



## BIOLOGICAL CLOCK OF GOLDEN SNAIL (*Pomacea canaliculata*) UNDER CONDITIONS OF MALAKA REGENCY EAST NUSA TENGGERA PROVINCE, INDONESIA

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### ABSTRACT

Biological clock of golden snail (*Pomacea canaliculata*) was observed for three consecutive days, day (12 hours of light) and night (12 hours of dark), under tropical climate conditions in the District of Malaka, East Nusa Tenggara Province, Indonesia. Each pair of male and female snails of 10 pairs was placed on the surface of the mud in the bucket at 05.30 a.m. local time. Twenty rice seedlings were planted at the middle of the bucket. Mobility, feeding, mating and egg laying were observed at every hour started from 06.00 a.m. Illumination did not affect significantly to the snails existence. Number of snails existed on the mud surface was 78.47% at day light and 93.61% at night, while inside the mud was 21.53% at day light and 6.39% at night. Illumination affected significantly to the snails activities. Most snails were more active at night (63.20%) than during the day (22.92%). Otherwise, the snails were more passive during the day (77.08%) than the night (36.80%). The snail activities during the day light as compared to the night were for mobility 5.70%: 29.58%, feeding 13.33%: 22.50%, mating 3.89%: 10.56%, and egg laying 0%: 0.56%, respectively. Implications of the findings is that hunting snails may be done in the afternoon or evening. Snails that are inside the mud escape from predation and hence they avoid extinction.

**Keywords:** biological clock, golden snail (*Pomacea canaliculata*), paddy.

### INTRODUCTION

Malaka District is directly adjacent to the Republic of East Timor and a center of rice production in West Timor. Irrigation water comes from Benenain dam and several wellsprings in the vicinity, so that in the dry season farmers can cultivate paddy. Up to the year of 2000 the golden snails (*Pomacea canaliculata*) were not known in the District of Malaka. When the exodus of the people of East Timor to the District of Malaka, there was someone who brought 5 snails and placed them in the pond of Wedik, Kamanasa. The snails reproduced and from there spreading quickly to the vicinity rice fields (Francisco, 2013; personal communication).

In 2010-2012 the snails were outbreak and caused serious damage so that rice production fell to less than 2 tons / ha. Prior to 2000 the snails were not known in the District of Malaka. This pest is a threat to rice cultivation due to breeding very fast (Wagiman, *et al.*, 2014). Golden snail is known as one of the hundred most invasive species in the world (Lowe, *et al.*, 2000; IRRN, 2005). The snail is very voracious and feeds on a lot of aquatic vegetation (Fang, *et al.*, 2010). The preferred host plants are young and soft as rice seeds, algae, spinach, vegetable plants, water hyacinth, taro, lotus and other aquatic weeds (Boediono, 2006, Matsukura, 2013), as well as very polyphagous (Bonetto and Tassara, 1987 in Memon, *et al.*, 2011).

Control measures that have been done by farmers in the District of Malaka were picking up snails, dried rice fields after rice transplanting, and chemical control with fentin acetate, Metaldehyde and niclosamide. The control measures are also done in Japan, the drain field as the

newly planted rice, handpicking and application of molluscicides (Yusa and Wada, 1999). Understanding of biological clock of the golden snail may relevant to the effectiveness of mechanical control by picking up snails. According to the Merriam-Webster Dictionary (2015), the biological clock is an inherent timing mechanism in a living system that is inferred to exist in order to explain the timing or periodicity of various behaviors and physiological states and processes. Knowledge of the characteristics of biological clock of the golden snails support the efforts of management and control the pest by hunting and herding ducks.

### METHODOLOGY

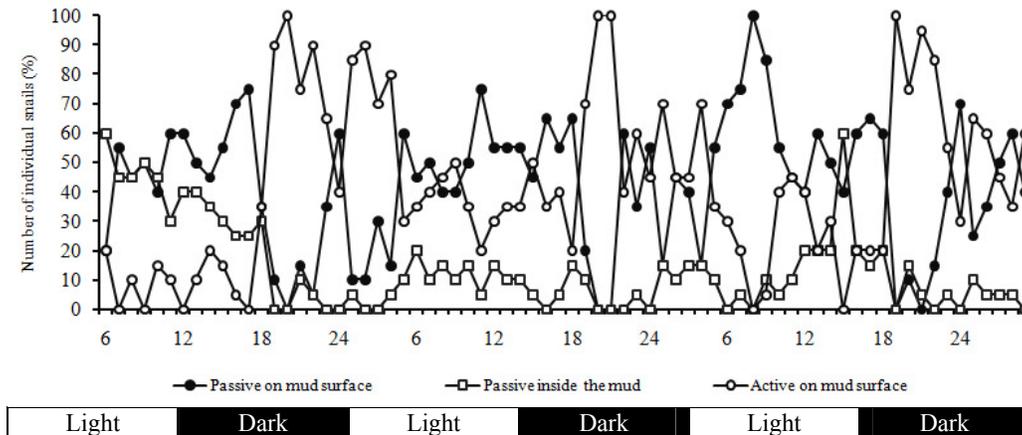
Experiment was conducted in the tropical area of Malaka Regency, East Nusa Tenggara Province, Indonesia. Light conditions in daylight for 12 hours and 12 hours dark. Arena experiment was a bucket-sized 22 cm high, 27 cm in diameter of top and 19 cm in diameter of bottom. The bucket was filled with mud and then water as deep as 6 cm. twenty paddy seedlings were planted in the center of the bucket surface. A pair out of 10 pairs of male and female snails was cultured in the bucket experimental arena. Snails placed on the surface of the mud at 05:30 a.m. local time. Snails were allowed to mobile, feed, mate, and lay eggs. The existence of snails on the surface and inside the mud as well as their activities were observed routinely once every hour from 06.00 a.m. local time for three consecutive days. The proportion of the number of snails doing activities was illustrated in the graph. Effects of illumination on the existence and activity of snails were analyzed by  $t_{0.05}$  test.



