

**WAZA Husbandry Guidelines for
aquatic typhlonectid caecilians
(*Typhlonectes* spp.)**



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SECTION 1. BIOLOGY AND FIELD DATA

BIOLOGY

1.1 Taxonomy

ORDER: GYMNOPHIONA

FAMILY: Caeciliidae

GENUS: *Typhlonectes*

SPECIES: *T. compressicauda*

T. natans

COMMON NAMES

Typhlonectes spp. Rubber Eel, Caecilian worm, Aquatic caecilian.

T. natans: Rio Cauca Caecilian, Anguilla

T. compressicauda: Cayenne Caecilian, Cunha's Caecilian

1.2 Morphology

LENGTH

T. natans, Adult size 250-725mm total length (Gymnophiona.org; Duellman & Trueb, 1994)

T. compressicauda 523mm Total length (Gymnophiona.org)

WEIGHT

T. natans may double their weight prior to giving birth, Kowalski reports an adult female *T. natans* weighing 250.0g in captivity.



Figure 1. Adult female *T. natans*

B. Tapley ©

COLOURATION

T. natans are dark grey with a lighter ventral surface. (Figure 1) and *T. compressicauda* are dark grey to dark brown with a lighter ventral surface.

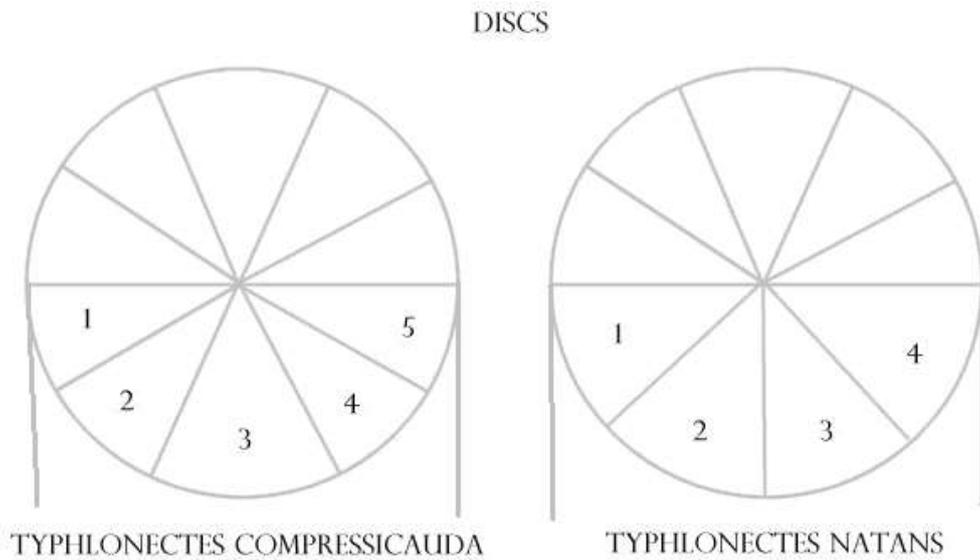


Figure 2. Cloacal discs showing the differences between *T. natans* and *T. compressicauda*.



Figure 3. The cloacal disc in *T. compressicauda*.

DESCRIPTION

Externally it is difficult to tell *T. natans* and *T. compressicauda* apart. Typhlonectids are legless and have a wormlike body due to the presence of cutaneous folds (each fold is known as an annuli). The eyes are small and covered with skin and the mouth is recessed. There is a tentacle (for olfaction and tactile sensory purposes) located in the nasolabial groove. Small external nares are present. *T. compressicauda* has a laterally compressed dorsal fin situated along the caudal third of the body, this fin is absent or far less developed in *T. natans*. In

typhlonectids the cloaca is situated on a cloacal disc at the terminus of the body (Wright and Whitaker, 2001). A tail is absent (Duellman & Trueb, 1994)

The only reliable way to tell *T. natans* from *T. compressicauda* is to examine the cloacal disc (Fig 3) The lower half of the cloacal disc (anterior part on the caecilians) is divided into 5 sections in *T. compressicauda* and into 4 sections in *T. natans*. The posterior half of the cloacal disc is divided into five sections in both species.

