

Captive Care of the Eastern Water Dragon

Physignathus lesueurii lesueurii

Contents

Preamble	2
Overview	2
Description	2
Evolutionary History.....	3
The Three Pillars of Reptile Husbandry.....	3
Equipment Checklist	3
Husbandry	4
Feeding.....	4
Hatchlings.....	4
From Juveniles to Adults.....	5
Enclosures	6
Indoor Enclosures	6
Outdoor Enclosures	8
Lighting.....	9
Indoor Lighting.....	10
Outdoor Lighting.....	10
Heating.....	11
Indoor Heating	12
Outdoor Heating	12
Shedding / Sloughing of the Skin	13
Sex Determination	13
Brumation	14
Breeding.....	15
Handling Techniques.....	15
Social Structure and Behaviour.....	16
Conclusion.....	16
Glossary.....	17
Bibliography	18

By Angus Kennedy

Preamble

Keeping water dragons can be a very rewarding experience. It is important to never lose sight of the fact that the animals in your care are living creatures that feel the same emotions that we do and deserve our respect. While keeping an animal in captivity takes away its liberty to a certain degree, the author believes that if they are provided with a big, stimulating environment that provides all they need to remain healthy then the animal's life can be at least as happy as a life in the wild. Animals in the wild will not live to anywhere near the age of a captive animal, as they will be predated upon and often face difficulties finding food, not to mention falling prey to a host of parasites. It is your duty as the carer of your water dragon to ensure that it is well fed and remains healthy. It is always best to consult with experienced keepers or reptile specific stores, as well as reference books. The keepers in particular will prove invaluable in guiding you and assisting you. Anyone who spends time around animals will realise they have distinctive personalities and display emotions, even if it is not in the same way that we are used to, and therefore demand the same respect that should be given to all other humans and living creatures.

Overview

Description

The Eastern Water Dragon (*Physignathus lesueurii lesueurii*) is a large, sturdy lizard that lives along the waterways of the Eastern Coast of Australia down as far as the South Coast. They can grow to over one metre long, and is the largest member of the dragon family (Agamidae) in Australia. They are known to have a long life span, with reports of animals living for over 25 years. **This should be taken into account if you are considering a water dragon as a pet; they are a very large, long term commitment!**



Figure 1 - Approximate distribution of Eastern Water Dragons

The Water Dragon (Physignathus) Family

The Eastern Water Dragon is one of two subspecies of Australian water dragon, the other being the Gippsland Water Dragon (*Physignathus lesueurii howittii*). The Gippsland Water Dragon lives further south than the Eastern Water Dragon. There is only one other species in the genus *Physignathus*, *Physignathus cocincinus* from South East Asia.

Physical Description

The Eastern Water Dragon has small, uniform scales with an olive to brown body and a large dark stripe from the eye to the neck. There can be banding along the body and red flushing across the chest, primarily in males. Males can grow to over one metre long, however females are usually significantly smaller. They have a very long laterally compressed tail that can be as much as $\frac{2}{3}$ of the total body length. Their powerful, flat tail allows them to swim strongly (Wilson & Swan, 2003, p. 326).

Did you know?

Reptiles are among the most energy efficient creatures in the animal kingdom



Evolutionary History

There are only two species in the genus *Physignathus* (water dragons) in the family Agamidae (dragon lizards). They are *Physignathus lesueurii*, the Eastern Water Dragon and *Physignathus cocincinus*, the Asian Water Dragon. The flora and fauna of Australia is primarily Gondwanan allochthonous (evolved in Australia) and autochthonous (in same state as it existed on Gondwana) as well as migrant species coming from Asia and by sea. It appears most likely that the Agamidae migrated to Australia from Asia, either by water or during an ice age when sea levels were substantially lower. Research has estimated that Australian and Asian water dragons diverged around 30 million years ago (Hugall & Lee, 2004), so this would be a pretty good estimate of the time of arrival into Australia.

