# Internal Parasites

## NEMATODES

There are over 500 identified reptilian nematodes, with most occurring in the stomach, small intestine, and large intestine. Certain larval forms are also found in the esophagus, lungs, and other unusual locations due to their migration as larvae. Pathological and deleterious effects are not always seen. Lesions are produced either as larvae migrate through organ systems or by adults entrenched in the gastrointestinal tract. Congregations in large numbers can result in organ obstruction, loss of nutrients, tissue destruction, and the introduction of bacteria.

A) **Roundworms** (*Ophiascaris* and *Polydelphis* sp. in snakes, and *Sulcascaris* & *Angusticaecum* in chelonians)

Ascarids (roundworms) are very common reptile parasites. They have an indirect life cycle and require intermediate hosts. Roundworms are acquired by ingesting intermediate hosts such as frogs, fish, amphibians, lizards, rodents, and marsupials.

Roundworm larvae regurgitated by an Arizona mountain kingsnake (*Lampropeltis pyromelana*). They have an indirect life cycle and require an intermediate host for successful reproduction. Photo by the author.



Reptiles can tolerate moderate loads as these parasites remain passive (not attached) in the GI tract, etc. The most common effect is a secondary malnutrition as these parasites can absorb and steal up to 40% of the usable nutrients available to the host. In a stressed animal that is not eating well, this loss of nutrients can be significant. Impactions of the GI tract, bile ducts, and pancreatic ducts can occur with large parasitic loads. Roundworm larvae migrate through various organ systems as part of their life cycle which can lead to purulent, ulcerative, and inflammatory lesions in the lung, trachea, and other sites. This creates an opportunity for secondary bacterial infections.

Diagnosis is usually based on finding thick-walled eggs in fecal flotations, but in heavy infestations adult worms may be passed in feces or regurgitated contents. Roundworms and tapeworms are the only common endoparasites that can be seen by the naked eye as adults. They appear as round, white, spaghetti-like worms ranging from 1/2 inch to 4 - 6 inches.

Roundworm egg seen on fecal flotation (photographed at x100).

Treatment consists of giving Panacur® (fenbendazole) at a dosage of 25-50 mg/kg orally, once a week for two to three treatments. Because this parasite hs an indirect life cycle, the reptile cannot reinfest itself. If food sources are the intermediate hosts then options such as 1) considering other food sources, 2) freezing food items first, or 3) de-parasitizing food colonies should be considered.

B) **Hookworms** (*Kalicephalus* sp., snakes; *Oswaldocruzia* sp., lizards; *Camallanus* sp.; and *Spinoxys contortus* sp., fresh water turtles)

Hookworms are parasites with a direct life cycle and are very common in reptiles. These parasites have very little host specificity and can pass to a number of potential hosts. The larvae that hatch from the eggs passed from the host can penetrate skin or gain entrance via contaminated food or water. In captivity, tremendous loads can build up in relatively short time periods.

Hookworms can be found anywhere from the esophagus to the rectum. These parasites attach themselves to the intestinal lining and

Hookworm eggs seen on fecal flotation (photographed at x100). Photo by the author.



feed on blood. This can lead to 1) hemorrhagic ulcers, 2) severe inflammation, 3) anemia, 4) peritonitis, and 5) an opportunity for bacteria to invade.

Diagnosis is based on finding thin-walled oval eggs on fecal flotation. Bloody and/or mucus-laden stools are a common finding. These worms are not visible to the naked eye.

Treatment consists of giving Pancur® (fenbendazole), at a dosage of 25-50 mg/kg, once weekly for at least two to three treatments. Strict cleanliness, prompt removal of feces, and frequent changing of bedding materials are steps required to prevent larvae hatching from eggs from gaining direct access to the host. Repeat fecals should be checked at least twice.

C) **Pinworms** (*Oxyurus* sp.)

Pinworms are very common, especially in lizards and turtles. These parasites have a direct life cycle and are acquired by exposure to fecally contaminated food and water.

Pinworm eggs (oval) as seen on fecal flotation (photographed at x100). Photo by the author.

Pinworms usually live in the lower GI tract and cause little overt disease. Obstruction and impactions have been reported in iguanas and tortoises.

Diagnosis is based on finding eggs on fecal flotation. Treatment consists of giving Panacur® (fenbendazole) orally, at a dose of 25-50 mg/kg, once a week until negative stools are obtained.

