to their exhibit have been opened they usually surface. In these cases the turtle is easily within hands reach. If this does not occur a net can be used to scoop up the turtle (Michael McFadden.pers.comm). Plastic containers are also useful as holding bins.

Techniques that are used to restrain these turtles include:

- Firmly holding the turtle shell with both hands positioned between the limbs,
- Firmly holding the turtle shell so that ones fingers are under the plastron and the thumb positioned above the carapace between the hind limbs, or
- Gently force out a hind limb and clasp it in your palm with your fourth and fifth finger whilst supporting the plastron with your middle and index finger and carapace with your thumb (Michael McFadden.pers.comm).

Image by Brendan Host

Figure 5: Technique #2

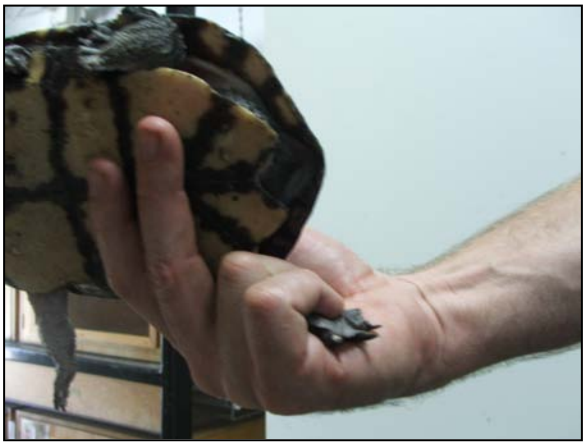

Image by Brendan Host

Figure 6: Technique #3

As chelonians claws are sharp they can inflict moderate scratches and so gloves may be worn as an extra precaution if required. It is most important that when handling a turtle a firm grip is applied. Turtles when handled are prone to squirm in ones hands and become difficult to manage, in some cases falling to the ground. This is most detrimental as it can result in a cracked shell and lead to many health problems.

7.3 Weighing and Examination

Eastern Snake-Necked Turtles can be weighed in a plastic container on scales. Turtles should not be left unattended, as they are capable of wondering off and potentially injuring themselves. The weight of the specimen can be recorded in grams and kilograms. Recordings can be taken of the carapace length, carapace width and/or head width using callipers or a tape measure. Ensure you **do not** place any pressure on the animal when measuring its dimensions using verniers callipers.

Image by Josh Hawkey

Figure 7: Weighing

Image by Josh Hawkey

Figure 8: Head Width

Image by Josh Hawkey

Figure 9: Carapace Length

Image by Josh Hawkey

Figure 10: Carapace Width

7.4 Release

When releasing turtles back into exhibits time of day isn’t of much importance, however if the turtle is being relocated or has been removed from its enclosure for some time, releasing the animal at night could be quite stressful (Michael McFadden.pers.comm). As this species is diurnal releasing it in the early morning would probably be more suitable as it will allow the maximum amount of time for the species to adjust itself to its new surroundings (Erna Walraven 1990).

7.5 Transport Requirements

7.5.1 Box Design

Transport boxes can be constructed from a number of rigid materials including wood, hardboard and expanded polystyrene (CITES [Unknown]) with caution taken to ensure that the materials haven't been treated with any chemicals that might adversely affect the chelonian housed inside (ARAZPA 2005). The dimensions of the box will vary according to how many specimens are to be transported and their size. As a general rule the inner compartment of the transport must be large enough for each specimen to lie naturally without 'stacking' occurring, that is without one animal lying on top of another. Minimising available moving space for transported specimens will reduce the risk of injury (ARAZPA 2005).

The transport box should have a solid base, no sharp edges on the inside, be leak proof and allow easy inspection of the animals within. In addition to this, ventilation holes must be provided on at least three sides of the container with metal strips running along them, but not hindering them, and wire mesh covering them. This is to ensure that these ventilation holes are not blocked if pushed up against another flat surface (ARAZPA 2005).

To assist delivery and ensure animals are transported as efficiently as possible the box should be labelled with name, address and contact number of both receiver and sender. Common and scientific name and species numbers should also be made evident. Labels' indicating a live animal is within the crate, which way it should stand and directions as to where it would be appropriate to leave the transport box to sit would all help to reduce the levels of stress the enclosed animals might be subject to (ARAZPA 2005). Including the date reptiles were packed and their preferred ambient temperature would also be beneficial (CITES [Unknown]).

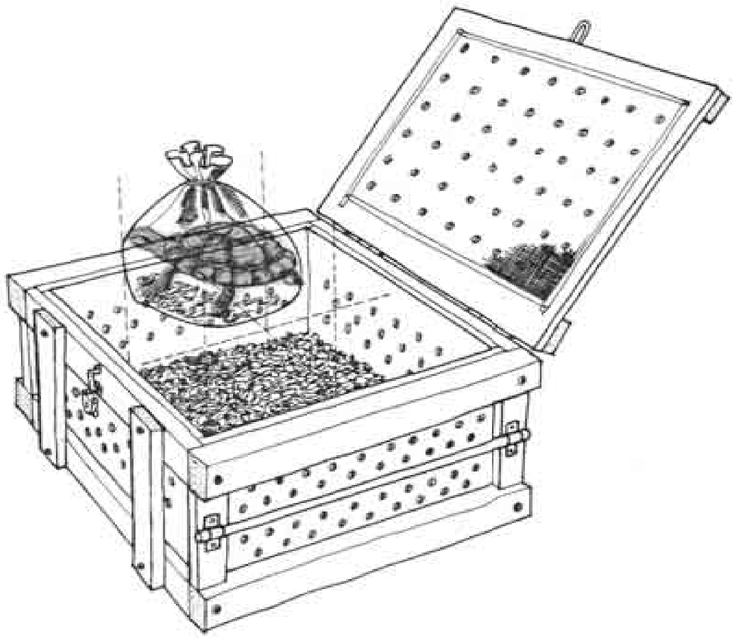

Figure 11: Transport Box Design for Aquatic Turtle Species (CITES [Unknown])

7.5.2 Furnishings

Eastern Snake-Necked Turtles can be either placed in moistened open-weave material bags (important as moistened cotton bags could lead to suffocation) or plastic containers. Suitable bedding material should be supplied around these furnishings to absorb moisture, reduce movement and limit the effect of external temperatures on the ectothermic animal. Shredded paper would be appropriate (ARAZPA 2005). If a temperature extreme is expected a chunk of ice in a leak proof bag can be enclosed, but not allowed to come into contact with the transported specimen, if it is to be a warm extreme, or a heat pack (same principle) if it is to be a cool extreme (ARAZPA 2005).

7.5.3 Water and Food

In preparation of transportation these chelonians, like all animals being prepared for transport, should not be fed for at least 48 hours prior to departure. No food should be shipped with the animals either. It is imperative that transported animals are well hydrated (ARAZPA 2005).

7.5.4 Animals per Box

Multiple Eastern Snake-Necked Turtles can be transported in a single bag within a transportation container. They may also be housed with other species so long as each species is confined to different compartments of the crate. Any specimen over 30cm in length should be assigned its own bag (ARAZPA 2005). Specimens should not be anaesthetised during transportation.

7.5.5 Timing of Transportation

For reptiles the ideal temperature for transportation is between 18-24^{o}C. If this cannot be maintained i.e. due to weather extremities, transportation should be delayed (ARAZPA 2005). If this poses a problem methods of manipulating the internal temperature of transportation boxes can be employed and are discussed above.

7.5.6 Release from Box

Chelonians do not require any acclimatisation to new exhibits as long as the enclosure is fully set-up and functional (Michael McFadden.pers.comm). Quarantine is required once received and depends upon the specific cargos circumstances. All packaging material should be destroyed following use and container thoroughly cleaned and disinfected both after and prior to use (CITES [Unknown]).

