Rec. zool. Surv. India, **81** : 95-100, 1983

EPIPHRAGM SECRETION POTENTIAL IN THE GIANT AFRICAN LAND SNAIL, *ACHATINA FULICA* BOWDICH (GASTROPODA : MOLLUSCA)

By

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(With 3 Text-figures)

Introduction

Generally land snails secrete a mucocalcareous epiphragm over the shell aperture with the beginning of aestivation or hibernation. The mechanism of epiphragm secretion has been described in *Helix aspersa* (Allman, 1894-95). *Achatina immaculata*, *Thaumastus sangoae*, *T. bitaeniatus* (Smith, 1899, 1904), *Glessula hastula* and *Zootecus insularis* (Hora and Rao, 1927), *Macrochlamys glauca* (Hora, 1928) and *Achatina albopicta* (Williams, 1951).

The number of epiphragms secreted by an individual during the whole period of aestivation varies with the species. The secretion of multiple epiphragms by land snails is generally interpreted as a response to conditions which threaten dormant snails. *Achatina fulica* is a serious agri-horticultural pest, and has spread to a number of countries having different length of hibernation or aestivation period. In the present probe the potentiality of epiphragm secretion has been studied under experimental conditions to evaluate its ability to withstand the different environmental conditions.

Materials and Methods

A total of 45 *A. fulica* with near equal shell length (70 mm) were selected for the study. They were divided into 3 groups (Group—I, Group—II and Group—III) with 15 snails in each. Individuals of the 3 groups were weighed and released groupwise in the terrarium measuring 75×30×70 cm in the first week of November, 1975. The terraria were covered with 1.0 mm polythene net. The snails underwent aestivation in a day or two.

The snails of each group were weighed again following aestivation and were left for 7 days undisturbed. On the 8th day, they were again

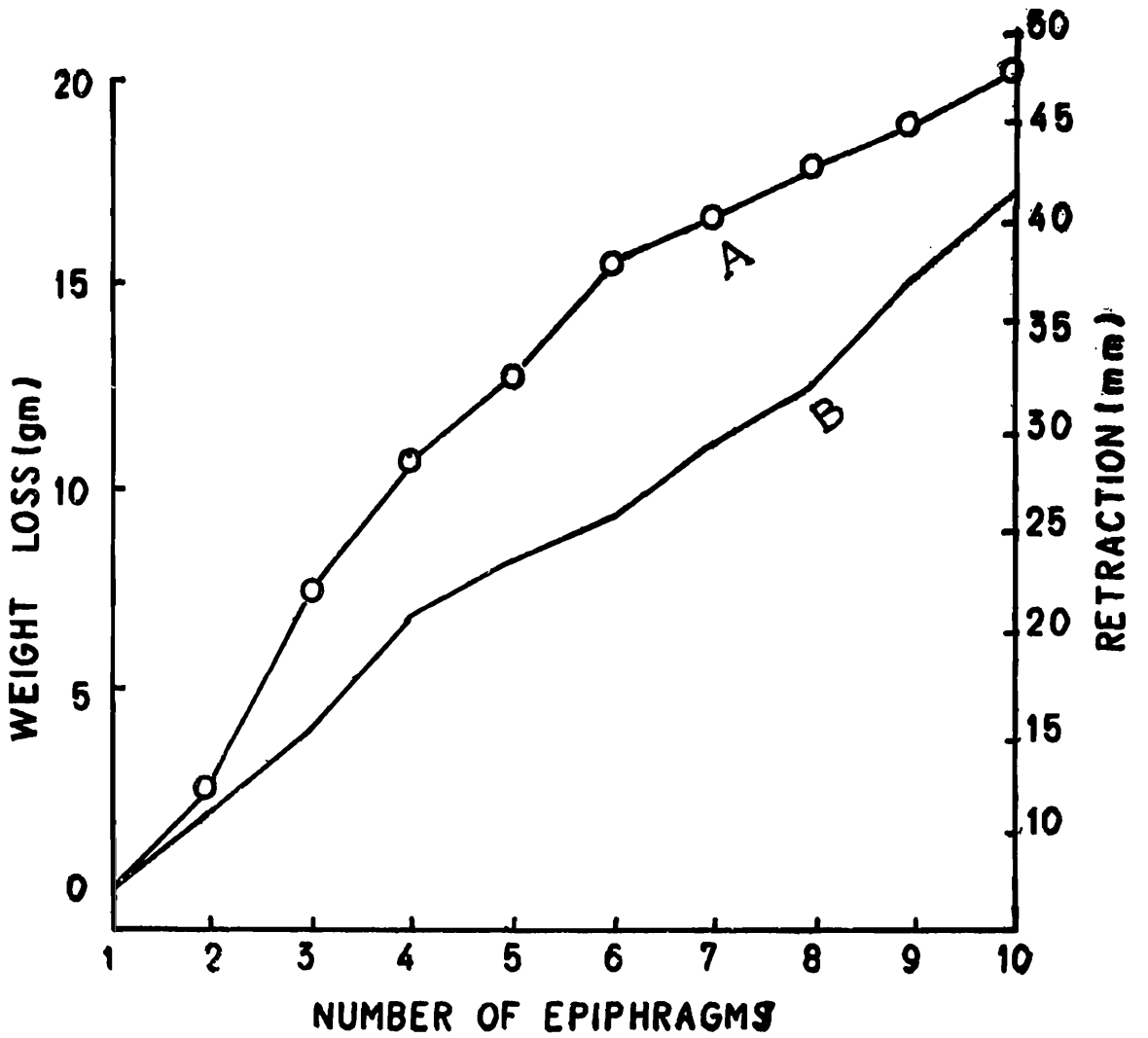
weighed and the epiphragm of all the snails was removed with the help of a pair of fine forceps. Almost all the snails became active during the process. Subsequently the snails of 3 different groups were treated differently. Individuals of Group—I were left to uninterrupted aestivation. The members of Group—II were subjected to water spray at different intervals for a period of 48 hrs. The snails of Group—III received treatment similar to Group—II but they were supplied with choice foods for a period of 48 hrs. which was denied to those of Group —II. The snails of Group—II and III were forced to aestivate and each individual was weighed following aestivation and prior to epiphragm removal. The same process was repeated till the termination of the experiments. In each case the distance between the outer lip of the shell aperture and the point of attachment of the epiphragm was measured.

