An Overview of the Golden Apple Snail's (*Pomacea canaliculata*) General Impact and Control

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ABSTRACT

Many golden snail producers finally gave up farming as the Asian region's market demand for the animals fell. As a result, the productive golden snail was released into the wild where it quickly spread to other plants, especially rice. During the day, this amphibious species will stay submerged and hide beneath plants near the surface. In order to find new plants, the golden snail will become increasingly active at night. The golden snail's activity level is reported to change significantly depending on the temperature of the water. Snails are macrophytophagous herbivores that specialize in eating a wide variety of plants and have a voracious appetite. Golden snails are a rice field pest that cause trouble and frequently burrow in rice fields. Once the temperature of the water in the morning is under 10°C, the majority of golden snails are found underground, which suggests that low temperature of water will raise the likelihood of the golden snail to burrow a hole in the ground. The number of native snail species, such the Pila snail in Southeast Asia, has decreased at some point since the golden snail's introduction. Prevention is the first step that must be taken to prevent the proliferation of golden snails inside a region. To stop the golden snail's introduction and spread, rigorous containment must be put in place. Emergencies of the golden snail should be controlled as quickly as possible.

Keyword: *apple snail, control, environmental impact, outbreak, prevention*

1. INTRODUCTION

Freshwater snail *Pomacea canaliculata* has a voracious craving for freshwater aquatic plants like lotus and paddy. The golden apple snail, or also refer as golden snail, was brought to Taiwan in the 1980s from its own native South America as a commercial and human food source [1]. There are reportedly 50 species of snails in the genus Pomacea, however the identification is difficult and needs several revisions, particularly for biochemical genetic approaches. These 50 species, including *Pomacea canaliculata*, have channeled shells in about 15 of them. Nevertheless, *P. canaliculata* is typically linked to the introduction of Pomacea snails to the Americas and the Indo-Pacific region [2].

When the market demand for golden snails in the Asian region declined, many golden snail farmers finally left their farming profession. This resulted in the successful golden snail being released into the wild and becoming a pest of plants, especially rice. The snails then became the main pest of rice in the Asian region, in Taiwan alone the area attacked by the golden snail pest reached 171,425 ha in 1986, an area of 16,196 ha was attacked in Japan in 1989 and 400,000 ha of land attacked by the golden snail in the Philippines in the same year [3]. After 10 years since the golden snail was first introduced, the costs incurred due to the golden snail attack ranged from US$ 425

million to US$ 1.2 billion [4]. This review paper aims to provide an overview of the general impact of the introduction of the golden snail and control methods that have been used against this plant pest.

2. LIFE HABITS

Golden snails generally live and are found in agricultural areas, lakes, waterways, and wetlands. In its area of origin, the golden snail is widely distributed in lakes, ponds and swamps along the Amazon and Plata Basin rivers. This amphibian animal will remain underwater during the day and hide under vegetation close to the surface. The golden snail will be more active at night to find fresh plants. The activity level of the golden snail is known to vary greatly depending on the water temperature. At 18^{o}C, the snails rarely move, the opposite happens if the temperature reaches 25^{o}C where the golden snail will be more active. Even so, *P. canaliculata* is a type of snail that is more resistant to low temperatures compared to other types of snails from the genus Pomacea [1].

2.1 Feeding Habits

The golden snail impairs plants by grating the plant tissue and eating it. This will cause the seeds of the plant to be lost. The former pieces of leaves and stems that were attacked by the golden snail will appear floating [5]. Snails are macrophytophagous herbivores that have a high appetite and are generalist plant eaters. In general, all types of plants will be eaten by the golden snail, but sometimes it is known that the golden snail shows preference for the plants it eats. For example, in Hawaii, golden snails do not eat hyacinths [1].

According to [6], aquatic gastropods are plant eaters. The algae layer that covers the layer below the surface of the water is one of the foods. In addition, golden snails can also eat moss, aquatic plants, tubers, bran, pellets, and kitchen waste. Even dead organisms are sometimes eaten, but especially the golden snail prefers vegetables such as mustard greens, papaya leaves, cassava leaves and taro leaves.

2.1 Burrowing Habits

The golden snail is a rice pest that is pestering and often burrowing in rice fields. Many golden snails will bury themselves in the ground during the day from 9am to 3pm and then emerge at night from 9pm to 3am. The proportion of golden snails that are in the ground will be greater when the water depth is shallow enough to submerge the shells. Female snails have a tendency to be underground before they get food but this is not found in adult and juvenile male snails. High water temperatures (>35^{o}C) will increase the likelihood of male snails digging holes and almost all golden snails are underground at temperatures close to 40^{o}C. On the other hand, an increase in temperature did not increase the number of adult and juvenile female snails to dig holes. Most of the golden snails are underground when the water temperature in the morning is below 10^{o}C, which indicates that low water temperature will increase the probability of the golden snail to dig a hole in the ground [7].

3. GENERAL IMPACT

P. canaliculata was first introduced to Southeast Asia in 1980 as a potential local food source and export food ingredient. The market never developed so the golden snail was released or released on its own so that it became a serious pest for rice plants in various Southeast Asian countries. In the Philippines, this snail is the number one rice pest and has caused great economic losses.

At some time after its introduction, the golden snail has caused a decline in the number of local snail species such as the Pila snail in Southeast Asia. In addition, Pila snails in the Philippines have been reported to be declining due to the application of pesticides to eradicate the golden snail. A prediction has shown that the golden snail has the potential to spread to various parts of the world such as India, United States of America (a threat to the rice industry in Texas and California) and Australia [1].

