SELECTED ENDOPARASITES IN REPTILES
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INTRODUCTION
Endoparasitism is a major cause of disease in captive reptiles. In captive bred animals the clinician will face a fairly limited number of parasites. However, it must always be kept in mind, that a significant number of wild-caught reptiles are still offered for sale, and these animals may harbour parasites which would not typically be expected (e.g. pentastomids, cestods).

Two studies have recently retrospectively evaluated reptile diseases presented to specialised exotic animal practices. Langenecker (2006) reported the clinical findings in 2620 reptiles presented to the Clinic for Zoo Animals, Exotic Pets and Wildlife of the Vetsuisse Faculty University of Zurich.1 Sinn (2004) analysed 1941 reptiles submitted for post mortem examination to the Ludwig-Maximilian-Universität in Munich.2 Both studies found that tortoises (Testudo spp.) were frequently affected by endoparasites (25% and 31%), whereas in terrapins (Trachemys spp.) endoparasites were rare. In snakes protozoan (amoebiasis and cryptosporidiosis) are of major concern, and it appears that the species Boa constrictor is more frequently affected by endoparasites than the ball python (Python regius). In lizards 40% had endoparasites, with oxyurids and coccidia in bearded dragons (Pogona vitticeps) being the main endoparasites diagnosed.

Endoparasites in reptiles should be seen as important predisposing factors for the development of diseases and clinicians are advised to include a parasitological examination in any reptile patient. The present summary emphasizes the main endoparasites in captive reptiles. For further information the reader is referred to the textbook by Schneller and Pantchev. 3

TORTOISES
Several institutions have reported endoparasitism in tortoises. In the wild, tortoises typically have a balanced parasite burden. Under captive conditions, however, an imbalance is more likely to occur because of stress factors such as inadequate diet, low temperature, or overcrowding. An imbalance of endoparasites may represent a serious threat to tortoises and may predispose them to other diseases. Some parasites are important parts of the intestinal microflora, especially ciliates, such as e.g. Balantidium and Nyctotherus. Treatment is not warranted. The most frequently diagnosed nematode in tortoises is of the order Oxiuridae. The clinical significance is unknown, but in animals showing signs of disease such as anorexia, weight loss or diarrhoea, treatment is recommended. Fenbendazole (50 mg/kg po SID for 5 days) and pyrantel (5 mg/kg po with a repeated treatment after two 2 weeks) have been used to treat nematodes in tortoises. Regarding the use of fenbendazole it should be noted, that one study in Hermann’s tortoises (Testudo hermanni) adverse effects were noted.4 The animals were treated twice with fenbendazole 50 mg/kg for 5 days with a 2 weeks break. Blood analysis revealed extended heteropenia with transient hypoglycemia, hyperuricemia, and hyperphosphatemia. An alternative might be the intracloacal application of fenbendazole, toxic effects have not been observed. Recently another nematode treatment was proposed for tortoises, lizards and snakes.5 A mixture of 1.98% emodepside and 7.94% praziquantel (Profender®, Bayer AG, Levekusen, Germany) was applied onto the skin of different reptiles. Reptiles up to 5 g body weight received 1–6 μl, those of up to 50 g body weight 7–70 μl, those of up to 500 g body weight 70–700 μl, and those up to 5 kg body weight received 700–7000 μl.

An important pathogenic protozoan parasite in tortoises and occasionally in terrapins are flagellates, that affect the kidneys, Hexamita. Infection occurs after ingestion of cysts, that are shed in the urine. Initially the parasite colonizes the intestine and subsequently invades the renal organs via the cloaca. The excreta of affected tortoises are soft and the urine has a jelly-like appearance. The motile parasite is easily identified in fresh samples. Clinical signs are linked to nephropathy and secondary effects may include metabolic bone disease. Treatment is with metronidazole (50 mg/kg po SID during 10 days) and disinfection of the terrarium is paramount, to avoid reinfection.

LIZARDS
Endoparasites are frequently diagnosed in agamid lizards (e.g. bearded dragon), chameleons and geckoes, but rarely in Iguana spp.. In one study it was found, that in affected bearded dragons (n = 63), 47% had Oxyurids, 39% had coccidia, 4% had flagellates, and 3% had Amoebae.1 Whereas in tortoises and snakes coccidia do not appear to be often related to disease, this parasite can

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be pathogenic in lizards, especially *Isospora* and *Choleoeimeria*. *Isospora amphiboluri* can cause significant morbidity and mortality in juvenile bearded dragons, while adults may be shedding large numbers of this parasite without clinical signs. Besides bearded dragons, chameleons are frequently affected, too. Pathogenicity of coccidia is linked to enteritis, which results in malabsorption and weight loss as well as dehydration. The latter leads to nephropathy, which ultimately will lead to death. Diagnosis is made by faecal flotation and detection of oocysts. Treatment is attempted with toltrazuril (10 mg/kg po twice). Small lizards may be difficult to treat by applying the medication individually. The author has successfully treated small panther chameleons (*Chamaeleo pardalis*) by spraying the animal for 5 days with a 0.1% solution of toltrazuril. Anticoccidial treatment is unsuccessful against *Choleoeimeria*, which affects the mucus membrane of the gallbladder and results in obstruction.

**SNAKES**
In captive snakes the most important parasites are protozoans, *Amoeba* and *Cryptosporidia*. Both parasites are transmitted directly by the faecal-oral route. *Entamoeba invadens* is the species most commonly linked to diseases. Clinical signs range from depression, anorexia, CNS signs and blood diarrhoea (due to colitis) to sudden death. Clinical signs typically occur late in the disease process. *Amoebae* can result in significant mortalities. Besides snakes lizards and carnivorous tortoises may also succumb to disease. Herbivorous tortoises are considered to harbour this parasite without showing clinical signs. It therefore is generally recommended, that herbivorous tortoises should not be housed together with carnivorous reptiles, especially snakes. *Amoebae* cysts or trophozoites can be detected in the faeces. Adding a drop of iodine to the fresh faecal sample facilitates the detection of the *Amoebae*. For external analysis samples should be fixed and shipped using sodium acetate–acetic acid–formalin (SAF) fixative. Animals suffering of amoebiasis should be separated from cagemates for treatment and the terrarium thoroughly disinfected. Desiccation helps to eradicate *Amoebae*. Treatment may be successful with a combination of metronidazole (50 mg/kg po SID during 10 days), which only affects trophozoites and paromomycin (50 – 100 mg/kg po SID for up to 4 weeks), which also affects cysts. It should be noted, that paromomycin is potentially nephrotoxic and monitoring the hydration status of the patient during treatment is important. Prognosis is guarded to bad.

*Cryptosporidia* represent an important threat to reptiles, especially snakes, because currently no effective treatment exists. Therefore the detection of this parasites should be included in any reptile quarantine. The two main species of *Cryptosporidia* in reptiles are *C. serpentis* and *C. saurophila*. Both affect snakes and lizards. *C. serpentis* typically affects the stomach and results in hypertrophic gastritis, which is clinically obvious as a midbody swelling. Regurgitation has been observed in snakes with cryptosporidiosis. *C. saurophila* affects the intestine and clinical signs include weight loss and abdominal swelling. Juvenile geckoes appear to be frequently affected. If *Cryptosporidium* spp. are to be found, a fresh faecal sample must be submitted. The parasite is detected by special staining, PCR or ELISA. Treatment has been attempted with paromomycin, but this does not appear to completely eliminate *Cryptosporidia* and euthanasia may be necessary to eliminate the risk of spreading.

**REFERENCES**