

## Captive snake's care as parasite's life cycle conservation program

Formidable parasitic infections are a common health problem in exotic reptiles lately introduced to European pet markets. Besides the common acts of negligence, some immanent noxious effects during acclimatization may aggravate the wasting of the reptile, especially stress by enforced enclosure, lack of hygiene, and many a well-intentioned animal keeper's erratic behavior. Merging into biological oddities like progenesis, that is premature sexual maturation in a morphologically juvenile organism, peculiar epidemiological effects concerning the intermediate hosts (= the organisms in which a parasite passes its larval, pre-sexual existence) and the definitive host (= the organism in which a parasite gains its adult and sexual existence) of parasites may result. This case report is given to expert keepers of exotic animals and pets, herpetologists and reptile veterinarians with the intention to evoke thoughtfulness on the unanticipated effects, while creating the artificial biocenosis.

A Bristly Bush Viper *Atheris hispida* LAURENT, 1955, recently imported from Uganda via Slovakia to Austria, weighing 24 g, died briskly five weeks after being force fed on reportedly defrosted autochthonous water frogs (*Rana* sp.) with symptoms of a disseminating *Monocercomonas* infection (RICHTER et al. 2008). Necropsy revealed cachexia, severe anaemia, and an infestation with about three hundred opaque, exsanguinous flukes adhered to the mucosa of the oral cavity (Fig. 1), oesophagus and stomach. The eye-catching, but obviously minor pathogenic distomes were identified as *Pleurogenoides* sp., most probably *P. medians* (OLSSON, 1876) or *P. compactus* (STROM, 1940), by morphological and biometrical criteria after the implementation of a carmine staining (ODENING 1955; ANDREAS 2006). Additionally, an infection with the facultative pathogenic protozoan *Monocercomonas* sp. was diagnosed by gene amplification, mainly in the cloaca, ureters, kidneys and the pancreas (RICHTER et al. 2008).

In the literature digenean trematodes crawling in a snake's oesophagus are casually identified as *Ochetosoma* flukes (e.g. SCHNELLER & PANTCHEV 2008), although this genus is definitely a member of the neotropic realm and, in cases of recurring infestations of pet snakes in Europe, this exotic distome would thereby be designated an exceptional neozoon, as it would be an invasive animal in an artificial ecosystem. The visual nature of the parasites detected is however perfectly consistent with the morphological description of the Palearctic anuran fluke genus *Pleurogenoides* (TRAVASSOS, 1921; Trematoda: Lecithodendriidae) according to RYZHIKOV et al. 1980. In Europe, the distribution area of the genus *Pleurogenoides* presumably covers the range area of its key host, water frogs of the genus *Rana*, keeping in mind the unsettled species differentiation within this genus. The fluke's body (Fig. 2) is elliptical, with rounded anterior and posterior ends, up to 2.0 mm in length, 0.56 mm in maximum width at the level of testes; the surface is armed with dense spines at the anterior end, which disappear toward the posterior end of the body. The oral sucker is sub-terminal and spherical, the ventral sucker lays almost equatorial and is slightly smaller than the oral one. The uterus is located post-acetabular and post-testicular, it occupies the entire area up to the hind region of the body, and it forms numerous ascending and descending coils. It is filled with many ovoid, dark brown eggs of 0.03 mm x 0.016 mm; and these egg-filled uteri are distinguishable as brown spots even in Fig. 1.

The obligatory parasitic trematode *Pleurogenoides* has been considered to pass through a straightforward, indirect reproduction cycle, including two intermediate hosts, freshwater snails (*Lymnea*, *Bithynia*, *Planorbarius*) and dragonfly larvae, and European anurans, *Rana*, *Hyla*, *Bufo*, *Bombina*, and *Pelobates*, as definitive host (e.g. BESPROZVANNYKH 2000; DÜŞEN & ÖZ 2004; ANDREAS 2006). Surprisingly, apparently grown-up flukes of *Pleurogenoides tener* (LOOSS, 1898) were detected naturally parasitizing Egyptian chameleons (*Chamaeleo chamaeleon* LINNAEUS, 1758) (GROSCHAFT & MORAVEC 1983) and Ukrainian Sand Lizards (*Lacerta agilis* LINNAEUS, 1758) (MACY



Fig. 1: *Pleurogenoides* sp. in the oral cavity of *Atheris hispida* LAURENT, 1955.



