

Survey of The Snail Hosts of Medically Important Parasites on Lan-Yu (Orchid) Island

David Chao*

Abstract

A survey and collection of freshwater and land snails were conducted in July 1984 on Lan-yu island. More than 1,400 snails were collected from 17 different foci. They were preserved and carefully classified. A total of twelve species of freshwater snails and five species of land snails were found. Their distributions, habitats, and relationships to parasitic diseases are discussed.

Introduction

Mollusks are found in nearly all regions and habitats of the earth. They belong to Phylum mollusca, a very diverse group of animals. They cause disease in man in many parts of the world. Studies in medical malacology reveal three groups of medically important mollusks, i.e. intermediate hosts of helminth parasites, carriers for pathogens and toxins, and venomous mollusks. Approximately 15 different species of freshwater snails can play the role of intermediate host

in Taiwan (Pace, 1973; Lo, 1974). Snails, as required intermediate hosts in the life cycles of parasitic helminths infecting man and their domestic animals, occupy a position of utmost importance in man's war against parasitic diseases. The final control of these snail-borne diseases relies on the field survey of medically important snails.

The land and freshwater snails of Lan-yu (Orchid) island were originally described by Kuroda (1932) and Kano (1933). More recently and detailedly described by Reigle (1963) and Lin

* Department of Parasitology National Yang-Ming Medical College, Taipei, Taiwan, R.O.C.

(1974). However, previous literature had little medical ecological value, since they did not provide information about the distribution, ecological environment, and medical importance of those snails.

Previous parasitological studies revealed a high prevalence in Lan-yu (Bergner et al., 1973; Chung and Cross, 1975; Lin and Chung, 1972). Personal data showed that parasitic infection were still high 10 years later (unpublished). Due to a special interest in control of these diseases, a medical malacological study was conducted. The purpose of this study was to know the extensive picture of medically important snails on this island.

Materials and Methods

The survey was conducted in July, 1984 in Lan-yu. The collecting sites are shown on the map (Figure 1).

Lan-yu lies off the southeast coast of Taiwan, 70 km east of Manchow, 88 km south of Tai-tung (between $121^{\circ}30'08''$ and $121^{\circ}36'22''$ North Latitude, $22^{\circ}00'06''$ and $22^{\circ}05'07''$ East Longitude). This 45.71 sq km islet, the second largest one of Taiwan, is of submarine volcanic origin.

Lots of specimens of fresh-

water and land snails were gathered by the author using snail forceps and collecting hand nets. The natural environments of the collecting sites were recorded. Most shells were cleaned and dried while some snails were killed and preserved in 70% ethanol. Anatomical studies were based on these shells and 70% ethanol preserved materials. They were classified mainly according to their diagnostic features described by Pace (1973).

Results

The land and freshwater snail faunas of Lan-yu and Taiwan are fundamentally similar. However, the ecological data show that some differences exist (Table 1). Unlike Taiwan, rivers or streams are extremely short at Lan-yu. Most snails are found in water taro (*Colocasia kotoensis*) plots and irrigation canals, some can be found in shallow streams and small ponds. Pollution of artificial sludge is seen in a few stations, but not industrial pollutants. Most habitats are pretty well conserved.

Twelve species of freshwater snails, five species of land snails and one species of slug were discovered in Lan-yu by this trip. The distributions of each snail

