The Competition between golden apple snail (*Pormacea canaliculata*) and Thai native apple snail *Pila* scutata (*Pila ampullacea*) and Its Effects on Their Growth

การศึกษาสภาวะการแก่งแย่งของหอยเชอรี่ (*Pormacea canaliculata*) ต่อการเจริญเติบโตของหอยโข่งพื้นเมือง (*Pila ampullacea*) ของประเทศไทย

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ABSTRACT

The aim of this study is the influence of competition between golden apple snail (*Pormacea canaliculata*) and Thai apple snails (*Pila ampullacea*) and its effects on the growth of both species. By comparing the growth of the two species raised separately and together with the ratio of 1:1 (each 1 species to 1 container) resulted from 5 repeated experiments for 5 months, it was found that the both species were increasingly and constant growth rates measuring by weight, length, width. However, the growth of the golden apple snails was faster than that of the apple snail in both conditions. In the condition that the snails were raised together, the average weight of the golden apple snail and Thai native apple snails was 2.62 ± 2.02 and 0.69 ± 0.10 g/month. The average width of the shells was 2.04 ± 0.43 and 1.21 ± 0.06 cm/month. The average height was 2.12 ± 0.34 and 1.28 ± 0.07 cm/month. Furthermore, it was found that the growth of both species raised together was slower than that of the snails raised separately. It was found after feeding them, the golden apple snails to crawl to foods faster than the native apple snails. This fact may be the reason for the faster growth and consumption behaviors of the golden apple snails as compared to that of the apple snail.

บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาอิทธิพลของการแก่งแย่งอาหารระหว่างหอยเชอรี่และหอยโข่งพื้นเมืองของประเทศไทยต่อการเจริญเติบโตของหอยทั้งสองชนิด ผลจากการศึกษาการเปรียบเทียบการเจริญเติบโตของหอยในสภาวะเลี้ยงแยกกันกับเลี้ยงร่วมกันทั้งสองชนิด ในอัตราส่วน 1: 1 (ชนิดพันธุ์ละ 1 ตัวต่อโถ) จำนวน 5 ซ้ำ เป็นระยะเวลา 5 เดือน พบว่า หอยทั้งสองชนิดมีแนวโน้มการเจริญเติบโตเพิ่มขึ้นอย่างคงที่เช่นเดียวกัน แต่หอยเชอรี่มีการเจริญเติบโตมากกว่าหอยโข่งทั้งสองสภาวะการเลี้ยง โดยสภาวะการเลี้ยงร่วมกัน หอยเชอรี่กับหอยโข่ง มีน้ำหนักเท่ากับ 2.62 ± 2.02 และ 0.69 ± 0.10 ก./เดือน ความกว้างของเปลือก เท่ากับ 2.04 ± 0.43 และ 1.21 ± 0.06 ซม./เดือน และความสูงของเปลือก เท่ากับ 2.12 ± 0.34 และ 1.28 ± 0.07 ซม./เดือน เป็นต้น ซึ่งหอยเชอรี่และหอยโข่งในสภาวะเลี้ยงร่วมกันมีการเจริญเติบโตน้อยกว่าหอยเชอรี่และหอยโข่งในสภาวะเลี้ยงแยกกัน และหลังจากให้อาหาร หอยเชอรี่จะมีการคลานเข้าหาอาหารและกินเร็วกว่าหอยโข่ง ซึ่งการที่หอยเชอรี่เข้าถึงอาหารได้เร็วกว่าหอยโข่งนี้อาจเป็นสาเหตุทำให้หอยเชอรี่สามารถกินอาหารได้เร็วและเจริญเติบโตได้ดีกว่าหอยโข่ง

