SURVEY OF BRACKISH-WATER SNAILS IN EASTERN THAILAND

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Abstract. Various brackish-water snails in Thailand are known or suspected intermediate hosts of trematode diseases of human and veterinary importance. Surveys of brackish-water snails were performed in six provinces of eastern Thailand: Samut Prakan, Chachoengsao, Chon Buri, Rayong, Chanthaburi, and Trat. Thirty-five species of brackish-water snails were present in the studied provinces. They belonged to nine families: Neritidae, Potamididae, Muricidae, Littorinidae, Iravadiidae, Thiaridae, Stenothyridae, Assimineidae, and Auriculidae. Natural infection of brackish-water snails with trematodes was revealed through shedding and crushing methods. Several types of cercariae were found, with or without eye-spots, tail fin-fold, collar spines, and stylet.

INTRODUCTION

The literature concerning studies of brackish-water molluscs living in the mangrove areas and estuaries of Thailand is sparse. Brandt (1974) studied the mollusks of Thailand between April 1963 and February 1971. In his investigation, about the last third of the unidentified fresh- and brackish-water snail species was described. Systemic arrangement, including identification to genus and species of snails, both wet and dry specimens of Brandt's collection, and of the Faculty of Tropical Medicine's collection at Mahidol University, was revised and corrected by the world malacologist, Professor John B Burch, from the University of Michigan, Ann Arbor, USA, and published as "Identification keys to fresh- and brackish-water snails of Thailand" (Upathum *et al*, 1983). Since then, information on brackish-water snails was not progressed, especially snails of known or suspected intermediate hosts of trematode diseases of human and veterinary importance.

Thailand has developed shrimp farms immensely during the past decades. The industrial sector has also promoted the development of new shrimp farms in order to increase their income by export, local supply, and sale feed-stuffs for shrimp. Numerous industrial factories have been established in the Eastern Sea-Board Project. These developments have had adverse impacts on water resources and mangrove forests, and hence some biological entities living in them have also been disturbed and may be extinct, including brackish-water snails. This study aimed to 1) to fulfill the knowledge gap on the medical and veterinary importance of the brackish-water snails of Thailand, and, 2) to investigate the distribution of brackish-water snails currently inhabiting estuaries and mangrove forests in the eastern part of Thailand.

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MATERIALS AND METHODS

Twenty-six of 44 stations along the eastern coast of Thailand were visited for brackish-water snail collection during the period July 17-20, 2003. These stations were in six provinces, Samut Prakan, Chachoengsao, Chon Buri, Rayong, Chanthaburi, and Trat (Fig 1), in which 4,1, 6, 8, 5, and 2 stations were situated in each province, respectively. Two criteria for station selection were 1) situated at the estuary of a river or canal, and 2) situated in a mangrove forest in the province studied.

The brackish-water snails were collected by 1-hour search method, as described by Lohachit (2001). This method involved searching for snails at each station area for one hour. All likely habitats, including leaf-filled surface depressions, log-mud interfaces, log and stone crevices, soil or mud around the roots and on the leaves, stems and trunks of the mangrove trees, were examined, and the snails collected.

At each station, each of 6 persons searched for the snails, collected them by hand, placed them in a plastic bag which was labeled with the station number, and then placed all collected snails in ice buckets, in order to prevent the snails being killed by the hot weather. No water was added to the plastic bag containing the snails. At the end of each day, the snails kept in each plastic bag were examined for dead ones. If any snail died, it was transferred to a new plastic bag labeled with the same station number, in order to discard the decomposition products of the dead snail, which may

Fig 1- Map of Thailand showing the 6 surveyed provinces: 1. Samut Prakan; 2. Chachoengsao; 3.Chon Buri; 4. Rayong; 5. Chanthaburi; 6. Trat

cause other snails to die. In addition, the brackish water was collected in several large plastic bags and kept cool in an ice bucket. This brackish water was used to immerse the snails for cercarial shedding.