Mouse pinworms are often seen in stools of rodent-eating reptiles. These eggs came from the ingested rodent and the eggs are passed through the GI tract. Mouse pinworms do not cause disease in reptiles.

D) **Stomach worms** (*Physaloptera* sp.)
This parasite occurs almost exclusively in lizards that eat the intermediate hosts (ants). The indirect life cycle with ants as the intermediate host limits this parasite to lizards who dine on ants as their staple diet, like horned lizards (*Phrynosoma*).

Larva of stomach worm (*Physaloptera*) viewed under themicroscope (photographed at x100). This parasite occurs almost exclusively in ant-eating lizards. Photo by the author.



Stomach worms can cause inflammation and obstruction of the GI tract.

Diagnosis is based on finding eggs on fecal flotation. Treatment consists of giving Panacur® (fenbendazole), at 25-50 mg/kg, given once a week until negative fecals are obtained.

E) **Lungworms** (*Rhabdias* sp. in snakes, *Entomelas* sp. in lizards)
The snake lungworm has a direct life cycle and is a common parasite found in frogs, toads, snakes and chameleons. The larvae that hatch from eggs can gain entrance to the host by percutaneous penetration and by ingestion of fecally contaminated food and water, similar to hookworms.

Lungworms generally have limited effects on the host. Like hookworms, their direct life cycle allows them to build up in large numbers. A "verminous" pneumonia, characterized by gaping mouth, wheezing, and exudate from the trachea, can be seen in heavily infested or extremely stressed animals. The author has confirmed reports from breeders that they had poorly nourished or "double-clutched" snakes dying from such a verminous pneumonia.

The lizard lungworm, *Entomelas*, has a very similar life cycle and behavior, and causes symptoms similar to those of the snake lungworm, *Rhabdias*. Diagnosis is made by finding characteristic eggs in fecal floats, or by find larvae and ova in sputum. If a snake that has been gaping its mouth is found dead with excessive sputum containing larvae, it is due to these *Rhabdias* lungworms.

The recommended treatment is Panacur® (fenbendazole) at 50-100 mg/kg (a slightly higher dose than with the other nematodes) or with ivermectin at 0.2 mg/kg orally. Panacur® is given weekly and ivermectin every two weeks for at least two to three treatments. As with other direct life cycle parasites, strict cleaning, removal of fecal matter, and good hygiene is required.

F) **Strongyloides**

This parasite is similar to *Rhabdias*, but exerts its effects primarily in the GI tract. *Strongyloides* has a direct life cycle, and larvae hatching from eggs gain access to the body by percutaneous penetration and oral ingestion of fecally contaminated food and water.

Diarrhea due to GI irritation is the most common symptom, often with mucus-laden stools. The infective larvae migrate through the lungs of the host and, occasionally, respiratory distress is noted.

Diagnosis is based on finding larvae, not eggs, in fresh fecal samples. Many fecal samples might contain larvae from eggs that were passed and hatched. However, a fresh sample (collected within minutes of passage) that contains larvae instead of eggs is usually *Strongyloides*. Eggs, when seen, are thin-walled and contain larvae and are very similar to those of *Rhabdias* and *Entomelas*.

Treatment consists of giving Panacur® (fenbendazole) orally, at 25-50 mg/kg, once a week, for at least two or three doses. Due to the direct life cycle, strict cleaning and hygiene is required.

*Strongyloides* larvae among eggs characteristic of *Strongyloides* or *Rhabdias*. Larvae found in fresh stools are more characteristic of *Strongyloides*. Photo by the author.



G) **Hepatic worms** (*Capillaria* sp.)

*Capillaria* are seen in lizards and snakes. These parasites have an indirect life cycle (perhaps direct as well) and are acquired by ingestion of the intermediate host. The author primarily found these in garter and water snakes that have eaten earthworms.

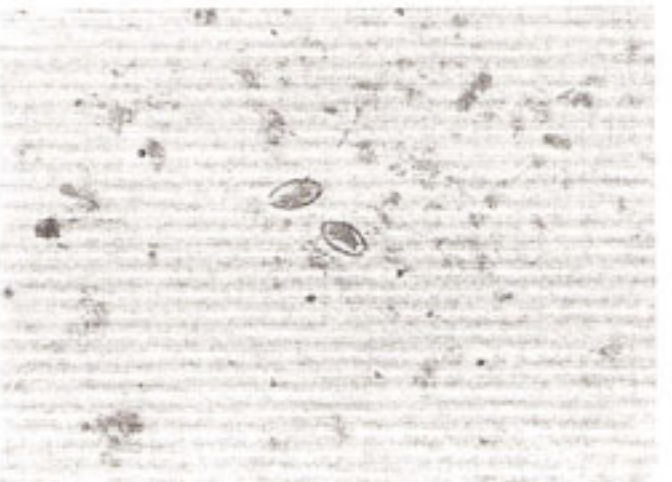
Heavy parasite loads can cause reduced hepatic function in affected reptiles.

