Efforts at Golden Apple Snail Control in Hawaii

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Abstract

A program of control of the apple snail *Pomacea canaliculata* has been conducted in Hawaii over the last 6 years. The apple snails devastate taro production. Elements of the control program include modified culture methods for growing the crop, use of carnivorous ducks to feed on the apple snails, and hand picking apple snails to stock aquaculture tanks. Better than 95% control was achieved. So much pressure was put on apple snails that their populations declined in wild wetlands surrounding farms. Experience is showing that control efforts must be continual and apple snail populations return to their former size when control efforts are relaxed.

Introduction

The apple snail *Pomacea canaliculata* is native to South America (Cowie, 1993). It was originally imported to Hawaii by the aquarium trade. This is supported by the fact that most animals in the wild are the yellow color variant. A few individual farmers reasoned that if they placed apple snails in taro patches, at harvest the snails could be sold as food and would provide supplemental income in addition to taro. This proved to be a fallacy. In the taro patches snails will multiply rapidly and will destroy the taro. Moreover, hindsight has shown that the snails will spread throughout the irrigation system and contaminate the wetlands surrounding the taro patches. The same faulty reasoning occurred in many rice growing countries of Southeast Asia (Anderson, 1993; Halwart, 1994; Litsinger and Estano, 1993; Vitousek, et al., 1996).

Taro production is of both cultural and economic significance in Hawaii. Currently taro is a $2-3M industry with 7 million pounds grown annually (Statistics in Hawaiian Agriculture, 1993). This is down from a conservative estimate of 14 million pounds in 1948. However, resurgence in taro growing is occurring. This is fueled by native Hawaiian pride and by the fact that there has been a shortage of poi and taro chips in the State. Poi is an excellent food being hypoallergenic and very easily digestible. There is also a shortage of taro leaves, which are used as cooked vegetables. Legend has it that taro was given by the gods to the Hawaiian people. It served the Hawaiian people well providing food. It is in turn, the responsibility of the Hawaiian people to honor taro, which they do to this day by caring for taro. One rarely sees weeds in a taro patch cared for by Hawaiians. Taro plays a role analogous to the eldest sibling in the traditional Hawaiian family structure. The eldest sibling takes care of the younger siblings. The younger siblings, in turn, honor the eldest.

Taro is traditionally grown in patches filled with water. The water flows from streams or springs in the mountains and is carried through the patches. It then returns to the streams which flow into the ocean. Along the way, it is shared by farmers using a complicated array of ditches. It has been argued that the highly stratified chiefdoms of ancient Hawaii evolved as a means of managing water (Kikuchi, 1976).

Before current studies/control efforts began, the State of Hawaii made efforts to control the apple snail through use of copper sulfate (Estebenet and Cazzaniga, 1990). This did not solve the apple snail problem. Other disadvantages include potential toxicity to crops (Robson and Reuter, 1981), lack of specificity/toxicity to other aquatic organisms (Birge and Black, 1979; Cheng, 1979), and the possibility of sterilizing the land. This is an

especially sensitive issue to native Hawaiians who have a reverence for the land because the spirits of their ancestors inhabit the land of their birth. This being the case, poisoning the land is sacrilegious.

We observed intermediate levels of control. Farmers 'weed' their patches removing snails constantly. However, once taro plants have rooted, they cannot walk into the middle of the patches without damaging the root systems of the plants. Hence, their patches sometimes have bald patches in the middle of them. Bald patches reduce yield and insult a Hawaiian's efforts to care for his taro. Snails eat secondary shoots on the taro plants (keikis). These yield secondary corms and additional planting material for the next cycle. We have seen taro corms damaged by snails. We have spoken to poi millers who complain about trimming costs and lowered yields. Taro planting is impossible if no efforts are made to control the apple snail. Taro tops (huli) from a previous crop are planted in mud covered with a few inches of water. Farmers have reported being able to watch their newly planted huli topple one after another in a patch filled with apple snails. Apple snails chew through the tender stalks of young taro plants.

