

The Food Preference and Biology Study of Giant African Land Snail *Achatina fulica* (Bowdich).

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ABSTRACT

The survey of the data with respect to giant African land snail *Achatina fulica*. The infestation commenced with the onset of monsoon and remained active throughout the rainy season. It started declines gradually from the middle of September. The preferred host of giant African land snail *Achatina fulica* was Cabbage, Mulberry, Spinach, and Hibiscus etc. A marked preference for food was observed for snail of different sizes groups. Young snail preferred plant of soft texture and the increases in size. *Achatina fulica* laid 200-350 eggs in the depression of soil with large amount of mucous. The eggs are oval in shape and yellow in color. The clutch size varied from different eggs clutches. The survival data revealed that 50% young ones survival at the end of hatching period. After hatching, 83.14% survival and 20.27% of unsurvival was recorded up to 6-7 days.

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Introduction

Giant African Snail is one of the world's largest and most damaging land snail pests. The World Conservation Union (IUCN) has listed *Achatina fulica* as one of the world's 100 most invasive species. It is popularly known "Ghonda" or "Harshankh" in India infests agriculture crops and horticultural plantation. This pest was reported Calcutta, India (Mead, 1961). Under favorable climatic conditions these snails reach an great abundances hence it is used in prediction of *Achatina fulica* population (Raut and Barker, 2002). It has been observed that in Asia-Pacific regions- Bangladesh, China, Fiji, India, Indonesia, Japan, Kiribati, Malaysia, New Zealand, Palau, Papua, New Guinea, Philippines, Samoa, Island, Sri Lanka, Vanuatu and Vietnam *Achatina fulica* is recorded in abundance (Manipal et al. 1981 Tillier, 1982; Raut & Barker, 2002) that were threat to plants of all ages which makes very difficult to estimate the actual damages (Sridhar et al. 2012). The adult snail is around 8cm (2.3 in) in height and 20cm (7.9 in) or more in length. The shell has a conical shape, being about twice as high as it is broad. Shell coloration is highly variable, and depends on diet. However, typically, brown is the predominant color and the shell banded (Skelley et al., 2011). The aperture is relatively short, even in the broadest specimens, being always shorter than the spire. The normal life span is 3-5 years, but some may live as long as 9 years. The snail reaches sexual maturity in less than a year. It is simultaneously hermaphrodite, which means that each individual is capable of producing both sperm and ova (Mead 1961). They are nocturnal move along on single foot, driven by waves of muscle contraction in sole. There are two pairs of tentacles, one pair longer than the other, and the eyes are located on the longer pair sensitive to light; the shorter pair is used for smelling and feeling substratum on its way around. The snails have no gills and operculum, but the mantle cavity serves a lung and a protective back (seal) to the shell by a mucus plug.

During the mating two individual come side by side in such in such a manner that their genital aperture are opposed. The intermediate organ of one come out through the genital aperture and pushed into the vagina of other and vice versa. Like other land snails, these have intriguing mating behavior, including petting their heads and front parts against each other. Courtship can last up to half an hour and the actual transfer of gametes can last for two hours. Transferred sperm can be stored within the body for up to two years. The number of eggs per clutch averages around 200-300 yellow colored eggs per clutch are released in 5-6 clutches per year with hatching viability about 90% percent (Ghose 1963; Aslam et al 2000).

As reported earlier in *Achatina fulica*, the aestivation period is about 5-10 months and hibernation generally occurs in winter season. Some species can aestivate for as long as many months, and this is accompanied by a reduction of their metabolic rate to 30% of the normal rate (Mead 1961 Singh and Roy 1979). If conditions become unfavorable, the snail can aestivate by burrowing underground and covering its shell opening with a calcareous membrane, called an epiphragm, until such time as the environment improves (Mead, 1979, Raut & Barker, 2002). Some nematodes may reduce the fecundity of their hosts, for instance, the number of *Nemheli bakeri* infecting *H. aspersa*, was negatively correlated with egg production (Morand and Faliex, 1994). The protozoan parasite *Tetrahymena rostrata* was found to be more abundant among intensively managed *A. fulica* (Segade, et al., 2009). Gastropod populations (Raut, 2004). Understanding the pattern of life activities of the snail, *Achatina fulica* is an urgent need to combat the pest population. In our university for more than two decades the biological and neuroendocrine studies are ongoing. However, garden giant snails were very rarely were located. In couple of years there is notable increase in pockets of snail population, especially in gardens.

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Hence present study on biology *Achatina fulica* at laboratory conditions was performed. The observations in natural conditions along with laboratory are discussed in light of breeding and feeding behavior.