All snails were brought to the laboratory in Bangkok, identified for species, and screened for infection. Maintenance of brackish-water snails in the laboratory was managed in a plastic aquarium 15 cm wide, 28 cm long, and 8.5 cm high. Soil was added to the aquarium but no water. Snails were fed with freshwater diatoms cultured in the laboratory, as described by Davis (1971), and with fresh lettuce.

Snail identification followed the method of Upathum *et al* (1983) for family and genus, and Brandt (1974) and Van Benthem Jutting (1956) for species.

All brackish-water snails collected were screened to determine possible natural infections with trematodes. Two techniques, following that of Bruce (1985), were employed for screening purposes. The first technique involved exposing the snails to light for two hours, in order to induce shedding of cercariae. If the cercariae were emitted, the mature cercariae were identified, based on their morphological characteristics, as described by Malek (1962) and Bruce (1985). The second technique involved crushing some brackish-water snail shell to expose the internal organs. The organs were gently teased apart to search for parasitic larval stages using of a stereomicroscope.

RESULTS

A total of 6,013 live brackish-water snails was collected from estuaries and mangrove forests situated along the eastern coast of Thailand (Table 1). Among these snails, 859 brackish-water snails (14.29%) were obtained from Samut Prakan Province, while 100, 1,472, 2,152, 831, and 599 snails (1.66, 24.48, 35.79, 13.82, and 9.96%) were from the Chachoengsao, Chon Buri, Rayong, Chanthaburi, and Trat Provinces, respectively.

At least thirty-five species of brackish-water snails were found in the studied provinces, except that *Alectrion (Zeuxis) taenia* Gmelin needs more snail samples to be identified prior to reaching any conclusion (Table 1). Those species belonged to nine families: Neritidae, Littorinidae, Stenothyridae, Iravadiidae, Assimineidae, Thiaridae, Muricidae, Potamididae, and Auriculidae, in which 22 genera were present, excluding the genus *Alectrion*.

The distribution of the brackish-water snail species studied was not even. Not all of those brackish-water snail species were found in the six provinces. Only five species were commonly found in the five provinces. They were *Dostia violacea* (Gmelin), *Littorinopsis undulata* (Gray), *Assiminea (Sphaerassiminea) brevicula* (Pfeiffer), *Cassidula aurisfelis* (Bruguiere), and *Cassidula mustelina* (Deshayes).

It is also recognized that there are twelve species of brackish-water snails occurring only in three provinces, *Stenothyra polita* (A Adams), *Iravadia ornata* Blanford, and *Thiara scabra* (OF Muller), which were only found in Samut Prakan Province. *Nerita (Nerita) articulata* (Gould), *Neritodryas cornea* (Linnaeus), *Faunus ater* (Linnaeus), *Telescopium mauritisi* Butot, *Telebralia palustris* (Linnaeus), and *Laemodonta punctatostriata* (H & A Adams) presented only in Chanthaburi Province. Other snails,

Table 1
Brackish-water snails in eastern Thailand (July 17-20, 2003).

