BODY OF REPORT

SEATO Medic Study No. 21	Studies on Opisthorchis viverrini in Thailand - Snail Intermediate Hosts
Project No. 3A 025601 A 811	Military Medical Research Program S. E. Asia
Task 01:	Military Medical Research Program S. E. Asia
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Reporting Installation:	US Army-SEATO Medical Research Laboratory APO San Francisco 96346
	Division of Medical Research Laboratories
	Department of Medical Zoology
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Objective: The study was designed to determine the snail intermediate hosts of O. viverrini and to determine the types of cercariae shed by the various snail species. A more detailed study of the latter portion is being undertaken separately (see SEATO Medic Study No. 27, R&D Grant).

Description: Over 1,000,000 snails have been collected and examined during the past year. Inasmuch as Bithynia goniomphalus is the recognized snail host of O. viverrini in the northeast, special attention has been given to it. Snails were placed in water for periods up to 12 hours after which the water was examined for cercariae.

Progress: B. goniomphalus have been collected from several areas and the type cercaria recorded. Data are recorded from Nong Bua (Table 1), Nong Hin (Table 2), areas not in villages (Table 3), Women's Teachers College (Table 4), Nong

Korn Kwang (Table 5), Non Sida (Table 6), Ban Non Soong (Table 7), Ban Phran Muang (Table 8), Non Nivet (Table 9), Yothanimit (Table 10) and Ban Houy (Table 11). In all, these data indicate that of 1,309,853 snails collected at random, 586 (.04%) proved to harbor type 1 cercariae (O. viverrini). The other 9 types of recognized cercariae are shown in the individual tables. The remaining cercariae are largely unidentified except by general morphological classification (Table 12). The alternate means of identification (i.c. IVb/1, etc.) refer to SEATO Medic Study No. 27. Type 2 cercaria is that of a Heterophyes species, 3 is a Digoniostoma, 4 is a cystocercous type, 5 and 7 are Xiphidiocercariae, 6 is a paramphistomatida, 8 is a notocatylus, 9 is a microcercous, and 10 is a furcocercous. The most frequently found was type 3, 0.54% in 2030 B. siamensis. The least frequently found was Type 9 (0.0003% of 440,840 examined specimens).

The type cercariae shed by Bithynia snails is depicted in Fig. 1, while the types shed by Thiarinae snails is shown in Fig. 2. In both, the Xiphidiocercous is the most frequently found.

The individual Thiara snails examined numbered 101,404. The most frequently found type of cercaria was Xiphidiocercous from Melanoidea tuberculata taken from Nakorn Nayok area (Table 13).

In addition to the above mentioned snails, 12 other genera have been studied (Table 14). Different areas of Thailand were studied and the snails were examined particularly for cercariae of Paragonimus, or Schistosoma. In all, 42776 specimens were studied.

In connection with studies on Paragonimiasis, a total of 3609 crabs were studied for cercariae. Areas of study included Lopburi, Udorn, Petchaburi, Ubol, Saraburi and Bangkok. Paragonimus cercariae were recovered from 2.2% of 2561 crabs collected from Ban Kok Sathon, Jangwad Udorn (Table 15) (Fig. 3).

Summary and Conclusions: Snails and some crabs have been examined for cercariae, and 10 types have been recognized from B. goniomphalus. Further studies are required to determine the species to which most of these 10 types of cercariae belong. In all, over 1,000,000 snails have been studied.

Table 1

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN NONG BUA, UDORN PROVINCE, THAILAND

Date collected	No. examined	Positive by type of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Jun 1963	13,289	3	86	384	2	32	1	3	0	0	18	529	3.98
Jul 1963	5,900	18	4	210	23	44	6	13	0	0	5	323	5.47
Aug 1963	2,680	0	1	1	0	6	0	0	0	0	0	2	0.075
Dec 1963	15,598	17	0	9	0	7	51	0	28	0	0	112	0.718
Jan 1964	5,095	0	0	18	0	4	4	0	6	0	0	32	0.628
Total	52,562	38	91	622	25	87	62	16	34	0	23	998	
Percentage		0.072	0.173	1.183	0.047	0.165	0.117	0.03	0.064	0	0.043	1.899	