The method of local distribution of the golden snail probably originates from accidental dispersal of eggs or small snails to agricultural products or deliberately introduced to uncontaminated wetlands with the aim of harvesting them as a food source. The most likely mechanism of dispersal is snails that have escaped or been released from culture facilities and aquariums. In addition, the last possibility is that the way it spreads is caused by water currents [1].

4. PREVENTION AND CONTROL

The first thing that needs to be done to prevent the spread of golden snails in an area is prevention. Strict quarantine must be implemented to prevent the introduction and spread of the golden snail. New golden snail outbreaks should be handled as soon as possible. The use of filters in waterways will be useful to prevent the golden

snail from spreading. The filters must be cleaned periodically from dirt. In the vicinity of rice fields, if possible, it should be limited by copper which can slow the spread of the snails, because copper is a compound that is toxic to snails and they cannot pass through it. Copper is installed above the water level at the boundaries of the fields [1].

The characteristics of rice fields infested by the golden snail include the presence of missing rice seeds, floating leaves, cut stems, reduced plant height and plant positions that are rare and not the same [8]. All plants and obstructions around the field should be removed as the snails will need them to lay their eggs. The snails will be forced to deposit the eggs on the ground where the eggs can easily fall into the water and drown the eggs. Before irrigating the fields, narrow ditches should be made so that the snails gather in the trenches and can be caught easily [1].

Molluscicides or anti-mollusc agents are still expensive and not widely available in the market. Many studies have been conducted to find plants that can be used as chemical control for snails. Sambong leaf extract (*Blumea balsamia*) is known to be only effective against young golden snails. In addition, this extract can cause more severe damage to plants because small doses can cause the snails to have an even higher appetite. Another study on Neem leaves proved ineffective while the extract was quite effective against golden snails. Rotenone root extract (*Derris eliptica*) is highly toxic to golden snails. LC50 for rattanone is 400 ppm, less toxic than metaldehyde but not effective in destroying the golden snail egg mass. Tobacco (*Nicotiana tabacum*) was proven to be toxic in greenhouse experiments but was found to be ineffective when tested in actual fields. *Rerak* fruit (*Sapindinus rerak*), Pinang seed (*Areca catechu* Linn), showed effectiveness in greenhouse and real field experiments. In the market, saponins are introduced as pesticides to control unwanted fish in fish and lobster ponds. A study showed that in laboratory experiments it turned out that saponins proved effective.

Mice become prey for the golden snail during the summer. Other golden snail predators include common carp which are capable of eating young snails voraciously where a common carp weighing 150 g can devour around 40 young golden snails. Tilapia and *mujair* fish are also able to consume golden snails but not as much as the common carp. According to [9], several things can be done in the future to avoid the outbreak and spread of the golden snail population, including:

a. Encourage farmers to apply a range of control technologies such as gathering, trapping and other controls. Local instructor or authorities must actively ask farmers in one area to carry it out even when the snail population is low
b. Conducting research on socioeconomic losses due to golden snail attacks.
c. Search for local ingredients that can kill or change the golden snail eating habits.
d. Search for possible diseases or parasites and the long-term effects of toxic plant compounds or synthetic mollusk pesticides on local snails and other aquatic animals.

[10] stated that the golden snail population in rice fields can be regulated by its density. With a density of as low as two adult snails per square meter, the growth, number of hatching and eggs per female snail will be limited. This is likely due to the low availability of golden snail food.

Control of snails with biological plants is based on phytochemical compounds found in all parts of the plant which are toxic to golden snails. Several of them are papaya leaves (*Carica papaya* L.), banana leaves (*Musa paradisiaca*), starflower (*Calatropis giganta*) and neem trees (*Azadirachta indica*). Control with this method has several advantages including that it is very easy to implement and manage, it is suitable for small agricultural land areas, low maintenance costs and environmental methods like this can be more accepted by traditional farmers. While some of the disadvantages are that it is difficult to apply to large agricultural land, it requires high costs for planting and its growth takes time so that to get the benefits of this plant also takes a certain amount of time [11].

Controlling the spread of golden snails can also be done using natural methods, including by taking the snails and their eggs by hand or using a mesh filter. Some of the advantages possessed in the application of this method are low material and application costs, socially acceptable, environmentally friendly and can prevent the spread. While the disadvantages are that it requires human labor, requiring a long-time commitment, equipment and traps can be expensive and cause water irregularities that impair crop yields. It can be concluded that to get the best control results, it is advisable to combine more than one type of control and community awareness and involvement are very necessary as well [1],[11].

5. CONCLUSION

Golden snails typically inhabit and can be found in wetlands, lakes, and agricultural regions. The golden snail is a common sight in the lakes, ponds, and swamps that line the Amazon and Plata Basin rivers in its native region. Compared to other varieties of snails from the genus Pomacea, *P. canaliculata* is more tolerant of cold temperatures. The golden snail will often consume any kind of plant, although occasionally it is reported that it has a

taste for certain plants. One of the foods is the layer of algae that covers the water's lower layer. Additionally, aquatic plants, tubers, bran, pellets, and kitchen garbage can all be consumed by golden snails. Numerous golden snails will burrow in the earth between the hours of 9am and 3pm throughout the day and then surface between the hours of 9pm and 3am. When the water is shallow enough to submerge the shells, the percentage of golden snails that are underground will be higher. The way the golden snail is distributed locally most likely results from unintentional introduction of eggs or young snails to unpolluted wetlands with the intention of gathering them as a protein source. The density of the golden snail in the environment can be changed, biological control techniques can be used, and other technical approaches can also be used to control it.

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