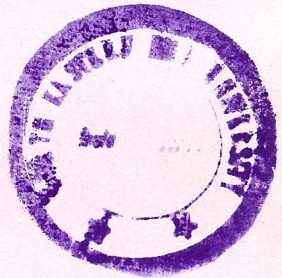


# HELMINTH PARASITE SPECTRUM OF AMPHIBIAN HOSTS IN MEGHALAYA

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THESIS SUBMITTED IN FULFILMENT OF THE DEGREE OF  
**DOCTOR OF PHILOSOPHY IN ZOOLOGY**

To



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MAY, 1989



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I certify that the thesis entitled " HELMINTH  
PARASITE SPECTRUM OF AMPHIBIAN HOSTS IN MEGHALAYA "  
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of Doctor of Philosophy in Zoology of the North-Eastern  
Hill University, Shillong embodies the record of ori-  
ginal investigation carried out by her under my super-  
vision. She has been duly registered and the thesis  
presented is worthy of being considered for the award  
of the Ph.D. degree. This work has not been submitted  
for any degree of any other university.

Date: 19<sup>th</sup> May, 1989

Place : Shillong.

*VTandon*

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*Catherine A. R. Diengdoh*  
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## PREFACE

For centuries, frogs have constituted one of the most favourable animal types for a wide range of biological studies. This group of vertebrates draws considerable importance in North-eastern region of India from the point of view of the fact that the amphibians constitute a consumable and a highly palatable food item for a section of local tribal population in the region, as in Korea, too (Heusser, 1974). Amphibians serve as a final host to all the major groups of animal parasites like Protozoa, Trematoda, Cestoda, Nematoda and Acanthocephala and, thereby, sustain a rich parasitic fauna; besides, a few helminth parasitic species are known to utilize amphibia as paratenic hosts for completion of their life cycle.

The group Amphibia comprising ~~of~~ toads, frogs and their congeners is one of the largest living orders among the vertebrates. There are as many as 2,600 species belonging to 250 genera (Heusser, 1974) and these extend through all temperate and tropical lands except perpetually snow capped mountains, waterless deserts and some islands of the Pacific. About 100 anuran species have been reported from the Indian subcontinent; out of these, approximately 40 species representing 6 different families occur in the N.E. region of India (Pillai and Chanda, 1976) and 30 species are distributed in the hills of Meghalaya (Sahu, 1981). The prevailing climatological conditions, viz. high rainfall and humidity coupled with moderate temperature seem congenial to the amphibian fauna in Meghalaya in comparison to only 16 species recorded from Arunachal Pradesh, 8 from Assam, 2 from Manipur (Pillai and Chanda,

loc. cit.) and 21 from Nagaland (Kiyasetuo, 1986). There is no record available for Mizoram and Tripura.

Though studies have been carried out on the ecology and biology of several species of amphibia (Roy, 1979; Sahu, 1981; Kumar, 1982; Kiyasetuo, 1986) from this region, a comprehensive account of parasitic infections associated with the great wealth of amphibian fauna of the region is completely lacking. In view of this, a study on the helminth parasitic spectrum of amphibian hosts in Meghalaya has been taken up. The present investigation aims at giving a first hand comprehensive knowledge of the various helminths parasitizing the commonly occurring and mostly edible species of Amphibia in the state. The focal aspects of the study include:

- (i) a record of the monogenea, digenea, cestodes, nematodes and acanthocephala, i.e., the whole helminth parasitic spectrum represented in these hosts accompanied by a brief description of each species dealt with herein;
- (ii) the surface fine topography (scanning electron microscopic studies) of the readily available parasite species so as to reveal features of functional significance or of adaptive value to the parasites; and
- (iii) seasonal incidence pattern and population dynamics of helminth parasites in relation to two anuran host species -- one of which hibernates during winter months (i.e., Rana limnocharis) and the other which does not (i.e., Rana cyanophylactis).

Abbreviations used in figures

CI SA	Cirrus sac
COR	Cortex
EX V	Excretory vesicle
GP	Gonopore
ILM	Inner longitudinal muscles
MED	Medulla
OV	Ovary
PUO	Paruterine organ
T	Testis
UC	Uterine capsule

## INTRODUCTION

Countries which are situated in the tropics or subtropics abound in helminth fauna and also provide the most optimum conditions for the growth and propagation of helminth parasites. Being in a tropical zone, India is by no means an exception to this for her helminth fauna are rich, both in number and variety. The vast majority of metazoan parasites known to invade vertebrate hosts are mainly representatives of three phyla, the Platyhelminthes (Trematoda and Cestoda), Nematoda and Acanthocephala. Many of the parasitic members of these three phyla collectively known as helminths form the causative agents of a terrible list of debilitating, deforming and killing diseases of man and animals and it is for this reason that they form interesting topics for study and research purposes. Helminthology being one of the oldest sciences, its references are found in ancient literature of India, Egypt and Greece; Indian Vedic literature bears ample testimony to this.

