

## TAXONOMY AND DISTRIBUTION OF MEDICALLY IMPORTANT SNAILS OF THE GENUS *PARAFOSSARULUS* (CAENOGASTROPODA, RISSOOIDEA, BITHYNIIDAE) IN VIETNAM

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### ABSTRACT

Freshwater snails of the genus *Parafossarulus* are the major first intermediate host for Chinese liver fluke (*Clonorchis sinensis*), the causative agent of clonorchiasis affecting people throughout South East Asia including Vietnam. Information on both taxonomy and distribution of these medically important mollusks is contradictory, while the most precise data on biology of mollusk vector are necessary for better understanding of the disease epidemiology.

**Keywords:** *Parafossarulus*, distribution, morphology, major vector of the Chinese liver fluke, clonorchiasis, *P. chaperi*, *P. striatulus*, *P. manchouricus*.

### 1. INTRODUCTION

Genus *Parafossarulus* was established by Annandale with type species *P. striatulus* [4] from Zhejiang Province of China for bithyniids having spiral ribs [3]. Later, [13] reported the genus is widely distributed in China, Japan, Korea and Taiwan. Earlier the bithyniids with spiral sculpture were revealed in North Vietnam [16] and northeastern Myanmar [20]. Local data on more wide distribution of the *Parafossarulus* in Vietnam, including Mekong delta [9] are rather doubtful.

Records of the genus in Malay Peninsula [13] not supported in later field surveys are probably misidentification of *Digoniostoma*. Thus, snails of the genus *Parafossarulus* occupy East Asia from the Amur River on the north to northeastern Indochina on the south.

These snails are the first intermediate hosts for not less than of 13 trematode species in 12 genera, including *Clonorchis* and *Opisthorchis* as the most important for human [5, 6]. These trematodes constitute a public health hazard in many regions. The Chinese liver fluke, *Clonorchis sinensis*, the third most prevalent worm parasite in the world causes Clonorchiasis in humans [2] distributed from the Amur River basin to Indochina [5, 15] up to North Vietnam [17, 18]. Area of the Chinese liver fluke mainly coincides with that of the *Parafossarulus*. Among other snails, *Parafossarulus* species seem to be the major vector of the Chinese liver fluke [2]. The same is observed in North Vietnam, where parasitologists had long ago reported the

*Parafossarulus* to be the most important intermediate hosts of the clonorchiasis [11], infecting about 10 % [5], or even more than 30 % of local people [10].

Bithyniids of the genus *Parafossarulus* from North Vietnam (Figure 1, 2) are more often identified as *P. striatulus* [6, 8]. Some parasitologists [2, 15, 24] follow to [1], who proposed that the *Bithynia striatula* should be incorporated into the species *Parafossarulus manchouricus* distributed from Amur to Indochina. We support opinion that Vietnamese specimens belong to distinguished species *P. chaperi* described by [16] from the Tonkin Bay region [11, 22] (Figure 3). Distribution of the species *P. manchouricus* described from the Middle Amur River [7] is restricted by the Amur River basin without upper reaches [19]. Species *P. striatulus* described from Yangtze River mouth (Chusan Island) [4] occurs through Central and partly South China.



Figure 1. Alive specimens of the *Parafossarulus chaperi* from Nam Dinh Province of North Vietnam.

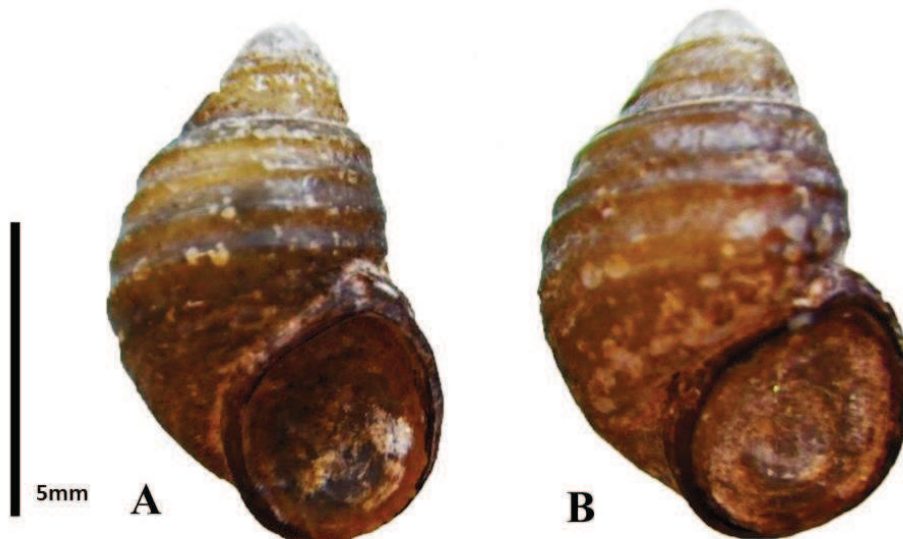


Figure 2. Shell of male (A) and female (B) of the *Parafossarulus chaperi* from Nam Dinh Province of North Vietnam. Scale bar – 5 mm.



