Reports on Apple Snails

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REPORT ON A VISIT TO CAMBODIA

TO ADVISE ON APPLE SNAILS AS

POTENTIAL RICE PESTS

Prepared for

Cambodia–IRRI–Australia Project, Phnom Penh

By

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1. INTRODUCTION AND OBJECTIVES

A visit to Cambodia was undertaken by the author of this report from 29 October to 7 November 1995 (including travel time), at the invitation of the Cambodia–IRRI–Australia Project (CIAP), Phnom Penh. The visit was organized by Dr. Gary Jahn of CIAP.

The visit was undertaken because of the potential rice pest problems caused by non-native, freshwater "apple snails" in the event that these become widespread in Cambodia. These snails had recently been discovered for the first time in Cambodia, but had not at that time been recorded in rice fields.

The purposes of the visit were:

1. To collect and confirm the identity of snails suspected as potential rice pests in Cambodia.
2. To train CIAP crop protection staff in identification, preservation and breeding of snails for research.
3. To advise on methods of snail management.
4. To review CIAP snail research protocol.

These objectives were addressed as outlined in the following sections.

2. IDENTITY OF THE SNAILS

Dr. Jahn and his staff had previously collected a number of specimens of freshwater snails that had been discovered in private growing and breeding facilities in three areas in Cambodia: in the vicinity of Phnom Penh, in Prey Veng and in Svay Rieng. These were identified as belonging to the genus *Pomacea* in the family Ampullariidae. Snails in the family Ampullariidae are generally known as "apple snails", because of their large size and often greenish or yellowish color. Additional specimens were obtained during field trips to some of these facilities; these were also identified as species of *Pomacea*.

The specific identity of these specimens remains somewhat uncertain. They belong to the group of species that includes *Pomacea canaliculata.* This group contains about six to eight species, all originally from South America. The taxonomy of the group is extremely confused and detailed taxonomic research is necessary to resolve this confusion. There may in reality be only one or two species, each exhibiting much morphological variation. Provisionally, the specimens collected can be identified as *Pomacea canaliculata* and/or *Pomacea insularum*. These species of *Pomacea* must all be considered as potentially serious rice pests and hence as a serious threat to Cambodia's food security.

Numerous common names have been used for species of *Pomacea* in south-east Asia and the Pacific: "golden snail", "golden apple snail", "mystery snail", "golden mystery snail". At least

two and perhaps more species have been confused under these names. The use of "golden" can be confusing. There can be considerable color variation within a single species. Individuals can be green, brown, orange, yellow, with many intergrades among these. They can also have dark brown bands superimposed on the basic color. Often one population may be relatively uniform in appearance, but may nevertheless be conspecific with another population of somewhat different appearance. No doubt founder effects are involved in these populations that may often be derived from just one or a few individuals.

One or more species of apple snails (family Ampullariidae) are native to Cambodia. They belong to the genus *Pila*. Specimens of *Pila* were also collected for comparison with the *Pomacea*.

3. TRAINING

3.1. Background

Photocopies of basic literature dealing with apple snails were left with Dr. Jahn. These included taxonomic works, papers outlining the history of the introduction of non-native species to south-east Asia, and reports of the extremely serious pest problems the snails have caused and the so far unsuccessful attempts to control them.

These publications will give Dr. Jahn and his staff sufficient basic understanding of the enormous threat that introduced apple snails pose to Cambodia's rice crop. Extensive discussions with Dr. Jahn augmented the basic information in these papers.

3.2. Snail Identification

Dr. Jahn and members of his staff were instructed in how to distinguish the native *Pila* from the introduced *Pomacea*. There are subtle but consistent differences in shell morphology, but the most reliable distinguishing feature is the nature of the "operculum". The operculum is the trap-door-like structure that the snail uses to seal the shell opening when it retracts its body inside its shell. In *Pila*, the operculum is hard, brittle and calcareous, often with a shiny, mother-of-pearl-like internal surface. In contrast, the operculum of *Pomacea* is not brittle and has a distinctly horn-like texture; it is somewhat pliable, not rigid like that of *Pila*, and is generally brown in appearance.

The eggs of *Pomacea* are laid above the water level on emergent vegetation, rocks, etc. The eggs of the species in Cambodia are bright pink or red (varying somewhat in color according perhaps to age). They are highly distinctive and visisble. Often they will be the first sign of an infestation. The eggs of *Pila* are laid under the substrate surface and are thus not visible.

3.2. Snail Preservation

CIAP staff were instructed in the best methods for preserving snails collected in the field. The snails, although living naturally in freshwater, can be killed by drowning in airtight containers. Snails should be drowned for a period of about 24 hr (no longer than 36 hr, or they will begin to decompose). The advantage of drowning as a method for killing snails is that the snails die with the body extended out of the shell rather than contracted deep within the shell. This facilitates dissection, should this prove necessary for ultimate identification. Once drowned, the snails should be removed from the water and placed in 70% ethanol. After 1–2 days the ethanol should be replaced with new 70% ethanol for permanent preservation. About once a year the container should be inspected to check for evaporation of ethanol, and topped up as necessary.