Hogson in 1820 first introduced zoology in India but it was not until 1841 that the earliest record of helminths from modern systematic point of view was made by Gilchrist in his book entitled 'A practical treatise on the diseases of elephants, camels and horned cattle', by which he described two types of worms (Ghosh and Chauhan, 1975). Credit of earlier work in helminthology goes to the enthusiastic officers of the medical and veterinary services such as Gaiger, Claryton Lane, Stewart, Sewell, Ware and Sheather who in their routine work came across worms and either described them or sent them abroad for classification. In later half of the nineteenth century or

in early twentieth century, several worm kinds have been mentioned by Sushruta in his treatise, 'Krimi Roga Pratishedh'. Dujardin, Cobbold, Bombford, Shipley, Gaiger, etc. made sporadic reports of various helminths from India but no systematic surveys were made then. Many comprehensive surveys and detailed studies on the helminth fauna of India were spear-headed by the Zoological Survey of India (Z.S.I.). Dr. B. Prashad (Southwell and Prashad, 1918a, b) is credited to be the first Indian worker to report some helminths from fishes. In addition, the very fascinating and interesting works by such pioneers in the Z.S.I. as Sewell (1918-26), Kemp (1919-22), Southwell (1918-26), Chauhan (1945-69), Mukherjee (1960-69), Srivastava (1961-69), Soota (1954-69) and Gupta (1962-69) need mention of (Ghosh and Chauhan, 1975).

With regard to the amphibian parasitic platyhelminthes the first studies were carried out with the observation by Swammerdam (1737) of a worm in the lungs of a frog. Roesel von Rosenhof (1758) described and figured from the urinary bladder of a frog, a leech-like organism which Zeder (1800) thought was his newly described Polystoma ranse. Goeze (1782) first recorded a cestode from a toad in Germany which he named Taenia dispar. Zeder (1800) considered Swammerdam's lung worm identical with a trematode he found and described it as Distoma cylindraceum. Rudolphi (1809, 1810) listed five species of trematodes, one monogenean and one cestode from amphibians. Dujardin (1845) gave fairly good accounts of many of the worms dealt by Rudolphi and mentioned nine trematodes, one monogenean and one

cestode. Diesing (1850, 1851) in his 'Systema Helminthum' presented a synopsis of all known parasitic worms but changed the scientific names of many worms. Linstow (1878, 1889) published list of helminth parasites and their hosts. Mace (1880) and Looss (1894) each gave descriptions of the monogeneans and trematodes of European amphibians. Bensley (1897), Pratt (1902), and Stafford (1900, 1903), following these works classified the trematodes recorded from North American amphibians. Luhe (1901) and Klein (1905) reported on trematodes in Asiatic frogs and Johnston (1912) wrote a monograph on trematodes of Australian frogs. In North America, Brandt (1936), Rankin (1938, 1944) and others have contributed several interesting and important studies on the ecology of platyhelminth parasites and their amphibian hosts. The most extensive contribution to the study was given by Walton (1964, 1967) during which time he issued a number of lists of parasites and their amphibian hosts as well as a bibliography. Yamaguti (1958, 1959, 1961, 1963) produced a series of treatises also entitled 'Systema Helminthum' in which diagnoses of families and genera with lists of species of helminths of the amphibia have been included. Yamaguti (1971) again revised his earlier work but dwelt more upon the erection of suprageneric taxa and not enough upon a critical appraisal of existing genera.

According to Yamaguti (1971), amphibian digenetic trematodes have been represented by thirteen families, seven of whose members are found to occur in the Indian subcontinent. In the Indian context, several notable workers in the field

include Klein (1905), Sewell (1920), Mehra and Negi (1926, 1928), Bhalerao (1926, 1936, 1937), Jordan (1930), Pande (1932, 1937, 1938), Srivastava (1933, 1934), Mehra (1937), Kaw (1943, 1950), Gupta (1954), Baugh (1956), Fotedar (1959), etc. Surveys conducted from the various localities by the above workers include, in chronological order, South India, Calcutta (Bengal), Allahabad (Uttar Pradesh), Nagpur (Maharashtra) and Allahabad, Kashmir, Punjab, Banaras (U.P.) and Kashmir. Chauhan (1953) published some comprehensive works on the Indian forms of Aspidogastrea, Gasterostomata and Prosostomata and these works adjudged as basic reference, stimulated further research in these fields. Mukherjee and Chauhan (1965) published the fifth part of 'Studies on the Trematode fauna of India' in continuation of the series initiated by Chauhan (1953).