The Three Pillars of Reptile Husbandry

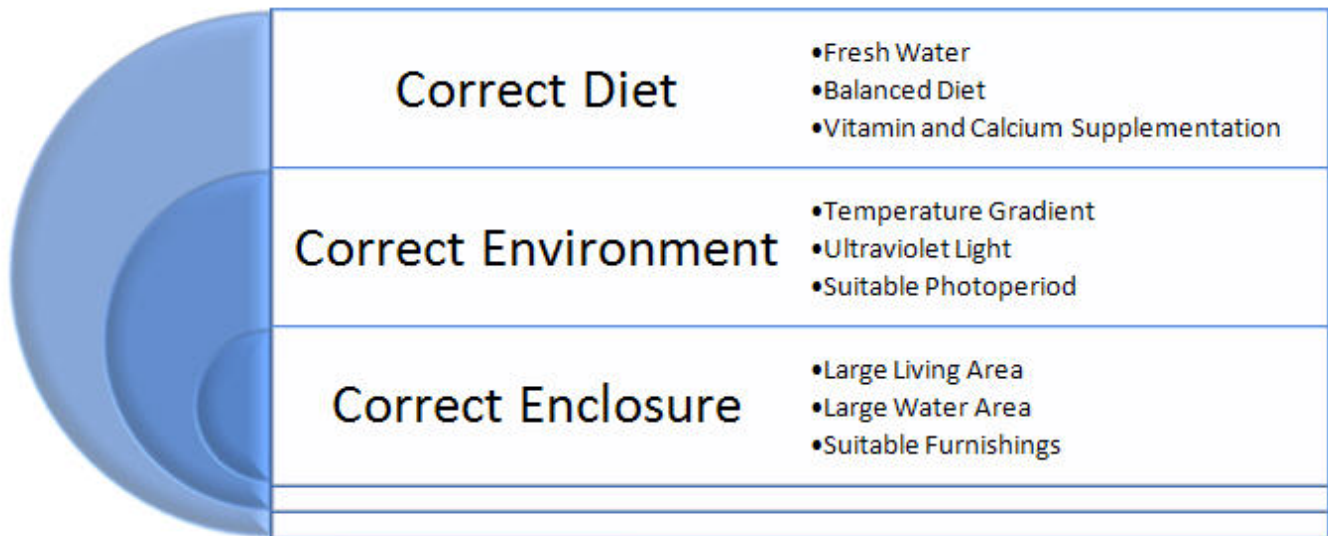


Figure 2 - The essential elements of reptile husbandry

If you follow the information provided in this care sheet and ensure that the necessities of reptile husbandry, as outlined above, are maintained, then you will have a very long lived and happy reptilian companion.

Equipment Checklist

- Enclosure (an indoor enclosure for a young dragon, and an outdoor enclosure for an adult)
- Food (make sure you have access to a regular supply of live insects)
- Calcium and vitamin supplements (these are necessary for a balanced diet)
- Heat source (For an indoor enclosure, a ceramic fitting and an overhead heat source such as an infrared bulb or flood light)
- Full spectrum UV lighting (Either full spectrum fluorescent or mercury vapour bulbs)
- Mechanical 24 hour timer to control lighting (Available from any hardware store)
- Thermostat (This is important to make sure the temperature doesn't get too hot or cold)
- Thermometer (A thermometer is essential to measure the temperature in your enclosure)
- Water area (A large water area at least big enough for the dragons to completely submerge themselves, make sure it has sloped sides so they can get out easily)
- Substrate and furnishings (make sure you have a big enough hide for the reptile)

Husbandry

Feeding

Introduction

Water Dragons are hardy animals in captivity and will accept a large variety of freshly prepared food and live insects. **They require fresh drinking water at all times.** Drinking water should be checked daily as dragons in general, but water dragons in particular, have a tendency to defecate in water. As hatchlings they are predominantly insectivorous, however as they grow larger and become adults they will also take a variety of larger prey along with vegetables and fruit. It is important to remember that the captive diet can never completely match the variety and quality of a wild diet, and therefore **supplementation with vitamins and calcium is an essential part of captive husbandry.** The captive diet of hatchlings and adults will be addressed separately below.

Be Careful!

Feeding prey that is too large can cause impaction in the gut, and ultimately death!

Hatchlings

- Are primarily insectivores
- Require fresh water at all times
- Should be fed every day, and no food items can be larger than $\frac{2}{3}$ the size of their head
- Need a balanced diet, including vegies and vitamin and calcium supplements once every third feed
- Be careful of insecticides – contamination of food items can kill your dragon



Figure 3 - Hatchling water dragons

Dietary Requirements

Hatchling water dragons need to be fed every day until they have reached a snout vent length (SVL) of approximately 100mm, when they are considered to be juveniles. Remember that **fresh water should be available at all times**, and checked daily for any contamination. Hatchlings are primarily insectivorous and in captivity the best way to feed them is with pre purchased crickets and native wood roaches (woodies). These can be purchased in different sizes, and small is suitable for hatchling water dragons. **Never feed dragons food that is bigger than $\frac{2}{3}$ of the size of their head.** This can cause impaction in the gut and ultimately death. Insects caught from the wild or garden are not recommended as they often carry parasites and insecticides used in the garden do not always kill insects immediately and **if an insect that has been exposed to insecticide is fed to your dragon it will become very sick and ultimately die.** This applies to the house as well – if your dragons are kept indoors **you should not use any sort of insecticide in the house**, such as fly spray, as this can contaminate your feeder food.

Warning!

Be careful with insecticides, any contaminated insects can kill your dragons. Do not use insecticides in the garden, nor in the house, including fly spray

It can also contaminate stray insects that can end up in your enclosure and without your knowledge be eaten by your dragons. After a few weeks you can begin to feed them very finely chopped fruit and shredded vegetables. Fruit and vegetables are essential parts of a balanced diet.

There is no set rule as to the time that your animals should be fed or the quantity that they should be fed, however there are some general guidelines. Reptiles should be fed when they are warm and

active, so the best time is usually between mid morning and early afternoon. The amount of food that you should feed your reptiles is a difficult thing to quantify. As a general rule, they should be fed as much as they can eat in a period of 5 – 10 minutes, twice a day. Dragons are prone to obesity, so if you notice your dragon getting fat, then reduce the amount of food being fed until they take on a normal to slightly plump appearance.

Supplementation

A diet of insects in captivity will not be balanced; therefore **it is essential to supplement your dragon's diet** with a ready made calcium and vitamin powder. It is sufficient to add the supplements to their food once every third feed. Supplements can be purchased from some local pet stores, specialty reptile stores and many online reptile stores. Rep Cal and Rep Vite have had positive feedback. The supplements can be fed by either dusting insects before feeding, or mixing a pinch in with vegetables or other food.

From Juveniles to Adults

- Need fresh water at all times
- Can be fed 3-4 times a week
- Need a balanced diet, including fruit and vegies and occasionally pinky mice or lean meat

Dietary Requirements

As water dragons grow larger their dietary requirements change and they become slightly more omnivorous. At this stage they can be fed less regularly, as little as three times per week. As mentioned before, **it is essential that they be provided with fresh water at all times** and that it be checked daily for contamination. Adults, like hatchlings, often defecate in water, and their faeces can be particularly large and messy! The diet for adult water dragons can be a lot more varied than for hatchlings.