Diagnosis is made by finding operculated (football shaped with knobs on both ends) eggs on fecal floats.

Treatment consists of giving Panacur® (fenbendazole) orally, a 25-50 mg/kg, once a week for at least two or three treatments.

H) **Filarial nematodes** (*Oswaldofilaria, Foleyella, Macdonaldius*)

Filarial nematodes are either rare or rarely diagnosed in reptiles. They have an indirect life cycle and are transmitted by arthropods such as ticks or mosquitos and live in the blood stream of the host.



*Capillaria* eggs viewed under the microscope (photographed at 100x). Note the football shape and operculated ends. Photo by the author.

Effects on the host are variable as they are normally found in the blood stream of certain hosts, particularly boids, colubrids, vipers of western Mexico, and in old world chameleons. Problems relating to the circulatory system as with heartworm disease in dogs is possible. In aberrant hosts these filarial worms can migrate and cause blisters and ulcers of the skin.

Diagnosis is based on finding the filarial worms on direct examination of blood smears.

Treatment is accomplished by giving ivermectin at 0.2 mg/kg orally, once every two weeks for two to three treatments.

## PROTOZOANS

The protozoan parasites are very common in reptiles. There is some controversy as to the significance of some of these protozoans, as they are so common as to suggest that they are non-pathogenic. The protozoans we will be discussing all have direct life cycles and thus can build up in captivity. As with all parasites with direct life cycles, cleanliness and good hygiene are essential to their control.

### A) Amebiasis

Far and away the most important protozoan parasite in reptiles is *Entamoeba invadens*, which can be extremely pathogenic. It can exist in carrier animals in which it does no harm, but can be devastating to other reptiles in other geographic regions.

*Entamoeba* is not rare, but not as common as it has been in years past. It is acquired by ingestion of fecally contaminated food and water and from the environment (cysts are the infective stage). A number of animals that seldom become affected or die can serve as carriers. These include garter snakes, northern black racers, and box turtles. While most turtles are resistant, the giant tortoises are very susceptible. Other resistant groups include eastern kingsnakes, crocodiles, and cobras, possibly as an adaptation that allows them to eat snakes. Most boas, colubrids, elapids, vipers, and crotalids are highly susceptible.

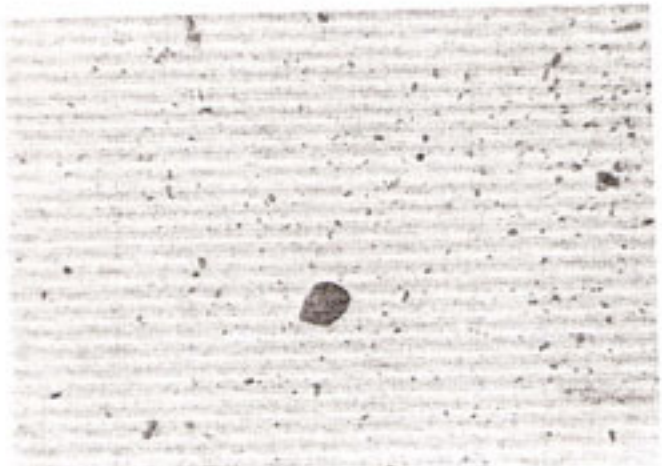


The clinical signs are highly variable, but amoebic dysentery can lead to anorexia, wasting, dehydration, and death. These animals usually are anorectic and often pass mucus-laden, bile-stained, and/or bloody stools.

The diagnosis of *Entamoeba* is made by finding the amoeba, uninucleated trophozoites, or multi-nucleated cysts in smears of fresh stools.

The drug of choice is Flagyl® (metronidazole), at 25-50 mg/kg, given orally once daily x 5-10 days. Post treatment fecals should be carefully monitored. The maximum dose given to tricolor king snakes, indigo snakes, and Uracoan rattlers should be 40 mg/kg.

