DIVERSITY OF MOLLUSKS IN THE LAM TA KHONG RESERVOIR, NAKHON RATCHASIMA, THAILAND

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Abstract. Sampling surveys to study the diversity of mollusks in the Lam Ta Khong reservoir, Nakhon Ratchasima Province, northeast Thailand, were carried out in the hot, rainy and cold seasons. The study area was divided into: Area I-the upper part where the Lam Ta Khong river drains; Area II-the mid-section of the reservoir; Area III-behind the dam. Mollusks were collected from four locations on each bank (to the right and left) of each area. Each location was sampled to include 6 cross-sectional stations; in total, 144 stations were sampled. In the deep water, an Ekman dredge was used to collect samples; the scoop or manual method was used at the water's edge. Ten species of snails and four species of clams were found. The dominant species of snails were: *Clea helena, Bithynia siamensis goniomphalos* and *Melanoides tuberculata;* clams were dominated by *Corbicula* sp. The intermediate host of the human blood fluke was not found. The population of most mollusk species increased during the cold season while that of clams and that of some species of snails increased during the rainy season. Clams and operculate snails predominated in Areas II and III. Pulmonate snails were mostly found close to the bank and on aquatic plants especially in Areas I and II. Operculate snails and clams mainly inhabited water 1 to 10 m deep. Two species of edible mollusks were found: *Filopaludina martensi martensi* and large numbers of *Corbicula.* Neither shedding light nor digestion with pepsin A revealed any human parasites in the mollusks sampled.

INTRODUCTION

Man-made reservoirs serve agriculture, provide urban water storage, and generate power. They also seriously disrupt their surrounding ecosystems: native fauna are displaced and non-native species are introduced. Some species have the potential to pose risks to public health: snails and fish may act as intermediate hosts and insects may transmit parasitic and other vector-borne diseases.

In Thailand, many species of mollusks serve as the intermediate hosts of parasites. For example, the snail *Bithynia siamensis goniomphalos* is the intermediate host for the trematode *Opisthorchis viverrini* in northeast Thailand, which is a highly prevalent infection in inhabitants and is markedly correlated with cholangiocarcinoma (Jongsuksantikul *et al,* 1992; Vatanasapt *et al,* 1993). Other snails, such as *Filopaludina martensi martensi, Corbicula* sp and *Lymnaea auricularia rubiginosa,* serve as the first and second intermediate hosts of the intestinal fluke echinostomes. Nematodes, *eg Angiostrongylus cantonensis,* can vector through many kinds of snails (*eg Pila* sp, *Filopaludina martensi martensi*) (Vajrasthira and Yamput, 1971; Viboolyavatana *et al,* 1981; Burch and Upatham, 1989).

Dams and their reservoirs should have a baseline datum of aquatic life, which can be refered to when developing water resources and planning parasite control.