Did you know?

It is mainly movement that stimulates dragons to eat, so they will normally not accept dead insects

Protein Component of Diet

Water dragons should be regularly fed large insects such as woodies, crickets and mealworms. A lean, salt and fat reduced (less than 1.5%) dog food (not fish) can also be mixed in with vegetables, calcium supplements and vitamin supplements to form a staple part of their diet. Mealworms should be fed as occasional filler rather than a regular part of their diet, as they are very fatty and contain relatively little nutritional value (Brown, 2008). They will also accept small rodents such as pinky or fuzzy mice and very lean meat such as kangaroo mince in suitably small portions. Frozen mice can be purchased humanely killed from many pet stores and all reptile specialists. Plain meat should not be a regular part of their diet, but serves well as an occasional treat. Fruit and vegetables make up an important part of a balanced diet for dragons.

Vegetable Component of Diet

Fruit and vegetables should be soft (i.e. avoid apple) and chopped small enough so that it is easy to consume. Some favourite fruits include banana, strawberry, mango, raspberries and blueberries.

They will accept many vegetables as long as they are soft and can fit in their mouth. Shredding can be a good way to help feed them hard vegetables. Note that iceberg lettuce has almost no nutritional value and should not be offered as food. Many people also make up a mix of vegetables and lean meat or dog food that they can freeze in portions and serve at their leisure. This can be very nutritious and serves as a good staple part of their diet, but should never completely replace regular feeding with live insects.

Warning!

Iceberg lettuce and tomato should not be fed to any dragons as they will cause diarrhoea

Supplementation

Even as adults, dragons will benefit from occasional supplementation with a quality vitamin and calcium supplement. These supplements can be fed by either coating prey insects, or mixing with other food sources.

Enclosures

Introduction

One of the most essential parts of captive husbandry is having a suitable enclosure that meets the animal's needs. Water dragons need very large enclosures, with a large water area for swimming and appropriate furnishings. Adequate ventilation is essential, as are heating and lighting which will be discussed later. For your first enclosure it is highly recommended that you consult an experienced, professional reptile store or enclosure builder. They will be able to offer detailed advice on enclosures and the best way to set them up, including lighting and heating. **It is essential to make sure that your enclosure is set up correctly – this more than anything will ensure your reptiles are happy, healthy and that they survive.**

'Escape Syndrome' and facial damage

Water Dragons have been known to repeatedly rub their snouts on the sides of their enclosures to the point of serious damage to the dragon. This is primarily caused by two things; firstly, an enclosure that is too small, and secondly, the desire of a subordinate dragon to escape from its aggressor. While there are other reasons that the dragons will try and escape and repeatedly rub their noses, these two are the most common. **The root cause of the problem is a desire to escape the enclosure, which indicates that there is something about the housing that makes the dragon feel uncomfortable.** In order to fix the problem, you must first determine what is causing the dragon to want to escape. If it is a dominant animal bullying the dragon, there is no other solution than to separate the animals. If the enclosure is too small, you will need to build a larger one. If the furnishings do not give a natural feel, or there are not suitable areas for the dragon to hide when it feels like it, then this may cause the animal distress and you will need to upgrade the enclosures furnishings. If you cannot fix the problem naturally, then you will need to erect a Perspex fence around the perimeter of your enclosure that the dragon will not be able to damage its snout on, but the solution can often be found naturally.

Warning!

Dragons can damage their snouts by repeatedly rubbing them against the sides of an enclosure, if they are uncomfortable and want to escape

Indoor Enclosures

- Enclosures must be at least three times the length of the animal, and twice the length of the animal in width.
- Make sure enclosures are tight and escape proof, as dragons are master escapees.
- Adequate ventilation to ensure airflow and reduce humidity is required.
- A large water area is required, at least as big as the animal, and should be cleaned daily.
- Special heating and lighting is needed, this is discussed later on.

Introduction

Water dragons are very large dragons that can grow to over one metre long, at which point **it is strongly recommended**



that they be kept outdoors. However, it will take them more than 3 years to start to approach this sort of size, and until then it is often best to keep them in an indoor enclosure. There are benefits and drawbacks to having an indoor enclosure, a few of which I will mention here. The essential parts of an indoor enclosure are appropriate size, correct heating and lighting, adequate ventilation and appropriate furnishings to make your lizard comfortable. Heating and lighting are discussed further on in their own sections.

Enclosure Size

Always build the biggest enclosure that you can possibly afford or accommodate. An enclosure can never be too big! As an adult the minimum enclosure size is 3m x 2m. When younger, the minimum enclosure size is proportional to the dragon being kept. As a hatchling, a small enclosure is suitable but as they grow larger the enclosure will need to be upgraded. Although a small enclosure may seem cheaper at the time, a large enclosure will be much more cost effective in the long run.

Enclosures should always be at least three times as long, and twice as wide as the total length of the animal, including its tail.

Materials

Indoor enclosures are usually made from either entirely glass or clear plastic, or wood with a glass or plastic front. Although wood enclosures have good insulation properties, they are more susceptible to becoming water damaged and growing mould than glass or plastic enclosures. However they still make very good enclosures, as long as you are careful that they do not get too wet. Glass enclosures are good because they are waterproof, however they do not have good insulation properties and you need to be more careful with ventilation and temperature fluctuation.

Ventilation

Adequate ventilation is absolutely essential for an indoor enclosure.