Some researchers (Frye, 1991) have suggested that this dosage range may be inadequate for the boid snakes. He suggests a dosage of 125 mg/kg. It is very important to change bedding frequently, remove feces promptly, and observe proper hygiene.



**Trophozoites and cysts of *Entamoeba* on a direct smear viewed under the microscope (photographed at x100). Photo by the author.**

Since carrier animals do exist, the aforementioned species that are common carriers should be carefully evaluated before mixing with susceptible species. Many cases of amoebic dysentery were traced back to infected feeder animals or contaminated water.

B) **Coccidia** (*Eimeria, Isospora, Caryospora, Cryptosporidium* sp.)
These parasites are common protozoans that are generally acquired by exposure to fecally-contaminated food, water, and the environment.

Coccidia, like most of the protozoans, rarely cause problems in free-ranging animals. Coccidia are another example of a parasite with a direct life cycle that builds up in captivity and is aided by stress, poor hygiene, etc., of its host.

Symptoms vary from animals that are feeding but have mild diarrhea, to reptiles afflicted with severe diarrhea, anorexia, debilitation, and eventual death.

Oocysts of coccidia viewed under the microscope (photographed at x400). These oocysts are small and can be difficult to locate. Photo by the author.



Diagnosis is based on finding oocysts on direct fecal smears or fecal flotas of fresh stools.

Treatment consists of orally administering sulfadimethoxine (Albon®) at a dosage of 50 mg/kg daily for three days, and then the same dose every 48 hours as is required to eliminate the parasite. Strict hygiene measures are a must.

C) **Cryptosporidiosis**
This coccidian parasite strikes fear into the heart of the bravest herper. This because so little is truly known of the signifcance of this parasite. Some authoriities claim the reptilian parasite to be capable of causing disease in humans. While there is no doubt that cryptosporidia can induce pathology, many authorities feel it is blamed for too much.

*Cryptosporidia* have been found in lizards and snakes since first reported by Brownstein (1977). Snakes and lizards seem to be the only reptiles in which the parasite will cause disease. Immunocom-

*Cryptosporidium* oocysts (dark dots) viewed under the microscope (photographed at x100). This parasite is currently not treatable and can be devastating when present in collections. Photo by the author.

promised individuals, such as young and very stressed individuals, are the most commonly affected. In human medicine this disease is most commonly seen in three groups of patients. AIDS patients, due to their poor immune status, are commonly affected. Frye reports that veterinary students and meat packers are commonly affected, but the disease caused is limited to about thirty days, and is characterized by gastrointestinal symptoms. This zoonotic potential impacts the treatment and disposition plan of affected animals as will be discussed.

If healthy specimens are exposed to cryptosporidia, they may become affected by a mild diarrhea for 2-4 weeks or may be completely asymptomatic. Affected animals can become carriers that shed the protozoal agent for up to a year or longer. For obvious reasons, affected animals need to be strictly isolated from the rest of a reptile collection.

As with the other protozoans, cryptosporidiosis is confracted by exposure to sporulated oocysts in contaminated food and water, and also the surrounding environment. Its direct life cycle allows for build-up in captivity. Due to this direct life cycle, cryptosporidia pose a direct threat to any or all reptiles that come into contact with them. The life cycle of cryptosporidia is not completely known, but some researchers, the author included, feel that infected mice can transmit the disease to snakes that eat them. If a group of snakes is found to be affected by this disease, then it is recommended that the client have some mice from their colony or supplier sacrificed for examination. Mice can be asymptomatic carriers of cryptosporidia.

The main lesions induced by this parasite cause severe irritation of the stomach wall (snakes) or intestinal wall (lizards) leading to vomiting/regurgitation. Initially, vague signs such as anorexia, listlessness, wasting, and depression may be noted. In snakes, thickening of the stomach wall leads to an inability to retain food, and regurgitation is common. A firm, mid-body swelling is often noted in affected snakes, due to the extreme swelling and thickening of the stomach lining. However, the author has seen several cases where the stomach thickening was noted only on post-mortem exam, and was not

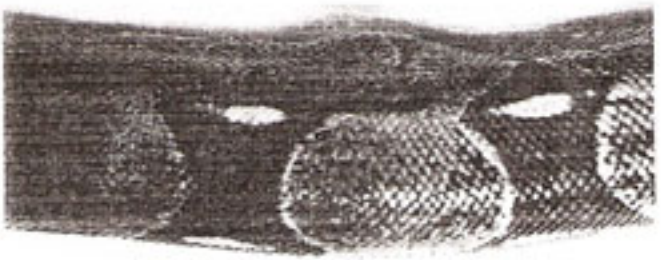


observed externally. In lizards, the intestine rather than the stomach is the site of pathology, and the intestinal lining does not become thickened. Death is a very likely consequence in an affected animal, although they may linger on for months or even years.

