

Morphological deformity due to metacercaria infection – is it to make prey more vulnerable to predation for successful parasite transmission?

Digenetic trematodes require more than one (many a time more than two) hosts to complete their lifecycles. First intermediate host is always a gastropod snail and the second intermediate host/s generally include/s aquatic invertebrates and lower vertebrates. Definitive hosts are vertebrates, right from fishes to mammals. Composition of the parasite fauna largely depends on the ecological associations of the hosts and the mode of parasitic transmission from metacercaria to adult stage depends on the predator–prey association of their hosts.

Frogs harbour diverse species of adult and larval (metacercariae) trematodes^{1–5}, some of which are pathogenic to their hosts. They can cause severe disability and death of the host when they become too abundant⁶. The borderline between those which parasitize live without causing damages to the hosts as commensals and those which cause definite damage and disease is not always easy to determine⁷.

Even though the Western Ghats have rich fauna, flora and high level of endemism, the parasite fauna is least studied. Heavily infected frogs of the genus *Fejervarya*, of which two (one in 2018 and the other in 2019) with altered morphological feature – an abnormal pouch (a bulging) at their posterior ends (Figure 1) – were observed while studying the trematode fauna of frogs in the southern Western Ghats. The first frog was subjected to detailed scientific study.

Fejervarya sp. collected from Moolithode, Wayanad, Kerala during August to October 2018 and 2019 using sweep hand nets were maintained in the laboratory and fed occasionally with insects. Abnormal frogs were photographed using the Coolpix B500 (Nikon) digital camera. The infected frogs were sacrificed after narcotizing with chloroform and thoroughly examined for trematode metacercariae. Separated organs were also examined and the recovered parasites were studied under the phase contrast microscope ECLIPSE Ni-U (Nikon). Neutral red was used for supravital staining. Cantwell⁸ was followed to prepare permanent whole mounts of metacercariae with acetocarmine stain-

ing. Trematode metacercariae were photographed with the Y-TV55 (Nikon) digital camera attached to the ECLIPSE Ni-U (Nikon) phase contrast microscope.

The abnormal bulging (a pouch) at the posterior end of the frogs was 1.2 × 0.3 cm in size. Detailed examination revealed that the pouch was packed with the encysted metacercariae of the digenetic trematode, *Uvulifer* sp. (Figure 2).

Close examination of the skin revealed that both the deformed specimens were heavily infected with *Uvulifer* sp. Melanization was evident surrounding each parasite, throughout the skin. Normally, these parasites are almost invisible to the naked eye, but are easily seen due to the local melanosis stimulated by the infestation⁶. A total of 3600 individuals of *Uvulifer* sp. were recovered from the single

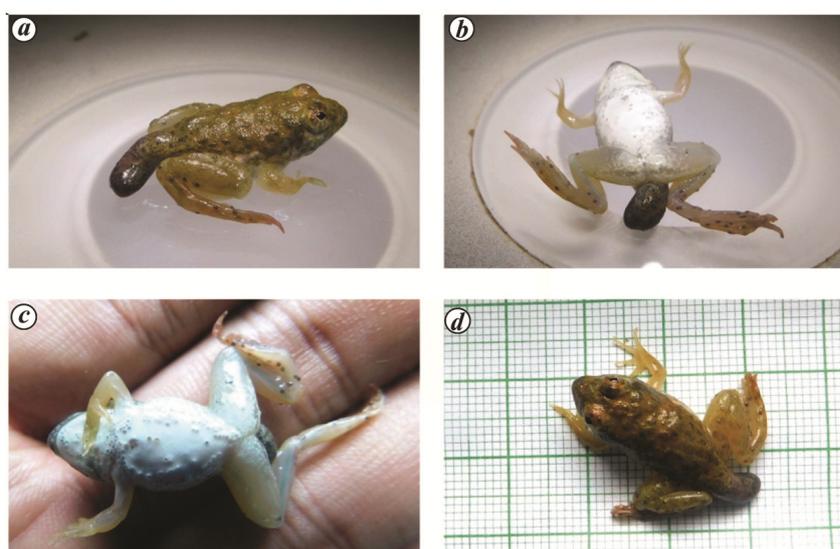


Figure 1. *Fejervarya* sp. with metacercariae: (a) dorsal view, (b) ventral view, (c, d) *Fejervarya* sp. showing encysted metacercariae of *Uvulifer* sp. under the skin.



Figure 2. Excysted metacercariae (a) and encysted metacercariae (b and c) of *Uvulifer* sp.

individual of *Fejervarya* sp. collected in 2018. Detailed examination of the anatomy of the frog revealed that the pouch was formed by the skin and subcutaneous tissue of the frog.

The genus *Uvulifer* was erected by Yamaguti⁹ with the type, *U. gracilis* from Kingfisher, *Ceryle lugubris* in Japan. It was followed by the addition of nine species under the genus *Uvulifer* by Yamaguti¹⁰. After that, eight species were added to it from different parts of the world. The infected frogs have parasite-induced altered morphological features and looks like having a tail with blunt posterior end. The pouch is formed as an extension of the posterior end of the body, which is filled with encysted metacercariae.

Changes in the morphological features may make the frog more vulnerable to predation and thereby promotes trophic level transfer of developing stages of parasites, so as to complete their life cycles. In the present study, the parasites significantly altered the appearance of the host to facilitate easier transmission to the definitive hosts as reported earlier¹¹⁻¹³. The natural definitive hosts of *Uvulifer* spp are birds. When the frog intermediate host/s with poor mobility and distorted morphology are present in the natural frog population, such hosts will be chosen by their predators (definitive hosts) as they are more vulnerable to predation. This may be treated as a strategy of parasites for successful transmission to the definitive host. Increased rate of contact between parasites and hosts, increases success rates in the transmission of parasites¹⁴. In terms of simple ecological energetic we can say that it may be advantageous to the predators if the weaker individuals from the prey population are selected¹⁵⁻¹⁷.

Literature survey reveals that disproportionately large number of parasite-infected preys are being taken by predators¹⁷⁻²⁰. In order to facilitate transmission to the final host, the parasites may significantly alter the behaviour and even appearance of their hosts¹¹⁻¹³. The pathology may lead to the death of parasites and hosts. It has been demonstrated that more profita-

ble prey items will be selected by predators for foraging²¹. It is a fact that heavily infected hosts or hosts with high intensity of parasites are more susceptible to predation as many parasitic infections may lead to host morbidity²².

All the four frogs (100%) screened were infected, of which two were with morphological deformity.

It may be concluded that, parasite recruitment can be enhanced by host density depending on the mode of transmission, and if the infected intermediate hosts are having poor mobility and morphological deformity, such hosts are more vulnerable to predation.

Ethical approval. For the present study, the institutional, national and international guidelines for the care and use of animals were followed. The study involving animals were made strictly following the procedures made in accordance with the ethical standards of the institution.

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P. K. PRASADAN*
K. SHINAD
SHERIN CHACKO

*Ecological Parasitology and Tropical Biodiversity Laboratory,
Department of Zoology,
Kannur University,
Mananthavady Campus,
Wayanad 670 645, India*

*For correspondence.
e-mail: prasadankp@kannuruniv.ac.in