Family		Genus-Species	Province[a]/Number of snails						
			1	2	3	4	5	6	Total
Neritidae	1	*Clithon* (*Clithon*) *faba* (Sowerby)	3	0	0	200	11	0	214
	2	*Clithon* (*Pictoneritina*) *oualaniensis* (Lessson)	0	0	107	527	2	86	722
	3	*Dostia violacea* (Gmelin)	259	0	2	3	33[b9]	14	311
	4	*Nerita* (*Nerita*) *articulata* (Gould)	0	0	0	0	14	0	14
	5	*Neritodryas cornea* (Linnaeus)	0	0	0	0	11	0	11
Littorinidae	6	*Littorinopsis intermedia* (Philippi)	0	0	0	2	0	14	16
	7	*Littorinopsis melanostoma* (Gray)	2	0	20	1	0	0	23
	8	*Littorinopsis scabra* (Linnaeus)	0	0	170	120	201[b5] (1/40)[c]	82[b3] (1/20)[c]	573
	9	*Littorinopsis undulata* (Gray)	74	0	1	41	53	14	183
Stenothyridae	10	*Stenothyra polita* (A. Adams)	3	0	0	0	0	0	3
Iravadiidae	11	*Iravadia ornata* Blanford	138	0	0	0	0	0	138
Assimineidae	12	*Assiminea* (Ovassiminea) *obtusa* Wattebled	4	2	14	0	1	0	21
	13	*Assiminea* (*Sphaerassiminea*) *brevicula* (Pfeiffer)	146	98	193[b4] (4/68)[c]	9	44	0	490
Thiaridae	14	*Sermyla riqueti* (Grateloup)	80	0	257[b3,5] (5/80)[c]	76	2	0	415
	15	*Melanoides tuberculata* (O.F. Muller)	64	0	11	97	0	0	172
	16	*Tarebia granifera* (Lamarck)	13	0	17	0	0	0	30
	17	*Thiara scabra* (O.F. Muller)	1	0	0	0	0	0	1
Muricidae	18	*Chicoreus copucinus* (Lamarck)	0	0	0	1	21	0	22
????	19	*Alectrion* (*Zeuxis*) *taenia* (Gmelin)	0	0	0	0	4	0	4
Potamididae	20	*Cerithidea* (*Cerithidea*) *obtusa* (Lamarck)	1	0	1	0	0	2	4
	21	*Cerithidea* (*Cerithidea*) *quadrata* Sowerby	0	0	5[b3] (1/3)[c]	2	77	119[b1,8] (2/40)[c]	203
	22	*Cerithidea* (*Cerithideopsilla*) *alata* (Philippi)	0	0	0	9	102	0	111
	23	*Cerithidea* (*Cerithideopsilla*) *cingulata* (Gmelin)	0	0	386[b1,2,6] (6/110)[c]	572[b5] (18/65)[c]	109[b5] (21/21)[c]	52	1119
	24	*Cerithidea* (*Cerithideopsilla*) *djadjariensis* (Martin)	0	0	0	431[b5,6] (4/30)[c]	62[b6] (15/26)[c]	45	538
	25	*Faunus ater* (Linnaeus)	0	0	0	0	1	0	1
	26	*Telescopium telescopium* (Linnaeus)	0	0	0	0	0	2	2
	27	*Telescopium mauritsi* Butot	0	0	0	0	4	0	4
	28	*Telebralia palustris* (Linnaeus)	0	0	0	0	1	0	1
Auriculidae	29	*Ellobium aurisjudae* (Linnaeus)	8	0	27	0	14	8	57
	30	*Ellobium aurismidae* (Linnaeus)	0	0	0	0	0	36	36
	31	*Cassidula aurisfelis* (Bruguiere)	26	0	13	15	32	24[b7] (1/18)[c]	110
	32	*Cassidula multiplicata* Martens	0	0	1	0	0	6	7
	33	*Cassidula mustelina* (Deshayes)	33	0	244[b7] (2/15)[c]	46[b7] (1/17)[c]	26	33	382
	34	*Melampus* (*Micromelampus*) *siamensis* Martens	4	0	3	0	0	1	8
	35	*Laemodonta punctatostriata* (H & A Adams)	0	0	0	0	6	0	6
	36	*Pythia* (*Trigonopythia*) *trigona* (Troschel)	0	0	0	0	0	61	61
		Grand total	859	100	1,472	2,152	831	599	6,013

[a]Province: 1 Samut Prakan, 2 Chachoengsao, 3 Chon Buri, 4 Rayong, 5 Chantaburi, 6 Trat
[b1-9]found cercariae by type [c] = number snail(s) found cercariae/total snail crushing
Types of cercariae found: 1 Cercaria with cystogenous gland, neither eye-spot nor collar spines; 2 Cercaria with eye-spot and cystogenous gland; 3 Small cercaria with stylet; 4 Undetermined; 5 Cercaria with eye-spot, 4 and 3 penetration gland cells forming two rows and tail with fin; 6 Cercaria with eye-spot, 7 penetration gland cells lining and tail with fin; 7 Cystophorus cercaria within huge radia; 8 Cercaria with large excretory bladder; 9 Nematode infection.

