



Reprint of “An overview of freshwater snails in Asia with main focus on Vietnam”[☆]



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ABSTRACT

Freshwater snails have received much attention for their role as intermediate hosts for trematodes causing disease in people and animals such as schistosomiasis and various food-borne trematodes. While effective medical treatment exists for some of these diseases there is need for preventive measures to reduce transmission, e.g. control of intermediate hosts because transmission patterns are often complicated due to presence of reservoir final hosts. In order to implement control measures against the intermediate host snails with minimal impact on the freshwater ecosystems and their biodiversity, a profound knowledge on transmission patterns of the trematodes is required and this is partly related to distribution, habitat preferences, and seasonal variation in density of the intermediate host species. Identification of snail species can be problematic on the basis of morphological and anatomical characters alone as some species show morphological plasticity and similarly morphological differentiation of cercariae found in snails may be difficult and this could lead to biased perceptions of intermediate host spectra and transmission patterns. In this paper, we give an overview of the snail families and their medical and veterinary importance in Asia but with main focus on Vietnam.

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1. Introduction

Freshwater snails (Fig. 1) constitute an important element of the freshwater fauna; thus they are very important consumers of primary production and secondary producers (Brönmark, 1989; Yeung and Dudgeon, 2014) and many species from across a wide range of taxa, both invertebrates and vertebrates may include snails in their diet and some species are specialized molluscivores (Brönmark, 1992; Dillon, 2000; Michelson, 1957). Certain species of freshwater snails are important as intermediate hosts for trematodes (Table 1) that cause diseases in humans or animals such as schistosomiasis (Attwood, 2001, 2009; Attwood et al., 2004, 2008; Muth et al., 2010) and various food-borne trematodes (Cabrera, 1984; Carrique-Mas and Bryant, 2013; Chai et al., 2005a,b, 2013; Cheng et al., 2011; Conlan et al., 2011; De, 2004; Fürst et al., 2012; Iwagami et al., 2000; Mas-Coma et al., 2005; Nguyen et al., 2012; Odermatt et al., 2007; Rim, 2005), and retard animal production in both terrestrial farming (e.g. cattle, sheep, goats, among others) and aquaculture e.g. fishes (Cortés et al., 2010) by interfering with somatic growth and reproduction. Several species may also serve as intermediate hosts of nematodes such as *Angiostrongylus* causing eosinophilic meningitis in people (Chen et al., 2011; Lv et al., 2009; Tesana et al., 2008). Other species, especially the apple snails are serious agricultural pests causing significant damage to newly planted rice fields (Greene, 2008; Joshi et al., 2001). In addition, several snail species in Asia are harvested as food for humans (Köhler et al., 2012, pers. obs.; Fig. 1).

The freshwater snail fauna in Asia is quite diverse and especially the large rivers, such as the Mekong have very high diversity of snails (Attwood, 2009; Davis, 1979; Köhler et al., 2012; Strong et al., 2008). Although, some snail control will be necessary in order to control some of the diseases transmitted by snails, this should be done only in limited areas and focussed on specific transmission sites if possible, in order not to jeopardize the unique diversity of snail fauna in the region. Threats to biodiversity of snails may include snail control measures (Kristensen and Brown, 1999), dam constructions along larger rivers, pollution and sedimentation and invasive species such as the Apple snails, especially *Pomacea canaliculata* (Köhler et al., 2012).

Although effective medical treatment exists for some of these diseases in humans and domestic animals, there is a need for preventive measures to reduce transmission, e.g. control of intermediate hosts, because transmission patterns are often complicated due to presence of reservoir final hosts which may not be possible to control (for example fish-eating birds in the case of heterophyid intestinal trematodes). It may be difficult to determine exact transmission sites from the distribution of infected intermediate host snails and exact identification of trematode cercariae based on morphological characters may not be possible. Also the prevalence of infection in the intermediate host snails maybe quite low, often less than 1% (Ngern-Klun et al., 2006) but sometimes can be higher (Kiatsopit et al., 2012) and yet this low level of infection in the snail host can result in high levels of infection in final (for schistosomes) or second intermediate hosts (Clausen et al., 2012; Madsen et al., 2011). In order to control these diseases effectively a detailed knowledge of transmission patterns is essential and a

holistic approach to control should be adopted. No single control measure is likely to produce sustainable reductions in infection level.

In order to develop interventions against snail hosts or pests, we need a clear picture of the entire snail fauna and especially the species that are involved as intermediate host for the various trematode caused diseases. Information is required about their exact distribution, preferred habitats, seasonal variation in density and prevalence of infections by the various trematode species causing disease. Many snail species or species groups may show substantial morphological plasticity (Correa et al., 2010) sometimes making exact identification based on morphological characteristics alone difficult. In this paper, we give an overview of the snail families and their medical and veterinary importance in Asia but with main focus on Vietnam.

2. Taxonomic position

Snails belong to the phylum Mollusca and the class Gastropoda. The only other class of Mollusca represented in freshwater is the Bivalvia. Traditionally the Gastropoda were divided into three subclasses Prosobranchia, Pulmonata and Opisthobranchia (Thiele, 1931) and many of the available identification keys follow this classification. Pulmonata and Opisthobranchia were grouped together in the clade Euthyneura. Caenogastropoda is a large group comprising about, 60% of living gastropod species (Ponder et al., 2008) and include most of the families of the former subclass Prosobranchia. A detailed description of the major clades within the Gastropoda is beyond the scope of this paper and readers are referred to (Colgan et al., 2007; Grande et al., 2004; Ponder and Lindberg, 1997; Ponder et al., 2008).

3. Identification

Characters that are used for identification vary among taxa and may include morphological characters such shell shape, coloration and size, characteristics of the whorls, sutures and aperture, shell sculpture, operculum characteristics, anatomical characters, characteristics of the radula etc. Often snails can be identified on the basis of relative dimensions of the shell. Terminology may vary somewhat from key to key. Useful keys for Southeast Asian snails include Yen (1939) for China, Pace (1973) for Taiwan, Brandt (1974) and Upatham et al. (1983) for Thailand, Burch (1980) for the Philippines and Thanh (1980) for Northern Vietnam and there are probably other local keys for other regions. Species lists of freshwater gastropods have been published for several areas (Brandt and Temcharoen, 1971; Burch and Chung, 1985; Sri-Aroon et al., 2005; Temcharoen, 1971).

4. Snail families represented in freshwater in Southeast Asia

4.1. Family: Neritidae Lamarck, 1816

These are species of medium sized snails with a characteristic shell, radula and operculum (Fig. 2). The family is of no known

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