
A STUDY ON BREEDING BIOLOGY AND POPULATION OF GIANT AFRICAN SNAIL (*ACHATINA FULICA*) AND ITS MANAGEMENT IN THONNIYAKAVU, PARAVUR MUNICIPALITY IN ERNAKULUM DISTRICT, KERALA

Seema K

Assistant Professor, Department of Zoology, St. Xavier's College for Women, Aluva-683101

Niya Benny

Department of Marine Biology, Microbiology and Biochemistry, School of Marine Science, Cochin University of Science and Technology-682022

Abstract: A study was carried out on the breeding biology and population of the invasive alien species, the Giant African snail (*Achatina fulica*) and its management in Thonniyakavu, Paravur Municipality in Ernakulam District, Kerala. Thonniyakavu is an area where Giant African Snails have turned to be a menace causing damage to plants, water resources and even concrete walls and buildings. The population density of snails was ascertained by quadrat method. The study was conducted from July 2015 to February 2016. General observation was done during first three months. Quadrat method was done from October 2015 to February 2016. Population density was maximum during November 2015 and minimum during January 2016. Mark recapture method was also adopted for the study. Management strategies like spraying tobacco decoction and copper sulphate mixture were adopted. Once the snail becomes established, it is very difficult to control their population. It is appropriate to activate an emergency response plan.

Keywords: Giant African Snail, Mark Recapture Method, Quadrat Method, Thonniyakavu.

Introduction: The Giant African Snail (*Achatina fulica* Bowdich, 1822) promotes substantial ecological and economic impacts in areas where it has been introduced (Rauth and Barker, 2002). This snail, originated in Africa, is one of the most destructive pests affecting subtropical and tropical areas, causing large damages to farms, commercial plantations and domestic gardens. It can also be found on trees, decaying materials and next to garbage deposits (Mead, 1995; Vansconcelos and Pile, 1999). The snail derives its name from its large size (up to 7 inches) and has the biotic potential for developing large colonies. It is regarded as one among the worst hundred invasive alien species known to the world and attacks over 500 species of economic plants. Furthermore, *A. fulica* could be an intermediate host of *Angiostrongylus costaricensis* (Morera and Céspedes, 1971), the etiological agent of abdominal angiostrongylosis, and its dispersion could imply a possible risk of transmission of this disease (Teles *et. al.*, 1997).

During favourable environmental conditions, this snail lives for five to six years. The shell is long, narrow and conical and can attain a length of 20 cm. The shell is usually light brown in colour with darker brown and cream banding. The activity, growth and reproduction of the snail are abundant during rainy weather and stops or considerably slow down when it is dry (Aqis, 1997).

Methodology: Study Area: Thonniyakavu of Paravur municipality (fig. 1) in Ernakulam district of Kerala was the study area selected. *Achatina fulica* turned to be a menace in this region. An area covering ten cents in Thonniyakavu was taken for the study.

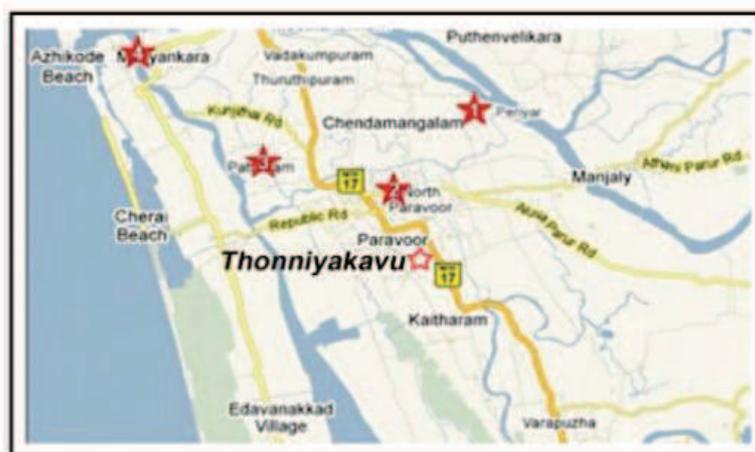


Fig. 1: Map Showing Study Area

Study Period: The study was carried out from July 2015 to February 2016. During the study breeding biology and population of *Achatina fulica* was recorded.

Breeding Biology: Breeding biology of giant African snail (*Achatina fulica*) was studied by continuous observation in the natural habitat.