Telescopium telescopium (Linnaeus), *Ellobium aurismidae* (Linnaeus), and *Pythia (Trigonopythia) trigona* (Troschel), were found only in Rayong Province.

Among all the brackish-water snails found in the six provinces studied, only nine species can mediate trematode diseases (Table 1). They were *Dostia violacea* (Gmelin), *Littorinopsis scabra* (Linnaeus), *Assiminea (Sphaerassiminea) brevicula* (Pfeiffer), *Sermyla riqueti* (Grateloup), *Cerithidea (Cerithidea) quadrata* Sowerby, *Cerithidea (Cerithideopsilla) cingulata* (Gmelin), *C. (C.) djadjariensis* (Martin), *Cassidula aurisfelis* (Bruguiere), and *C. mustelina* (Deshayes) (Fig 2), of which 4 species were found positive in Chon Buri, 3 species in Rayong, 3 species in Chanthaburi, and 3 species in Trat.

Seven types of cercariae were found from the naturally infected bracksh-water snails collected. The 7 types of cercariae found were: 1) cercaria with cystogenous gland, neither eye-spot nor collar spines, 2) cercaria with eye-spot and cystogenous gland, 3) small cercaria with stylet, 4) cercaria with eye-spot, 4 and 3 penetration gland cells forming two rows and tail with fin, 5) cercaria with eye-spot, 7 penetration gland cells lining and tail with fin, 6) cystophorus cercaria within huge redia, and, 7) cercaria with large excretory bladder. One type of cercaria was undetermined, while the other was a nematode worm (Table 1). Detailed results about cercariae will be published elsewhere.

The local people said that at least five brackish-water snail species could be eaten (Fig 3), *Cerithidea*