1.3 Physiology

RESPIRATORY RATE

Frequency of lung ventilation for *T. natans* 6.33 ± 0.84 breaths hr^{-1} (Prabha *et al.*, 2000)

GAS EXCHANGE

94% of gaseous exchange for *T. compressicauda* derived from pulmonary respiration (Sawaya, 1947)

1.4 Longevity

Maximum recorded age for *T. natans*, 13 years. Sp. still living

FIELD DATA

1.5 Zoogeography / Ecology

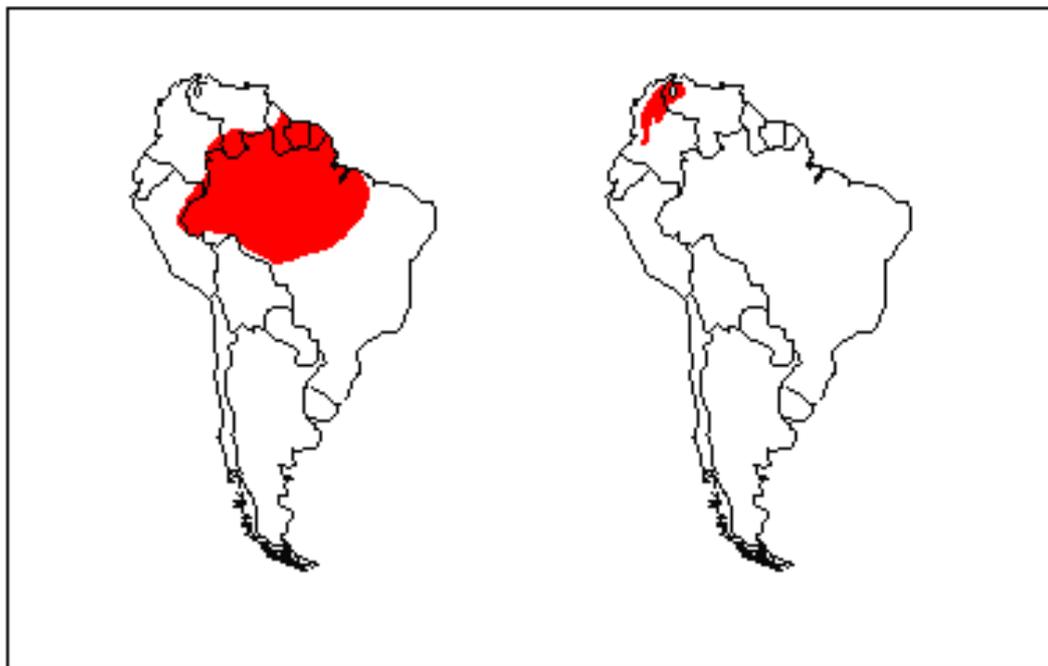


Figure 4. The distribution of *T. compressicauda* (left) and *T. natans* (Right)

DISTRIBUTION

T. natans - Cauca and Magdalena Drainages of Colombia and North eastern Venezuela (Fig. 4)

T. compressicauda - Amazon basin of Brazil, Colombia, French Guiana, Guyana, Peru, Surinam, Peru, and Venezuela (Fig. 4)

HABITAT

T. natans - Is an aquatic species, living in rivers, marshes and lakes, usually in open areas, and is only rarely found on land (IUCN *et al*, 2008). *T. natans* has been recorded in eutrophic waters in synanthropic and urbanized habitats in Venezuela (Gower & Wilkinson, 2005).

T. compressicauda - Is an aquatic species, inhabiting permanent rivers and marshes, mainly in the lowland forest zone (IUCN *et al*, 2008). Moodie (1978) reports that *T. compressicauda* inhabits water filled burrows.

CONSERVATION STATUS & POPULATION

T. natans - Least Concern in view of its wide distribution, tolerance of significant habitat degradation, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (IUCN *et al*, 2008).

T. compressicauda - Least Concern in view of its wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category (IUCN *et al*, 2008).

1.6 Diet and Feeding Behaviour

FOOD PREFERENCE

Hofer (2000) notes that typhlonectids can be particularly abundant around fishing villages where they have been observed feeding on the discarded entrails of fish.

T. compressicauda – In the wild juveniles of this species consume oligochaete worms, aquatic insects, terrestrial insects and anuran larva and eggs (Verdade *et al*, 2000). Gut contents of wild specimens also contained large amounts of detritus and plant matter which could have been ingested accidentally or indicate partial detritivorous habits (Verdade *et al*, 2000). *T. compressicauda* has also been observed feeding on dead fish caught in nets in French Guyana (Exbrayat & Delsol, 1985). In Manaus the stomach contents adult *T. compressicauda* included shrimp and arthropods, local fisherman reported that the species also feeds on small fish (Moodie, 1978)

Little is known about the wild diet of *T. natans*.