8. HEALTH REQUIREMENTS

8.1 Daily Health Checks

- Free movement of limbs and all anatomy in tack i.e. retainment of set claws and ability to raise and hold head and limbs off ground
- Feeding (Appetite) – *Refusal of food often an indicator of inappropriate environmental conditions or ailment (Darren Green 2000)*
- Eyes clear and completely open – *Swollen eyes are an indicator of dirty enclosure conditions (John Cann 1998) whilst eyelids completely closed over are an indicator of Vitamin A deficiency (Craig Latta 2005)*
- Appearance – check for lesions, skin/shell condition and discolouration, abscesses
- Discharges (Nasal/Cloacal) – *nasal discharges usually an indicator of respiratory problems such as pneumonia (Aleyshia Manning 2001) whilst cloacal discharges usually an indicator of diarrhoea (Craig Latta 2005).*
- Behavioural changes such as lethargy or escape attempt. Should appear alert.
- Physiological changes such as wheezing (very distinct sound), sneezing, blowing bubbles, mouth gaping or buoyancy problems (Aleyshia Manning 2001)

Structured on S. Jackson's 'Standardising Captive Management Manuals Guidelines'

8.2 Detailed Physical Examination

There is no proof that lowering the body temperature of a turtle (or any reptile) renders it immune to pain and can risk possible infection, neurologic injury or death (Aleyshia Manning 2001). **Not** recommended, especially for surgery.

8.2.1 Chemical Restraint

Chelonians can be anaesthetised using inhalation gases. This is often a prolonged procedure though as they can hold their breath for a remarkably long time (Bonnie Ballard, Ryan Cheek 2003). By moving the limbs of the patient in and out the anaesthetisation rate can be increased as ventilation to the lungs is enhanced (Bonnie Ballard, Ryan Cheek 2003). Intramuscular and intravenous routes may be used to administer an induction agent (Bonnie Ballard, Ryan Cheek 2003). Halothane is commonly used as a gaseous anaesthesia and Ketamine as an injectable alternate (Aleyshia Manning 2001). Isoflurane and sevoflurane are other inhalants that can be used to maintain anaesthesia (Bonnie Ballard, Ryan Cheek 2003).

Ensure all patients being administered an anaesthetising agent are not feed for 24-48 hours prior to procedure, are well hydrated prior to procedure and operated upon in their preferred temperature range. Full stomachs can lead to compression of the lungs and regurgitation (Andrew Tribe, Derek Spielman 1996). Ballard and Cheek recommend slightly elevating ambient temperature of turtle to assist in recovery.

8.2.2 Physical Restraint

When physically restraining a turtle it is important to remember that its stress levels will elevate the greater you handle it. If performing a physical examination most turtles will not struggle if their eyes are covered or head withdrawn (Murray Fowler, Eric Miller 2003). If access to limbs or head is required these can be extended by gently applying pressure behind the turtles neck (Bonnie Ballard, Ryan Cheek 2003). Force does not need to be excessive, gentle pressure and patience will prevail (Jacki Salkeld.pers.comm). Once the head is extended a firm grip behind the turtle's head will prevent retraction (Bonnie Ballard, Ryan Cheek 2003). This same technique can be employed in the extraction of limbs (Bonnie Ballard, Ryan Cheek 2003). Getting a person to assist makes this process much easier. Wrapping a towel around the shell will protect examiners from scratches if the turtle flails around (Bonnie Ballard, Ryan Cheek 2003). Ensure the limbs are retracted before doing so.

Take care not to rotate the patient upside down and then back again too fast as it will result in stress induced bowel movements (Bonnie Ballard, Ryan Cheek 2003).

8.3 Routine Treatments

No routine treatments are administered to freshwater turtles. Medications are instead delivered as observed necessary (Michael McFadden.pers.comm).

DO NOT START ANY FORM OF MEDICAL TREATMENT WITHOUT CONSULTING YOUR VET FIRST

NEVER USE IVERMECTIN AS A WORMING AGENT AS IT IS TOXIC TO TURTLES

8.4 Known Health Problems

BACTERIAL

RESPIRATORY INFECTIONS (PNEUMONIA):

Cause: Poor husbandry such as inferior diet, poor hygiene, cold conditions (Darren Green 2000) and sudden changes in ambient temperature (Aleyshia Manning 2001). Vitamin A deficiency may attribute to this ailment (Aleyshia Manning 2001).

Signs: Inappetence, drooping of head, inflation of throat region, lack of alertness in eyes (John Cann 1998), lethargy, distinct nasal discharges, wheezing when surfacing to breathe (Darren Green 2000), blowing bubbles and mouth gaping (Aleyshia Manning 2001). **Turtles with respiratory infections cannot dive and swim on uncharacteristic angles** (Craig Latta 2005).

Treatment: Enrofloxacin [injectable antibiotic solution] administered at 2.5mg/kg every five days by a veterinarian until signs disappear (Craig Latta 2005). After treatment place turtle in quarantine for a few days to observe recovery. If signs do not alleviate can self-administer a course of Terramycin#50™ [soluble antibiotic/antifungal powder]. Do so by placing the ill turtle in a separate dry container under a heat source for approximately 15 minutes to ensure the turtle becomes thirsty. Then place the turtle into a container filled with 20g of Terramycin per litre of water. Leave patient in tub for another 15 minutes to allow the turtle to drink and take in the medication. Complete procedure by removing the turtle and placing it in its original holding container for an hour (remove from heat source) and then return it to its enclosure thereafter. Repeat for the next three days (John Cann 1998). If detected early enough daily injections of Chloromycetin Succinatine for seven days is an alternative treatment (John Cann 1998).

Prevention: Improved husbandry – ensure a constant temperature between the range of 22°C to 26°C is maintained. Vary diet and feed animal in a separate container if possible to minimise water contamination. The addition of liver once a month will ensure Vitamin A is included in the diet. Establish a general cycle of maintenance activities and keep to it.

NECROTIC DERMATITIS:

Cause: Lesions to turtles skin can be caused by moving over a sharp/rough surface or inflicted by another turtle. Bacteria within the water can then enter the body and cause an infection. Predisposing factors include stress and a low immunity (Craig Latta 2005).

Signs: Green/yellow discolouration of infected area. Area can be seen rotting away until it eventually starts weeping blood (Craig Latta 2005).

Treatment: Consult your vet immediately. Chloramphenicol Antibiotic should be injected daily [IM/SC] at dosage rate of 40mg/kg until recovery observed (Craig Latta 2005). Debriding of skin and appliance of Iodine [diluted at 1:10] will also aid recovery (Craig Latta 2005). Whilst being treated quarantine animal and only expose it to water for no more than one hour a day to rehydrate (Craig Latta 2005).

Prevention: Remove/smooth any abrasive surfaces or furniture within the exhibit. Ensure regular water changes and treatment as part of cycle of maintenance activities. Feeding of turtles in a separate container will limit bacteria levels within enclosure.

OSTEOMYELITIS OF THE SHELL (SHELL ROT):

Cause: Abrasion to shell, usually plastron, can be caused by moving over a rough surface (John Weigel 1988). Anaerobic bacteria within the water can then enter the shell and cause an infection (Craig Latta 2005).

Signs: Superficial bleeding and decay of infected area with easy removal of infected scutes from healthy shell below by scraping (John Weigel 1988). Large yellow ulcers are a typical indication of ‘shell rot’ (John Weigel 1988).