Population Estimation: This was carried out by two methods:

Quadrat Method: The population density of *Achatina fulica* was ascertained by quadrat sampling with 0.5m x 0.5m sized quadrats. Ten square quadrats were placed randomly in the study site. Sampling was carried out at evening to minimize bias, as snails were more active and easily available at that time than later in the day. The number of adult and juvenile snails found in each quadrat were recorded immediately and population density was determined using the equation,

$$\text{Population Density} = \frac{\left\{ \frac{\text{Total count of Snails}}{\text{No. of quadrats}} \right\}}{\text{Area covered by one quadrat}}$$

Mark Recapture Method: For estimation of absolute numbers, mark recapture method is very effective. *Achatina fulica* were marked with waterproof paints on their shells and the marked animals were immediately released near the collection site itself. The size of the population was estimated from the number of marked individuals recaptured on the second day.

The Lincoln Index: The Lincoln Index is a method which is used to estimate the size of closed populations based on the capture – marked – recapture technique. The results were used in the following equation to arrive at an approximate estimation of population.

$$\frac{\text{Number marked in second sample}}{\text{Total caught in second sample}} = \frac{\text{Number marked in first sample}}{\text{Size of whole population (N)}}$$

Management: Management of Giant African snails was carried out using tobacco decoction and copper sulphate mixture taken in equal proportion. This was done during the month of October along with Paravur Municipality. Population was analyzed during the time of treatment and after the treatment.

Observation & Results: Breeding Biology: The giant African snail *Achatina fulica* is a hermaphrodite. Young snails become sexually mature after 3-5 months. The shell is about 55 mm long when the snails mate and they prefer same size group for mating. The courtship behaviour of *Achatina fulica* was observed in the field and mating occurred during early morning (plate 1).



Plate 1 Mating of Giant African Snail



Plate 2 Egg Mass of Achatina Fulica

Shell is 60 mm long when they lay eggs. Egg laying begins 8-20 days after mating (Shripats, 2002). The eggs are pale yellow, elliptical, about 4-5mm in diameter and were laid in clutches (plate 2). The eggs laid vary in numbers from 100-400. During the present study it was observed that the eggs took eleven days for hatching. From 18th December 2015 to 20th February 2016 *Achatina fulica* remained in dormancy. During that time shell opening was sealed off with a calcified membrane and the membrane was removed only after awakening from dormancy with the help of another snail (plate 3).



Plate 3 Removal of Calcified Membrane with The Help of Another Snail



Plate 4 Movement of Achatina Fulica on A Wall

Quadrat Method: Average population density was maximum during November and minimum during January (fig. 2). By late December and during the month of January Giant African snails were in dormancy. During February again the population showed an increase.

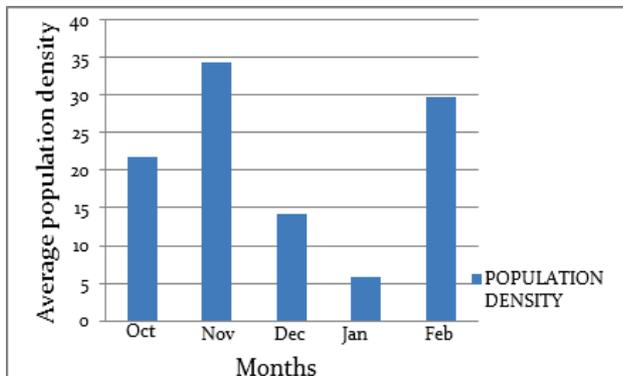


Fig. 2 Average population density of Giant African snail in each month

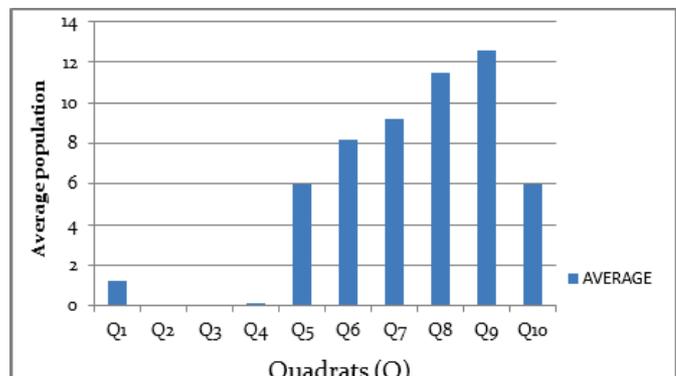


Fig. 3 Average population of Giant African Snail in the ten quadrats during the study period

Giant African Snails were rarely seen in quadrats 2, 3 and 4 as they were placed in sunny areas while quadrats 8 and 9 recorded the highest population due to moistened conditions of the area (Fig. 3).