FEEDING

T. compressicauda - Carnivorous and generalistic. Juvenile wild specimens have been observed actively foraging in shallow water at night. Analysis of gut contents found that prey items associated with the bottom of the aquatic habitat as well as items associated with the surface (perhaps encountered when caecilians surface to breath) (Verdade *et al*, 2000)

1.7 Reproduction

DEVELOPMENTAL STAGES TO SEXUAL MATURITY

Viviparity is characteristic of typhlonectids. Development of the embryo is supported by yolk reserves (Wells, 2007). These yolk reserves are rapidly depleted. Young of *T. compressicauda* may increase their length six times by the time their yolk is fully absorbed (Stebbins & Cohen, 1995). Once the yolk is

depleted the embryos emerge from their egg membranes and uncurl, embryos then align themselves lengthways in the oviduct (Pough *et al*, 2002). The larvae are sustained by a lipid rich secretion from the walls of the oviduct. Oviductal young have well developed dentition which is very different to the dentition of the adults (Wake, 1976) The larvae use these specialised foetal teeth to scrape the oviductal epithelium which stimulates the secretion of the nutrient substance (Wake, 1976). The larvae of typhlonectids develop very large, highly vascularised sac like gills (Fig. 5) which are probably used for gas exchange across the maternal uterine wall (Wells, 2007), oxygen affinity of foetal blood in *T. compressicauda* is higher than that of adult blood (Duellman & Trueb, 1994). It has been suggested that the gills may uptake nutrients. These gills are lost within several hours after birth (Parkinson, 2004). At birth juvenile *T. compressicauda* may measure 40% of the females total length (Stebbins & Cohen, 1995).



Figure 5. *T. natans* with external gills

Wendy © M Zac

AGE OF SEXUAL MATURITY

T. compressicauda attain sexual maturity at 16months (Exbrayat & Delsol, 1985). The age at which *T. natans* reach sexually maturity in the wild is unknown. In captivity a female was recorded being sexually mature at approximately 4 years of age (Ilze Duncce pers. comm.)

SEASONALITY OF CYCLING

The reproductive biology of typhlonectids in the wild has not been studied in great detail. One study on *T. compressicauda* in French Guyana found that males have a yearly cycle of spermatogenesis which occurs from June – July, copulation occurs between February and May (Exbrayat & Delsol, 1985). Females have a biennial cycle. During the first year females are vitellogenic from October to February. This period is when ovulation occurs and gestation begins. Parturition occurs between July and October. Vitellogenesis occurs once again but very quickly. During the second period of reproduction Oocytes are not mature and they degenerate becoming atretic follicles (Exbrayat & Delsol, 1985).

It is thought that the reproduction of *T. compressicauda* is related to seasonal variation in rainfall. During the wet season there is an increased supply of food so this is when spermatogenesis, copulation and gestation occur (Exbrayat & Delsol, 1985).

T. natans is a seasonal breeder, breeding occurs during the wet season (Herman, 1994).

GESTATION PERIOD

In the wild gestation in *T. compressicauda* lasts six months (Exbrayat & Delsol, 1985).

In *T. natans* gestation period is unknown

NUMBER OF OFFSPRING

In the wild *T. compressicauda* give birth to on average 4 young. In captivity an average of 3 young are born (Exbrayat & Delsol, 1985).

The number of offspring produced by *T. natans* in the wild is unknown.

BIRTH DETAILS AND SEASONS

Young of *T. compressicauda* are born at the beginning of the dry season when water levels are still high (Exbrayat & Delsol, 1985).

Birth details and seasons of *T. natans* in the wild are unknown.

1.8 Behaviour

ACTIVITY

Activity patterns of typhlonectids in the wild are largely unknown. However *T. compressicauda* has been observed foraging in shallow water at night (Verdade *et al.*, 2000)

LOCOMOTION

Lateral undulation.

PREDATION

Not known

VOCALISATION

In captivity a squeaking sound has been reported in Typhlonectids when they surface to breath (Stebbins & Cohen, 1995).

SOCIAL BEHAVIOUR

In captivity typhlonectids are gregarious and share refugia. Refugia sites appear to be marked with chemical signals, and individuals are attracted to chemicals emanated by conspecifics (Wells, 2007). A captive study on *T. natans* showed breeding males in captivity may be aggressive towards one another but not necessarily territorial (Wells, 2007). Tests show that non reproductive females preferred chemical cues from other females over male chemical cues. Reproductive males preferred cues from receptive females to unreceptive females and did not discriminate between related and unrelated females (Warbeck & Parzefall, 2001)

SEXUAL BEHAVIOUR

There are not many records of mating in Caecilians. One observation of *T. natans* showed that males entwine themselves around females, the lower bodies entwined vent to vent. Fertilisation is internal; the males then inserted the phallosome, the intermittent organ of the caecilian (Fig. 6) into the cloaca of the female. Mating initially is frenzied but soon subsides. The animals can remain entwined for several hours (Parkinson, 2001). Murphy (1978) noted that copulation continued for three hours in *T. compressicauda* after it was first noted.