Figure 3. Original picture of the *Parafossarulus chaperi* from North Vietnam by Morlet, 1886.

At least 12 valid species of the genus *Parafossarulus* distributed in different freshwater basins are described in malacological literatures [4, 7, 16, 25, 26]. They are difficult to identify because of similar conchology and corrosion of upper whorls. That suggests that substantial revisions of the genus taxonomy using molecular data are required, and further field surveys are needed for such revisions.

In accordance with data from IUCN Red List, *P. chaperi* (Figure 1-3) is only known from a number of locations in or near to Ha Noi: Grand Lac de Hanoi and Phu Quoc Oai, Tonkin [22]. Specimens used in the present study were collected in Nam Dinh Province of North Vietnam (20° 09'N, 106° 17'E) (Figure 4) from rice fields (Figure 5) during 2011-2014 by V. Besprozvannykh and A. Ermolenko (Institute of Biology and Soil Science). Irrigation system of these fields is connected with channels of the Red River delta. The species *P. chaperi* is most likely endemic for the Red River basin whereas all indubitable records of the *Parafossarulus* in Vietnam are restricted by the river delta.

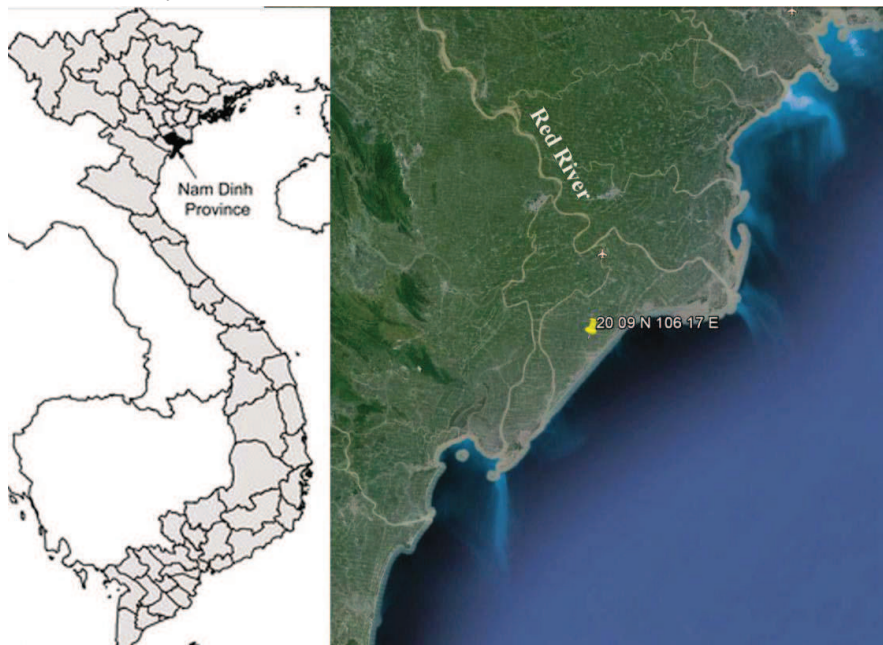


Figure 4. Map showing location of sampling area of the *Parafossarulus chaperi* (modified from Google Earth).



Figure 5. Rice fields with the *Parafossarulus chaperi* in Nam Dinh Province of North Vietnam (photo by V. Besprozvannykh, 5 April 2011).

Collected snails were transported in Institute of Biology and Soil Science of Far East Branch of the Russian Academy of Sciences (Vladivostok, Russia) alive, to study their parasites and morphology. Species identification was made based on original description and illustration by [16] (Figure 3). Sex of studied specimens was determined based on external soft body morphology. Shell shape of male and female specimens (Figure 2) demonstrates absence of sexual dimorphism described for Amurian *Parafossarulus* [19, 26].

Male reproductive anatomy of *P. chaperi* was examined earlier using histological method [21]. The male reproductive system of Vietnamese *Parafossarulus*, like that of other studied bithyniids [12, 14], is composed of the testis, seminal vesicles, prostate gland, vas deferens, and external penis with accessory gland and flagellum. The prostate of *P. chaperi* is composed of diverticula arranged in a flat belt what is opposite to lump-like prostate in Korean *Parafossarulus* [12]. In both species – *P. chaperi* [21] and Korean one [12] - tubular accessory gland is formed by a strongly coiled thin-walled tube.

Similar shape of last whorl and corrosion of upper whorls make difficult to discriminate *Parafossarulus* species based on morphology only. To define more exactly the species status of Vietnamese *Parafossarulus*, genetic data are necessary. Preliminary we regard *P. chaperi* as an endemic of the country, distributed in the Red River basin mainly.

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