There needs to be good airflow through the enclosure to make sure that humidity does not get too high and fresh air can circulate. You will need more ventilation in humid tropical areas than in colder areas, where retaining heat is more important than reducing humidity; however you will always need to make sure that humidity stays low as **dragons can easily contract respiratory infections and have mould and fungal problems if humidity is too high.**

Warning!

High humidity can cause many different respiratory and fungal illnesses that can be fatal

Water Area

Water dragons need a large water area. In an indoor enclosure this is best done by having a large plastic tub, that can be easily moved in and out of the enclosure for cleaning. The water area should be at least big enough for the dragon to fully submerge itself, and the dragons should preferably be able to swim around. **Make sure that the dragons can get out of the water – they can drown surprisingly easily.** Either have a sloping bank or objects in the water that they can use to get out.

Warning!

Make sure that the dragons can easily get out of the water, as they can drown

Furnishings

Enclosures need furnishings, both to recreate the dragons natural environment and help it feel comfortable, and to improve the aesthetic value of an enclosure for the person viewing it. **Branches for the dragons to perch on and areas for them to hide are essential.** Water dragons feel more secure when they have easy access to water, so they will appreciate having some branches over their water area. Hide areas can be made from a variety of materials, ranging from ice cream containers with a cut-out entrance, to hollow pieces of fallen timber. Whatever the material, the hide should be large enough for the dragon to completely conceal itself and should be cleaned

regularly. **Hides are very important for the mental health of your lizard**, as they provide a comfortable place to escape if your dragon feels the need for solitary time away from prying eyes.

Substrate

There are many different substrate possibilities for water dragons. There are two main things to remember; make sure that the substrate is clean and faeces and old food is removed very quickly, and make sure that the dragons are not accidentally eating their substrate. Be careful of using any sort of woodchip based substrate as there can be sharp pieces of wood that if accidentally swallowed can cause impaction and digestion problems. These can be very serious and result in death. Sand is a common substrate and gives the dragons the ability to dig. If using sand though, you should be very careful that food is kept off the sand and that the dragons are not swallowing it when they are eating. Swallowing too much sand can cause impaction and blockages in the gut, however a little bit in larger dragons will be fine. The other most commonly used substrates are various carpets, synthetic turf and newspaper. They are all suitable, however they can look unsightly and more importantly they do not allow the dragon to dig. There are also pre made reptile bedding products you can buy. They can be good, however they are often overpriced and not much easier to use than natural substrates.

Outdoor Enclosures

- Adult dragons should be kept outdoors.
- The enclosure should be **at least three times as long and twice as wide as the total length of the dragon**.
- Provide a large water area, at least big enough for the dragon to fully submerge itself.
- Make sure there is nothing in the enclosure the dragon can hurt itself on, i.e. Loose wire



Figure 4 - An example of an outdoor enclosure, with a pond that is the absolute minimum size

Location

Outdoor enclosures are very well suited to water dragons and are the only real option as dragons start to reach their full adult size. They are best located where they will receive maximum sunlight, especially the morning sun.

However make sure that there is a shaded area where the dragons can retreat from the heat should it become too much for them. The other essential part of an outdoor enclosure is ensuring there is an area that will stay dry and protected from the weather at all times, and this is where hides should be provided. This allows the dragon to retreat from bad weather. This is often achieved by having a roof over $\frac{1}{3}$ of the enclosure, providing both protection from the elements and shade.

Size and Furnishings

As an **absolute minimum**, the enclosure should be three times as long as the total length of the animal, and twice its total body length wide, and as high as possible (at least one metre). For example, an adult water dragon that has a total length of one metre should be housed in an enclosure at least three metres long and two metres wide. This is an absolute minimum, and **an enclosure should be as big as you can possibly fit into your backyard**. Remember that an enclosure this minimum size is like us having to live our entire lives in a small bedroom, and water dragons are very active animals and would feel as uncomfortable as we would.

Hint

Try to grow non toxic plants in your enclosure, they look great and can attract insect food

Water dragons are primarily terrestrial, meaning they live on the ground; however, they love to climb branches and survey their territories. Suitable perches in the form of old branches and logs should be provided for them to climb. It is also essential that you provide your dragons with areas where they can hide and feel secure. These can be in a variety of forms, such as hollow logs, propped up flat rocks such as slate with caves underneath, or human made 'dog kennel' style hides. I usually prefer to offer them a natural hide in which they would no doubt feel more comfortable. Whatever you choose make sure that it is secure, weatherproof and that they can completely hide themselves under it. As mentioned before, hides are important for the mental health of your dragon.

Water Area

Water dragons, as the name implies, need a large water area as they like to swim. Apart from making the water area as large as possible, the **most important thing is to keep the water clean**. Water dragons will defecate in the water, and as soon as this happens it should be cleaned. Having faeces in the water is very unhealthy and will quickly lead to sickness. They can stay submerged for long periods of time, usually as a method of escaping predators. They are sometimes seen sleeping underwater overnight, a great example of how effective the reptilian body's metabolism can be. The water area should be as large as you can possibly make it – they would love a swimming pool if you could fit it in! However, as this is often impossible, the water area should be at least big enough for the dragon to fully submerge itself and preferably swim around a bit. So, for an adult water dragon you would want a water area of **at least 1m long by 50cm wide by 30cm deep**, but preferably much larger.