Figure 6. A preserved male *Typhlonectes natans* illustrating protrusible phallodeum B. Tapley ©

SECTION 2. MANAGEMENT IN ZOOS OR AQUARIUMS

This section has been completed with the help and support of private keepers, Zoological institutions and Aquaria. Questionnaires were sent out to many typhlonectid keepers. We received 12 responses. There was a great deal of knowledge held by all sectors and their responses to the questionnaire have been invaluable when compiling these guidelines.

2.1 Enclosure

The enclosure must be aquatic and should have a land area.

2.1.1 Substrate

For easy maintenance and monitoring a substrate is not essential when keeping typhlonectids. If a substrate is required, aquarium sand and aquarium pea gravel have both been used successfully as a substrate for typhlonectids. Caecilians may spend significant amounts of time buried in the sand if this particular substrate is used.

2.1.2 Furnishings and Maintenance

Refugia should be provided, animals often congregate under any such refugia made available. PVC pipes, bog wood and terracotta can be used. Rough edges of refugia will enable easy shedding, these edges should not be sharp. For aesthetics aquatic plants can be added, bare in mind that during the frenzy when animals are fed these plants are likely to be uprooted or damaged. *Ceratophyllum* sp. has been reported by one keeper to be an excellent shedding aid.

A land area should be provided. A floating section of cork bark is commonly used. Typhlonectids will often sit on this for hours at a time.

Partial water changes (20 – 30%) should be carried out on a regular bases (dependant on the volume of water in the aquaria and stocking density). Smaller densely stocked aquaria will require more water changes than larger aquaria with fewer animals. Water should be left to stand at room temperature before it is added to the aquaria to prevent temperature shock. Water changes should be carried out after feeding so that uneaten food is removed from the aquaria as quickly as possible before it has the chance to decay. The filter media should be cleaned regularly.

2.2.3 Water

Typhlonectids are commonly kept in tap water. Water conditioners should be used and have not been reported to cause problems. The water should be deep enough to allow the animals adequate space to swim. The lowering of the water level to 18cm was one of the factors attributed to the breeding of *T. natans* by one breeder (Parkinson, 2004).

2.1.4 Temperature

Water temperature should be between 24 – 28 °C. Aquarium heaters can be used for this purpose but ensure that heater guards are used, often typhlonectids lie wrapped around heaters and having a guard can prevent the potential risk of burns.

2.1.5 Filtration

Typhlonectids are messy feeders and shed their skin often. It is easy for detritus to accumulate in aquaria. For larger aquaria or aquaria with many animals, large external filters are vital. For small aquaria with a pair or trio of animals internal box filters are sufficient.

Juvenile animals can easily find their way into the internal mechanisms of filters. For this reason it is vital that any way into the filter is blocked up with mesh or sealed with silicone.

2.1.6 pH

pH does not appear to be of great significance in the husbandry of typhlonectids, however it would be advisable to avoid extremes.

It has been reported that a drop in pH from pH 5-6 to 5 was one of the factors attributed to the breeding of *T. natans* (Parkinson, 2004).

2.1.7 Hardness

Kowalski (2001) reports that *T. natans* may die if the hardness of the water exceeds 5.6dH (100PPM).

2.1.8 Lighting

Standard aquaria lighting with a 12:12 photoperiod seems to be sufficient for the maintenance of typhlonectids. The UV requirement of typhlonectids is unknown.

2.1.9 Dimensions

The larger the enclosure the better. A larger volume of water requires fewer water changes. A minimum of an 80 litre aquaria would be suitable to a trio of typhlonectids.

2.2 Feeding

Typhlonectids should be fed 2 to 3 times a week. For the first year juvenile animals should be offered food at least three times a week. Typhlonectids probably locate their food via olfaction. Juvenile *T. natans* have been observed swimming up and down an enclosure with jaws open and pressed down against the substrate, the jaws close immediately when they encounter the food item (personal observation). Typhlonectids can be conditioned to hand feed which can help ensure all specimens are fed suitable amounts.