Fig. 2: *Pleurogenoides* sp., dorsal view, carmine staining, bar: 0.4 mm.

1964) even – observations, which generate the problem of the genuine host status of the taxons subjected to infection. In consideration of the known facultative progenesis of this distome (GRABDA KAZUBSKA 1976; LEFEBVRE & POULIN 2005), an alternative interpretation of the observations can be given: dragonfly larvae act as paratenic hosts (= a substitute of an intermediate host, in which no ontogenetic development of the parasite occurs), and a modified life cycle involving precocious metacercaria becomes operative immediately. Our case report may spotlight this topic – four hypotheses of ascending probability are addressed:

First, in Central Africa exists a yet undescribed, *Pleurogenoides*-like *Ochetosoma* species with an unknown life cycle and Bush Vipers as the definitive host. Secondly, *Pleurogenoides* is a bizarre parasite genus, in Europe able to use anurans as genuine definitive hosts where anurans are common, and Squamata elsewhere. Thirdly, the adult distomes may survive the gorging of their hosts,

penetrate the tissue of the ingested frog corpus, and adhere to the oesophagus of the predator for an ultimate chance of egg deposition. This option of some distomes, but definitely not *P. medians*, was experimentally verified some years ago, regrettably written down as a non citable reference (BOZHKOVA without year). Fourthly, and the hypothesis with maximum parsimony, *Pleurogenoides* is an exceptional fluke genus modifying its life-cycle according to ecological requirements, integrating paratenic hosts and skipping definitive or intermediate hosts (GRABDA KAZUBSKA 1976). As the metacercaria of *P. medians* attain such a degree of maturity that they do not only produce viable eggs, but cannot be distinguished from genuine adults morphologically (= neoteny; LEFEBVRE & POULIN 2005), the second intermediate host, water frogs, may occasionally be considered as the definitive host – making *Pleurogenoides* a classic anuran parasite. The European *Pleurogenoides* flukes seem to display facultative life-cycle modifica-

tions as alternative survival strategies, with normal, modified, and abbreviated cycles simultaneously present in the parasite populations. The evolutionary force behind this oddity is the infrequency of the transmission act between intermediate and definitive host. The metacercaria of *Pleurogenoides* infect an intermediate host, perennial water frogs, that outlive the parasite (LAGRUE & POULIN 2009). A fortuitous transmission of the precocious parasite larva to the genuine definitive host puts the life-cycle simply back on track – as observed in the case presented.

Especially stenoeicous and thus frequently endangered exotic reptile species seem to be favored victims of grotesque parasitism caused by bizarre, opportunistic and/or facultative pathogenic microorganisms in captivity. Even well meant actions of the reptile keeper can produce counterproductive effects, if an infective organism with an unknown ecology establishes itself in the artificial ecosystem of captive reptile care. In the case described, the only significant noxious effect detected during transport and acclimatisation of the snake was the feeding with local frogs, apparently housing autochthonous parasites, which could not be killed by short-time freezing in a domestic refrigerator. Establishing breeding in captivity of rare and endangered reptiles simultaneously broadens the life basis of some odd parasitic organisms – undesirable, but unavoidable effects, which confer species conservation efforts an extensive, extraordinary, and maybe even innovative subject matter.

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**KEY WORDS:** Reptilia: Squamata: Serpentes, *Atheris hispida*, Bristly Bush Viper; Trematoda, Digenea, *Pleurogenoides medians*, *Pleurogenoides compactus*, trematode infection, fluke, anura, *Rana*, progenesis, definitive host, parasitology, exotic pet keeping

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**AUTHORS:** Andreas R. HASSL, Micro-Biology Consult Dr. Andreas Hassl, Ameisgasse 63-4-12, 1140 Vienna, Austria; Barbara RICHTER & Anna KÜBBER-HEISS, Institute of Pathology and Forensic Veterinary Medicine; Department of Pathobiology; University of Veterinary Medicine Vienna; Veterinärplatz 1, 1210 Vienna; Austria

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Autor(en)/Author(s): Hassl Andreas R., Richter Barbara, Küber-Heiss Anna

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