Treatment: The longer this ailment goes without medicated treatment the larger the abrasion will expand to and the deeper it will become. If left untreated this bacterial decay will eventually form a perforation of the flesh resulting in the turtle’s death (John Weigel 1988). Debride dead tissue and clean area with either Iodine or Betadine twice daily. Rinse area with water and then quarantine animal in a dry area until recovered. Expose to water once daily for drinking. **Quarantine is absolutely necessary due to the contagious nature of the ailment**. Ensure that quarantine area is well ventilated, as fresh air will assist in treatment due to anaerobic bacteria being cause of infection (Craig Latta 2005).

Prevention: Remove/smooth any abrasive surfaces or furniture within the exhibit. Ensure regular water changes and treatment as part of cycle of maintenance activities. Feeding of turtles in a separate container will limit bacteria levels within enclosure. Instalment of an air pump will increase flow of oxygen within water.

FUNGAL

FUNGAL DISEASE:

Cause: Fungal agents within the enclosure. Usually restricted to indoor-housed specimens who lack exposure to sunlight (Craig Latta 2005).

Signs: Appearance of grey/yellow patches around claws/eyes that later appear on other parts of turtles anatomy eg. feet, tail and upper neck (John Cann 1998). Lethargy, motionless floating, swelling of feet and claw loss are other indicators (Darren Green 2000).

Treatment: John Cann recommends coating the affected area with Tinaderm™ or Mecurochrome™ or a 60% diluted alcohol solution. Craig Latta recommends coating area with Betadine or Iodine ointment. After treatment quarantine animal in dry area for up to twelve hours repeating two to three times daily (John Cann 1998, Craig Latta 2005).

Prevention: Add fungal treatments to water periodically (as specified by brand of treatment). Such products include Algicide by Aquasonic and Fungus-Adea by Wardley. Regular water changes will also assist, as will exposure to a medium of UV light. Fungal infections appearing around the feet, tail and upper neck of individuals is usually due to lesions inflicted by other turtles, sometimes in an effort to establish territories. The installation of additional retreat/hiding areas will minimise fungal disease resulting from this behaviour (John Cann 1998).

ENVIRONMENTAL

OSTEODYSTROPHY (SOFT SHELL):

Cause: Lack of calcium and exposure to UV light (Aleyshia Manning 2001).

Signs: Soft shells, deformed bones and swollen limbs (Aleyshia Manning 2001). Condition very common in neonates and can lead to death. The shells of neonates usually harden within two weeks. If this does not occur osteodystrophy is likely (Craig Latta 2005).

Treatment: Add Calcium Lactate to the water or simply a block of plaster-of-paris (John Cann 1998). The further a case has developed the less chance there is of recovery (Aleyshia Manning 2001). Increase exposure to UV light.

Prevention: Ensure an adequate supply of UV is provided (30cm above housed specimens) and if using a UV light replace it annually (Aleyshia Manning 2001). A varied diet should provide the turtle with the correct Ca to P balance and calcium/vitamin supplements should be administered. Calcium water conditioning blocks replaced regularly can also assist (Craig Latta 2005). Outside sunning periods also good.

NUTRITIONAL

SWOLLEN EYES:

Cause: If eyes are puffy cause is likely due to being confined to unsanitary conditions or a sudden drop in temperature. Puffy eyes can also be the result of reviving from hibernation (John Cann 1998). However if eyes are completely closed over this is much more serious and is probably due to a deficiency of Vitamin A in the diet (Craig Latta 2005).

Signs: Swelling of eyes or eyelids completely closed over causing recoverable blindness. Swelling of Harderian and Lycrymal glands may also be observed (Craig Latta 2005).

Treatment: Puffy eyes can be treated with an all round antibiotic such as Terramycin#50™ followed by a drying off period of 24 hours (John Cann 1998). This procedure should be repeated every few days till resolved. However if Vitamin A deficiency is believed to be the cause of the condition an injection of Vitamin A by a veterinarian will be required (Craig Latta 2005). This should be administered intra-muscularly once a week for two weeks (Aleyshia Manning 2001).

Prevention: Improved husbandry including regular water changes, pH tests and careful monitoring of temperatures to maintain a temperature of between 22°C to 26°C. Feeding turtles in a separate container will also assist is maintaining high water quality. If Vitamin A deficiency is the major concern provide liver once/twice monthly as part of diet (Aleyshia Manning 2001).

IODINE DEFICIENCY:

Cause: Provision of a limited or repetitive diet (Aleyshia Manning 2001).

Signs: Inappetence, lethargy and swelling of the thyroid gland resulting in a goitre (Aleyshia Manning 2001).

Treatment: Prepare a solution of 1g Potassium Iodide to 7ml of water. Then apply 1-5 drops of this solution to recipient's food twice weekly until conditions recede (Aleyshia Manning 2001).

Prevention: Ensure a natural varied diet is provided. See **Chapter 6 Feeding Requirements**.

PARASITES

ECTOPARASITES:

Species: Leeches and Mites (Most common)

Cause: Introduced into collection specimens via outside factors such as infested individuals, plant material or furniture. Outside enclosure might suffer natural invasion.

Signs: Visible to the naked eye. Cause little discomfort to the animal. Exception is when large numbers of parasite is present and can result in death (John Cann 1998). Leeches in particular will attack the eyes, body, carapace, inside of mouth and throat (John Cann 1998).

Treatment: Can either place the infected turtle in a salty water solution until parasitic infestation drops off (Craig Latta 2005) or dab infested areas with alcohol (John Cann 1998). Kerosene as an alcohol solution should not be used as will create an oily layer over the water surface when the turtle is returned to its enclosure. This can lead to respiratory problems (John Cann 1998).

Prevention: Quarantine any new acquisition as per **8.5 Quarantine**. When providing new plant material or furniture inspect and disinfect before installation. Periodic substrate changes will prevent a build up of the parasite in enclosure soils.

ENDOPARASITES:

Species: Red Nematode Worm and White Ringworm (Most common)

Cause: Introduced into collection specimens via outside factors such as infested individuals or outside bought foods (John Weigel 1988).

Signs: Severe weight loss, lethargy, developmental pause (Darren Green 2000), pneumonia, enteritis, gastrointestinal blockages (Murray Fowler, Eric Miller 2003) and **presence of worms wriggling on bottom of quarantine bays** (Craig Latta 2005). Can be tested by vet using faecal smears (Darren Green 2000).

Treatment: Veterinarian can administer Panacur at a dosage of 25mg/kg every 2 weeks for 8 (Craig Latta 2005). Adult turtles may be administered 1g Santonin and 1g Calomel, supplemented by an eyedropper full of castor oil the following day. Piperazine citrate diluted at 50mg/kg is an alternate treatment, repeated after a fortnight (John Cann 1998).

Prevention: Quarantine any new acquisition as per **8.5 Quarantine**. Purchase foods from reputable suppliers or self cultivate. Practice proper husbandry and ensure enclosure guidelines outlined in **Chapter 4** are met.

INJURIES

Any scratches or bites can simply be debrided and topically treated daily with a Betadine or Iodine solution (Craig Latta 2005). This should be followed by isolation in a dry container for an hour prior to release back into enclosure. If stitches are required contact a vet (Darren Green 2000).

ABSCESSES:

Cause: Infection of a wound, usually on the ventral part of the body, that is incurred from passing over an abrasive surface (John Cann 1998, Darren Green 2000).

Signs: A hard lump forms underneath the skin, essentially pus and dead rotted flesh. It can form growth rings of grey, white or yellow colouration and is of a texture similar to cooked chicken (Darren Green 2000). Inflammation of area may also be seen.

Treatment: Veterinary assistance will be required to cut out and remove the abscess, as well as clean the infected area (Darren Green 2000). A course of antibiotics will also need to be supplied with the turtle isolated in a dry container until completely healed (Darren Green 2000).