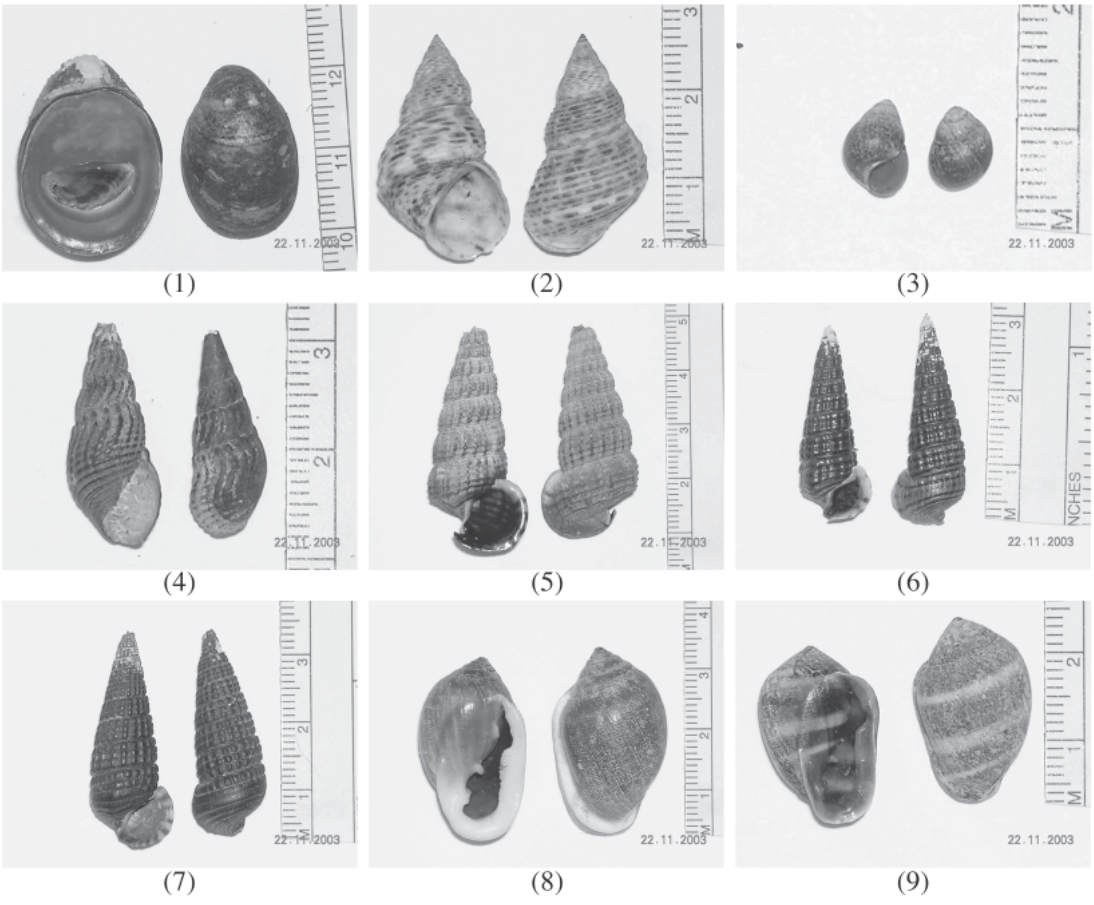

Fig 2- Brackish-water snails shedding cercariae :(1) *Dostia violacea* (Gmelin); (2) *Littorinopsis scabra* (Linnaeus); (3) *Assiminea (Sphaerassiminea) brevicula* (Pfeiffer); (4) *Sermyla riqueti* (Grateloup); (5) *Cerithidea (Cerithidea) quadrata* Sowerby; (6) *Cerithidea (Cerithideopsilla) cingulata* (Gmelin); (7) *Cerithidea (Cerithideopsilla) djadjariensis* (Martin); (8) *Cassidula aurisfelis* (Bruguiere); (9) *Cassidula mustelina* (Deshayes).