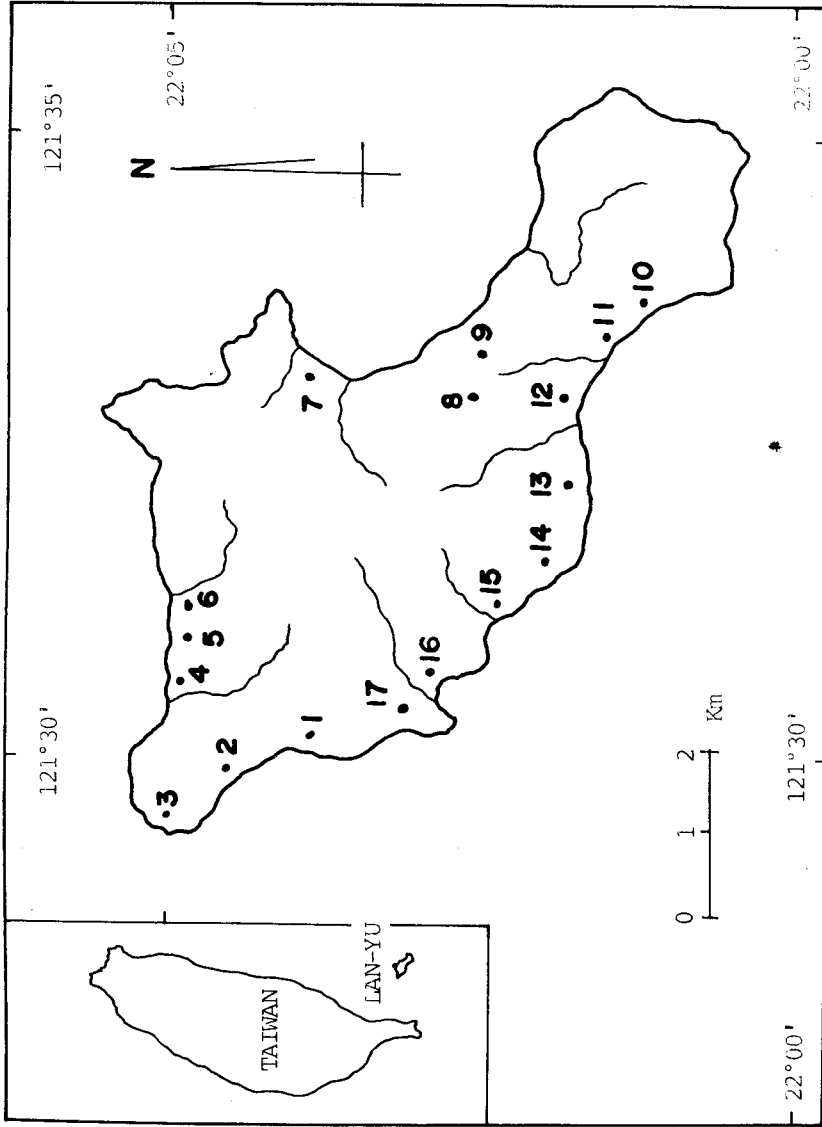


Figure 1. Map of Lan-yu showing different collecting localities.

Table 1. Collecting localities and their ecological data

District (Village)	Station number	Location	Description*	Vegetation**	Apparent pollution
Yeh-yu	1	Kai-yuan Port	G, T, IC	S	+
	2	Din-hsin Farm	IC, TP	A	-
	3	Hung-tou-yian	IC	S	-
Lang-tao	4	Wu-kung-dung	G, S	N	+
	5	Lang-tao	TP, IC	A	-
	6	Lang-tao Stream	S	N	-
Tung-ching	7	Tung-ching	TP, IC	A	-
	8	Weather Station	G	N	-
	9	Yeh-yin	TP, IC	A	-
Hung-tou	10	Lan-yu Farm	P, IC	M	-
	11	Lan-yu Guest House	TW	S	+
	12	Hung-tou	S, TP, IC	A	+
	13	Yu-jen	TP	M	+
	14	Lan-yu Airport	IC	M	-
Yeh-yu	15	Jung-ming Hamlet	IC, TP	S	-
	16	Anonymous Stream	S	N	-
	17	Yeh-yu	TP, IC, P	A	+

*Description: IC, irrigation canal; G, ground; P, pond; S, stream; T, tree; TP, taro plot; TW, temporary water pool.

**Vegetation: A, abundant; M, moderate; N, none; S, sparse.

species were included in the following list of collecting sites.

(An asterisk denotes land snails)

**Aegista lautsi* (Schmacker & Bottger): 1, 8.

Ampullarium canaliculatus (Lamarck): 1, 2, 3, 10, 11, 12, 13, 14, 15, 16, 17.

**Bradybaena kotosyonis* Kuroda & Kano: 1, 4, 8.

Cipangopaludina chinensis (Griffith & Pidgeon): 10.

Gyraulus spirillus Gould: 13, 15, 17.

Lymnaea ollula (Gould): 10.

Lymnaea swinhoei (Adams): 2, 3, 5, 10, 17.

- **Pancalana batanica pancala* (Schmacker & Bottger): 8.
 **Reimia eastlakeana yami* Kuroda & Kano: 1, 8.
Segmentina hemisphaerula Benson: 5, 10.
Thiara costellaris (Lea): 1, 3, 10, 13, 17.
Thiara granifera (Lamarck): 3, 5, 6, 10, 13, 17.
Thiara plicaria (Born): 1, 3, 4, 13, 17.
Thiara scabra (Muller): 13.
Thiara torulosa (Bruguiere): 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 16, 17.
Thiara tuberculatus (Muller): 1, 2, 5, 6, 7, 9, 10, 13, 14, 17.
 **Vaginulus alte* (Ferussac): 1, 12.

The specimens obtained are kept in Department of Parasitology, National Yang-Ming Medical College for teaching and further research.