Prevention: Ensure you treat any bites, scratches or lesions with an antibiotic treatment as soon as noticed (John Cann 1998). Betadine or Iodine solutions are adequate (Craig Latta 2005). Following treatment isolate turtle in a dry container for a day prior to release back into enclosure. Isolate for as long as required (John Cann 1998).

CRACKED SHELLS:

Cause: Dropped, falling or having an object fall onto the turtle. In the wild many cracked shells are the results of being run-over (John Weigel 1988).

Signs: Fractures evident in shell (John Weigel 1988).

Treatment: Scrub off any algae or dirt using a cotton bud or toothbrush and methylated spirits, exercising extreme care to not allow the alcohol to enter the exposed wound or inflame it by scrubbing too hard (Darren Green 2000). The shell can then be glued together using superglue or reconstructed with fibreglass (John Weigel 1988). Darren Green (2000) also suggests using 5-minute epoxy resin such as Araldite to achieve a similar effect. Antibiotics will be required. Dehydration may have resulted, proceed will fluid therapy (Erna Walraven 1990).

Prevention: Care when handling and careful assessment of enclosure to ensure no objects are loose or capable of causing this rather serious injury.

ACCIDENTAL DROWNING:

Cause: Usually occurs when juveniles are housed in an enclosure with an excessive depth of water (Craig Latta 2005). Objects within an enclosure may also act as traps preventing the turtle to surface for breathing.

Signs: Apparent death (Craig Latta 2005).

Treatment: The heart of a turtle will continue to beat post-drowning for a number of hours (Craig Latta 2005). It can still be resuscitated! Hold the turtle between your legs using both hands and supporting the neck with your fingers. Face the head downwards and slowly rock the turtle side-to-side. This will drain any water out of the lungs (Craig Latta 2005). If the turtle does not resuscitate air should be blown into the mouth of the turtle (Craig Latta 2005). Use your fingers to open the mouth and then softly blow till you can clearly see the limb pockets inflate. Allow air to retreat and continue until resuscitated (Craig Latta 2005). If you require assistance take the turtle to the vet immediately. A drowned turtle, even if resuscitated, should still be taken to the vet for treatment and monitoring, as it will most likely be in a critical condition (Craig Latta 2005).

Prevention: Gradually wean neonates onto deeper water volumes. This is a judgement of how strong the turtle appears to be and monitor its activity at the new depth regularly for the initial few hours. Also ensure the enclosure it will be housed in is trap proof and provides an area to completely remove itself.

8.5 Quarantine

Any new acquisitions should be quarantined before placing them into an enclosure with collection specimens, especially if they come from the wild. This period should last for at least three weeks (Craig Latta 2005). In a zoological institution three consecutive faecal tests must show negative for parasitic infestations and/or disease (Jacki Salkeld.pers.comm). Treat acquisitions with a solution of Bactonex in the ratio of 10ml per 40L of water (Craig Latta 2005). Bactonex is an 'Aquasonic' product (Craig Latta 2005). During this time you are looking for signs of parasites, illness or disease and should medicate accordingly. The Bactonex mixture should be changed daily (Craig Latta 2005).

9. BEHAVIOUR

9.1 Activity

C.longicollis is a diurnal, ectothermic species; therefore activity is based upon the ambient temperature. During the early morning this species will typically be inactive and rely on the warmth of the sun to speed up its bodily functioning, it does this by basking. Periods of high activity are mid-morning and mid-afternoon as the noon sun can be a deterrent to the turtles and they will look for shelter (Craig Latta 2005).

Seasonality also affects turtle activity as ambient temperatures change. During winter water temperatures begin to drop, as does turtle activity. As the water temperature drops to around $16^{o}C$ feeding and activity will slow and below $12^{o}C$ the turtle is likely to have stopped feeding all together and entered a state of torpor (Darren Green 2000). As spring approaches this activity pattern is reversed (Darren Green 2000). In the wild turtles may also go into a state of dormancy during the hotter, drier periods of the year, this is called aestivation (Darren Green 2000). In captivity this isn't recommended and can be a sign of inadequacy in enclosure design (Darren Green 2000). This species is therefore most active in spring.

Foraging or 'sit-and-wait' are techniques employed by *C.longicollis* to hunt food, this behaviour comprising a large component of their activity budget (Leah Parker 1999). They are known to lie concealed at the bottom of water bodies and then strike out at prey as it passes by. This involves completely opening their mouth and sucking the prey in (Darren Green 2000). Food is swallowed whole however the turtle may shred it with its claws to make the item easier to go down.

9.2 Social Behaviour

Turtles are not gregarious animals, however, this does not mean that they won't gravitate to the same area or engage in aggressive displays when in confined areas. The only time *C.longicollis* is likely to show interest in others of the same species is during breeding season and is otherwise unperturbed by the presence of others (Michael Frith.pes.comm). Territoriality is sometimes observed though (John Cann 1998). Head bobbing is also observed in this species and John Legler and Arthur Georges (1985) assume this to be a form of communication. In captivity turtles can be trained to exhibit specific head bobbing behaviours in response to a person passing their enclosure or waving their fingers (John Legler, Arthur Georges 1985).

9.3 Reproductive Behaviour

Reproductive behaviours and mating take place during the day (Raymond Hoser 1982) and begins with a male approaching a female and gravitating to her cloaca to smell; this is sex recognition (Craig Latta 2005). Before mating commences the male will partake in various displays to see if the female is receptive. These include forms of aggression, such as biting on the neck and limbs, and fanning of the females face using their forelimbs as they swim backwards (Craig Latta 2005). Leah Parker (1999) has also observed head bobbing to occur between sexes prior to mating.

If the female is receptive the male will then mount the female, similarly to a dog (Raymond Hoser 1982). All mating activities occur in the water and have never been observed on land (Raymond Hoser 1982). Once mounted the male will hold onto the females carapace using his claws and 'lock' his feet into her by placing them between the carapace and plastron on both sides of the cloaca and turning them sideways (Craig Latta 2005). The male will then proceed to rub the female with his claws to ensure the females still receptive (Craig Latta 2005). If so, the male will release his hold of the female's carapace and swim vertically for up to 20 minutes to copulate (Craig Latta 2005). Once mating is over the male will swim away.

9.4 Bathing

As Eastern Snake-Necked Turtles are an aquatic species of turtle they spend most of their life 'bathing'. In the case of freshwater turtles they require a medium to exit the water and completely dry off if they wish, such as submerged rock or log.

9.5 Behavioural Problems

Problems associated with *C.longicollis* include:

- Biting of neck or limbs or chasing of other turtles it is housed with. This is due to turtle's trying to establish a territory within the enclosure and can easily be countered by providing extra hiding places (John Cann 1998). If not managed this can lead to health issues such as bacterial and fungal infection via bites.

- Whilst more a comical antic rather than a behavioural problem, freshwater turtles may adopt the habit of biting a feeders fingers. This is because the turtle has become tame and sees the feeder as a food source (Michael Frith.pers.comm). This behaviour generally arises if the specimen is hand fed (Michael Frith.pers.comm).

9.6 Signs of Stress

Indicators of stress include:

- Inappetence
- Prolonged habituation of hiding areas
- Predator defence behaviours; tucking the head and limbs into the shell and tilting the shell towards an offender (Leah Parker 1999)
- Expulsion of eggs by gravid females in a water source (Darren Green 2000)
- Secretion of an odorous fluid (John Cann 1998); not common in captivity
- Bowel movements when handling

Excessive handling can contribute to stress levels (Scott Thomson 2003).