Materials and Method

Systematic position

Classification

Kingdom: Animalia
 Phylum : Mollusca
 Class : Gastropoda
 Order : Pulmonata
 Family : Achatinidae
 Genus : *Achatina*
 Species : *fulica*



Satellite view of Siddhartha garden and Sample Collection site L, 19°52'49.18''N, Longitude, 75°18'52.52''E)



***Achatina fulica* (Bowdich, 1822)**

Snails were collected from in Aurangabad city, India in public garden near a central bus stand (The Geographical latitude 19°57'49.07''N and Longitude 75°16'52.86''E). The snails were collected by simple hand picking method using hand gloves. Collection snails were maintained in the laboratory in plastic tubs using same soil of their habitat. The total 16 snails were provided with feeding material such as leaves of mulberry, spinach, hibiscus, cabbage, jujube to observe their food preference. Simultaneously shell morphometric studies were carried out by taking measurements of Animal shell length(ASL), animal shell width(ASW), aperture length(ASL), Aperture width(ASW), total body weight(TBW) by using scales (cm), thread, and electric weight balance. Daily observation is done till yet observation like, feeding, mating, locomotion etc, and photographs also taken. Snails mating are on date 19-06-2015, after mating of snail with 6-8 days eggs laying takes place, on dated 27-06-2015. On that eggs was measured is size, shape, length, width and color observed. then eggs were hatch after 5 to 6 days on date 03-07-2015. was observed in the laboratory that clutch size varied from 30-350 eggs. The experiment was carried out on Giant African land Snails

Achatina fulica which were feeded by five different types of food, to take the food in same quantity each one groups in 100 gm, for 12th hrs, like (Leaves of Spinach, Mulberry, China rose, jujube, Cabbage etc). To daily observation in 1 week, Snails were divided into 3 groups, (Group A, B, and C), No. of snails in first two groups were 5 and group (C) having 6 snails and they were grouped according to their body weight. Group (A) snails recorded maximum body weight which ranges from 44.12-83.30gm, Group (B) ranges from 24.22-36.22gm, and Group(C) ranges from 11.93-19.44gm. After 1 week again counting the total body weight in same animals and compare to the first weight, to give the some differences in body weight, group (A) 44.12-83.30gm and 45.35 - 85.29gm, group(B) 24.22-36.22gm and 28.10-37.90gm, group (C) 11.04-19.44gm and 13.15 - 21.15.

Group (A) clutch size to vary from 25-350 eggs, freshly laid eggs were globular in shape, light yellowish in color, shining and covered with mucus but within few hrs the mucus dried up & egg assumed dull yellowish coloration with an average size of 3.4x2.6mm for the study of its detailed biology. The taxonomy of the species was confirmed in ZSI Pune.

Result and Discussion

Achatina fulica is a large snail with a shell length ranging from 5 to 10 cm, and body weight is 11.04 to 83.39gm. *Achatina fulica* is hermaphroditic; each individual snail has both male and female reproductive parts. There are no distinguishing parts separating sexes because each snail contains both sex reproductive systems. They do not self-fertilized, so the snails need to mate with another snail of their species. As a Stylommatophora, *Achatina fulica* does not mate randomly; the snails mate with respect to age and size of other snails. Immature, small snails that are still growing produce only spermatozoa, while larger, mature adults produce both spermatozoa and ova. There is an age dependent mate choice when it comes to young snails because they need and prefer older adults to mate with. Young giant African snails copulate at all hours of the night, while older adults mate in the middle of the night. Breeding interval the giant African snail breeds every two to three months. Breeding season Breeding can take place any time of the year. Range number of offspring -100 to 500 Average numbers of offspring -200 Range gestation periods -11 to 15 days



Fig A. Snail damage of garden Lawn.



Fig B. Snails are feeded in hibiscus leaves and mulberry leaves in the laboratory.



Fig C. Snails mating time.



Fig D. Snail Egg lay in soil and eggs are collected Petridis.



Fig E. Newly hatching of snails and young ones of snails.

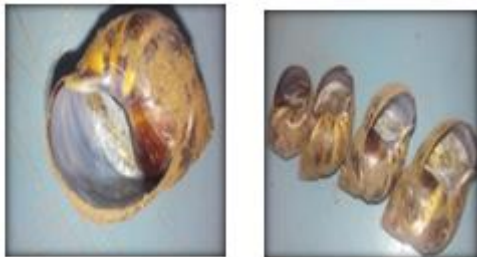
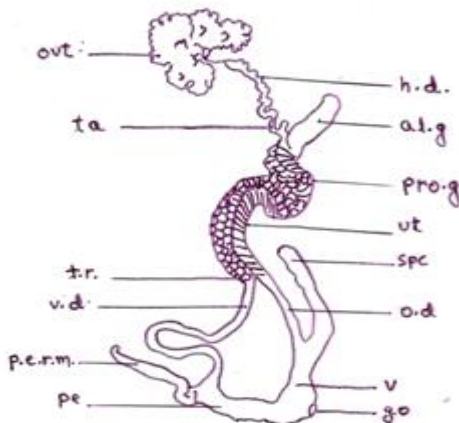


Fig F. Snail is gone into long resting period (Aestivation/hibernation).

Fig G. Reproductive system of *Achatina fulica*.