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MATERIALS AND METHODS

The Lam Ta Khong dam, constructed on the Lam Ta Khong river, is bound by moun-

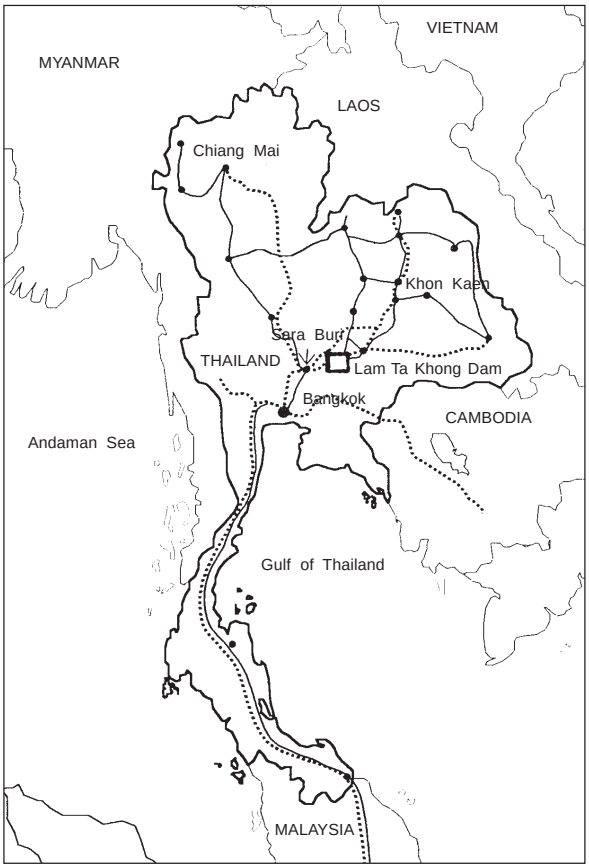

Fig 1–Map of Thailand showed the location of Lam Ta Khong dam.

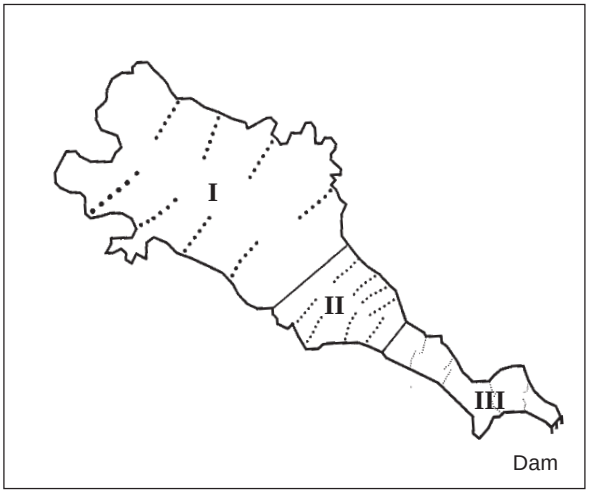

Fig 2–Sampling stations.

tains on the border of the Pak Chong and Sikhiu districts in the province of Nahkon Ratchasima (Fig 1). The dam began operating in 1969. At its greatest, the surface area of the reservoir is ~37 km^2; the dam's maximum capacity is 310 million m^3.

The reservoir was divided into three areas for mollusk sampling. Area I-the entrance to the reservoir-is where water enters from the Lam Ta Khong river. The maximum depth was 10 m. Some parts of this area are dry during hot season; Area II represented the middle of the reservoir; Area III was behind the dam-the deepest part of the reservoir (Fig 2). In 1994, mollusk sampling was carried out three times: once in the hot, dry season (April); once during the rainy season (July-September); once during the cold season (November).

In each of the three areas, four sampling locations were chosen by the water's edge. Each location was sampled in 6 cross-sectional stations. A total of 144 stations were sampled (Fig 2). The sampling method depended on the ecology of the station. An Ekman dredge was used in deep water twice at each station. The water level was measured using a marked rope on which hanged the Ekman dredge. The depth of the water and the characteristics of the mud, sand and soil substrata of each station were recorded. A hand scoop was used at the stations where aquatic plants grew: sampling at these locations was conducted five times for each station. Manual collection was undertaken by two people at stations where the soil was solid, sand, mud or rock. Sampling took 5 minutes at each station.

Mollusks in the mud or soil, found using a 1.2 mm sieve, were placed on a white tray. The sampled materials, which included water plants, were kept in large white bowls of water to keep the snails from crawling out. The mollusks were then put into plastic bags marked with

Table 1
Species of mollusks in the Lam Ta Khong reservoir.

Snails	Clams
Clea (Anentome) helena (Philippi, 1847)	*Scabies phaselus* (Lea, 1856)
Bithynia (Digoniostoma) siamensis goniomphalos (Morelet, 1866)	*Limnoperna siamensis* (Morelet, 1875)
Melanoides tuberculata (OF Muller, 1774)	*Corbicula* sp (Mehlfeld, 1811)
Stenothyra koratensis koratensis (Brandt, 1986)	*Scaphula pinna* (Benson, 1856)
Gyraulus convexiusculus (Hutton, 1849)	
Wattebledia siamensis (Hutton, 1849)	
Lymnaea (Radix) auricularia rubiginosa (Michelin, 1831)	
Filopaludina (Siamopaludina) martensi martensi (Frauenfeld, 1865)	
Bithynia (Gabbia) pygmaea (Preston, 1908)	
Camptoceras (Culmenella) jiraponi (Hubendick, 1976)	

Table 2
The total number of each species of mollusks which sampling in three seasons, found in each area.