3.3. Snail Maintenance and Breeding

These snails are easy to maintain and breed in captivity, as witnessed by the huge numbers being produced in the tanks and ponds seen during this visit. They can be easily maintained in buckets, essentially in the manner already adopted by Dr. Jahn. Experience now suggests that avoidance of over-heating may be important. So, if maintained in small containers of water that are susceptible to rapid temperature fluctuations dependent on direct insolation, extra care should be taken.

These snails are not hermaphrodites; they have separate males and females. Males and females cannot readily be distinguished externally, certainly not when they are small juveniles. Thus, for breeding experiments that require known parentage of bred juveniles, it will be necessary to pair snails at random, and discard those pairs that do not breed (i.e., that are male–male or female–female pairs).

4. RESEARCH

4.1. Current Projects

The work in progress during the course of this visit clearly demonstrated the serious impact these snails could have on rice. During the course of the visit, some of the experimental snails died, perhaps as a result of over-heating. Nevertheless, the level of damage sustained by the rice tillers exposed to the snails was sufficient to demonstrate the potentially devastating effect these snails could have. Of 40 2–3-week-old tillers, 17–48% were destroyed by one snail in 5 days feeding. In the Philippines and in Hawaii, *Pomacea* snails have been seen in rice fields and

taro fields at densities of around 100 per sq m. A simple calculation is all that is needed to see that the result of this experiment is convincing.

4.2. Suggested Future Projects

I strongly countenance against performing experiments on damge levels outside the confines of the CIAP greenhouse facility. Often, accurate yield loss assessments can only be obtained in field trials and on-farm trials. However, such trials are usually undertaken once the pest is established, in an attempt to evaluate potential IPM methodologies. In the present case, the pest is not established. Introducing snails to rice fields, even experimental fields, would be foolish in the extreme. These snails can readily crawl out of water and could easily cross bunds into non-infested fields. During times of flooding, snails could easily be carried far and wide. No doubt it is by such methods that the snails have become widespread in other countries.

However, a number of worthwhile projects can be suggested, as follows.

1. To provide even more convincing evidence of the potential damage these snails could inflict on rice in Cambodia, the experiment in progress during this visit could be repeated. The re-run experiment should include more controls (i.e., buckets with rice but no snails). With the experience of the initial experiment and the death of some snails probably through over-heating, the re-run experiment should address this problem, perhaps by providing more shade for the experimental buckets.

2. The true identity of the *Pomacea* snails in Cambodia remains uncertain. This reflects the very insecure understanding of the taxonomy of the group. It is just possible that more than one species is involved. Many of the adult snails seen were around 4 cm in shell height, while others were especially large—up to almost 10 cm, initially suggesting two species. However, large females were seen mating with small males. There may be sexual dimorphism within a single species. Simple breeding experiments would help to clarify this situation.

3. Extremely little is known of the basic biology of these snails. Valuable data on growth rate, age of reaching maturity, rate of egg production, and so on, could readily be obtained in simple experiments in buckets at the CIAP greenhouse. Such data would add enormously to our understanding of the biology of these animals and, by documenting their no doubt immense productivity, would add weight to efforts to characterize them as potentially devastating pests within Cambodia.

4. In the longer term, the taxonomy of these pest species must be clarified. This may not fall under the purview of CIAP, but neverthless, until there is a more secure taxonomic basis, pest management will necessarily be undertaken in something of a vacuum.

5. ASSESSMENT OF PEST POTENTIAL

South American snails in the genus *Pomacea* were first brought to Asia towards the end of the 1970s. The intention was to raise them as a potential gourmet restaurant commodity for sale internationally. This market never developed. Subsequently, they were perceived as potential sources of both food and revenue locally. This market never developed either. Nevertheless, the snails have been deliberately taken all over south-east Asia for these purposes. They have now been recorded from Japan, the Philippines, China, Hong Kong, Taiwan, Vietnam, Thailand, parts of Malaysia and Indonesia, and Papua New Guinea. Now they have been found in Cambodia. They have also been reported in Guam and Hawaii. In all these countries the snails escaped or were deliberately released into rice fields. They are now serious pests in many places, especially in Vietnam and the Philippines, where they are considered the number one rice pest, causing millions of dollars worth of damage annually.

Whether a market for these snails as food could be developed or not, there seems no question that the potentially devastating loss in staple food production far exceeds any possible economic gain from selling the snails.

