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Coccidia (Apicomplexa: Eimeriidae) of amphibians of the world

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Abstract

The coccidia are protists (phylum Apicomplexa) that, likely, are both the most abundant (numbers of individual zoites) and most speciose of all the kinds of parasites found in, or on vertebrate animals. They also are among the least studied and understood, with the exception of those species that cause pathology in domesticated hosts. Here we review and evaluate all published descriptions of coccidians within the largest family of the phylum, Eimeriidae Minchin 1903, because there has never been a detailed taxonomic summation for those species that infect amphibians. About 35 of the named species are invalid, either because rules concerning the naming of new species (International Code of Zoological Nomenclature) were not followed and/or the original description was so incomplete as to be of little use; such names have been relegated to *species inquirendae*, *incertae sedis*, or *nomen nuda*. The class Amphibia has three orders, 56 families, 464 genera and 6009 species (Frost *et al*. 2006). There are no coccidia known from 41 of the 56 (73%) families, 436 of the 464 (94%) genera and 5964 of the 6009 (>99%) species. In the Anura (frogs), only 14 of the 44 (32%) families (Bombinatoridae, Bufonidae, Dicroglossidae, Hylidae, Hyperoliidae, Leptodactyllidae, Limnodynastidae, Megophyridae, Microhylidae, Pipidae, Ptychadenidae, Pyxicephalidae, Ranidae, Rhacophoridae), 30 of the 388 (8.8%) genera, and 67 of the 5283 (1.2%) species have been examined for coccidia and 30 coccidia are known (18 *Eimeria*, 9 *Isospora*, 2 *Goussia*, and 1 *Hyaloklossia* species). In the Urodela (salamanders), 7 of the 9 (78%) families (Ambystomatidae, Amphiumidae, Cryptobranchidae, Plethodontidae, Proteidae, Salamandridae, Sirenidae), 18 of the 64 (28%) genera and 45 of the 553 (8%) species have been examined and 21 coccidia are known (19 *Eimeria* and 2 *Isospora* species). In the Gymnophiona (caecilians), only 1 of 3 (33%) families, 1 of 12 (8%) genera, and only 1 of the 173 (0.6%) species, *Dermophis mexicanus* (family Caeciliidae), have been examined and 1 *Eimeria* species is known. Also in the Amphibia, there are 10 *species inquirendae* (a species of doubtful identity), 22 *incertae sedis* (uncertain taxonomic position), and 5 names are considered *nomen nuda*. In general, herpetologists are encouraged to be more receptive to working with parasitologists to use comparative parasite data that might provide insights into amphibian evolution and habitat use. The eimeriid coccidia are ideal parasites for such cooperative efforts because they can be collected easily by noninvasive fecal collections.

Key words: Eimeriidae, *Eimeria*, *Isospora*, *Goussia*, *Hyaloklossia*, review article