Species	Number of mollusks			Total
	Area I	Area II	Area III	
Clea helena	110	513	321	944
Bithynia siamensis goniomphalos	90	266	29	385
Melanoides tuberculata	100	210	151	461
Stenothyra k. koratensis	39	167	86	292
Gyraulus convexiusculus	129	70	1	200
Wattebledia siamensis	0	5	0	5
Lymnaea auricularia rubiginosa	11	38	8	57
Filopaludina martensi martensi	2	17	0	19
Scabies phaselus	83	275	196	554
Limnoperna siamensis	72	228	295	595
Corbicula sp	5,002	8,652	9,230	22,884

the relevent station number. The mollusks were separated and indentified following the methods of Brandt (1974) and Upatham *et al* (1983). Mollusks were examined for parasitic infection by shedding under electric light and by digestion with 0.25 Anson units of pepsin A (for large-sized mollusks) at pH 2.2 at 37ºC for one hour. The parasites were examined under a dissecting microscope.

The presence of aquatic plants, the ecology of the station, and the water quality (including conductivity, turbidity and pH) were recorded.

RESULTS

Aquatic plants were found on the sheltered banks of Areas II and III and along most of the bank in Area I. Turbidity was generally high but gradually decreased towards Areas II and III. Area I had a broad surface area with shallow water; the banks in Areas II and III had steep slopes and the water was deep (between 15 and 19 m respectively at the deepest point). The substratum in Area I was sandy or clay-like mud; in Areas II and III, the substratum was decaying organic matter-

Table 3
The total number of each species of mollusks in each seasons (Hot, rainy, cold seasons) from three areas.

Species	Hot	Rainy	Cold	Total
Clea helena	272	265	407	944
Bithynia s. goniomphalos	33	117	235	385
Melanoides tuberculata	78	223	160	461
Stenothyra k. koratensis	13	79	200	292
Gyraulus convexiusculus	61	17	122	200
Wattebledia siamensis	0	2	3	5
Lymnaea auricularia rubiginosa	0	12	45	57
Filopaludina martensi martensi	0	17	2	19
Scabies phaselus	153	254	147	554
Limnoperna siamensis	73	280	242	595
Corbicula sp	6,674	9,296	6,914	22,884

Table 4
The frequency of sampling mollusks of each species which were found in 6 sations of different dept (including 3 seasons and 3 areas, total frequency of 72).

Species	1	2	3	4	5	6
Clea helena	14	33	38	34	27	26
Bithynia s. goniomphalos	20	12	14	12	14	14
Melanoides tuberculata	4	18	20	30	22	15
Stenothyra k. koratensis	4	8	18	10	16	14
Gyraulus convexiusculus	12	0	1	0	0	0
Wattebledia siamensis	1	1	0	0	1	0
Lymnaea auricularia rubiginosa	12	0	0	0	0	0
Filopaludina martensi martensi	3	0	0	0	0	0
Scabies phaselus	2	18	27	30	26	17
Limnoperna siamensis	14	30	27	18	15	19
Corbicula sp	32	62	65	61	57	46

black mud. The range of pH was 7.5 to 8.4. Area I turbidity at half-depth in rainy season was high (~24 NTU) and clear (4.5 NTU) in cold season.