Knowledge on cestodes of India is said to date back to the time of Herdman (1903) who discovered the presence of a minute larval cestode in the tissues of pearl oyster in Ceylon (Sri Lanka) which was responsible for low pearl production. Southwell studied cestode parasites of animals in Bengal, Bihar and Orissa, publishing a number of papers in 'Records of Indian Museum' (1913, 1916). These reports formed first-hand knowledge on the cestode fauna of the then British India. Southwell (1921, 1922, 1927), further in a series of papers made notable contribution to the study of cestodes from various vertebrate hosts and published 'Fauna of British India -- Cestoda' (1930). Chauhan (1949) recorded various cestode species from fowls, pigeons, ducks and fishes. Mukherjee (1962) extensively studied large collections of cestodes from Rajasthan and described

eight new species and recorded another eighteen species from various vertebrate hosts. However, the literature on amphibian cestode fauna is rather scanty (Wardle, McLeod and Radinovsky, 1974), more so in the Indian context. Yamaguti (1959) described three orders of amphibian cestodes, two of which are represented in India. Each of these orders is represented in turn by a single species found in both acaudate and caudate amphibians. Notable Indian contribution in the field of amphibian cestode fauna is that of Fotedar (1966).

The first observations on nematodes in the Indian sub-continent was recorded by members of the medical and veterinary services in the beginning of the 20th century. A number of European helminthologists have played their role in determining species new to science from both domestic and wild animals. Baylis and Daubney (1922, 1923) published fourteen new species and five new genera (besides proposing a few new subfamilies and higher taxa) from the numerous collections of material preserved by the Indian Museum, Zoological Survey of India, Calcutta. Based on various reports, 'Fauna of British India -- Nematoda : Part 1 & 2' was published by Baylis (1936). Yamaguti (1961) in 'Systema Helminthum' has described seven orders of amphibian nematodes, five of which are represented in India and adjoining region. Among the notable Indian workers, Stewart (1914), Karve (1927a, b, 1930, 1944), Chatterji (1936), Lal (1942, 1944), Khara (1954), Rao and Singh (1954), Singh (1958) are few names worthy of mention. The localities surveyed by them include Chilka Lake (Orissa), Muktesar and Poona (Maharashtra), Lucknow (U.P.), Burma, etc.

If studied, frog parasites can serve as valuable research models in solving many basic parasitological problems. The frog with its rich fauna of parasites can introduce students to many of its branches like taxonomy, morphology, cytology, physiology and ecology. Amphibian parasites also serve as superb experimental material to introduce students to some basic techniques in cell biology, physiology and experimental parasitology. Valuable surveys of frog parasites have been made by Mazurmovich (1951), Lees (1962), Vojtkova (1963, 1976), Walton (1964, 1967), Reichenbach-Klinke and Elkan (1965), Combes (1968), Cox (1971), Vojtkova and Vojtek (1975) and others.

It has been already mentioned that numerous Indian workers have been involved in researches pertaining to helminth parasites of amphibia from various Indian localities in the form of new host and locality records, new genera or new species. The present investigation on the helminth parasite spectrum of amphibian hosts in Meghalaya, although a preliminary random survey, is the first of its kind in North-East India and the state of Meghalaya in particular. Seventeen species of helminth parasites were recovered from the various localities surveyed. While all the species, except two, represent the already known forms, it is for the first time that the occurrence of all is being reported from the north-eastern region of India. The two forms, both monogeneans, one from Rhacophorus nigropalmatus and the other from R. leucomystax, respectively appear to be new to science. Of these, only one is being described herein as a new species, while the erection of a new species for the

other form is kept pending for want of some more material and confirmation of certain characters. However, their genus is being reported for the first time from India.

The present study includes a description of all these forms, with remarks on the already known species and a discussion on the validity of the new one. The type specimen of the form described as a new species are deposited in the helminthological collections of the Eastern Regional Station, Zoological Survey of India, Shillong, Meghalaya.

#### MATERIALS AND METHODS

##### Study area

The study area incorporates several localities (Fig. 1) coming under the jurisdiction of the Khasi, Jaintia and Garo Hills, based on physiographic divisions but not necessarily political entities of the state of Meghalaya. The state is located approximately between latitudes  $25^{\circ}10'N$  -  $26^{\circ}12'N$  and longitudes  $89^{\circ}49'E$  -  $92^{\circ}45'E$ .

Meghalaya, which means 'the abode of clouds' is situated between Assam plain on the north and Surma plain on the south. It is bordered on the north by Dhubri, Goalpara and Kamrup districts of Assam; on the east by North Cachar and Karbi Anglong (Mikir Hills) of Assam, and on the west and south by Bangladesh. The southern boundary is also the country's international border with Bangladesh.

Physiographically, Meghalaya is divisible into three