Native *Pila* snails are indeed sold in markets, but do not seem particularly popular. Neither do populations of *Pila* ever reach the enormous numbers that *Pomacea* can achieve. Probably the *Pila* snails are controlled by their co-evolved natural enemies, parasites, diseases. *Pomacea* would have its own suite of enemies in its native south America, but is released from them once introduced to south-east Asia.

Once established there is no adequate method for managing the snails. Molluscicides have been used but are generally extremely unsafe and inappropriate for use over extensive areas. Control by introducing ducks to the fields has been tried but has not achieved major success—rarely is it possible for a vertebrate predator to control an invertebrate pest. Hand-picking of snails and destruction of their egg masses have been tried, but require vast amounts of intensive labor. No biological control agents (egg parasites for instance) have been identified. At present there is no adequate means of managing the snails once they are established. It is thus doubly important that they do not become established in Cambodia.

The spread of *Pomacea* snails in Asia has been extremely rapid. In less than 15 years they have become major pests in a number of countries. At one locality in Prey Veng, snails were seen in three ponds adjacent to rice fields. Although not yet infesting the rice, it only requires one flood, or a child playing with snails, or snails moving of their own accord, for the snails to be into the adjacent fields. Once this happens, the snails will spread rapidly, as has happened in other

countries. In two years they could become rice pests in some parts of Cambodia; in five years they could be serious pests throughout rice-growing areas of the country. Immediate action is necessary to prevent this happening.

6. ACTION TAKEN DURING THE VISIT

A brief presentation was made at the pesticide legislation meeting held at the CIAP offices. The presence of *Pomacea* in Cambodia was indicated and it was stressed how important it is that Cambodia prevent the snails getting established.

A brief statement was written and given to Mr. Ith Nody, Department of Agronomy, Ministry of Agriculture. This statement included a basic outline of the origins of *Pomacea* in Asia, relevant aspects of the snails' biology, the potential pest problems the snails could cause in Cambodia, and recommended actions to prevent their spread into rice in Cambodia. This statement is attached at the end of this report.

7 . RECOMMENDATIONS FOR IMMEDIATE FUTURE ACTION

Non-native apple snails, species of *Pomacea*, have become extremely serious pests of rice (and other crops) in south-east Asia. In Cambodia, they have not, as yet, become established in rice. Research to demonstrate their pest potential and to obtain basic knowledge of their biology is of considerable importance, especially in the event that they do become established in Cambodia. However, experience in other countries shows beyond doubt that these snails are potentially of devastating significance to Cambodia's food security, should they become established and widespread. The most important action that can be taken is action to prevent this happening. This includes:

1. Ban the raising, sale and purchase of the snails in Cambodia.
2. Ban the import of the snails into Cambodia
3. Confiscate and destroy the snails and their eggs wherever they are found in Cambodia.
4. Check rice fields along national borders frequently for presence of the snails or their eggs, and destroy any that are found.
5. Raise public awareness of the threat the snails present to Cambodian food security. The television statements proposed by Mr. Ith Nody are a good start.

This is the same list of items as presented in the brief report to Mr. Nody. The last recommendation is perhaps the most important, as it is only with public cooperation and a real public understanding of the potential problems that Cambodia will be able to avoid the kind of disasters that have befallen other south-east Asian countries that have been unsuccessful in preventing establishment of the snails in their rice fields.

8. ACKNOWLEDGEMENTS

I thank Dr. Gary Jahn for making my visit not only enjoyable and interesting but, I hope, useful to CIAP and to Cambodia. The CIAP office staff were extremely helpful in the administration of my visit.

9. ITINERARY

29 October 1995	Honolulu - Bangkok (crossed international date line)
31 October	Bangkok - Phnom Penh
	Reviewed essential literature with Dr. Gary Jahn
	Visited the CIAP greenhouse facility and discussed Dr. Jahn's experimental work
1 November	CIAP office: studied preserved snail specimens from various localities in Cambodia
	CIAP greenhouse: assessed snail damage to rice in Dr. Jahn's experiment
	Explained snail identification to CIAP staff
	Collected snail specimens from three localities around Phnom Penh
2 November	Visited CIAP field station, Kap Srau
	Discussions with Dr. Jahn
	Began drafting preliminary report for Mr. Ith Nody, Agronomy Department
3 November	CIAP greenhouse: assessed snail damage to rice in Dr. Jahn's experiment
	Attended pesticide legislation meeting, made a brief presentation on apple snails
	Trained CIAP staff in snail killing and preservation
	Completed report for Ith Nody
	Ministry of Agriculture, Department of Agronomy offices: met with Ith Nody
	CIAP greenhouse with Ith Nody: discussed potential apple snail problems
4 November	Field trip to Prey Veng: collected snail specimens
5 November	Day off
6 November	Looked for apple snails on sale in a Phnom Penh market
	Prepared snail specimens for shipment
	Phnom Penh - Bangkok
7 November	Bangkok - Honolulu