Fourteen species of mollusks were found in the reservoir: 10 were snails and 4 were clams (Table 1). The most numerous mollusks were *Corbicula* sp. Between 1 and 10 m, the major population of snails was *Clea helena* and of clams was *Corbicula* sp (Tables 2-3). The operculate snails too were usually found in deep water; they were frequently found farther from the bank (stations 2-5). The pulmonate snails, such as *Lymnaea (Radix) auricularia rubiginosa, Camptoceras (Culmenella) jiraponi, Gyraulus convexiusculus*, usually lived on sallow water plants: they were often found near the banks (station 1) (Table 4) distributed in Areas I and II. The other species of mollusks were mostly distributed in Area II (Table 2). No mollusks were found in the middle of Areas II and III where the water was deeper than 12 m.

No human parasites were found in the sampled mollusks. *L. (R.) auricularia rubiginosa* was not infected with the animal schistosomes,

Orientobilharzia harinasutai, *Trichobilharzia maegraithi* or *Schistosoma incognitum* (Kruatrachue *et al*, 1965, 1968; Bunnag *et al*, 1983).

The mollusks increased in number during the cold season although species of the operculate snails, namely *M. tuberculata* and *F. m. martensi* and the clams, *Corbicula* sp, *S. phaselus* and *L. siamensis*, reproduced during the rainy season (Table 3).

DISCUSSION

The density of mollusks of each species was variously distributed in each area and the population fluctuated seasonally. The river stopped flowing due to the construction of the dam, resulting in a lower oxygen content below the surface of the water, decreased turbidity and a sedimentation of organic material: all may cause changes of inhabitant mollusks.

Pulmonate snails such as *G. convexiusculus, C. jiraponi* and *L. a. rubiginosa* were found primarily in Areas I and II, where they crawled onto the water plants and into the soil in the shallow water. In these areas, the surface area was the greatest and the water level changed significantly because the slope was very gradual and so, during the hot, dry season, it dried out. The clams or snails, which were partly buried in the mud, sometimes could not move towards the water and so died; the pulmonate snails, which floated and attached themselves to water plants, were drawn into the water and survived. The other reason why pulmonate snails were fewer in Areas II and III was the strong wind; the location of the reservoir, between mountains, creates a wind tunnel in which water plants grow only in sheltered areas. Most operculate snails and clams inhabited water of moderate depth (1 to 10 m). In Areas II and III, where the water was deeper than 12 m, mollusks were not found, possibly because the oxygen content was too low.

Area II had a large number of many kinds of mollusks, especially operculate snails, because of the high content of organic material in the substratum. The seasons affected the snail population: clams such as *S. phaselus, L. siamensis* and *Corbicula* sp and some species of snails reproduced during the rainy season; however, most snails increased their population during the cold season. During the rainy season, food for mollusks was abundant and the weather suitable. Broadcast fertilizers washed into the river nourishing the water plants, which in turn nourished the mollusks. During the cold season many species of mollusks increased in population: hatching during the rainy season and growing large enough to be detected by the dry season. Most populations declined during the hot, dry season. *B. s. goniomphalos*, the first intermediate host of *O. viverrini*, produce their progeny twice a year peaking during the rainy season (Brockelman *et al*, 1986). In the Lam Ta Khong reservoir, a small number of *B. s. goniomphalos* snails were found among the sampled mollusks; cercariae of the liver fluke, *O. viverrini*, were not found.

In the two species of edible mollusks, *Corbicula* sp and *Filopaludina martensi martensi*, no evidence of human parasites was found. A large number of *Corbicula* sp were discovered.

The only species of snail of the Viviparidae family was *F. martensi martensi.* Greater variety exists in the Sirikit dam (*Filopaludina (Filopaludina) sumartensis polygramma, F. (F.) filosa* and *F. (Siamopaludina) M. martensi)* and the Bhumibol dam *(Filopaludina (F.) doliaris, F. (F.) filosa, F. (S.) m. martensi, Idiopoma ingallsiana* and *Mekongia swainsoni*) (Temcharoen, 1992a,b).

ACKNOWLEDGEMENTS

The study was granted by Electricity Generating Authority of Thailand. The author thanks Mr Bryan Roderick Hamman for assistance with the English-language presentation of the manuscript.

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