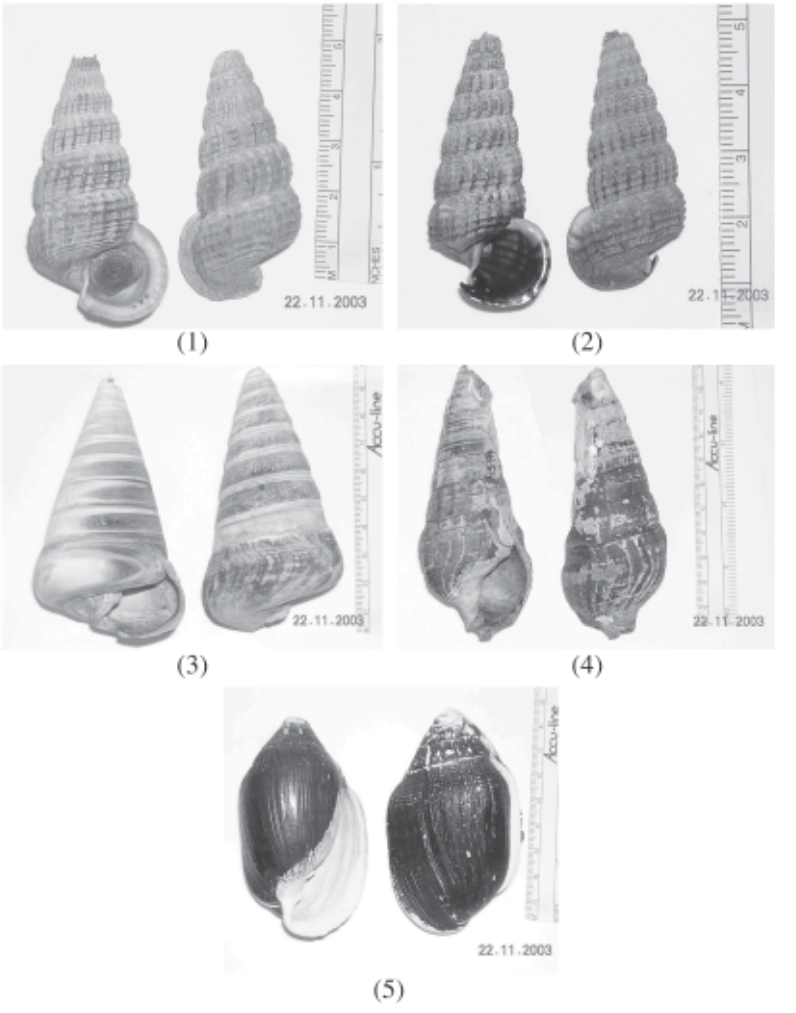

Fig 3- Edible brackish-water snails of eastern Thailand: (1) *Cerithidea (Cerithidea) obtusa* (Lamarck); (2) *Cerithidea (Cerithidea) quadrata* Sowerby; (3) *Telescopium telescopium* (Linnaeus); (4) *Telebralia palustris* (Linnaeus); (5) *Ellobium aurismidae* (Linnaeus).

(Cerithidea) obtusa (Lamarck), *C. (C.) quadrata* Sowerby, *Telescopium telescopium* (Linnaeus), *Telebralia palustris* (Linnaeus), and *Ellobium aurismidae* (Linnaeus). The first two snails are locally called 'hoy jub jang' in which the first snail has the specific name 'hoy kee lard' (snail causing diarrhea when eaten). The last species, *E. aurismidae*, is locally called 'hoy chalong'; to eat this species one must break its shell, since it is very hard and thick.

It is noteworthy that two live freshwater *Pomacea canaliculata*, or golden apple snail, which is a pest of rice cultivation, were found inhabiting the Na Jomtien Canal in an area of mangrove forest near Na Jomtien Temple, Sattahip District, Chon Buri Province. Numerous empty shells of the golden apple snail were also present in the stations investigated. Some brackish-water snails serving as food sources for local people were found being cultivated in the mud under a house and no-one was permitted to harvest these snails. In addition, some shrimp farmers, who had invaded the mangrove forests, did not allow the investigators to explore brackish-water snails in their farm areas, so 18 stations were not able to be surveyed for snails. Moreover, several species of brackish-water snails were found living on leaves, stems, and trunks of some mangrove trees.

DISCUSSION

The present study confirms the report of Brandt (1974), that brackish-water snails inhabit the estuaries and mangrove areas in the eastern part of Thailand. In the present survey, it seems evident that the more stations in a province visited, the greater the number of snails obtained (Table 1). Thus, there are variations in the numbers and percentages of snails collected in each province. However, the eastern part of Thailand is rich in brackish-water snails, since at least 35 of 96 species of snail occur there.

At least 9 species of brackish-water snails are now known as intermediate hosts of digenetic trematodes. The cercariae found appeared to be of veterinary importance, since most of them presented eye-spots (Bruce, 1985). However, the life cycles of these larval stages have not been studied. Therefore, more detailed study, in both experimental and field investigations, are encouraged to obtain trematode parasites of medical and veterinary importance.

The brackish-water snails of the east of Thailand appeared quite variable in number. Because of the lack of temporal stability of snail populations for surveys, there were insufficient cases to allow conclusions to be drawn about abundance or distribution. In addition, as the areas of the east coast of Thailand have been disturbed by shrimp farms and manufacturing industries, it is suggested that brackish-water snails can be an indicator of ecological disturbance, since 26 known habitats have appeared.

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