9.7 Behavioural Enrichment

Enrichment that may be employed to stimulate natural behaviours in *C.longicollis* include:

- Adding extra substrate to allow for hibernation/aestivation displays
- Ensure pond is as large as possible
- Fitting submerged rocks and logs for basking
- Install various retreats or construct natural boundaries within the exhibit so territories can be established and defended
- Vary food and feeding schedules
- Reduce food proportions but supply the same quantity of food
- Introduce a stabilised population of mosquito fish for chasing and dietary enrichment
- Scatter small prey items for foraging (will require increased water changes)
- Construct and install delayed food dispensers (Adam Beadsmoore 2006)
- House with other specimens to simulate competition behaviour during feeds (monitor turtles if choosing this enrichment and aim to feed in separate areas)
- Provide frozen blocks of fish for tearing apart
- Provide larger feed items for tearing apart (Jacki Salkeld.pers.comm)
- House with/feed out small live crayfish/yabbies (Invertebrate species)
- Swap animals over between enclosures to provide new areas to explore
- Install running water systems or water jets for locomotion activities
- Simulate environmental conditions i.e. rain (Jacki Salkeld.pers.comm)

Figure 12:

A delayed food dispenser designed and constructed by Adam Beadsmoore. It is essentially a piece of piping with holes drilled along the base for prey items to gradually crawl out of. The turtle can then spend hours siting and waiting for its food rather than consuming it all in a matter of minutes.

Image Courtesy of Adam Beadsmoore

9.8 Introductions and Removals

As this species is not gregarious and indifferent about whom it is housed with no introduction or removal periods/procedures are necessary. However I would recommend any introductions or removals to take place early in the day so they have the maximum amount of time to adjust to new surroundings. Craig Latta (pers.comm.) does not recommend introducing any specimen less than 70mm into an enclosure with fully developed adults.

9.9 Intraspecific Compatibility

Eastern Snake-Necked Turtles are quite compatible, and as detailed in **9.2 Social Behaviour**, generally do not invest in intraspecific combat. Many turtle enthusiasts recommend not to house turtles of significantly differing sizes together, out of safety concerns of the smaller individual; whether it be enclosure design concerns or intraspecific due to aggressive feeding (John Cann 1998). Raymond Hoser (1982) has successfully done so though.

9.10 Interspecific Compatibility

It is possible to include *C.longicollis* in mixed exhibits provided the turtle is of appropriate size. This depends upon mixed specimen species and size. You would not for instance house a neonate with a fully developed agamete due to predation concerns. I have seen this species housed with other turtle species, snakes, lizards, birds and even primates. Refuge points should be implement for retreat if required or stressed.

In the wild studies by Legler (1978) have found that these turtles can co-exist in the same water body as other species, each inhabiting a separate niche. He recorded *C.longicollis* was found in the deepest level, *C.expansa* in the top vegetated layer and *E.Macquarie* in the middle (Harold Heatwole, Janet Taylor 1987).

9.11 Suitability to Captivity

This species adjusts almost immediately to captivity (John Weigel 1988) and is well suited as its natural environment can be easily provided or simulated if need be. They tame fairly easily and once they recognise humans as a food source readily show themselves upon being approached.

10. BREEDING

10.1 Mating System

C.longicollis is a polygynous species when conditions allow. This is highlighted by the fact this species is capable of laying double clutches, the second clutch most likely from another partner (Michael Frith.pers.comm). In a captive situation they would be monogamous if paired and enclosed exclusively together. This would not be the case in the wild (Michael Frith.pers.comm). Craig Latta and associate are both sceptical about the occurrence of double clutches in this species (Craig Latta.pers.obs).

10.2 Ease of Breeding

It is relatively easy to breed *C.longicollis* in captivity, with much greater success achieved when this process is allowed to occur in an outside enclosure, as it is exposed to the natural environment and cues that would normally initiate copulation (Darren Green 2000). However if the seasonal cycle of where they are housed does not resemble their natural habitual cycle, indoor housing and environmental manipulation may need to be employed.

In the wild natural cues to simulate breeding include:

- Gradual drop in temperature to below 12^{o}C in winter followed by gradual increase in spring.
- Decrease photoperiod during winter followed by an increased photoperiod in spring/summer.
- Ovulation stimulated by greater availability of food in spring (John Legler, Arthur Georges 1985)

Mating will occur subsequent to this cycle (Darren Green 2000). Therefore the extent both heat and light are provided in an exhibit should reflect this natural cycle. As should levels and composition of foods provided.

Other techniques that can be employed to promote breeding include the separation of sexes prior to the breeding season and use of multiple males. By leaving prospective couples together for extended periods both parties may loose interest in one another, or, excessive mating may occur when the female is not ready resulting in the male not wanting to copulate when the female is receptive (John Weigel 1988). By introducing multiple males you are reducing the chance of incompatibility between a breeding pair. This also encourages competition between males, which reflects natural behaviours (John Weigel 1988). If this aggressive behaviour is prolonged remove additional males.

10.3 Reproductive Condition

Palpation can be used to determine if a female is gravid. This technique involves carefully feeling around the hind limbs of the specimen to feel for eggs. The presence of eggs can also be determined by x-rays or ultrasounds (Darren Green 2000).

10.4 Techniques Used to Control Breeding

The most effective way to control breeding in this species is to separate the sexes. When first separating the sexes (permanent or temporary) you are not guaranteed a lack of gravid turtles down the line, as females are able to withhold sperm from males, to produce eggs at a later date in the event of optimum conditions (Oliver Roempp 2003). In this scenario or the case of a mixed sex enclosure eggs can simply be destroyed (Adam Skidmore.pers.comm). If space is an issue a mixed enclosure is preferable with eggs removed and destroyed. As the reproductive cycle of this species is stimulated by environmental cues eliminating these cues should also prevent breeding.

10.5 Occurrence of Hybrids

Styx River Hybrid:

Chelodina longicollis x *Chelodina canni*

Eastern Snake Necked Turtle x Cann's Snake Necked Turtle

Hybrid occurs on the coastal plains of central Queensland where the species co-habituate. Species freely interbreed with resulting young displaying random mixtures of characteristics (John Cann, Marc Dorse, Arthur Georges [Date Unknown]).

Thomson Hybrid (Scott Thomson.pers.comm):

Chelodina longicollis x *Emydura subglobosa*

Eastern Snake Necked Turtle x Red-Bellied Short Necked Turtle

Occurred unplanned in captivity. Resulted in spinal deformities from mixing of species characteristics (Scott Thomson.pers.comm).

10.6 Timing of Breeding

Eastern Snake Necked Turtles are seasonal breeders. Breeding behaviours begin in September/October of each year following winter hibernation (Darren Green 2000). Mating however has also been observed in the wild occurring in April/May by John Cann (1998) and in captivity by Craig Latta (pers.comm.). Nesting occurs in November/December (Darren Green 2000).

10.7 Age at First Breeding and Last Breeding

Females reach sexual maturity at approximately 165mm whilst males do so at 145mm (John Cann 1998). Oliver Roempp states this is approximately 3-6 years old in captivity. In the wild studies have approximated maturity in females at 10-11 years and males at 7 years (Patrick Wong, Shelly Burgin 1997). Breeding ceases in this species usually the season before dying of old age (Craig Latta.pers.comm).

10.8 Ability to Breed Every Year

C.longicollis has the ability to breed annually providing conditions are adequate.

10.9 Ability to Breed More than Once Per Year

Do not typically breed more than once per year but are capable of laying a double clutch (Oliver Roempp 2003). Both John Cann (1998) and Craig Latta (pers.comm.) have witnessed otherwise, with breeding occurring up to two times a year.

10.10 Nesting, Hollow or Other Requirements

A soil/sand mixture should be present in the enclosure for eggs to be laid in. It should be a mound of approximately one foot deep. On average nest excavations are 100mm-150mm deep (Darren Green 1997, Oliver Roempp 2003). If you are unable to dig a hole in the soil without it caving in, this substrate is not appropriate, as the turtle will not be able to excavate her nest (Oliver Roempp 2003). The same principle applies if the soil is too hard as juveniles will not be able to dig out of the nest and die (John Weigel 1988). You may need to regularly moisten to soil to ensure these scenarios do not occur. For nesting if the soil is hard it is not an issue as the female secretes fluids from her cloaca to loosen the soil (Oliver Roempp 2003).