Table 2

BITHYNIA GONIOMPHALUS SNAILS COLLECTED AT NONG HIN, UDORN PROVINCE, THAILAND

Date collected	No. examined	Positive by type of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
May 1963	10,033	1	6	108	2	1	0	0	0	0	2	120	1.196
Jun 1963	25,725	12	68	671	44	162	11	20	0	0	11	999	3.883
Jul 1963	5,860	6	27	105	1	33	6	1	0	0	5	184	3.140
Aug 1963	6,360	1	108	63	14	51	2	0	3	0	0	242	3.805
Mar 1964	2,040	0	0	0	0	0	0	0	0	0	0	0	0
Apr 1964	1,950	0	1	3	0	0	0	0	0	0	0	4	0.205
Jun 1964	7,750	0	1	8	0	1	0	2	0	0	0	12	0.155
Sep 1964	8,560	2	0	57	0	19	3	13	0	0	1	95	1.110
Oct 1964	1,220	0	0	8	0	0	0	1	0	0	0	9	0.746
Nov 1964	4,560	1	0	14	0	1	2	0	1	0	0	19	0.417
Dec 1964	12,880	4	0	11	0	0	10	0	3	0	1	29	0.225
Total	86,938	27	211	1048	61	268	34	37	7	0	20	1713	
Percentage		0.031	0.243	1.205	0.070	0.308	0.039	0.043	0.008	0	0.023	1.970	

Table 3

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN VARIOUS AREAS, UDORN PROVINCE, THAILAND

Date collected	No. examined	Positive by type of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Jun 1963	1,310	0	0	11	0	0	0	0	0	0	0	11	0.840
Jul 1963	9,345	11	6	91	0	46	4	6	0	0	18	218	2.333
Aug 1963	8,183	10	0	149	4	27	11	0	0	0	1	420	5.133
Mar 1964	590	0	0	0	0	1	0	0	0	0	0	1	0.169
Jul 1964	950	0	0	15	0	0	0	0	0	0	0	15	1.579
Sep 1964	2,220	1	0	12	0	0	5	0	0	0	0	18	0.811
Oct 1964	8,361	0	3	68	0	11	17	0	1	0	2	102	1.220
Nov 1964	36,695	1	0	8	0	0	11	0	1	0	0	21	0.057
Dec 1964	380	0	0	0	0	0	0	0	0	0	0	0	0
Total	67,654	23	9	354	4	85	48	6	2	0	21	806	
Percentage		0.034	0.013	0.523	0.006	0.126	0.071	0.009	0.003	0	0.031	1.191	

Table 4

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN WOMEN'S TEACHER COLLEGE, UDORN CITY, THAILAND

Date collected	No. examined	Positive by type of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Jun 1963	1675	0	5	4	0	4	0	0	0	0	1	14	0.836
Jul 1963	2618	0	1	20	1	2	7	0	0	0	4	35	1.337
Jul 1964	1530	0	0	18	0	1	0	0	0	0	3	22	1.438
Total	5823	0	6	42	1	7	7	0	0	0	8	71	
Percentage		0	0.103	0.721	0.017	0.120	0.120	0	0	0	0.137	1.219	

Table 5

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN NONG KORN KWONG, UDORN PROVINCE THAILAND

Date collected	No. examined	Positive by types of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
July 1964	340	0	0	1	0	1	0	0	0	0	0	2	0.588
Sept 1964	9,160	2	0	8	0	45	1	2	0	0	0	58	0.633
Oct 1964	10,480	3	3	23	2	4	3	1	6	0	1	46	0.439
Total	19,980	5	3	32	2	50	4	3	6	0	1	106	0.531
Percentage		0.025	0.015	0.16	0.01	0.25	0.02	0.015	0.03	0	0.005	0.531	

Table 6

BITHYNIA GONIOMPHALUS SNAIL COLLECTED IN NON SIDA, UDORN PROVINCE, THAILAND

Date collected	No. examined	Positive by types of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Aug 1963	8,720	4	0	12	0	9	100	1	1	0	0	127	1.456
Jan 1963	11,450	2	6	0	0	0	1	0	0	0	0	9	0.079
Feb 1964	22,293	5	0	18	0	12	12	0	16	0	0	63	0.283
Mar 1964	1,084	0	0	1	0	0	0	0	0	0	0	1	0.092
Nov 1964	450	0	0	3	0	0	6	0	1	0	0	10	2.220
Dec 1964	5,940	0	0	1	0	0	2	0	1	0	0	4	0.067
Total	49,937	11	6	35	0	21	121	1	19	0	0	214	
Percentage		0.022	0.012	0.070	0.000	0.042	0.242	0.002	0.038	0.000	0.000	0.429	