Construction and Materials

Construction methods can be very varied, there are a few important things to factor in. Make sure that the enclosure is escape proof, water dragons can dig and climb very well and will eventually make their way out if the enclosure has any small holes. **Do not use a concrete slab as a base for your enclosure!** There will be no drainage, and your soil will stay damp and get mouldy very quickly. You are much better off having a dirt floor with wire mesh or shade cloth across it. This will allow plants grow, ensure that there is adequate drainage and the soil doesn't get waterlogged, and be much cheaper than a concrete slab. **Enclosures should also be lockable, as thieves have been known to steal reptiles.** The most common methods of outdoor enclosure construction are frames with wire mesh or sunken pits with walls. Both of these work well, however with pits be careful that predators cannot get in and eat your lizards, and with wire mesh you need to be careful of the size and quality of mesh that you use. Mesh must be free of any pointy or loose pieces of wire that the lizards can hurt themselves on. The mesh hole size must also be small enough that they cannot try and push their heads through the mesh – this can result in quite significant damage to the lizards. I would recommend using a 12.5mm² bird aviary mesh. Chicken wire is not very good, as it is poor quality, the holes are too large and it often has loose wires that can hurt your lizard.

Lighting

Introduction

Natural light conditions are important to keep your dragon happy and healthy. In an indoor environment you need to recreate natural lighting, while outdoors you must ensure that they have access to normal light conditions. **All dragons require ultraviolet (UV) light in order for proper bone development to occur.** Failure to provide this will result in the slow, painful death of the animal. **UV light is almost entirely blocked out by glass**, therefore it is essential that there is nothing between the UV light and your reptile.

Indoor

- Both UVA and UVB light is required, and can be provided through fluorescent tubes or mercury vapour bulbs.
- All reptiles will benefit from a few hours of supervised time in natural sunlight every week.
- A photoperiod of approximately 10-12 hours is acceptable, however to stimulate breeding the photoperiod should change to follow the seasons.

Introduction

Ensuring that the lighting conditions in an indoor enclosure are correct is absolutely essential to the health of your dragon. There are two important things to remember; **they must have ultraviolet (UV) light**, and they need to have the correct photoperiod to match the season that you are trying to simulate for breeding to occur.

Warning!

Fluorescent UV tubes need to be replaced every 6 months as they lose their ability to produce UV

Ultraviolet (UV) Light

Making sure that your reptile receives adequate UV light is absolutely essential. There are two types of UV light that we are concerned with, UVA and UVB, and you will need to supply both, but UVB is particularly important. UVB light provides the dragon with vitamin D which is an essential vitamin for bone development. **Without UVB and the vitamin D it produces, bones will not grow or become strong and the dragon will die an unnecessary, slow and painful death.** UV light can be provided from a variety of sources; however the most common form is from specially made fluorescent tubes that provide UV light. Note that fluorescent UV lights should sit as close to the dragons as possible, as UV output is reduced dramatically every few centimetres and fluorescent lights should be no higher than thirty centimetres from the dragons. There are also now compact fluorescent bulbs that can be screwed into a standard fitting, or mercury vapour self ballasted bulbs that generate large amounts of UV as well as heat. Mercury vapour bulbs are often used in very large enclosures, and in most cases a fluoro light is sufficient. Remember that all reptiles, and especially dragons, will benefit enormously from a few hours of supervised play in natural sunlight every week. The UV output from a fluorescent bulb over a full day, although sufficient, is the equivalent to a fraction of that time in natural sunlight. **Always consult the instructions on any lighting products purchased for the exact placement instructions.**

Warning!

UV light is filtered out by glass, so there must be nothing in-between the light and your dragon

Photoperiod

The photoperiod is the amount of light hours out of a full day. It is sufficient to have a year round photoperiod of around 10-12 hours per day, however to stimulate breeding it is recommended that the photoperiod be changed to follow the seasons. For example, in summer the natural photoperiod can be over 12 hours, and become as short as 8 hours over winter. **The photoperiod must be maintained in a regular way**, and it is not sufficient to just turn the lights on or off when you are at home. A 24 hour timer can be purchased from hardware stores for as little as \$5 and will save you a lot of hassle.

Hint

A mechanical timer can be bought from hardware stores for \$5 and ensures that the correct lighting regime is being followed

Outdoor

Outdoor lighting is very easy compared to indoor lighting. All of the dragons UV requirements and the photoperiod are provided by natural sunlight, so the only consideration is for positioning of the enclosure to ensure a balance between shade and sun

exposure. The ideal situation is to have a hot, exposed sunny area at one end of the enclosure where the dragons can warm up and bask in the sun with another cool, protected area at the other end where they can move to cool down and escape the heat if it becomes too much. This is often accomplished by simply putting the enclosure in a warm exposed area, and having a roof at one end to provide a shaded cooler area.

Heating

- Dragons will maintain their body temperature by heating and cooling themselves as necessary
- Dragons require a thermal gradient; the warm end of an enclosure should be from 30-35°C while the cooler end should be from 20-25°C, with a gentle gradient in-between.
- Dragons will not eat if they are not warm enough, yet if they overheat they can die from dehydration.
- It is important to regularly monitor the temperature in your enclosure using a thermometer
- A thermostat will ensure that your enclosure is maintained at the right temperature
- Heat can be provided from a variety of sources such as standard light bulbs, infrared light bulbs, ceramic heat emitters, heat cords and radiant heat mats or panels