2.2.1 Basic Diet

A huge variety of food will be readily accepted by typhlonectids including both live and dead invertebrates, thawed fish (both freshwater and saltwater fish), crustacea, molluscs, pinkie mice and grated ox heart. Salt water fish should only be offered occasionally, as it has been linked to hypovitaminosis B due to the destruction of enzymes during the storing period (Javier Lopez, pers comm.). Typhlonectids have also been reported to accept commercially available amphibian pellet.

2.2.2 Special dietary requirements

Being aquatic there is no recognised method, as yet, of adding dietary supplements to the food of typhlonectids. For this reason a wider variety of food as possible should be offered.

2.2.3 Method of feeding

Food can be placed in the aquaria in different locations to ensure all the inhabitants get the chance to feed. Larger animals tend to consume food items more quickly than smaller ones and so can potentially consume more than their fair share.

2.3 Social Structure

Typhlonectids do not appear to be territorial (Warbeck & Parzefall, 2001), however during the breeding season males may become aggressive.

2.3.1 Changing Group Structure

Introducing a new male to an enclosure which already houses both males and females during the breeding season should be avoided.

2.3.2 Sharing Enclosure With Other Species

T. natans has been reported to eat small fish, it is best to avoid adding these to an enclosure housing typhlonectids. There were no reported problems when keeping typhlonectids with larger fish, providing the fish are not predatory. In the wild, Moodie (1978), noted that *T. compressicauda* was toxic to some fish. *T. natans* have been kept successfully alongside another aquatic caecilian, *Potomotyphlus kaupii*.

Housing typhlonectids alongside species originating from different geographical origins could expose the caecilians to new diseases. This should be avoided in captivity

2.4 Breeding

In captivity *T. natans* are regularly bred. Some zoological institutions in the United States have bred *T. natans* to F5.

2.4.1 Mating

In captivity mating has been observed for *T. natans* year round. In *T. natans*, Parkinson (2004), noted that mating commenced in July when water levels were lowered to 18cm, and the pH decreased to pH5 (from pH 5-6) and nitrates levels were increased (from dH3). Parkinson made these changes to the water chemistry in an attempt to replicate dry season conditions with low water. pH can be lowered by filtering water through peat moss (Bailey *et al*, 2005). Kowalski (2001) reports that the lowering of total hardness of aquarium water can induce breeding. He recommends the hardness should be halved providing that hardness does not drop below 1 dH (17.8PPM). Hardness can be lowered with the addition of distilled or reverse osmosis water.

2.4.2 Gestation period

A gestation period of 43 weeks has been reported for *T. natans* in captivity (Parkinson, 2004)

A gestation period of 24 – 30 weeks has been reported for *T. compressicauda* in captivity (Bruins *et al*, 1999; Exbrayat & Delsol, 1985).

2.4.3 Birth

T. compressicauda give birth to a maximum of 7 young which measure between 100 – 140mm (Bruins, 1999).

T. natans give birth to 1 – 11 young

Two authors (Wake, 1994; Parkinson 2004) have observed female *T. natans* carrying young on their backs to the waters surface for their first breaths of air. One author reports an adult attempting to eat a neonate (Kowalski, 2001)

2.4.4 Development and Care of Young

Young should be separated from the adults after birth as they require a different feeding regime. There is a risk that young *T. natans* may be eaten by the adults (Kowalski, 2001)