10.11 Breeding Diet

Slightly increasing the diet and changing is composition to allow for more fresh, low fat foods, such as crickets and fish, will hopefully contribute to stimulate breeding behaviours (Darren Green 2000). Providing cuttlefish bones to gravid females is a method employed by Oliver Roempp (2003) to maintain optimum calcium levels.

10.12 Incubation Period

In captivity Darren Green states that the incubation period lasts approximately 65 days at 30^{o}C, however Oliver Roempp states incubation can last up to 90 days. This would change dependant upon the temperature that the eggs were incubated at. A higher temperature would result is a shorter incubation time, whilst a lower temperature would result in a longer incubation time. This is demonstrated in the table below (period listed is averaged from number of clutches listed).

Incubation Period Dependant Upon Temperature

Temperature (^{o}C)	Period (Days)	Number of Clutches
30^{o}	69 ± 4.7	8
28^{o}	65 ± 0.0	1
25^{o}	81 ± 0.0	3

(John M. Legler, Arthur Georges [Unknown])

As incubation temperatures fluctuate in the wild, incubation is usually much more prolonged, lasting years if conditions are inadequate (Source Unknown).

10.13 Clutch Size

Multiple Clutches	1-2
Clutch Size	8-24
Average Clutch Size	6-10
Sex Ratio	1:1
Average Egg Dimensions	20 x 30mm
Average Egg Mass	6.7gm

(Derived from Darren Green 2000, Oliver Roempp 2003, Arthur Georges *et al* 1996)

10.14 Age at Weaning

This is a precocial species and so is born completely independent. The female does not provide any form of care and can breed again as soon as conditions are right. If introduced into a social environment the only danger to neonates are injuries resulting from aggressive eating. Turtles are indifferent about who they are housed with at all times, except for breeding season (Michael Frith.pers.comm).

10.15 Age of Removal from Parents

Eggs can either be left to naturally incubate in an enclosure or removed to artificially incubate. Removing neonates from an outside enclosure once hatched, if left to incubate naturally, is beneficial and will significantly reduce death due to predation and drowning. Most turtle enthusiasts house neonates indoors until they reach an approximate carapace size of 75mm (John Cann 1998). The risk of disease is significantly lessened at this stage, they should be able to swim quite capably and are less prone to injuries resulting from aggressive eating exhibited in adults (John Cann 1998). Introducing them into a pond with turtles the same size is preferable.

Raymond Hoser (1982) successfully breed and housed newly hatched neonates in an outside enclosure with adult specimens. He observed that adults did not attempt to eat the juveniles, presumably because other more preferred food sources were provided. This was further emphasised by the fact dead neonates were left to decay on the surface of his pond without being eaten by adults.

10.16 Growth and Development

A neonate will hatch out of its egg within 48 hours with an egg tooth and umbilical cord still attached. These drop off after a few days (Michael Frith.pers.comm). As they are a precocial species they are born completely independent however do not actively search for food until after the first few days of hatching (John Cann 1998). This is because they gain their nourishment from the residue yolk remaining from their eggs (Darren Green 2000). Once this food source is used up they will self-feed (Craig Latta 2005).

Neonates are born with vibrant oranges and reds rimming the carapace and decorating the plastron. These colourations fade as they reach maturity and the carapace slightly curves upwards (John Cann 1998). As a general rule if you notice your turtles growing, they are growing too quickly and feeding should be reduced (Michael Frith.pers.comm).

Figure 13:

Size comparison of a newly hatched *C.longicollis* to a ten-cent piece. The neonate is approximately 20mm in carapace length at hatching.

Image Courteously of Adam Beadsmoore

11. ARTIFICIAL REARING

11.1 Incubator Type

See Appendix V for Suppliers of Incubators.

Initially a simple container such as an ice-cream container will be required in which to house the eggs (Darren Green 2000). Half fill the container with vermiculite as per the standards described in **11.2 Incubation Temperature and Humidity** and place the eggs in this container as outlined in **11.7 Specific Standards**. Use plastic wrap to seal the container and retain the humidity. This transparent medium will allow for easy monitoring and minimise disturbance. Now place the container in the incubator.

Incubators can either be purchased or made, however those purchased will last a lot longer and require less maintenance. If you choose to make your incubator there are two methods: either an insulated box (polystyrene) or a heated aquarium (Darren Green 2000). Essentially light globes maintained by a thermostat heat the insulated box, the thermostat switching the globes on and off to maintain the desired temperature (Darren Green 2000). This style of incubator may incorporate fans into its design to provide circulation (Darren Green 2000). The heated aquarium involves half filling an aquarium tank with water and sitting the egg holding container inside. Aquarium heaters maintain the desired temperature in this method, however due to evaporation water will need constant refills (Darren Green).

If egg production is high Darren Green (2000) recommends the insulated box method.

11.2 Incubation Temperature and Humidity

Time of development during incubation is dependant upon the temperature the incubator is set at. A higher temperature will result in a shorter incubation period, whilst a lower temperature will result in a longer incubation period. This is exhibited in the table in section **10.12 Incubation Period**. Caution must be taken if employing higher temperatures as this may result in the death of the embryo (Darren Green 2000). Darren Green recommends an incubation temperature of between 29-30^{o}C.

In some species of reptiles, crocodiles for example, incubation temperature can determine the sex of offspring produced. This is not the case in *C.longicollis*. Studies undertaken by M Palmer-Allen, F Beynon and Arthur Georges in 1996 tested this aspect in wild specimens. Sexing as a result of temperature in artificial incubation had been disproved in previous studies. The experiment tested 14 differing field sites and each yielded the same 1:1 ratio typical of artificial incubation.

A high humidity is a must when incubating turtle eggs to prevent them from drying out. A vermiculite and water mixture at a ratio of 1:1 by weight (100g vermiculite to 100 ml water) will result in a desired 92% humidity (Darren Green 2000). This should be monitored to ensure the substrate does not become too dry. Mist spraying periodically should ensure this, but only if required. Peat moss can be used as an alternative to vermiculite however is less effective (Darren Green 2000).

11.3 Desired % Egg Mass Loss

Eggs to not loose mass during incubation, they increase in mass. Growth of the eggs by 10% is average and indicates development within the egg as well as the end of the incubation period (Craig Latta.pers.comm).

11.4 Hatchling Temperature and Humidity

After hatching neonates may be left in the incubator for a further 24 hours, however this is not necessary (John Cann 1998). John Cann places his neonates in separate containers on a slope with 20mm of water. The water temperature is fine to leave at the ambient temperature if around 22^{o}C-24^{o}C. Do not attempt to heat this volume, add more water if the temperature increases above that desired (John Cann 1998).

Above the dry part of the container a globe should be installed keeping the air temperature around 27^{o}C-28^{o}C (John Cann 1998). Carefully monitor this as over heating of neonates is apparently very easy to do (John Cann 1998).

11.5 Normal Pip to Hatch Interval

The normal pip to hatch interval typically takes 48 hours, with young emerging from their shell by use of an egg tooth that is lost in the immediate period after hatching (Michael Frith.pers.comm). As nest emergence is synchronised, higher eggs have been proven to delay when they hatch, whilst lower eggs will speed up when they hatch, to achieve this synchronised pattern (Michael Frith.pers.comm).