Abbreviation: al.g = albumen gland, g.o = genital opening, h.d = hermaphroditic duct, o.h = oviduct, ovt = ovatestis, pe = penis, pe.r.m = penial retractor muscle, pro.g = prostate gland, spe = spermatheca, ta = talon, tr = transition region, ut = uterus, v = vagina, v.d = vas deferens.

Mating behavior

The snails choose their mates with respect to size and age, but the reproductive stage-dependent mate is a more attractive mate than the body size-dependent mate choice. Mating occurs when one snail encounters a prospective partner that the individual snail deems acceptable to mate with. When two individual snails mate, there is a possibility that gametes will be transferred to each one by the other simultaneously. However, this is only the case if the snails are around the same size. If there is a size difference, the larger snail will act as the female and the gametes will only be transferred from the smaller snail to the larger snail, mating unilateral. When a two *Achatina fulica* encounter and deem each other worthy mates, they will mate by one mounting the shell of the other. The mating will begin once the two snails exchange sperm with one another. The sperm is used to fertilize the eggs in the snails, the fertilized eggs are laid between 8 to 20 days after mating has occurred, and are deposited in soils on the ground. The eggs usually hatch at temperatures above 20°C. The eggs, under the right conditions, will hatch after 11 to 15th days into small snails. The number of eggs that an individual snail lays often depends on the maturity and age of the snail and is between 50 to 300 eggs.

Clutch size

Giant African snails have no specific season of mating, as they are able to produce new clutches every two to three months. They lay about 1000 eggs during their life span of about 3-5 years. Snails hatching towards the end of rainy seasons take a long time to mature as they undergo hibernation and aestivation.

The experiment was carried out on Giant African land Snails *Achatina fulica* which were fed by five different types of food (Leaves of Spinach, Mulberry, China rose, jujube, Cabbage etc). Snails were divided into 3 groups, (Group A, B, and C), No. of snails in first two groups were 5 and group (C) having 6 snails and they were grouped according to their body weight. Group (A) snails recorded maximum body weight which ranges from 44.12-83.30gm, Group (B) ranges from 24.22-36.22gm, and Group (C) ranges from 11.93-19.44gm. Group (A) Snails highly prefers to spinach leaves as compared to the mulberry leaves, China rose leaves Jujube leaves and cabbage. They preferred spinach because spinach leaves are soft and easily ingest. The data presented (Table-2) indicates that the group A showed highest Average of Total Body weight (57.76 ± 15.99), Total No. of Egg laying (216 ± 43.35), Total No. of eggs/Clutch (220 ± 70.71), hatchability (188.6 ± 17.31) and Undeveloping eggs, As compared to other two Groups (A and B). The Group B showed the mean and SD of Total Body Weight (31.65 ± 5.60), Total No. of Egg Laying (146 ± 11.40), Total No. of Egg/Clutch (145 ± 21.21), Hatchability (122.8 ± 11.23), Total no. of Egg Developing (100.6 ± 17.51), Total No. of Undeveloping Eggs (21.2 ± 8.10). The mean and S.D of Group C showed Total Body Weight (16.10 ± 3.41), Total No. of Eggs Laying (116 ± 10.36), Total No. of Egg/Clutches (111.5 ± 19.0), Hatchability (100 ± 9.50), Total No. of Undeveloping Eggs (11.33 ± 6.59) which are the lowest values, but accept in Total No. of Developing Eggs (88.6 ± 10.42) The mean were highest as compared to other two groups (A and B) Group A is (163 ± 21.09) and Group B is (100.6 ± 17.51).

Table 1. Food preference of plant habitat in *Achatina fulica*.

Plant	Scientific name	Family of Plant
Cabbage	Brassica oleracea v. capitata	Cruciferous
China rose	Hibiscusrosa sinensis	Malvaceae
Mulberry	Morusalba	Moraceae
Spinach	Spinacia oleracea	Amaranthaceoae
Jujube	Ziziphus jujube	Rhamnaceae Zygothylaceae

Table 2. Breeding parameter MEAN \pm SD of *Achatina fulica* under laboratory Condition.

Batches	No. of Snails	Total Body Weight (Mean \pm SD)	Total No. of eggs Laying (Mean \pm SD)	Total. No. of Eggs /clutch	Hatchability (Mean \pm SD)	No. of Developing Eggs Mean \pm SD)	No. of Undeveloping Eggs (Mean \pm SD)
Group A	5	57.7 \pm 15.99	216 \pm 43.35	220 \pm 70.71	188.6 \pm 17.31	163 \pm 21.09	25.6 \pm 21.31
Group B	5	31.65 \pm 5.60	146 \pm 11.40	145 \pm 21.21	122.8 \pm 11.23	100.6 \pm 17.51	21.2 \pm 8.10
Group C	6	16.10 \pm 3.41	116 \pm 10.36	111.5 \pm 19.0	100 \pm 9.50	88.6 \pm 10.42	11.33 \pm 6.59

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