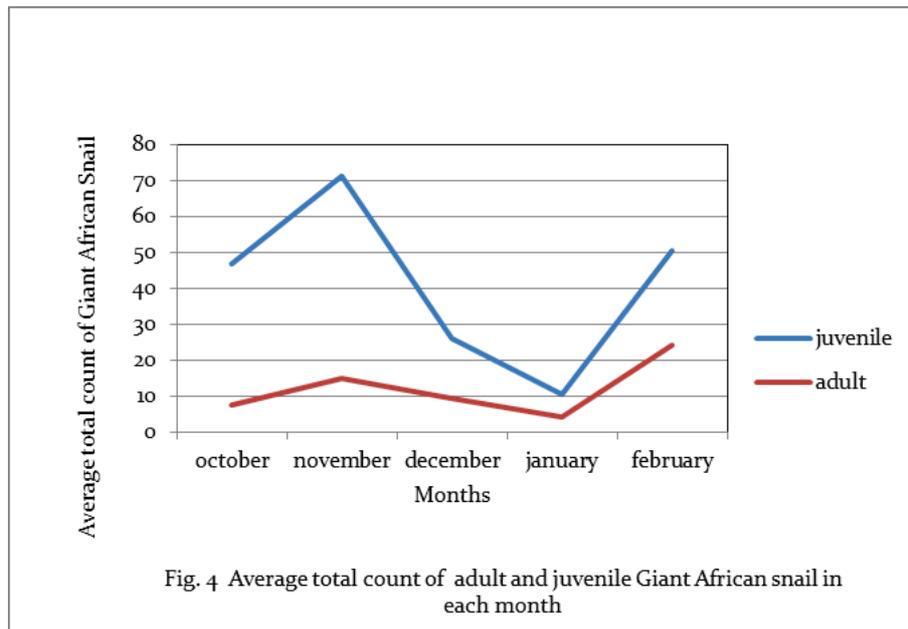


Fig. 4 Average total count of adult and juvenile Giant African snail in each month

Study results reveal that average population of adult as well as juvenile Giant African snails fluctuate in a synchronous manner (Fig. 4). The population was highest in November and lowest in January.

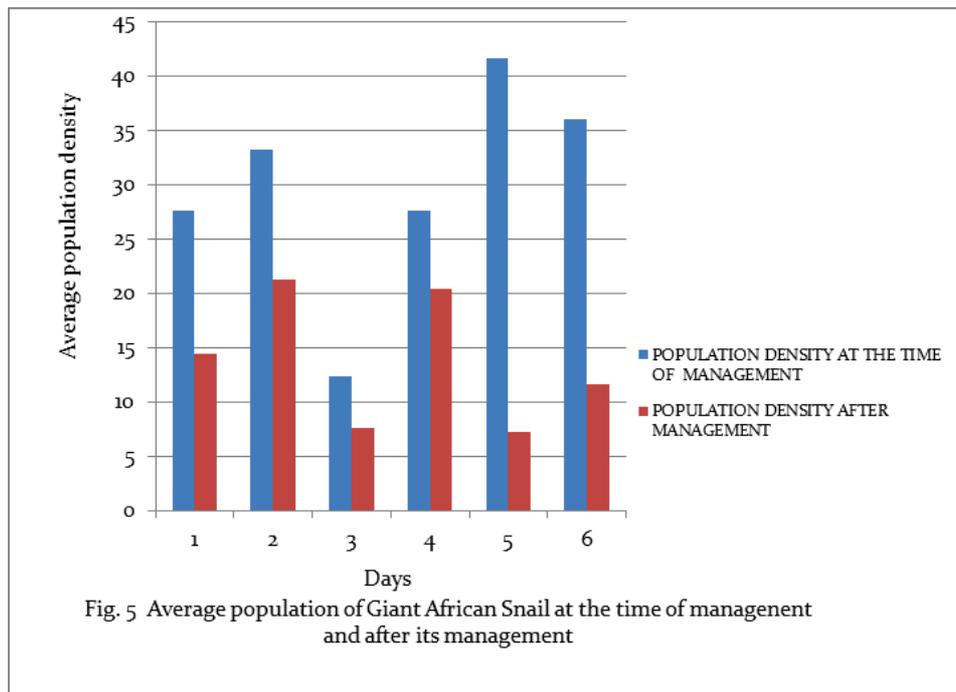


Fig. 5 Average population of Giant African Snail at the time of management and after its management