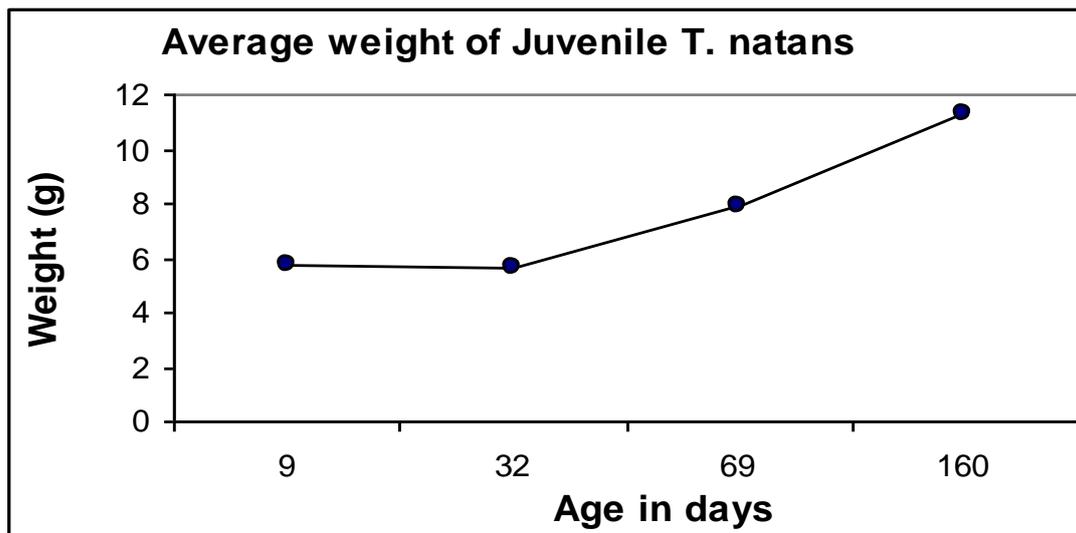


Figure 7. Average weight of juvenile *T.natans* after birth. (*T. natans* born on 17.10.2007). Data provided by Ilze dunce

2.6 Handling

Caecilians should be handled as little as possible. Gloves should always be used when handling amphibians (see WAZA guidelines) to avoid disease transmission and damage and injuries to the animals themselves. A recent study (Cashins & Alford, 2008) suggested that latex and Nitrile gloves can have lethal effects on tadpoles. The potential lethal effect of gloves on caecilians has not yet been investigated.

2.6.1 Individual Identification and Sexing



Figure 8. Cloacal disc of male *T. natans* (left) and female *T. natans* (right).

It is difficult to individually identify animals. Gower *et al* (2006) successfully used Alpha numeric fluorescent tags to mark the caecilian *Gegeneophis ramaswamii*. Branding has also been used to mark caecilians. When marking individuals it is important that marking does not damage the borders of each of the annuli as this may be detrimental to the locomotion of the caecilian. Tags should not be implanted parallel to the main axis of the body, but transversally and maintained within the anterior and posterior edges of the annuli. Animals need to be anaesthetised as they are difficult to restrain. Immersions in a 0.1% MS222 bath at a pH of 7.2 until righting reflex is lost should give enough time for marking (Javier Lopez, pers comm.).

Sex can only be reliably determined in mature animals. Males have enlarged cloacal discs (Fig. 8). The cloacal discs of females appear more slit like and elongated. The diameter of the cloacal disc is greater in males (Stebbins & Cohen, 1995).

2.6.2 Catching/Restraining

A net should be used to capture typhlonectids.

2.6.3 Transportation

Typhlonectids can be transported in ventilated boxes on moist sphagnum moss. In temperate climates care should be taken that the animals are not transported in cold periods.

2.6.4 Safety

Typhlonectids pose no threat to the keeper. However, Moodie (1978) found that skin secretions of *T. compressicauda* were toxic to the coexisting predatory fish *Hoplias malabaricus*. If the mucus of typhlonectids comes in contact with the eyes or with cuts it causes a burning sensation (Stebbins and Cohen, 1995).

2.7 Specific Problems: Considerations for Health and Welfare

Typhlonectids are escape artists. Lids of aquaria must be heavy and extremely tight fitting.

Newly imported wild caught typhlonectids can be heavily infested with nematodes, as the nematodes develop, cause lumps under the skin (O'Reilly, 1996). These lumps eventually erupt as the worms hatch (Wake, 1994); these open lumps can develop into open lesions. Eruptions of nematodes from the skin have lead to fatal bleeding (Carsten Kirkeby, Pers comm)

Kowalski (2001) reports that temperatures as high as 32.2°C can cause thermal stress in *T. natans*.

Fungal dermatitis has been observed in typhlonectids. Kowalski (2001) reports that neonate *T. natans* are more susceptible to fungal infections at temperatures lower than 25.6°C. The fungal dermatitis has been observed as multiple raised, white cotton wool like spots on the surface of the skin. Fungal dermatitis can be diagnosed by microscopic examination of a fresh skin scrape (Javier Lopez, pers comm.). Fungal dermatitis has been treated successfully in *T. natans* using Itraconazole baths (3 parts Itraconazole to 100 parts water). The specimen concerned was bathed for five minutes daily for eleven days.

Traumatic wounds can take several months to heal. Daily 6 hour baths of Enrofloxacin for a period of three weeks have been successful in treating such injuries.

Mortality was observed in a group of *T. natans* when they were placed in a tank that had previously been treated with Flubendazole, despite the tank having two 90% water changes before the addition of the animals. Toxicity was suspected. This product should not be used with typhlonectids.