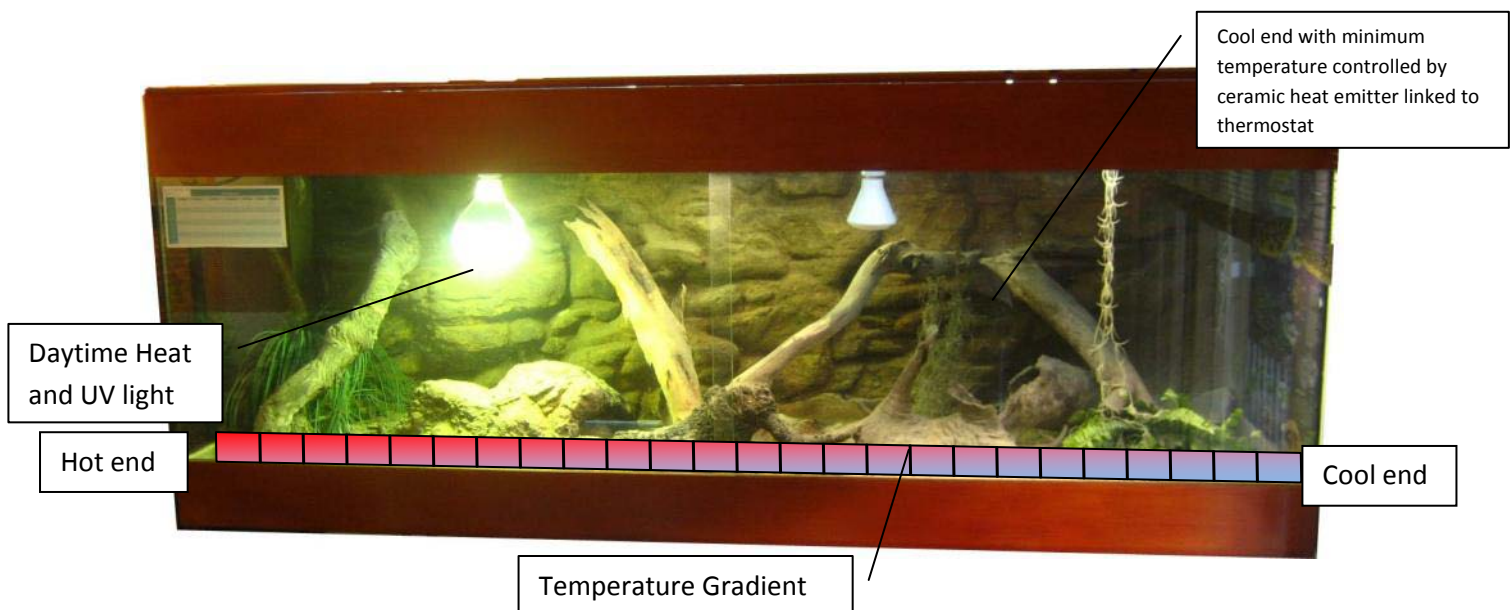


Figure 5 - Diagram showing heat sources and the thermal gradient

Introduction to heating

Reptiles are ectothermic, which means that they rely on external sources of heat to warm their bodies up. They are mistakenly called cold blooded – their blood is not cold, they just rely on external sources of heat to warm themselves. In humans, our body is heated by using the energy we gain from food, in contrast reptiles warm their bodies by using the energy from the sun. The result of being ectothermic is that reptiles can keep their body warm without having to expend energy from food, and because of this feature they are some of the most efficient animals on the planet. This has large implications for the captive husbandry of reptiles. **Ensuring that the temperature in an enclosure is correct is perhaps the most essential part of reptile husbandry.** If the temperature is not warm enough then reptiles will refuse to eat because their metabolism cannot process food

and they will slowly starve to death, and if the temperature is too high they can easily die of dehydration. For these reasons it is absolutely essential that the temperature is maintained within the dragons functional limits.

Indoor Heating

Temperature Ranges

Reptiles must have a warm area at one end of the enclosure where they can bask and heat themselves up. This area should be from 30-35°C and is best provided from an overhead heat source such as an infrared or standard light bulb, or ceramic heat emitter as this encourages natural basking behaviour (Figure 5). It is a good idea to have a rock or solid piece of wood under this heat source that can warm up during the day and provide radiant heat overnight, making the temperature transition from day to night smoother. The other end of your enclosure should be cooler, around 20-25°C. In between the warm and cool areas of the enclosure should be a gentle temperature gradient, allowing the dragon to move around the enclosure and find an area that it feels comfortable in to keep it at its optimum temperature.

Thermostats and Temperature Regulation

A thermostat is a highly recommended and extremely helpful device for all indoor reptile enclosures. A thermostat has a dial on which you set a temperature, it will then turn on a heat source when the temperature goes below the set temperature and turn off the heat source when it goes above the set temperature. This takes a lot of the uncertainty out of maintaining the correct temperature, as the thermostat makes sure the enclosure neither gets too hot or too cold. There are many brands available, but Microclimate is held in high regard, offering a range of specialty thermostats. You should still check temperatures in your enclosure daily with a thermometer as it is not unheard of for a thermostat to jam and cook a dragon, and their temperature sensing devices can be inaccurate so it is best to double check.

Hint

Check temperatures in your enclosure regularly with a thermometer, even if you have a thermostat

Outdoor Heating

Overview

In contrast to keeping a dragon indoors, managing the temperature outdoors is largely out of your control. The first consideration is whether the local climate is suitable. Water dragons are fairly hardy and adaptable, so as long as you do not live in an alpine area or in a desert they should be fine, given the temperatures are warm enough, they have a suitably large water area and protection from the elements. In outdoor enclosures the dragons will receive a natural annual temperature cycle, and will almost certainly brumate over the winter season. It is important to ensure that there are adequate areas for the dragons to bury themselves and get out of the elements during brumation. Hollow logs and gaps under large, slightly raised rocks filled with straw are good areas for brumation. Brumation will be covered in more detail further on.