There was a gradual decrease in population density of Giant African Snails after its management using tobacco decoction and copper sulphate mixture (Fig. 5).

Many plants, including agricultural crops and ornamentals were attacked by this snail. The severity depends on the individual situation and its infestation has been reported in plants like beans, cabbage, carrot, citrus, and corn seedlings, cucumber, hibiscus, melon, papaya and peanuts. *Achatina fulica* multiplies in almost unbelievable numbers and during the peak of its infestation, it is impossible to walk any distance in an infected area without stepping on a snail.

Mark Recapture Method:

Plate 5 Snails Collected During Mark-Recapture Method

Mark recapture method was also adopted during the study (plate 5). The population size of *Achatina fulica* was estimated using Lincoln Index and the value obtained was 270.22. The results shows that the study area is widely infested by *Achatina fulica*.

Discussion: From the result it is evident that population of *Achatina fulica* is extremely abundant in the study area. In quadrat sampling, only the surface of the area enclosed by the quadrat was inspected where as the soil beneath has been neglected. Quadrat 2 to 4 was kept in sunny area where there is no moist condition and population of snails were extremely low. This shows that they prefer damp and moist habitats.

Late December and during the month of January, Giant African snails were in dormancy. Terrestrial molluscs in cold and temperate countries hibernate and aestivate respectively with the onset of adverse climatic condition (Mead, 1961; Godan, 1983; Raut and Ghose, 1984; Raut, 1991; Gomot and Gomot, 1991; Fields, 1992; Raut and Barker, 2002; Ahmed and Raut, 2008). In both cases the snails attempt to overcome the unfavorable conditions by adjusting their physiological conditions. From the present field study observations, it is evident that dormancy in *Achatina fulica* is induced by some factors like temperature and relative humidity, and it burrows into the ground and seal off the opening of the shell with calcified membrane.

The snail *Achatina fulica* occurring in and around Kolkata, West Bengal, India usually undergoes aestivation with the advent of unfavourable weather during November every year (Raut, 1991). According to Rahman and Raut (2010) *Achatina fulica* belongs to three groups 40-45 mm (juvenile), 60-65 mm (adult) and 80-85 mm (old) in shell length. During the present study old *Achatina fulica* were observed on concrete walls and tree to satisfy their calcium requirements (plate 4). So only juveniles as well as adult Giant African snails were counted during quadrat sampling.

The Giant African snails, after dormancy became very active with fast movements in search of partner for mating. They produced viable eggs by reciprocal copulation. In most land observed at night, it was often been shown that rain result in increased mating (Tompa, 1984). During this study mating behaviour of *Achatina fulica* was observed during early morning. Young adults of *Achatina fulica* commence copulation, old adults copulate for only a short period. Pairs of *Achatina fulica* perform simultaneously reciprocal mating.

According to Mohr and Van Der (1949 B), *et al.*, larval stages in land snails are completed within the egg. The young snails resembling their parents hatch out from eggs. According to Mead (1961) with the increase of age, a snail may lay 1200 eggs per year. So a single fertilized snail can establish a whole colony. Once this snail becomes established it is difficult to eradicate.

Eradication of Giant African Snail is quite costly. In Florida, it is estimated that an annual loss of US \$ eleven million in 1969 happened due to lack of control measures. Florida has been declared the first place in history that successfully eradicated the Giant African Snail from an area where it had become thoroughly established (Poucher, 2002).

During the present study, eradication process was carried out in Thonniyakavu area along with North Paravur Municipality. Once in two days tobacco decoction - Copper Sulphate mixture (TDCS Mixture) was sprayed.