The author suspects the presence of cryptosporidia in snakes whenever chronic regurgitation is accompanied by:

1) failure to respond to conventional therapy;
2) extreme weight loss (up to 60-70%);
3) depression (may be due to gastrointestinal pain);
4) mucus-laden, cottage-cheesy stools;
5) mid-body firm mass.

The mid-body firm mass, with the aforementioned signs, is almost conclusive evidence of cryptosporidia. Not all snakes, and no lizards, will show this firm mid-body mass. A mid-body firm mass in a snake with no gastrointestinal problems is unlikely to be due to cryptosporidia.



A boa constrictor with an abdominal bulge caused by cryptosporidiosis. Photo by the author.

Diagnosis is difficult, but coccidia-like oocysts can be demonstrated on direct smears. These oocysts are very small and can easily be overlooked. Staining with acid-fast stains or even with the merthiolate mentioned earlier will help to define these tiny oocysts. Stomach flushes or mucous from regurgitated meals can be collected to examine. The author prefers an acid-fast stain (carbol-fuchsin and brilliant green), in which the oocysts will appear as small red organelles on a green background. G. Allen-Tate (1992) recommends staining fresh fecal material as it will have a richer content of oocysts. An impression smear may not be as productive, due to the organism's invasion of the tissue. In difficult cases, where a high index of suspicion exists, but the oocysts cannot be found, then a histopathology slide from a biopsy may be required. Unfortunately, this disease is often diagnosed during a necropsy following the death of the animal. Samples to be submitted for examination should not be frozen, and the fresher the sample, the better. Formaldehyde-preserved tissues will reveal the oocyst, if present.

To date, cryptosporidiosis is thought to have no treatment. Funk (1987) has suggested oral Trimethoprim-Sulfa at 30 mg/kg once daily or 15 mg/kg twice daily orally for seven days. The use of this regimen by the author has not impacted the course of the disease in affected animals. It is not known if the drug or supportive care offered is the most important component of this regimen. Supportive care consists of fluid, electrolyte, and nutrient supplementation. The author has stabilized affected animals by tube feeding a mixture of A/D (Hills foods) and lactated Ringer's solution every 2-3 days. Due to the bleak prognosis and potential for affecting other reptiles it may come into contact with, euthanasia is often suggested as a course of action by veterinarians. Affected individuals retained must be considered to be potentially very contagious and must be strictly isolated. The potential for the handler to be affected should also be considered when making a decision for the disposition of the affected animal.

D) **Flagellates**

There are numerous species of flagellates and their pathogenicity is questioned. These protozoans (*Hexamita, Trichomonas, Tritrichomonas*, etc.) are commonly found in the gastrointestinal tract of



reptiles. There is controversy over whether these are normal intestinal flora or true pathogens.

The flagellates are acquired by exposure to infective cysts in contaminated food and water, and during copulation. The effects on the body are variable. The author holds the opinion that small numbers of flagellates can be considered to be normal intestinal flora. However, large numbers in the presence of symptoms (diarrhea, mucous or blood in stools, anorexia, etc.) should be addressed.

Diagnosis is made on direct smears. It takes more practice and expertise with a microscope to accurately diagnose these parasites. Lugol's iodine or merthiolate help to highlight these organisms for easier viewing.

Treat with Flagyl® (metronidazole) orally, at 25-50 mg/kg once, with a follow-up dose, if needed, in three to four days.

**Trichomonads viewed under the microscope (photographed at x100). These flagellate protozoans can be present in many imported reptiles. To better visualize these protozoans, a drop of Lugol's iodine was added to the fecal material before it was mixed with saline on a smear. Photo by the author.**

## CESTODES

Cestodes, or tapeworms, are common inhabitants of reptiles and amphibians. All reptile cestodes require an intermediate host.