Furnishings

In an outdoor enclosure it is good to have large rocks and pieces of flat slate in sunny areas. These will absorb the sun's heat and the dragons will often bask on them. They have the added benefit of retaining heat for a while after the sun starts to go down, providing radiant heat for any lizards interested in remaining active. While wood is good for dragons to bask on, it does not retain heat like rocks, so both should be used.

Shedding / Sloughing of the Skin

All reptiles periodically shed their skin as they grow. When this starts to happen the reptile will release small amounts of fluid to aid the skin to come off, however if the humidity isn't appropriate they will have difficulties shedding their skin properly. This has serious implications for the health of the dragon, as skin that has not shed properly can cause constriction of toes, which will eventually result in the toe falling off due to lack of blood supply, provide hiding spots for parasites and a few other problems. For these reasons it is important to ensure that your dragon sheds its skin entirely. If a dragon is left with bits of skin remaining, then the first step is to just start either misting the dragon with water or lightly spraying it with a hose. The water can assist the skin to come off naturally. If this does not work, then the next step is to start giving the dragon shallow baths (make sure it can still touch the ground and isn't forced to swim). Give the dragon baths every few days for a few weeks, and if the skin still hasn't come off then you will need to manually try and peel it off. Rubbing the skin with a wet rag can help, always be gentle and make sure you don't hurt the dragon. If you do not feel comfortable doing this, then get a vet to assist.

Sexing

Introduction

It is almost impossible to tell the difference between sexes when the dragons are juveniles. Unless one everts a hemipene in front of you, you will need to wait until they are older when physiological changes will become apparent and it will be very easy to tell the sexes apart. It is strongly recommended that you never try and forcefully evert a hemipene or interfere with the lizard's cloaca, as this can easily cause irreparable damage to the lizard and its reproductive and excretory system.

Warning!

Avoid keeping adult male dragons together, as they will fight and can severely injure themselves

Sexual Dimorphism

Water dragons exhibit sexual dimorphism. This means that physiologically the males and females are quite different. These changes will become apparent from about 9-12 months of age, becoming more distinct all the time. Males will become much larger than the females, especially their head size, which will be significantly broader and larger. The other main difference is colouring. While both sexes can exhibit some red colouring on their chest, males without fail will have a large red area from the stomach up to the chest and neck. Males will also sometimes have yellow colours around their throats. In general, males are much more strikingly coloured while females are relatively plain, with limited colouring.

Social Behaviour

While water dragons are very sociable creatures and may live in large groups in the wild, in captivity due to the reduced territorial area you need to be careful of fighting and aggression, primarily between males. It is not recommended that more than one male be kept together in an enclosure, as fighting over territory, especially around breeding season will result in substantial damage and trauma to one or both of the lizards. Remember that the losing male has nowhere to hide, and will be badly harassed. The submissive male may also stop eating. For these reasons it is strongly recommended



Figure 6 – Adult Male Eastern Water Dragon

that males be separated. Females on the other hand are usually fine in larger groups with a single dominant male, however you should watch closely to make sure that all dragons are getting enough food, as a hierarchy will become established even among the females and sometimes there can be bullying.



Figure 7 - Female Eastern Water Dragon

Brumation

Introduction

Brumation is the term used by herpetologists to describe the more commonly known term 'hibernation' in reptiles. Hibernation and brumation basically mean that the body's metabolism slows down in order for the animal to live off energy reserves over a time when food is scarce. The main difference is the energy source used – hibernation uses fat reserves while brumation uses glycogen reserves. Brumating reptiles will still be responsive, and will wake up when it is warm enough or if there is some danger, and they will emerge for short periods as long as the warmer temperatures will allow. In reptiles, brumation usually occurs as temperatures start to go lower and the reptiles body naturally begins to slow down, however it can also happen in year round warm tropical areas over periods when food is scarce.

It is not essential for reptiles to go into brumation. If they are being kept indoors and the temperature is warm enough and the food is plentiful, then they will be perfectly happy not to brumate, and **it is usually recommended that captive reptiles are not brumated over their first winter**. However, it is during brumation that their sexual organs get a chance to build up sperm stores and 'recharge'. As such it is fairly unlikely that your dragons will breed if they do not enter a state of brumation.

Warning!

It is not recommended that a dragon be allowed to brumate over its first winter, as they have not had a chance to build up enough energy reserves

There are a few key points to remember when allowing the reptile to brumate. The process must be gradual, if the lizard is outside this will be achieved naturally by the slow change of season, however indoors it is being manipulated by your heat source, so **it is essential that you lower the heat gradually to induce brumation**. This leads into another important point. It is very important that the dragons are not fed for at least two weeks before they brumate, and over this period it must be warm enough (around 20-25°C) for them to still be able to digest their food. **If they enter a state of brumation with undigested food then it will rot in their stomachs and will kill them**. It is also important to make sure that the dragons are well covered and insulated. They will naturally search out a protected area, and it is best to leave them in the place they choose, unless you deem it to be unsafe. **Make sure that they will not be exposed to the elements, especially water and frost**. If they get too cold and freeze, they will either die or wake up with ruined eyes and frostbitten limbs. This should be avoided at all costs!

Warning!

If there is undigested food when a reptile enters brumation, the food will rot and the animal will die

Many reptile keeping guides recommend that you should not brumate a dragon when temperatures will drop below zero. This is true, the dragons should never be physically exposed to these sort of temperatures for extended periods, but if they are well insulated, under the ground and with straw or something on top then they should be fine. The author lives in Canberra, where temperatures regularly drop below zero over winter, and has no trouble with dragons brumating as they bury themselves deeply and have layers of straw placed over the top to insulate them further.