Table 7

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN BAN NON SOONG, UDORN PROVINCE, THAILAND

Date collected	No. examined	Positive by type of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Mar 1964	32,555	9	2	121	0	9	20	1	24	0	0	186	0.140
Apr 1964	107,557	5	1	221	5	32	27	1	33	1	7	333	0.309
May 1964	34,476	2	3	133	4	17	3	4	8	1	6	181	0.525
Total	174,588	16	6	475	9	58	50	6	65	2	13	700	
Percentage		0.009	0.003	0.272	0.006	0.030	0.029	0.003	0.037	0.001	0.007	0.401	

Table 8

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN BAN PHRAN MUANG, UDORN PROVINCE THAILAND
(DURING JULY 1963 - AUGUST 1964)

Date collected	No. examined	Positive by type of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Jun 1963	3550	0	0	12	0	6	14	8	0	0	3	43	1.211
Aug 1964	10430	0	2	12	0	8	74	14	0	0	3	113	1.083
Total	13980	0	2	24	0	14	88	22	0	0	6	156	
Percentage		0	0.014	0.172	0	0.1	0.629	0.157	0	0	0.043	1.116	

Table 9

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN BAN NON NIVET, UDORN THAILAND

Date collected	No. examined	Positive by type of cercaria										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
May 1963	7,707	0	1	0	0	0	0	0	0	0	1	2	0.026
Jun 1963	13,497	0	19	21	1	9	0	2	0	0	0	52	0.385
Jul 1963	34,014	24	137	361	37	59	26	11	0	0	54	709	2.084
Aug 1963	54,060	39	35	276	39	53	227	10	7	0	12	698	1.291
Sep 1963	49,830	5	5	53	3	14	111	2	30	0	0	223	0.448
Oct 1963	42,855	15	0	82	0	5	55	4	0	0	4	165	0.385
Nov 1963	32,140	12	0	43	1	12	36	0	44	0	0	148	0.460
Dec 1963	43,795	3	3	236	0	31	93	2	124	0	10	502	1.146
Jan 1964	7,660	0	0	18	0	3	48	0	45	0	0	114	1.488
Jul 1964	7,720	0	0	30	0	0	7	0	0	0	0	37	5.089
Aug 1964	44,705	4	0	480	0	40	76	0	14	0	0	614	1.373
Sep 1964	58,310	19	2	360	3	53	57	6	14	0	5	519	0.890
Oct 1964	22,560	0	0	77	0	8	14	0	9	0	1	109	0.483
Nov 1964	46,350	8	0	183	2	14	60	0	62	0	1	330	0.712
Total	464,743	129	202	2220	86	301	810	37	349	0	88	222	

Table 10

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN YOTHANIMIT, UDORN PROVINCE, THAILAND

Date collected	No. examined	Positive by type of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Aug 1963	21,902	5	4	126	4	18	26	0	6	3	2	194	0.885
Sep 1963	15,730	1	1	21	0	7	40	1	15	1	0	87	0.552
Nov 1963	597	1	0	10	0	0	3	0	1	0	0	15	2.512
Jan 1964	19,605	11	0	85	0	21	46	1	24	0	0	188	0.953
Feb 1964	25,400	9	0	101	1	9	36	0	40	0	0	196	0.771
Jun 1964	61,090	0	0	6	0	3	1	0	1	0	0	11	0.017
Total		27	5	349	5	58	52	2	87	4	2	691	
Percentage		0.018	0.003	0.242	0.003	0.040	0.105	0.001	0.060	0.002	0.001	0.479	

Table 11

BITHYNIA GONIOMPHALUS SNAILS COLLECTED IN BAN HOUY, UDORN PROVINCE, THAILAND

Date collected	No. examined	Positive by types of cercariae										Total positive	% positive
		1	2	3	4	5	6	7	8	9	10		
Jun 1963	1,100	0	0	0	0	0	0	0	0	0	0	0	0
Aug 1963	11,133	172	10	63	3	14	78	6	12	0	7	365	3.2800
Sep 1963	65,130	37	4	67	3	16	542	4	68	0	5	746	1.145
Oct 1963	123,085	28	17	224	2	37	288	17	18	4	7	642	0.522
Nov 1963	100,660	65	2	158	0	30	266	4	76	1	9	611	0.607
Jan 1964	10,600	1	0	10	0	5	26	0	26	0	0	68	0.642
Dec 1964	950	7	0	9	0	1	0	0	1	0	0	18	1.895
Total	312,558	310	33	531	8	103	1200	31	201	5	28	2400	
Percentage		0.099	0.010	0.160	0.002	0.032	0.380	0.009	0.064	0.002	0.008	0.784	