2.8 Recommended Research

Little is known about the biology of typhlonectids. Accurate record keeping is essential and wherever possible morphometric measurements as animals mature should be taken. Literature is lacking on the reproduction of typhlonectids in captivity. There has been very little research conducted on *T. natans* in the wild, this should be addressed.

ACKNOWLEDGEMENTS

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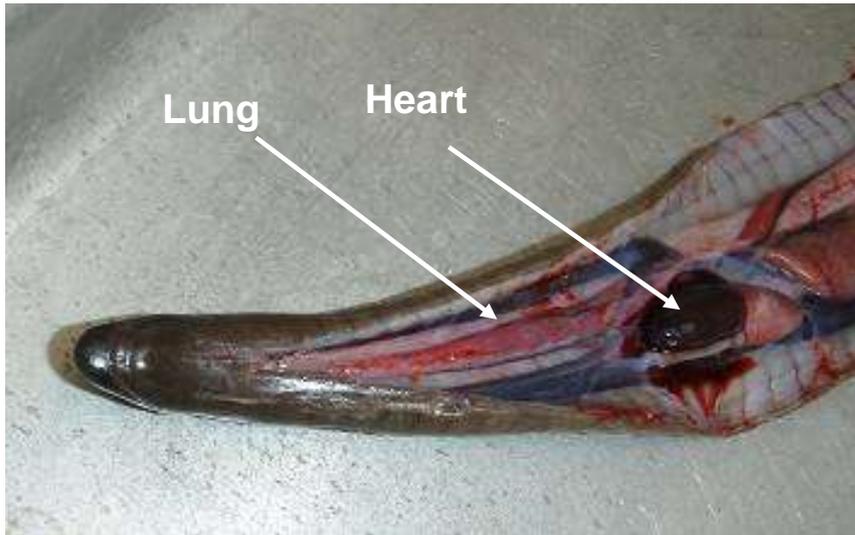
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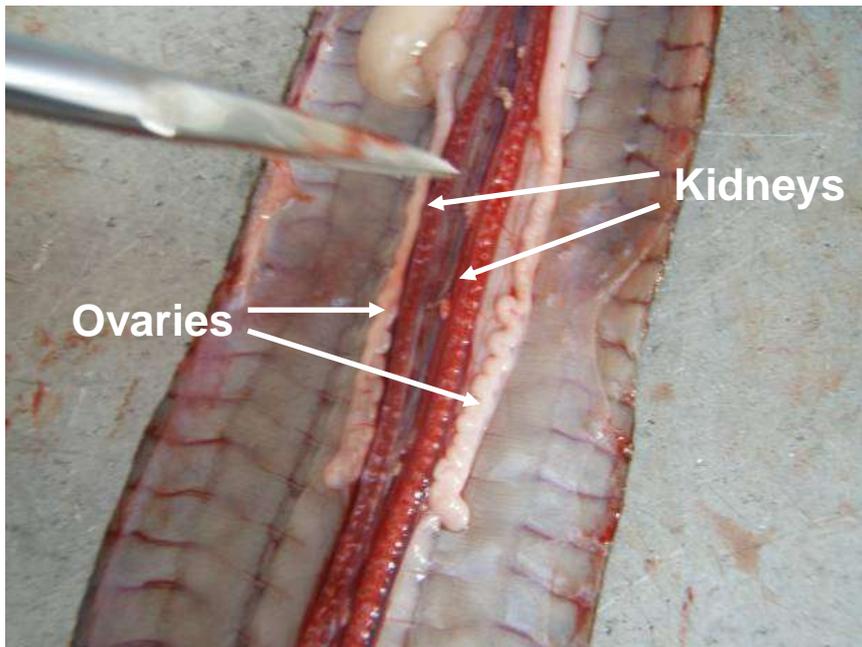
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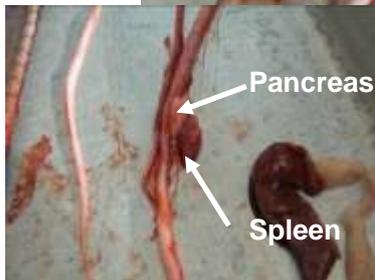
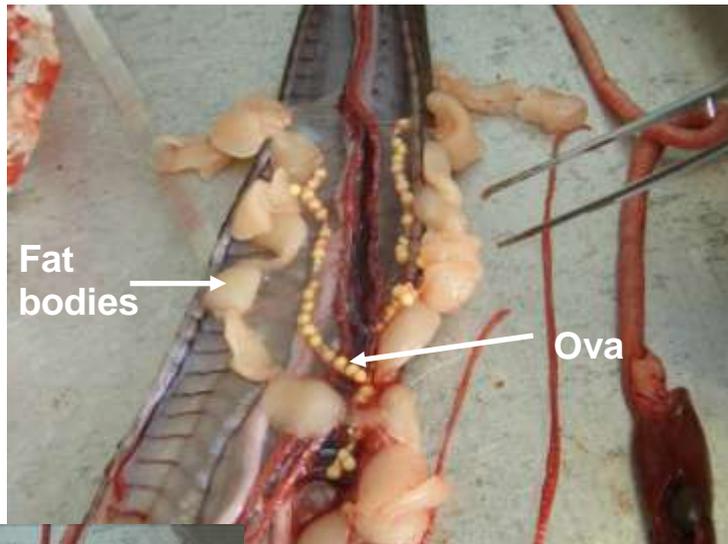
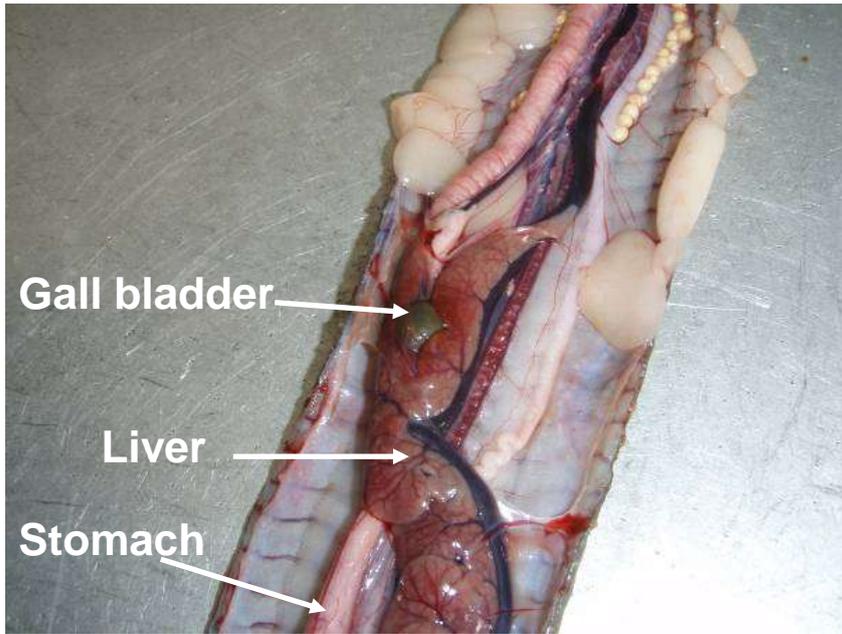
Appendix – Post mortem of female *T. natans*