Results

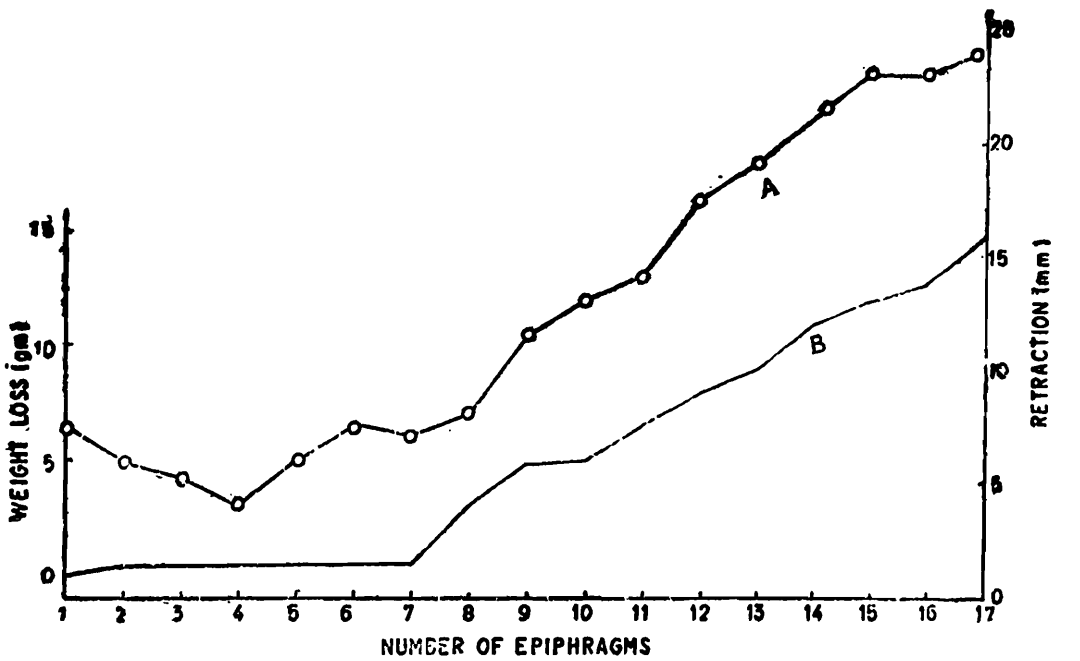
In Group—I, 4 snails died prior to and 11 snails died after the formation of the 10th epiphragm. The initial body weight of a snail was 31.2-34.8g. on an average 33.5g. The distance between the shell lip and the point of first epiphragm attachment was 3.0-5.1, on the average 4.1 mm. The contraction of the visceral mass was gradual and progressive with the formation of succeeding epiphragms and the distance of the 10th epiphragm was 47.8 mm from the shell lip. The maximum and minimum rate of contraction 10 and 2 mm respectively was recorded prior to the 3rd and 7th epiphragm secretion. The average retraction of visceral mass was 4.78 mm per epiphragm secretion.