Table 12

LIST OF INFECTION RATES OF EACH CERCARIA IN BITHYNIA SNAILS, 1964

No.	Type of Cercariae	Snail Host	Locality	No. examined	No. positive	Percent
1	Opisthorchis (IVb/1)*	B.goniomphalus	Udorn	740840	99	0.013
		B.laevis	Bangkok	2450	3	0.122
		B.furniculata	Chiengmai	1200	1	0.083
2	Heterophyes (IVb/7)	B.goniomphalus	Udorn	740840	8	0.001
		B.laevis	Bangkok	2450	2	0.081
3	Xiphidiocercous (Digoniostomae) (VIc)	B.goniomphalus	Udorn	740840	1448	0.195
		B.laevis	Bangkok	2450	7	0.285
		B. siamensis	Bangkok	2030	11	0.541
		B. siamensis	Chonburi	980	3	0.306
4	Cystocercous (X/1)	B.goniomphalus	Udorn	740840	8	0.001
5	Xiphidiocercous pigmented	B.goniomphalus	Udorn	740840	167	0.022
6	Paramphistomatidae (II/3)	B.goniomphalus	Udorn	740840	345	0.046
		B.crosseana	Udorn	8765	2	0.022
7	Xiphidiocercous (XI/7)	B.goniomphalus	Udorn	740840	12	0.001
8	Notocotylus (III/2)	B.goniomphalus	Udorn	740840	178	0.024
9	Microcercous (VII/2)	B.goniomphalus	Udorn	740840	3	0.0003
10	Furcocercous (IX/3)	B.goniomphalus	Udorn	740840	11	0.0014

* See SEATO Medic Study No. 27

Table 13

LIST OF THIARA SNAIL INFECTION

Type of cercariae	Snail Host	Locality	Total examined	No.	Percent
Xyphidiocercous	Melanoides tuberculata	Udorn	2292	6	0.261
	M. tuberculata	Saraburi	6082	97	1.594
	M. tuberculata	Nakorn-Nayok	30572	1376	4.500
	M. tuberculata	Bangkok	904	4	0.442
	Terebia schomburgi	Saraburi	8340	13	0.155
	M. housei	Saraburi	12277	5	0.040
	M. housei	Udorn	2663	21	0.788
Microcercous	M. tuberculata	Udorn	2292	1	0.043
Furcocercous	M. housei	Bangkok	3955	4	0.101
	M. housei	Udorn	2663	4	0.150
	M. housei	Saraburi	12277	5	0.040
Lophocercous	M. tuberculata	Saraburi	6082	50	0.822
	T. granifera	Saraburi	8342	23	0.275
	M. housei	Udorn	2663	2	0.075

Table 14

OTHER SNAIL EXAMINATION DURING 1964

Snails	Total examined	With Cercariae Type	No.	%	Locality
Radix rubiginosa	2058	Furcocercous	14	0.68	Phitsanuloke
Radix rubiginosa	48	-	-	-	Chandee
Indoplanorbis exustus	894	Furcocercous	8	0.89	Phitsanuloke
Indoplanorbis exustus	340	Xiphidiocercous	2	0.58	Chandee
Palucomus labiosa	10896	-	-	-	Chumporn
Gyraulus convexiuslus	784	Xiphidiocercous	6	0.76	Chumporn
Gyraulus convexiuslus	784	Echinostome	4	0.51	Chumporn
Paludomus petrosa	9120	Xiphidiocercous	17	0.18	Lampang
Paludomus siamensis	75	Furcocercous	1	1.33	
Pachydrobia parra	286	Paramphistoma sp.	5	1.74	Bangkok
Trochorbis trochoideus	49	Opthalmoxiphdio	2	4.08	Bangkok
Helicorbis umbilicalis	34	Opthalmoxiphdio	1	2.94	
Pila pesmai	537	Xiphidiocercous	27	5.027	Phitsanuloke
Filopauludina bengalensis	7651	-	-	-	Udorn
Clea	1028	-	-	-	Udorn
Idiopoma basaicarinata	51	-	-	-	Phitsanuloke
Porotia	250	-	-	-	Chumporn
Sinotaia martensi	7896	Xiphidiocercous	64	0.81	Udorn