## RESULTS

Half an hour after the snails were placed on the surface of the mud, 60% out of 20 individuals went into the mud, while the rests were remain on mud surface, 20% of them were active and 20% passive, respectively. In the first day, the active snails were less than 20%. In the

second and third day the snails seemed to have adapted and showed activity patterns with consistent rhythm. The proportion of the number of individual snails doing activities during the light and dark conditions for three consecutive days was illustrated in Figure-1.



**Figure-1.** The golden snail activities under light and dark conditions during three consecutive days.

The existence of snails on the mud surface is the total number of individuals that actively or passively, while residing inside the mud is considered passive.

Results showed that illumination had no significant ( $P = 0.127$ ) effect on the proportion of the presence of snails either on the mude surface or inside the mud (Table-1).

**Table-1.** The influence of illumination against existence of the golden snails on mud surface and inside the mud.

Illumination	Proportion of individual snails existing	
	On mud surface (%)	Inside the mud (%)
Day light	78,47	21,53
Night dark	93,61	6,39
$t_{\alpha 0.05}, P =$	0.127	0.127

Illumination affected significantly to the snail activities, especially to the their mobility. Most snails were more active at night (63.20%) than during the day (22.92%). On the other hand, the snails were more passive during the day (77.08%) than the night (36.80%). The

snail activities during the day light as compared to the night were for mobility 5.70%: 29.58%, feeding 13.33%: 22.50%, mating 3.89%: 10.56%, and egg laying 0%: 0.56%, respectively (Table-2).

**Table-2.** The influence of illumination to the golden snail activities.

Activities	Proportion of individual snails doing activities under conditions of		$t_{\alpha 0.05}, P =$
	Day light (%)	Night dark (%)	
Active:	22.92	63.20	0.0390
Mobility	5.70	29.58	0.0043
Feeding	13.33	22.50	0.1978
Mating	3.89	10.56	0.1474
Egg laying	0.00	0.56	-
Passive	77.08	36.80	0.0390



## DISCUSSIONS

Characteristics of the biological clock of golden snails showed that the snails are more active at night than during the day, while laying eggs is only done in the dark conditions. Indeed snails lay their eggs at night (Teo, 2004). Observation on the behavior of other snails, namely *Aplysia dactylomela*, *A. pervula* and *A. fasciata* showed that feeding activity is longer, then followed by resting and mating (Chase, 2002). Snails are more passive at light period than in the dark period. Halwart (1994) stated that the snails have a habit of immersing themselves into the mud and close their operculum.

Based on the characteristics of the golden snail biological clock, hence, hunting for snails should be done either at day or night, because of the presence of snails in the mud surface during the day as many as in the night. When people want to herder ducks at the paddy field it should be done in the day light conditions as the duck behavior may synchronous with the snail behavior. Colonies of snails before planting are dominated by nymphs as many as 61.45%, followed by juvenile and adults as many as 30.32% and 8.23%, respectively (Wagiman, *et al.*, 2015). This age structure of golden snail is very beneficial for ducks to feed on small snails. The existence of snails inside the mud is a snail strategy to sustain its life in nature. This is in accordance with the principles of Integrated Pest Management that by leaving little number of snails on the paddy field will create system of sustainable energy flow in the food chain.

## CONCLUSIONS

Illumination did not affect significantly to the snails existence. Number of snails existed on the mud surface was 78.47% at day light and 93.61% at night, while inside the mud was 21.53% at day light and 6.39% at night. Illumination affected significantly to the snails activities. Most snails were more active at night (63.20%) than during the day (22.92%). Otherwise, the snails were more passive during the day (77.08%) than the night (36.80%). The snail activities during the day light as compared to the night were for mobility 5.70%: 29.58%, feeding 13.33%: 22.50%, mating 3.89%: 10.56%, and egg laying 0%: 0.56%, respectively. Implications of the findings is that hunting snails may be done in the afternoon or evening. Snails that are inside the mud escape from predation and hence they avoid extinction.

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