### A) **Tapeworms**

Reptiles acquire tapeworms by ingesting an invertebrate or mammalian intermediate host. As a parasite with an indirect life cycle, there is little risk of these parasites building or spreading within a colony. There usually are few symptoms associated with tapeworms, although in large numbers they can cause: 1) secondary malnutrition by competing for nutrients; 2) inflammation and enteritis due to mechanical irritation; and 3) actual mechanical obstruction.

Diagnosis is made by observing: 1) the eggs on fecal flotation; 2) detection of proglottids in stool; or 3) visibly seeing a tapeworm passed. Like roundworms, tapeworms are large enough to see with the naked eye. Proglottids are small pieces of the adult worm that break off and serve to carry eggs to the outside. They are often described as rice-like and desiccate quickly if another host isn't found.

Segment of a tapeworm passed by a Nile monitor (*Varanus niloticus*). Photo by the author.



Treatment is initiated with Droncit® (praziquantel) at 5 mg/kg orally or by injection. A second dose should be given in two weeks.

## TREMATODES

This group includes the digenetic and renifer group of flukes. These flukes are commonly observed in the mouth, esophagus, lungs, intestine, and kidneys of their host. Flukes are rarely transmitted in captivity, as they have an indirect life cycle and require an intermediate host.

### A) **Flukes**

Flukes are very common especially in indigo snakes, hognose snakes, kingsnakes, water and garter snakes. They are acquired by the ingestion of an affected intermediate host. As snails are a

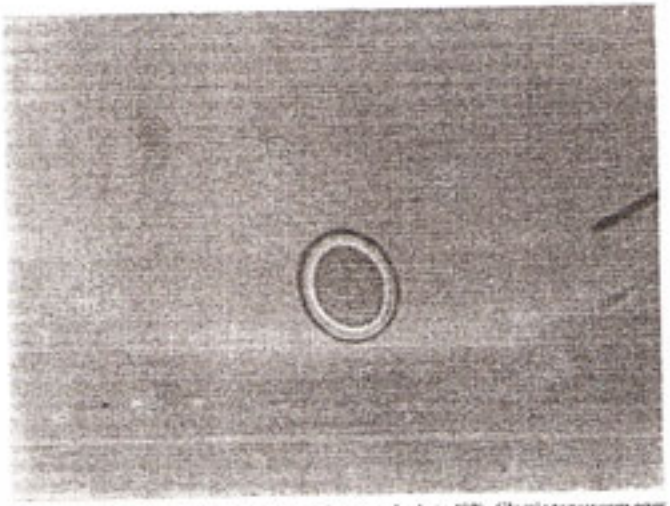
A tapeworm (top) and roundworms. Like roundworms, tapeworms can be seen with the naked eye. Photo by the author.

common intermediate host, flukes are often seen in aquatic turtles and reptiles that eat frogs and fish.

Flukes found orally, within the respiratory system or on superficial tissues, rarely cause any damage. Affected snakes occasionally have a gaped mouth. Renal flukes have been reported in kingsnakes, indigos, tropical rat snakes, bushmasters, and boas, and can cause a chronic interstitial nephritis or other kidney damage.

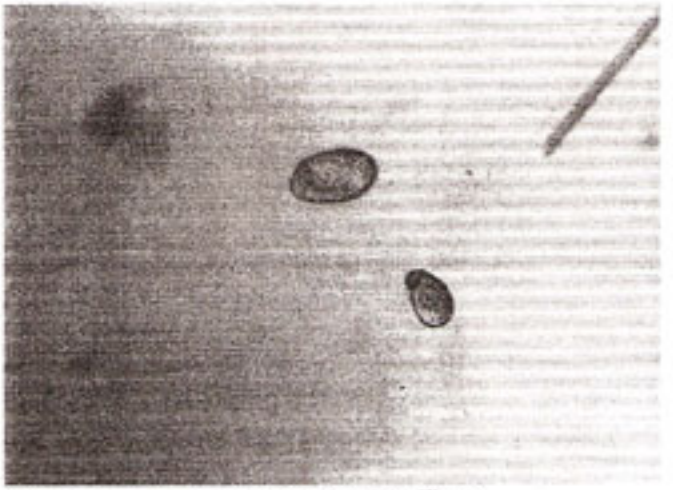
Diagnosis is by observing adult flukes in the mouth, cloaca, or feces. Ova can be found in the feces, but less commonly. Fluke eggs are large, yellow-brown eggs with a solitary operculum at one end.