Key Words: Food competition, golden apple snail, native apple snail

คำสำคัญ: การแก่งแย่งอาหาร หอยเชอรี่ หอยโข่ง

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Introduction

Golden apple snails or *Pomacea canaliculata* can be called as South America apple snails according to their place of origin. As Apichat (2004) cited Kaewjam (1986) and Nittaya et al. (1998), he mentioned about the origin and the nature of these snails by describing that they are freshwater snails from Ampullariidae family, which is the same family of Thai native apple snails. These snails were imported to Thailand during 1982 – 1984 for a commercial purpose (i.e. canning industry) and to be petted in aquariums in order to reduce mosses and fish feces. After that, the snails were released to natural water resources and caused damages to rice paddies in Thailand. This was because these snails can adapt themselves to and rapidly reproduce in that environment. Normally, these invaders can be founded in Thailand. Accordingly, Thailand's ecosystem and biodiversity were affected by them. In other words, the native species were reduced and the structure and the components of the ecosystem were damaged (Buchan and Padilla, 1999; Tilman 1999; Chapin et al. 2000; Kolar and Lodge 2000; Sala et al. 2000; Loreau et al. 2001). By reviewing relevant studies, it was found that the information about the effects from native apple snails is scarce (Cattau et al., 2010). Plus, there was a lack of studies concerning the effects of golden apple snails on the apple snail. Therefore, the present study focuses on the golden apple snails that affect and invade other species, rapidly reducing native apple snails (Pila ampullacea) that are from same family, Ampullaridae. Hence, the aim of this study is the competition between golden apple snail and native apple snails in Thailand and the effects of the competition on the growth of both species.

Materials and methods

The materials used in this study are two species of snails, *Pormaceae canaliculata* and *Pila ampullacea* The snails were sampled and collected when they were in their eggs laid by female snails on places above water surface. The collected eggs were incubated in a laboratory (Figure 1). Water spinach (*Ipomoea aquatic* Forsk.) was used to feed both species. There were other materials such as water constant growth rates measuring by weight, length, widths, air pumpers (e.g. rubber tubes, joints, pressure values, and air diffusers), a digital weighting apparatus, a vernier caliper, and recording devices. The experiments were conducted in the laboratory on the 8th floor of the building of Environmental Science Major, Science Faculty, Kasetsart University (Bangkhen Campus), Bangkok.

Both species of adult snails grown in the laboratory that were 1 centimeter or larger (or about 2 months old) (Figure 2) were raised together in the same container and feed with water spinach (*Impomoea aquatic*) (Carlsson and Bronmark, 2006). The experiment was repeated for 5 times with different size of snails. One of each species having the same size was selected for each experiment (Figure 3). The experiment about comparing the growth of the two species raised separately and together with the ratio of 1:1 (each 1 species to 1 container), raised separately such as golden apple snail to contianer : native apple snail to constant growth rates measuring by weight, length, width (one by one) and the together as the same constant growth rates measuring by weight, length, width 1:1, 2:2,…, 5:5. The constant growth rates measuring by weight, length, width is Cylindrical with 2,000 cm^3 and to brink clear water (tap water was collected) into constant growth rates measuring by

weight, length, width for ratio ¾ of the volume constant growth rates measuring by weight, length, width controlled by remark on side constant growth rates measuring by weight, length, width and oxygen additional into the water by air pump. It was resulted from 5 repeated experimental for 5 months, it was found that the both species were increasingly and constant growth rates measuring by weight, length, width. .The growth of the snails was compared by weighting them and measuring their length before raising them together and every week after that. The water spinach was weight before and after feeding the snails in order to consider the relationship between their consumption and growth. The behaviors of both species were also observed. The data collected from the experiments were compared and reported with statistics: means, ± SD, and t-test. The different means were compared and analyzed.

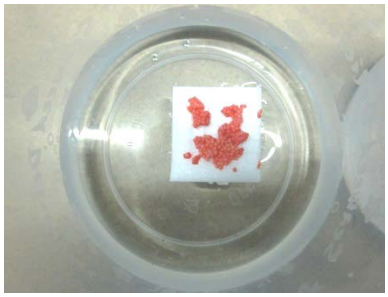

Figure 1 Incubation of Collected Snail Eggs on the Dry Materials above Water Surface (Photo by Thepbodee Sampan)

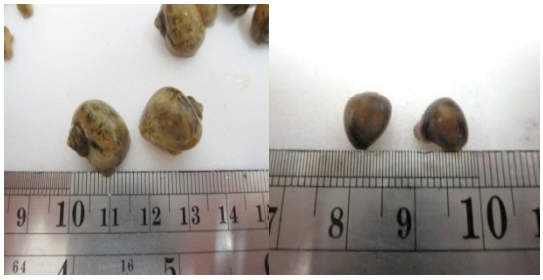

Figure 2 Adult Snails Grown in the Laboratory and 1 Centimeter or Larger (or about 2 months old) Left photo – Golden apple snails and Right photo – Native apple snails (Photo by Thepbodee Sampan)

Figure 3 Raising Golden apple snail and Native apple snails Having the Same Size (One of Each Species Was Raised in the Same Constant growth rates measuring by weight, length, width) (Photo by Thepbodee Sampan)