This was practiced for the first two weeks of October 2015 when a decline was observed in its population. As this process ceased, gradually an increase was observed in the population of *Achatina fulica* in the study area.

Conclusion: The invasive alien species, *Achatina fulica* turned out to be a real menace in Thonniyakavu area of North Paravur Municipality. Population estimation studies reveal that they flourish well in the area causing wide spread damage to plants and even buildings. Application of tobacco decoction - Copper Sulphate mixture (TDCS Mixture) is a successful management strategy for *Achatina fulica*.

Acknowledgment: We owe our thanks to Dr. T.V. Sajeew, Scientist and Head, Forest Entomology & Pathology department, Kerala Forest Research Institute, Peechi for his valuable guidance and support throughout the period of this work. We also extend our sincere gratitude to Department of Zoology, St. Xavier's College for Women, Aluva for all the facilities provided to us.

References:

- Ahmed, M. and Raut, S.K. "Changes in proximate constituents and the fate of aestivating *Achatina fulica* Bowdich." Proc. Nat. Acad. Sci. India. Sec. B. 78 (2008): 343-350
- Aqis. "Giant African Snail." Plant quarantine. Leaflet no:3 (1997)
- Fields, J.H.A. "The effects of aestivation on the Catalytic and regulatory prospectus of Pyruvates Kinase from *Helix aspera*." Comp. Biochem. Physiol., 102.B(1) (1992): 77 - 82
- Godan, D. "Pest Slugs and Snail." Berlin: Springer Verlag. (1983): 445
- Gomot, P and Gomot, L. "Length of Hibernation and the brains influence on temperature-induced Spermatogenic DNA synthesis in *Helix aspera*." Comp. Biochem. And physical., 100.A(3) (1991): 689-692.
- Mead, A.R. "Anatomy, phylogeny and zoogeography in African Land Snail family Achatinidae." In Proceedings of the 12th International Malacological Congress, Vigo, Spain (1995): 422-423.
- Mead, A.R. "The Giant African Snail: A Problem in Economic Malacology." University of Chicago Press, Chicago (1961).
- Mohr, J.C. and Van Der " On the reproductive capacity of the African of giants snail , *Achatina fulica* (fer)." Treubia, 20(1) (1949B): 1-10.
- Morera and Cespedes. "Presence of *Angiostrongylus costaricensis* in Colombia." Am J Trop Med Hyg Jan; 30(1) (1971):81-3.
- Poucher, C. "African Snail Eradication." Eradication of the giant African Snail in Florida. FDACS, Division of Plant industry. Winter Heaven. (2002): 524.
- Rahman, S. and Raut, S.K. "Factors Inducing Aestivation of the Giant African Land Snail *Achatina fulica* Bowdich (Gastropoda: Achatinidae)" Proc. Zool. Soc. 63(1) (2010):45-52.
- Raut, S.K. and Ghose, K.C. "Pestiferous land snail of India." Technical monograph, NO.11. Zoological Survey of India. Kolkata. (1984): 151.
- Raut, S.K. "Population dynamic of the Pestiferous Snail *Achatina fulica* (Gastropoda: Achatinidae)." Malacol.Rev. 24 (1991):79-106.
- Raut, S.K. and Barker, G.M. "*Achatina fulica* Bowdich and other achatinidae as a pest in tropicultural agriculture." Mollusks as Crop Pest. New Zealand: Ed. By Landscare Research Hamilton. (2002): 472
- Shripat, C. "Towards eradication of giant African snail *Achatina fulica* in Trinidad and Tobago." Centeno (2002): 56.
- Teles, H.M.S., Vaz, J.S., Fontes, L.R. and Domingos, F.M. "Registro de *Achatina fulica* (Mollusca: Gastropoda) no Brazil: caramujo hospedeiro intermediário da Angiostrongilíase." Rev. saude publica, vol. 31, no. 3.(1997): 310-312.
- Tompa, A.S. "Land Snails (Stylommatophora) In The Mollusca 7 : Reproduction" (A.S. Tompa, N H.Verdonk & J.A.M Van den Biggelaar, eds), Academic Press, London.(1984):47-140.
- Vasconcelos, M.C. and Pile, E. "Ocorrência de *Achatina fulica* no Vale do Paraíba." Estado do Rio de Janeiro, Brasil. Rev. saude publica, vol. 35, no. 6.(2001): 582-584.