Flukes are treated with Droncit® (praziquantel) at 5-8 mg/kg. Adult flukes observed in the mouth, etc., can be gently rolled up with a cotton swab and disposed of. Transmission can be prevented by freezing food items like frogs and amphibians for at least three days prior to feeding.

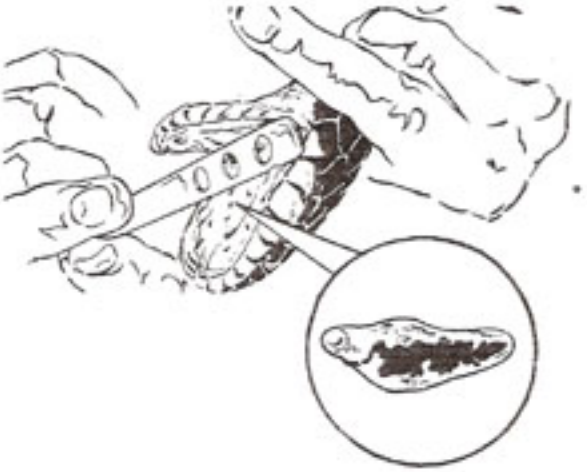


Tapeworm egg as seen on fecal flotation (photographed at x400). Classic tapeworm eggs have several dark "hooklets" in the center of the egg which can be visualized by focusing up and down (see egg reference drawings). Photo by the author.





Flukes in the mouth of a snake. Illustration by Glenn Warren.



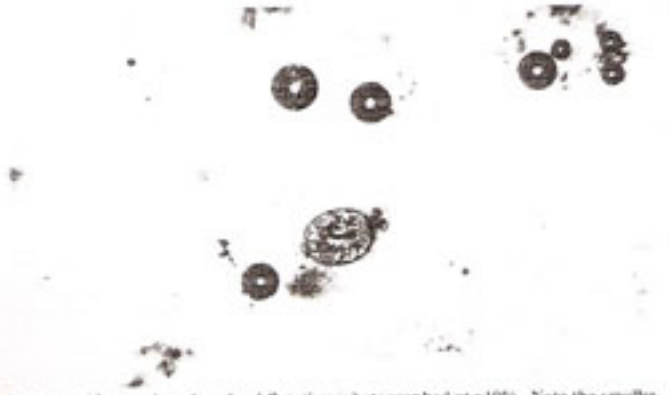
Fluke eggs as seen on fecal flotation (photographed at x100). These are large, heavy eggs, usually operculated at one end. Photo by the author.

## PENTASTOMIDS

The pentastomids are a group of parasites that migrate as larvae from the intestinal tract and undergo extensive organ migration. As adults, they tend to be found in the lungs and subcutaneous tissues.

These are not common parasites. *Armillifer armillifer* in pythons and vipers, *Porocephalus* sp. in boids and crotalids, and *Kiricephalus* in colubrids are the most frequently seen species.

These parasites have an indirect life cycle. Eggs containing the larvae are deposited and secreted from the lungs into the sputum and swallowed. The eggs are then passed in the feces, and a suitable intermediate host (insect, rodent, etc.) swallows the egg. The developing larvae become infective nymphs in the intermediate host, and the reptile host feeds on this intermediate host. Extensive larval migration occurs before adults form in the lungs and complete the cycle.



Pentastomid eggs viewed on fecal flotation (photographed at x100). Note the smaller, adjacent hookworm eggs. Photo by the author.



Despite large numbers and extensive larval migration, most infestations are without symptoms. In some cases, there can be damage to the tissue during larval migration or when in the lungs.

Diagnosis consists of observation of the adults or by finding eggs on fecal flotation. The adults are very primitive in appearance, often being described as looking like a prehistoric caterpillar.

Treatment is attempted with ivermectin at 0.2 mg/kg orally for at least two or three doses, two weeks apart.

## SUBCUTANEOUS PARASITES

The most common types of parasites found in a lump just under the skin are the plerocercoid stage of some tapeworms and, occasionally, a misguided pentastomid.

Regardless of type, a small incision through the skin and into the subcutaneous tissue will result in access to the parasite, which can easily be removed with tweezers. The lesion should be flushed with hydrogen peroxide solution or iodine, and an antibiotic ointment packed in the cavity. If the lesion is extensive, administration of systemic antibiotics should be considered.

Example of a subcutaneous parasite in the form of a misguided, migrating tapeworm. A small skin incision was made over the site at the fluctuant swelling and the tapeworm was teased out with forceps. Photo by the author.