Results and discussion

By comparing the experimental results of raising both species together, the both species was constant growth rates measuring by weight, length, width. However, the growth of the golden apple snails was faster than that of the native apple snail. For example, the average weight of the golden apple snail and the native apple snails was 2.62 ± 2.02 grams/month and 0.69 ± 0.10 grams/month, respectively (Figure 4). The average weight of the golden apple snail and the native apple snails shells was 2.04 ± 0.43 centimeters/month and 1.21 ± 0.06 centimeters/month, respectively (Figure 5). The

average height of the golden apple snail and the native apple snails shells was 2.12 ± 0.34 centimeters/month and 1.28 ± 0.07 centimeters/month, respectively (Figure 6). Due to the fact that the apple snails ate less and slower than the golden apple snail ones, the growth of the native apple snails was then slower than that of the golden apple snail ones when they were raised together. In other words, this was because the golden apple snails could eat more and faster than the apple snail. By comparing the different average growth of both species raised in different conditions, it was found that the growth of both species raised separately was faster than that of the ones raised together (Table 1). Thus, the average weight of both species raised together was lower than that of the ones raised separately because the growing snails required more foods and larger spaces. Nonetheless, the amount of foods and the spaces provided for them were not changed. This might be the cause of the competition between the two species in order to find foods and survive. The average weight of the native apple snails raised in both conditions was increasingly stable. Additionally, the width and the height of both species' shells were not clearly different, even though they were raised in different conditions (i.e. raising them separately or together). Nevertheless, the width and the height of the golden apple snails were longer/higher than that of the native apple snail in both conditions. By observing the consumption behaviors of both species, it was found that the amount of consumed water spinach (after 24 hours have passed) in the condition that they were raised separately was less than that in the other condition. By observing the behaviors of both species after feeding them, it was found that both species crawled to their foods. The golden apple snails took 3 - 5 minutes to crawl to the foods. That is, they took shorter time as compared to that (i.e. 10 – 15 minutes) of the native apple snails. This might be the reason for the faster consumption behavior and growth of the golden apple snails as compared to that of the native apple snail. It was expected that this was because raising both species together may result in group consumption behaviors. In other words, the same species of snails might consume food together and quickly as they needed to consume their foods before the other species arrived in order to survive. This was different from the condition that the snails were raised separately and fed sufficiently. In that condition, they did not have to compete. Therefore, the consumption rate in that condition was slower than that of the condition that the snails were raised together. For instance, by observing the behaviors of the snails raised separately, it was found that the native apple snails took 15 – 25 minutes to crawl to their foods and usually crawled at the bottom of the constant growth rates measuring by weight, length, widths. They took longer time as compared to that of the snails raised together. Due to the fact that there are no studies regarding the competition between these two species, the researcher then found other studies concerning other species of snails. These finding are consistent with the findings of other studies considering the competition between two species of snails. For example, the study about the effects of mud snail (*Ilyanassa obsolete*) on *Corophium volutator* (Coffin et. al., 2012) stated that the more population of mud snail, the lower survival rate of *C. volutator* (Drolet et al., 2009; Coffin et al., 2012). This is because the competition between the two species slowed down the growth of *C. volutator*, especially that during larval stage (Coffin et al., 2012). The competition also affected the reproduction of *C.*

volutator. That is, the number of male *C. volutator* that did not survive is more than that of female snails (Barbeau and Grecian, 2003; Coffin et. al., 2012). Furthermore, the reduced size of female snails ovigerous decreased the success rate of their reproduction (Coffin et. al., 2012). The competition also reduced the population of other species, especially ammelids (Kelaher et al., 2003; Coffin et al., 2012).

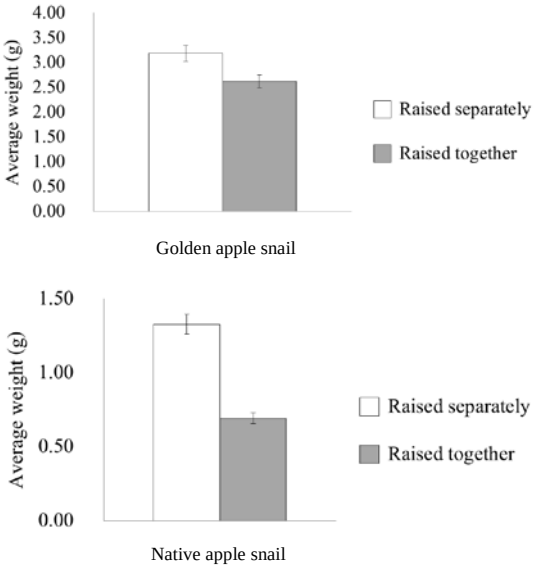

Figure 4 Comparison between the Average Weight of the Golden apple snails (Upper Photo) and Native apple snails (Lower Photo) in Two Conditions after 5 Months (gram/month)