Discussion

Although nearly every kind of mollusk is inhabited by some form of helminth parasite, only relatively few snails are of medical or veterinary importance. Of these, almost all live in freshwater. A few land snails, e.g. *Cionella lubrica* are vectors of lancet liver flukes in domestic and wild mammals (Belding, 1965), other land snails are important in the

spread of *Angiostrongylus cantonensis* in Taiwan (Chiu, 1964; Chen, 1972).

Freshwater mollusks are found in many regions and habitats of the earth, in deep lakes, shallow ponds, temporary water pools, mudflats, rice fields, taro plots, irrigation canals, rivers, swift maintain streams, sewers, shelters, and even on and in other animals as parasites. Some snails have been known to remain in a dormant state underground for a very long period of time (Khaw and Fan, 1964; Fan and Khaw, 1966).

Lymnaeids inhabit almost all types of freshwater habitats. In this study, we found that both *Lymnaea ollula* and *L. swinhoei* occurred in Lan-yu. Obviously, *L. swinhoei* is the predominant species in Lan-yu. These aquatic pulmonate snails can tolerate waters of low oxygen tension caused by pollution since they can take air directly into their mantle cavities. Both species are snail hosts of *Fasciola hepatica*, *Echinostoma revolutum* and *Echinoparyphium revolutum* (Ito, 1964).

Segmentina hemisphaerula is the most medically important species among the planorbid snails. It is the intermediate host of *Fasciolopsis buski* (Hsieh, 1959

Lo, 1967) and several human echinostomes, *Echinostoma cinetorchis*, *E. macrorchis*, and *E. revolutum* (Yamashita, 1964). The other planorbid snail species found in Lan-yu is *Gyraulus spirillus*. This is also the first report of this species in Lan-yu. *G. spirillus* is capable to transmit *E. macrorchis* (Ito, 1964).

Although many species of viviparid snails have been found in China, *Cipanogopaludina chinensis* is the only species established itself in Lan-yu. It has been known as intermediate host of *Angiostrongylus cantonensis* (Chang et al., 1968) and two species of human echinostomes, *Euparyphium ilocanum* and *E. recurvatum* (Belding, 1965).

Snails of Family Thiariidae are widely distributed in almost all habitats including brackish water. *Thiara torulosa* and *Thiara tuberculatus* are the predominant species established in Lan-yu. Belding (1965) listed *T. tuberculatus* as an intermediate host of *Paragonimus westermani* and *Diorchitrema formosanum*, while no parasitological studies of *T. torulosa* have been reported. Of the other four snail species of the Thiariidae group, *Thiara costellaris*, *Thiara plicaria* and *Thiara scabra* have not yet been implicated as

vectors of human disease, while *Thiara granifera* is an important first intermediate host of *P. westermani* and *Metagonimus yokogawai* (Belding, 1965).

Ampullarium canaliculatus, a new species introduced into Lan-yu recently, multiplies in tremendous rate. Now its pink egg clutches occupy most streams, ponds, and taro plots in Lan-yu. Apparently, *A. canaliculatus* is teaching the second lesson to people in Taiwan about introduction of foreign snails after the introduction of *Achatina fulica* 40 years before. The undesirable results include the damage of gardens, orchards, and farms, the capability of transmitting *A. cantonensis* (Yen et al., 1984), and also some other effects which may not become apparent immediately.

The introduction of a strange snail, whole habits and fecundity are completely foreign to the community while its parasites or predators are usually absent, may have rather profound and adverse effects on the organization of the community and nearly every organism in it.

The immigrant snails, in building up a large population, may not only outcompete the native well-regulated snails and other herbivores

for food, but also by destroying vegetation deprive many organisms of essential shelter. Reduction in abundance or disappearance of the native herbivores results in the reduction or extinction of many carnivorous species. This unbalanced state may cause many beneficial animals and plants to disappear permanently from the area. Therefore, the indirect economic importance of a introduced species may actually be far greater than the direct and more obvious economic impact.

Among the five land snail species found in Lan-yu, only the slug, *Vaginulus alte* is of medical important. *V. alte* is one of the intermediate hosts of *A. cantonensis* (Margono and Ilahude, 1974).

This study constitutes the record of collection (species and their localities) of the Lan-yu mollusks together with a discussion about their relationships with parasitic diseases and the miserable results of introducing foreign snails to a naturally balanced ecosystem. Studies of this kind are very important and essential to the eventual control of human parasitic diseases.

References

1. Belding, D. L., 1965. Text-

book of Parasitology. 3rd ed., 1374p., Appleton-Century-Crofts Co., New York.