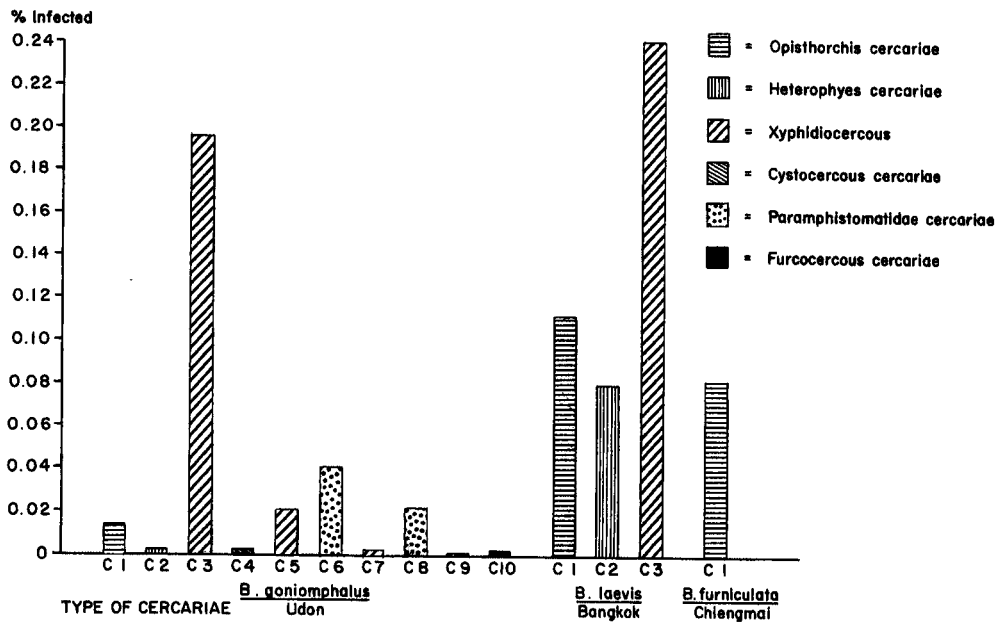
Table 15

EXAMINATION OF FRESH WATER CRABS

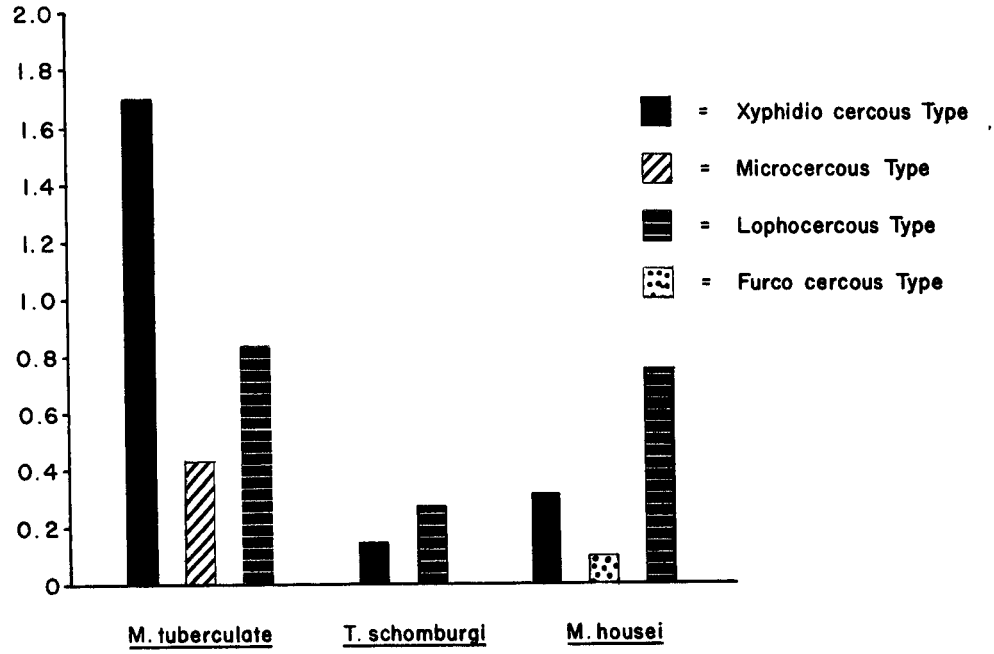
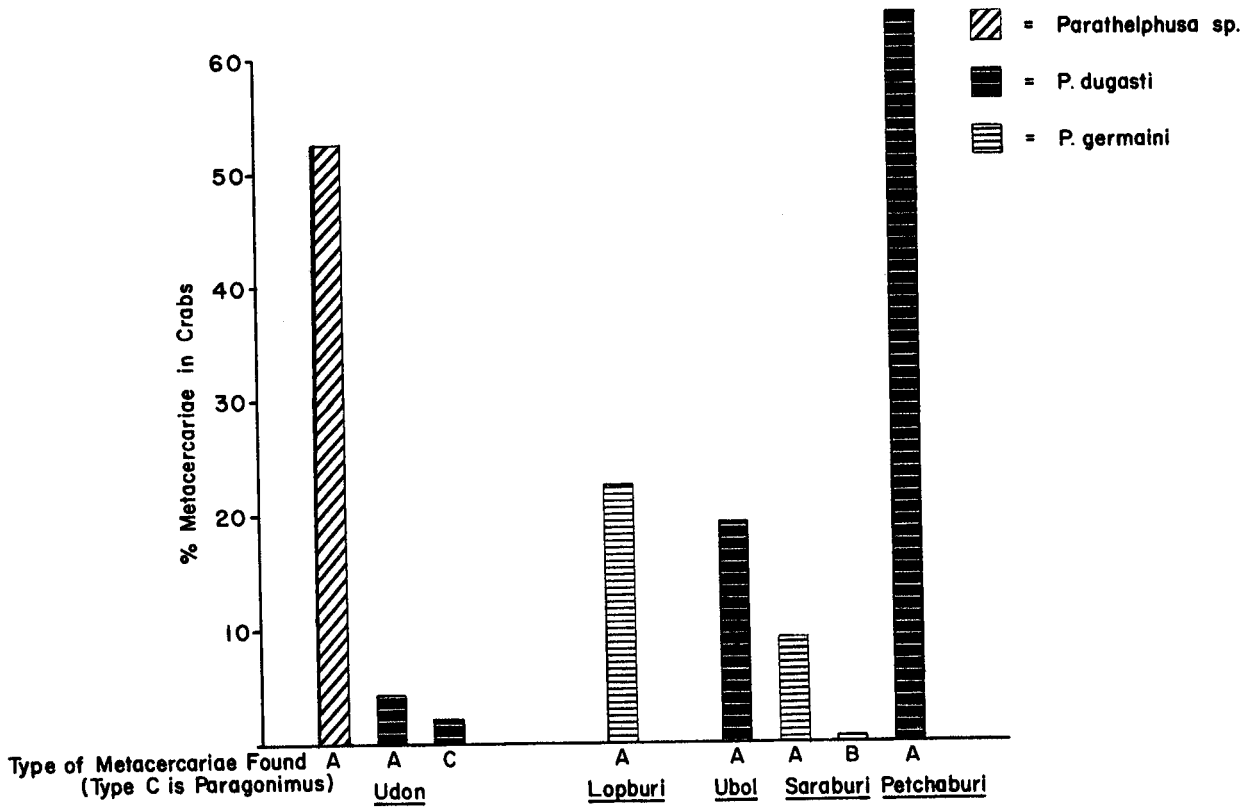
Scientific Name	Locality	No. exam.	Metacercariae		%
			Type	No.	positive
Parathelphusa (Parathelphusa) germaini (Rathbun)	Lopburi	280	A*	63	22.5
Parathelphusa (Parathelphusa) dugasti (Rathbun)	Ban Chieng Lao Udorn	343	A	10	2.91
Parathelphusa (Parathelphusa) dugasti	Ban Kok Sathon	2561	A	110	4.2
Parathelphusa (Parathelphusa) sp.	Ban Kok Sathon		C	67	2.2
Parathelphusa (Parathelphusa) dugasti (Rathbun)	Petchburi	22	A	14	63.6
Parathelphusa (Parathelphusa) dugasti	Ubol	303	A	58	19.141
Parathelphusa (Parathelphusa) germaini	Saraburi	372	A	34	9.1
Parathelphusa (Parathelphusa) sp.	Nonnivet, Udn.	692	A	361	52.16
Parathelphusa (Parathelphusa) germaini	Bangkok	36	-	-	-

* A - Unknown types
C - Paragonimus sp.

TYPES OF CERCARIAE SHED BY BITHYNIA SNAILS



TYPE OF CERCARIAE SHED BY DIFFERENT SNAILS OF FAMILY THIARINAE



METACERCARIAE FROM FRESH WATER CRABS