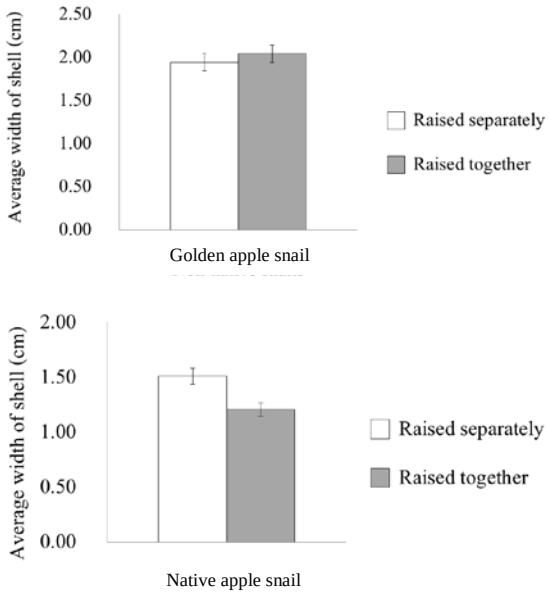

Figure 5 Comparison the Width of the Golden apple snails (Upper Photo) and Native apple snails (Lower Photo) in Two Conditions after 5 Months (gram/month)

Table 1 Comparison the Growth of Two Species after 5 Months

Measurements	Species					
	Golden apple snails			Native apple snail		
	Raised separately	Raised together	P-value	Raised separately	Raised together	P-value
Weight (g)	3.19 ± 4.49	2.62 ± 2.02	0.03	1.33 ± 0.42	0.69 ± 0.10	0.05
Width of shells (cm)	1.94 ± 0.39	2.04 ± 0.43	0.001	1.51 ± 0.13	1.21 ± 0.06	0.02
Height of shells (cm)	2.20 ± 0.46	2.12 ± 0.34	0.002	1.57 ± 0.14	1.28 ± 0.07	0.09

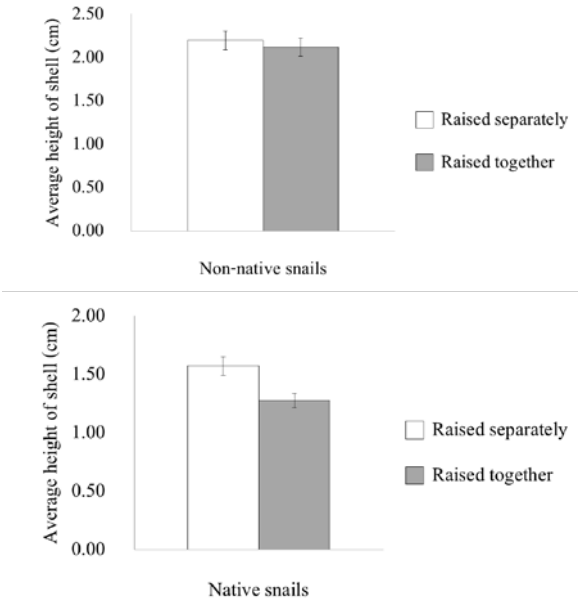

Figure 6 Comparison between the Height of the Golden apple snails (Upper Photo) and Native apple snails (Lower Photo) in Two Conditions after 5 Months (gram/month)

Conclusions

The competition between the two species of snails raised in two different conditions. Found that the average weight of the golden apple snails was increasingly stable in both conditions. The average weight of these snails in the condition they were raised separately was heavier than that in the condition they raised together. The average weight of the native apple snails was also increasingly stable in both conditions, but their weight was lighter as compared to that of the golden apple snail ones. Their average weight in the condition they were raised together was also clearly lighter than that in the condition they were raised separately and as compared to that of the golden apple snail ones. The average amount of consumed water spinach (after 24 hours have passed) in the condition they were raised separately was less than that in the condition they were raised together. Moreover, the width and the height of both species did not clearly different in both conditions. However, the width and the height of the golden apple snails shells were wider/higher than that of the native apple snail in both conditions. Hence, the growth of both species raised separately was faster than that raised together in the same constant growth rates measuring by weight, length, width.

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