2. Bergner, J.F.Jr., D.M. McCroddan, O.K. Khaw, and J. Devlin, 1973. A team approach to a disease survey on an aboriginal island (Orchid Island), Taiwan. I. Protozoa and helminth parasites of the Yami Aborigines, Chinese J. Microbiol. 6: 164-172.
3. Chang, P.K., J.H. Cross, and S.S. Chen, 1968. Aquatic snails as intermediate host for *Angiostrongylus cantonensis* on Taiwan. J. Parasit., 54: 182-183.
4. Chen, S.N., 1972. A survey of *Angiostrongylus cantonensis* in rodents and snails on Pescadores island (Peng-hu). Chinese J. Microbiol., 5: 129.
5. Chiu, J.K., 1964. Snail hosts of *Angiostrongylus cantonensis* in Taipei, Taiwan. Bull. Inst. Zool. Acad. Sinica., 3: 55-62.
6. Chung, P.R. and J.H. Cross, 1975. Prevalence of intestinal parasites in children on a Taiwan offshore island determined by the use of several diagnostic methods. J. Formosan Med. As-

- soc., 74: 411-418.
7. Fan, P.C. and O.K. Khaw, 1966. Further studies on distribution and density of *Oncomelania formosana*, intermediate host of *Schistosoma japonicum*, in Ilan. Chinese Med. J., 13: 224-268.
 8. Hsieh, H.C., 1959. Fasciolopsiasis in Taiwan. J. Formosan. Med. Assoc., 58: 623-629.
 9. Ito, J., 1964. A monograph of cercariae in Japan and adjacent territories. In: Progress of Medical Parasitology in Japan, Vol. I. Morishita, K., Komiya, Y., and Matsubayashi, H., eds., 753p., Meguro Parasitological Museum, Tokyo.
 10. Kano, T., 1933. Zoogeography of Botel Tobago Island (Kotosho) with a consideration on the northern portion of Wallace's line. Chirigaku Hyoron, 9: 591-613.
 11. Khaw, O.K., and P.C. Fan, 1964. Studies on ecology of *Oncomelania formosana*, Pilsbry and Hirase, 1905 on Taiwan. Chinese Med. J., 11: 353-369.
 12. Kuroda, T., 1932. Land molluscan fauna of Kotosho, Taiwan. Venus, 3: 187-192.
 13. Lin, C.C., 1974. Mollusks of Lan-yu (Orchid Island), and their zoogeography. Bull. Chinese Malacol. Soc., 1: 42-63.
 14. Liu, J.C. and W.C. Chung, 1972. Intestinal parasitic infections among aborigines on Lan-yu Island, Taitung, Taiwan. Chinese J. Microbiol., 5: 93.
 15. Lo, C.T., 1967. Life history of the snail, *Segmentina hemisphaerula* (Benson). and its experimental infection with *Fasciolopsis buski*. (Lankester). J. Parasitol., 53: 735-738.
 16. Lo, C.T., 1974. Flukes of medical and veterinary importance in Taiwan, and their snail hosts. Bull. Chinese Malacol. Soc. 1: 93-104.
 17. Margono, S.S. and H.D. I-lahude, 1974. *Angiostrongylus cantonensis* in rats and intermediate hosts in Jakarta and its vicinity. Southeast Asian J. Trop. Med. Pub. Hlth., 5: 236-240.
 18. Pace, G.L., 1973. Freshwater snails of Taiwan. Malacol. Rev., Suppl. 1., 118p.
 19. Reigle, N.J., 1963. Notes on the mollusks of Lan-yu, Taiwan, Quart. J. Taiwan

- Mus., 14: 81-87.
20. Yamashita, J., 1964. Echinostome. *In*: Progress of Medical Parasitology in Japan. Vol. I. Morishita, K., Komiya, Y., and Matsubayashi, H., eds. 73p. Meguro Parasitological Museum, Tokyo.
21. Yen, C.M., E.R. Chen, C. Shin, and H.C. Hsieh, 1984. Experimental infection of *Angiostrongylus cantonensis* larvae to *Ampularium canaliculatus*. Proceedings of Sino-Japanese Symposium on Parasitic Zoonoses. pp. 218-224.

蘭嶼之醫學貝類調查

趙 大 衛*

摘 要

作者在一九八四年七月間前往蘭嶼，趁進行全島寄生蟲防治工作之便，作醫學貝類調查。由十七個不同的地區採集得一千四百餘枚淡水及陸生腹足綱的軟體動物，經分類鑑定之結果顯示，該島計有淡水貝十二種及陸生貝五種。本文並討論其分佈、生態環境、及其與寄生蟲病之關係。

*國立陽明醫學院寄生蟲學科