11.6 Diet and Feeding Routine

Neonates have a more demanding food schedule due to their rapid rate of growth and should be fed daily until one year of age (Craig Latta 2005). For the first few days after birth this species will survive off the residue egg yolk from which it was hatched (Darren Green 2000). Reaching days 3-5, interest in solid foods will be observed and a diet of live mosquito larvae, bloodworms, plankton, small crickets, maggots, shrimp, worms and daphnia should be offered (Craig Latta 2005). The movement exhibited by these live prey species promotes self-feeding (John Cann 1998). Care should also be taken with foods provided as individual turtles will have their own preferences and may reject certain foods or not be seasonally ready for them (John Cann 1998). As they grow a varied diet consisting of small crickets, maggots, insect larvae and freshwater shrimp should be introduced and built upon with larger items i.e. fish as specimens reach maturity. Food proportions should never exceed the size of the turtle's head.

Once growth in noted in neonates, turtle breeders recommend to begin suppling vitamin and mineral supplements. Hikari^{TM} Cichlid Mini-Pellets (John Cann 1998) and Nutrafin Tropical Fish Flakes (Craig Latta 2005) come highly recommended due to the high levels of Vitamin D found in these products.

11.7 Specific Requirements

It is of utmost importance that you do not rotate or move the eggs at all once placed into the incubator, as this can result in the drowning of the embryos inside (Aleyshia Manning 2001). Eggs must be placed top end up in the vermiculite substrate. To ensure this, mark the top of each egg with a black dot before transplantation (Aleyshia Manning 2001). Space eggs out as much as possible and do not fill the egg holding container more then half way with vermiculite (Aleyshia Manning 2001).

11.8 Data Recording

The following data to be recorded is derived from Darren Green (2000):

Male	**Female**	**Breeding**	**Egg (Incubation)**	**Neonate**
Name	Name	*Date*	*Min/Max/Mean*	*Date*
Age	Age	Courtship Begin	Length	First Slit
Length	Length	Courtship End	Width	First Hatch
Weight	Weight	Copulation	Weight	Last Hatch
Features	Features	Oviposition	Temperature	
				Min/Max/Mean
Captive Breed	*Captive Breed*	*Temperature*	*Style*	
Yes	Yes	Water	Artificial	No. Hatched
No	No	Air	Natural	Sex Ratios
				Deaths
Locality	Locality	Clutch Size	Egg Deaths	Abnormalities

Min/Max/Mean in **Neonate** column refers to Length, Width and Weight.

11.9 Identification Methods

As neonates an effective way to identify individuals of a clutch is to place them in separate containers (Adam Skidmore.pers.comm). Other methods include scute notching and marking with different coloured non-toxic paints or liquid paper (Adam Skidmore.pers.comm). Transponder chips can also be installed once juveniles have reached at least 10cm in length, however the minimum size depends upon the skill of the veterinarian performing the procedure (Adam Skidmore.pers.comm). There is no real ‘rule’ as to when it is appropriate to implant these chips.

11.10 Hygiene

Most hygiene practices relating to neonate turtles are those that aim to reduce the occurrence and growth of disease agents within the confines of the animal’s living space. During incubation this involves regularly checking for expired eggs, as they will promote this unwanted growth (Jacki Salkeld.pers.comm). Signs indicating death include discolouration, foul smells and the presence of fungi (Darren Green 2000). Immediately remove the bad egg, and as much substrate in the immediate area as possible, to prevent the fungi reaching the others (Jacki Salkeld.pers.comm).

Bacteria populations can escalate if food is left to sit in neonate containers. A recommendation is to feed your turtles in different containers (John Cann 1998). Daily water changes would be beneficial. Also be wary of where your food comes from. Food caught from the wild will risk the introduction of disease as well (Oliver Roempp 2003).

As always ensure you wash your hands before and after dealing with your neonates due to the zoonotic risks associated.

11.11 Behavioural Considerations

If captive or a collection animal the imprinting of humans as a food source is not a problem. This can add to the appeal of these animals being exhibited as they will readily approach people or make themselves visible. If for re-release I would recommend providing live prey items whenever possible and limit the time the turtle is held captive.

11.12 Weaning

As neonates develop they should constantly be weaned onto larger food items, lengthier basking periods and deeper volumes of water. It is important that these weaning processes occur slowly or your turtle's life may be put at risk. This weaning is also to simulate its natural development in the wild, or as close to what it would be as possible. Weaning of food is described in **11.6 Diet and Feeding Routine**. Exposure to UV light should begin following the first fortnight after your neonates have hatched and last no more than 5 minutes at a time (John Cann 1998). This practice should occur at least once every few days (John Cann 1998). Upon reaching 60mm in carapace length John Cann recommends extending the exposure length to 15 minutes at a time. Water depth should be judged depending upon the strength levels of individuals.

12. ACKNOWLEDGEMENTS

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- Latta, Craig – Experienced Freshwater Turtle Breeder
- McFadden, Michael – Taronga Zoological Park (Herpetofauna)
- Salkeld, Jacki – ‘Feature Creatures’ Presenter / Richmond TAFE Lecturer
- Skidmore, Adam – Taronga Zoological Park (Herpetofauna)

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15. GLOSSARY

Aestivation -	A state of dormancy or torpor during the summer.
Anaerobic -	An organism that can survive without atmospheric oxygen.
ARKS -	Animal Record Keeping System.
Carapace -	A hard bony or chitinous outer covering, such as the fused dorsal plates of a turtle.
Chelonian -	Belonging to the order Chelonia (Testudines).
Clutch -	A grouping of eggs from one laying.
Concave -	Curved like the inner surface of a sphere.
Convex -	Having a surface or boundary that curves or bulges outward, as the exterior of a sphere.
Copulation -	To engage in sexual intercourse.
Daphnia -	A species of water flea.
Debride -	Surgical excision of dead, devitalised, or contaminated tissue and removal of foreign matter from a wound.
Dimorphism -	The existence among animals of the same species of two distinct forms that differ in one or more characteristics, such as coloration, size, or shape.
Diurnal -	Active during the daytime.
Exothermic -	Regulates body temperature by exchanging heat with its surroundings.
Forage -	The act of looking or searching for food or provisions.
Gravid -	When a female reptile is holding eggs.
Gregarious -	Seeking and enjoying the company of others.
Hemipene -	Male reproductive organ in reptiles.
Hibernation -	To pass the winter in a dormant or torpid state.
Inappetence -	Lack of appetite.
ISIS -	International Species Information System.

Monogamous - Having a single mate during a breeding season.

Neonate - A newborn infant.

Notching - A V-Shaped Cut.

Oviposition - The act of laying eggs via use of an oviduct.

Pinky - A newborn mouse pup.

Plastron - Ventral part of the shell of a turtle/tortoise.

Pleurodirous - The ability to retract the head and neck into the front lobe of a chelonians shell by a sequence of folds.

Polygymous - Having multiple mates during a breeding season.

Precocial - Capable of leaving the nest within a few days.

Probing - The act of using a slender, flexible surgical instrument to explore a wound or body cavity.

Scutes - Shed pieces of a turtle's shell.

Torpor - The dormant, inactive state of a hibernating or aestivating animal.

Ventral - Relating to or situated on or close to the abdomen.

Vermiculite - A mineral substance used as a form of insulation during incubation.