Methods

Before and after estimates of population densities of apple snails were made.
Several methods of apple snail control were tried (Tamaru et al., 1999). One involved changing the method of growing taro. Taro is normally grown in a few inches of water. A new method was developed in which ditches were dug around the sides of the patches and taro was grown in mud. The reasoning was that snails would migrate to the water on the sides of the patches and would be hand collectable. The strain of taro grown at that site was a hardy strain tolerant of lower water quality.

Another method that worked involved the use of cayuga ducks. The method requires that ducks be imprinted on humans. Ducks were trained to walk out of their cages onto the back of a 4 wheeler in the morning. They would be driven to a taro patch and would feed on apple snails until they were either moved to another patch or returned to their cages for the night. If the ducks are not caged when they are not watched, they will be killed by feral and others dogs running free in the area.

A third method involved hand collection and aquaculture. Calls went out to the community that apple snails were being purchased at $2/kg. Schoolchildren hand picked snails from harvested patches or from ditches. Sometimes snails were attracted to an area using chicken feed as bait. About 300 snails/bait/2 hr may be trapped. Snails were then aquacultured in tanks. Growth is about 5 g in a month for animals starting out with a mean weight of 8 g. The feed conversion ratio is about 1 meaning that 1 g of feed produces about 1 g of snail meat. The cost of feed is $0.30-0.40 per pound of snail produced. Each 100 gallon aquaculture tank can produce 70 pounds of snails per month and prices to farmers of aquacultured snails was about $8/kg.

Taste tests done by a professional chef and his staff suggested that wild snails are not gourmet items. They were characterized as 'crunchy' and had a mean length of 20 mm and mean weight of 4 g, substantially under the preferred market weight of 15 g. However, aquacultured snails were much better accepted and would be purchased by the chef if available in constant supply. The taste panel characterized cultured snails as 'tender', 'chewy', 'juicy' and 'sweet'. Aquacultured snails have a length to weight ratio of about 25 mm to 15 g. Aquacultured snails of this weight are young animals with a higher fat content. This was determined by fatty acid analysis. The excellent physiological condition of aquacultured snails suggest that glycogen content should be high. This explains the characterization as 'sweet'.

First efforts at apple snail control were completed near the end of 1996 in the Keanae region on the island of Maui. This area is the second largest taro growing region in the state and dominates State Department of Agriculture statistics for this region. Increases in production in 1998 and 1999 can be attributed to success in apple snail control.

Snail densities decreased significantly as a result of control methods. Decreases were more than 95%.

Patch	Snails/90 cm2, before control efforts	Snails/90 cm2, after control efforts

Patch 1	15.4	0.1
Patch 2	10.4	0.5

Discussion

As seen above, the combination of control methods was very effective. The ducks worked very well to eat small snails, the growing of taro in mud allowed farmers some income while apple snails were still a problem, and hand picking and aquaculture added the final touch to the control method. On hindsight, limited attention would probably have not been as effective as using the combination of methods described here.

These methods were transferred to other communities via visits between community members. The use of ducks became very popular on the Waipio on the island of Hawaii. The apple snail problem in Hanalei was controlled for several years by strict quarantine but eventually apple snails became a problem. As the area is a wildlife reserve, ducks are not allowed (because they might interbreed with wild ducks) and the hand picking/aquaculture approach is being tried. Another interesting aspect of the control methods is that so much pressure was put on snails on farms that they disappeared in the wild wetlands surrounding the farms also.

But the story does not end here. Two years after the major control efforts, populations of apple snails increased again, and community-wide control efforts had to be re-instituted. Our own data support estimates in the literature that if only two snails survive control efforts and breed with mortality among the young, there will be tens of millions snails at the end of the year. Hawaii is now in the third major cycle of apple snail control. Perhaps the mind set needs to change and it should be expected that control of pests like the apple snail needs to be thought of as continual.
With this in mind, several preliminary experiments were tried. One used ornamental carp or koi as biocontrol agents. This worked well in the laboratory as the carp ate the apple snails. Fish have been used in Asia (Halwart, 1992). Saltwater was tried because a stream infested with apple snails was cleared out when the hatchery effluent changed from freshwater the saltwater. A two hour exposure to saltwater was ineffective in the laboratory. Pyrethrin was tried at a 0.01% level in the laboratory. It was ineffective. However, 50 mg/L hydrogen peroxide was 90% effective after 24 hr exposure.

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