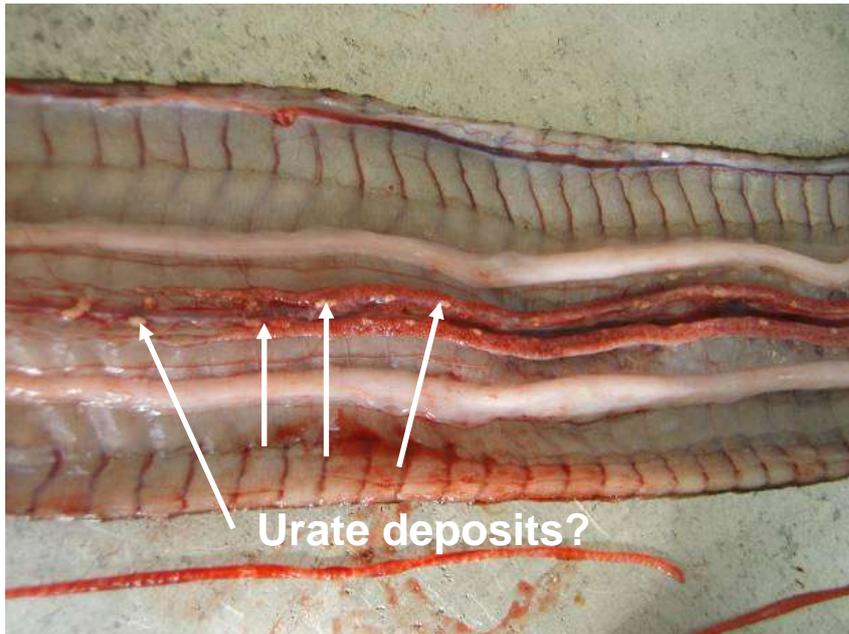
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