16. APPENDIX

APPENDIX I

KEY TO THE AUSTRALIAN SPECIES OF CHELODINA

1 Plastron greatly expanded anteriorly, usually only about 1.4-1.7 times longer than broad; and widest at about the level of the humerals; intergular usually at least twice as long as the suture between the pectorals ……………………………….. 2
Plastron narrow, not noticeably expanded anteriorly, usually 1.9 (or more) times as long as broad, and widest at about the level of the bridge; intergular usually scarcely longer than the suture between the pectorals ……………………………4

2 Expanded anterior lobe of plastron moderate, not extending laterally as far as the inner edges of the overlying marginal plates of the carapace …………………… 3
Expanded anterior lobe of plastron very broad, extending laterally beyond the inner edges of the overlying marginal plates of the carapace …………. *longicollis*

3 Carapace very flat, almost circular in outline ………………………. *steindachneri*
Carapace strongly convex, distinctly oval in outline ………………... *novaguineae*

4 Carapace broadly oval; plastron moderate, at most twice as long as its width immediately in front of the bridge ……………………………………………….. 5
Carapace very narrow, plastron long, slender, more than twice as long as its width immediately in front of the bridge ……………………………………... *oblonga*

5 Second and third vertebrals longer than wide; anterior lobe of plastron not beginning to taper immediately in front of bridge ……………………….. *expansa*
Second and third vertebrals wider than long; anterior lobe of plastron beginning to taper immediately in front of bridge ………………………………………. *rugosa*

Extracted directly from H.G Cogger (1975) *Reptiles and Amphibians of Australia*. A.H & A.W Reed, Sydney Wellington, London. 127-128.

APPENDIX II

DAILY RECORD SHEET CODES

AQC = ACQUISITION
Any importation from outside the collection, public donation, or capture from grounds or from the wild.

B/H = BIRTH/HATCHING
REPTILES: Generally recorded as a hatch date. If date of leaving the nest is used it must be noted as such under information column.

D/30 = DEATH WITHIN 30 DAYS
Death/euthanasia within 30 days of birth, hatching or acquisition.

D/E = DEATH, ESTABLISHED
Death/euthanasia of any animal that has been resident in the collection for longer than 30 days.

DIS = DISPOSITION
Includes exports from the collection, releases, sales and escapes.

BRD = BREEDING
Reproductive details/observations. Any nesting, laying of eggs, matings, courtship, sexing of previously unsexed individuals or any other reproductive matter.

INT = INTERNAL MOVEMENT/TRANSFER
Any movement of an animal from its residing enclosure, be it within a section or to a different section. Transfer/exports out of the collection NOT included.

TAG = TAGGING
Animal identification by banding, tagging, notching, tattooing, naming or any other method of identification.

W/L = WEIGHT/LENGTH MEASUREMENTS

Rx/Tx = TREATMENT
Any medical treatment administered to animals, either by vets, or continuing treatments administered by animal care staff. Include observations of anything related to treatment. Flag if veterinary examination is required using VET code.

VET = VET EXAMINATION REQUIRED

OTH = OTHER
Any notable observation made in reference to daily routine or animals (behaviour, routine change, ect). Also anything else of interest (maintenance, diet change, ect).

Extracted directly from ‘Daily Diary’ report sheet used at Taronga Zoo.

APPENDIX III

TURTLE PUDDING – ADAM BEADSMOORE (2006)

Ingredients:

- 1kg of Salmon Heads
- 1kg Seafood Mix
- 1kg Beef Heart
- 4 Eggs
- 1.2kg of Canned Vegetable Baby Food
- 200g Chicken Liver
- Reptivite
- 540g Gelatine
- 2.5L Water

Method:

- Soak seafood ingredients in water prior to cooking to remove excess salts
- Blend all ingredients together except for the gelatine and water and stir
- In separate pots heat both the meat mixture and the water at 40^{o}C
- At 40^{o}C add the gelatine to the water and stir until completely dissolved
- Add the meat to the water/gelatine mixture and stir
- Allow to cool and then separate into feeding proportions to freeze for later consumption

TURTLE FEED MIXTURE – CRAIG LATTA (2005)

Ingredients:

- 1kg Steak/Kangaroo Meat
- 1kg Seafood Mix (Prawns, Mussels, Fish, Calamari)
- ½ Broccoli (leaves)
- ½ Parsley Bunch
- 1 Banana
- 1 Tablespoon Vitamin Supplement
- 1 Tablespoon Calcium Supplement

Method:

- Blend together all food ingredients
- Add one tablespoon of vitamin and calcium supplement each and mix
- Package into serving proportion sizes and freeze for later consumption

APPENDIX IV

FOOD SUPPLIER DETAILS

- PISCES ENTERPRISES – Supplier of Aquatic Plants and Live Foods
  P.O. BOX 200
  Kenmore, QLD, 4069
  Phone: (07) 3374 1839

- LIVEFOODS LIMITED – Quality Live Insects and Frozen Rodents
  QLD, Australia
  Phone: (07) 5533 8375
  Fax: (07) 5533 8375
  the3porters@bigpond.com

- SQUAMATA EXOTIC FOODS AND HERPTILE PRODUCTS
  QLD, Australia
  Phone: (07) 3200 0265

APPENDIX V

INCUBATOR SUPPLIER DETAILS

- AUSSIE COMPANION PARROT SUPPLIES – Grumbach Products
  P.O. Box 129
  Dayboro, QLD, 4521
  Australia
  Phone: (07) 3289 9441
  Fax: (07) 3289 9415

- LYONS TECHNOLOGY INC – Bellsouth Asia Pacific
  8/5-7 Vesper Drive
  P.O. BOX 1233
  Narre Warren, VIC, 3805
  Australia
  Phone: (39) 796 7044
  Fax: (39) 796 7033

- PRIAM PSITTACULTURE CENTRE – Reptile Incubators Supplied
  2 Australis Place
  Queanbeyan, NSW, 2620
  Australia
  Phone: (02) 6128 0800
  Fax: (02) 6128 0810
  www.priam.com.au
  psittaculture@priam.com.au

APPENDIX VI

GENERAL SUPPLIER DETAILS

- GULLY REPTILE CENTA
  6/32 Famechon Crescent
  Modbury, SA, 5092
  Australia
  Phone: (08) 8264 9455
  Fax: (08) 8264 9488

- ROCKY REPTILES
  1/95 Dixon Rd
  Rockingham, WA, 6167
  Phone: (08) 95281310
  Fax: (08) 95281301
  rockyreptiles@hotmail.com.au

- ULTIMATE REPTILE SUPPLIERS
  P.O. Box 11
  Enfield Plaza
  Enfield, SA, 5085
  Australia
  Phone: (08) 8262 9162
  Fax: (08) 8262 9164

APPENDIX VII

REPTILE VETERNARIANS

- EXOTICS VET NORTH SHORE VETERINARY – Specialist Centre
  Dr. David Vella
  64 Atchison St
  Crows Nest, NSW, 2065
  Phone: (02) 9436 4884
  www.davidvella.com.au

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- WARRANWOOD VETERINARY CENTRE - Reptiles
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- WEST TOOWOOMBA VET SURGERY
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APPENDIX VIII - ANNUAL CYCLE OF MAINTENANCE ROSTER

Activity	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Drain Pond Clean/Refill			■					■				
Change Substrate			■					■				
Add Sand/Soil Substrate								■				
Add Leaf Litter Substrate											■	
Reduce Food By Half Proportion				■								
Supply No Food					■	■	■					
Supply Food At Half Proportion								■				
Hibernation				■	■	■	■					
Copulation									■	■		
Normal Feeding Schedule	■	■	■						■	■	■	■
Separate Sexes				■	■							
Reintroduce Sexes								■				

Activity	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Nesting (Monitor Eggs)												
Supplement More Calcium												
Faecal Sample												

Reduce Disturbance Periods: April – July (Hibernation) and September – October (Copulation)

Only reduce food proportions if the temperature of the enclosure in which a specimen is housed is going to drop during the winter period. If specimens are housed inside with a constant regulated ambient and water temperature the specimens will not enter a state of hibernation and thus food proportions do not need to be reduced as the body will be able to digest foods consumed. Breeding is only likely to occur in individuals housed outside that will go through this natural seasonal hibernation cycle.