Breeding

This guide will not go into the details of breeding or incubation. However, there are a few points of interest to quickly touch on. A brumation or 'cool down' period is very important for successful breeding, as this stimulates the sexual organs to produce sperm. Another interesting characteristic of water dragons, along with many other reptiles, is that they exhibit temperature based sex determination (TSD). Whereas humans and most other animals have genetic based sex determination, where two X chromosomes produce a female and XY produces a male, water dragon sex is determined not by their genetic makeup but by the temperature at which they are incubated. Research in this area has been pioneered by Professor Rick Shine, and has recently been conducted on water dragons by a Canberra based researcher named Sean Doody at the University of Canberra. Incubation temperatures that are very high tend to produce mainly female dragons, while mid range incubation temperatures produce a male biased sex ratio, and lower temperature incubation produces a more even mix (Doody, S.J., et al. , 2006, p. 319).

Did you know?

Water dragons have temperature based sex determination, where the sex of a baby is determined by the temperature that the egg is incubated at rather than their genetic makeup

Handling Techniques

Introduction

Water dragons are not the most easily tamed reptiles, however with patience, care and respect they will become used to human attention. The most important thing is to recognise that sometimes the animals will just want to be left alone – they have moods just as humans do. In order to tame a water dragon it is best to start handling it from a very early age. When handling any reptile it is most important to make the reptile comfortable. If the reptile is comfortable, it will be less likely to run away or scratch. Make sure that the animals entire body is supported, for example along the length of your arm, and never squeeze the animal unnecessarily (Figure 8, next page).

Warning!

While dragons very rarely bite, their claws can be long, sharp and painful. Wear protective clothing when handling any reptile

The easiest way to pick up a small dragon is to attempt to slide both hands under its body so as to support it entirely. If the dragon is too large, or too flighty, then it should be picked up with one hand around the base of the tail (never further down, as the tail can easily be broken) with the other hand support it under the belly if it is tame and is unlikely to scratch, or from behind the neck supporting the chest if it is aggressive or agitated (Figure 9, next page).



Figure 8 - How to handle a tame Water Dragon



Figure 9 - How to handle a flighty Water Dragon

Social Structure and Behaviour

Introduction

Water dragons are sociable creatures and in the wild they will often live in groups in fairly close proximity to one another along waterways. These groups can be made up of multiple females with one dominant male and occasionally submissive males. In captivity, it is best to keep males apart, as they will fight for dominance and in an enclosed area with nowhere to escape to this can result in serious injuries. Dragons should always be kept in at least a pair, as they are sociable animals. If possible, a male/female pair is the best, but a female/female pair would be second preference. If keeping them in larger groups it is best to keep a male with a harem of females, or if you have a very large outdoor enclosure it would be acceptable to keep a few males, but always keep an eye out to make sure they are not being bullied and are feeding.

Behaviour

Water dragons will undertake a variety of signalling and communication behaviour, especially around the breeding season. Most signals are directed towards either determining a pecking order between individuals or courtship and mating. Some of the more common behaviour that can be seen is hand waving, head bopping and arm stamping, and brightening of colours during courtship and fighting between males.

Conclusion

I hope that this guide has been of some help to you. This is a work in progress, and there are always areas to be improved. I would greatly appreciate any feedback, tips or recommendations on how you think the guide could be improved.

Please contact me at anguskennedy@grapevine.net.au – thanks!

Glossary

Snout Vent Length (SVL) – The snout vent length is a measure of the length of a lizard, from the snout of the animal to its vent at the beginning of its tail.

Husbandry – The term used to describe captive care of an animal.

Defecate – A nice term for going to the toilet.

Insectivorous – Diet primarily consists of insects.

Omnivorous – Diet is mixed, containing both meat and vegetable sources.

Faeces – A nice term for poo.

Photoperiod – The length of daylight hours in a given day.

Ultraviolet (UV) – Ultraviolet light is a type of non-visible light that has a wavelength shorter than visible light, but longer than x-rays. UVA is a longer wavelength form of UV and is primarily harmless; however UVB is responsible for skin cancer. Importantly for your reptiles, UVB is also responsible for production of vitamin D, an essential vitamin for bone growth.

Ectothermic – Ecto means external and thermic means temperature. The term ectothermic means 'heated from external sources'. Humans are endothermic, which means that they are heated internally.

Terrestrial – Living primarily on the ground.

Diurnal – Active in the daytime.

Cloaca – An excretory hole that is used for all functions, such as urine, faeces and sexual functions.

Hemipene – Hemi means two, so this is one of a pair of reproductive organs. Yes, they have two penises!

Herpetologist – Someone who studies reptiles and amphibians.

Bibliography

Brown, D. (2008). *The Pro's and Con's of Mealworms as a Food for Reptiles*. Retrieved 02 11, 2008, from Danny Brown's Home Page: <http://www.geckodan.com/The%20Pro.htm>

Doody, S., Guarino, E., Georges, A., Corey, B., Murray, G., & Ewert, M. (2006). Nest site choice compensates for climate effects on sex ratios in a lizard with environmental sex determination. *Evolutionary Ecology* (20), 307-330.

Hugall, A., & Lee, M. (2004). Molecular Claims of Gondwanan Age for Australian Agamid Lizards are Untenable. *Molecular Biology and Evolution* , 21 (11), 2102-2110.

Wilson, S., & Swan, G. (2003). *A Complete Guide to Reptiles of Australia*. Sydney: New Holland Publishers (Australia) Pty Ltd.