A gradual loss in body weight of the snails was recorded from first to last epiphragm secretion. The loss in each case was 1.0-2.5, on the average 1.75g. The mean total loss in body weight was 17.5g (53.85%). The loss of body weight and the retraction of the visceral mass in relation to epiphragm secretion have been shown in Text-fig. 1. Of the 10 epiphragms secreted by an individual the first 5 were transparent while the 6th and subsequent epiphragms were thick and heavy perhaps due to the secretion of more calcic substances.

In Group—II, one snail died following the secretion of 15th epiphragm while the remaining specimens died following the formation of 17th epiphragm. Body weight remained unchanged till the formation of the 7th epiphragm. There was a gradual loss of body weight from the secretion of the 8th epiphragm which continued up to the secretion of last epiphragm. The mean total loss of weight was 14.6g (43.9%) (Text-fig. 2).



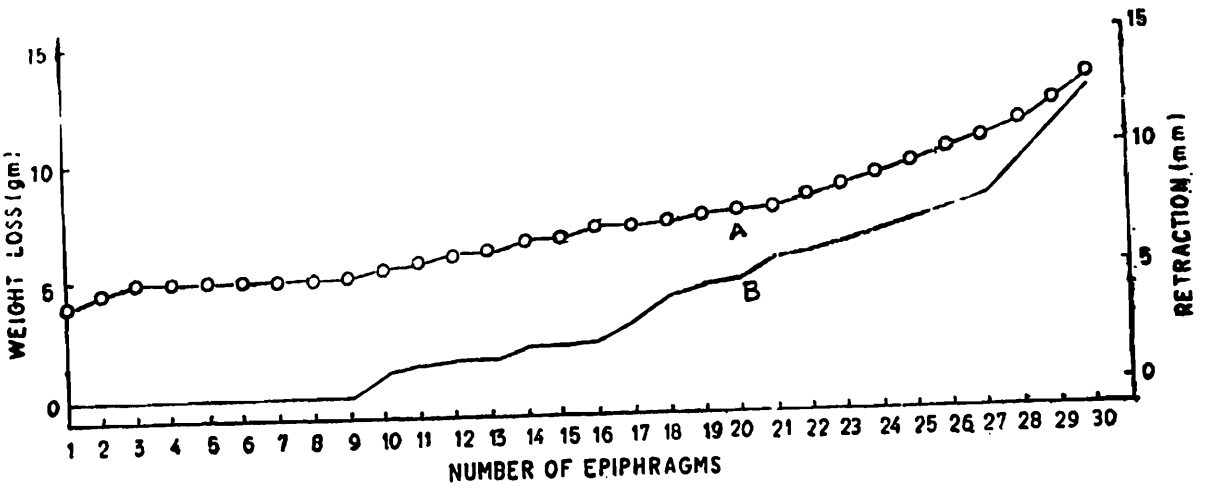
Text-fig. 1. Relation between the number of epiphragm secretion and the loss of body weight (A), and retraction of visceral mass (B) inside the shell cavity in *A. fulica* without food and water supply.



Text-fig. 2. Relation between the number of epiphragm secretion and the retraction of visceral mass (A), and the loss of body weight (B) in *A. fulica* when supplied water but no food.

On the average, the retraction of the visceral mass was 1.46mm after each epiphragm secretion from the 8th to the 17th. The distance between the epiphragm and the shell lip was 7.5, 6.0, 5.2 and 4.0 mm respectively during first, second, third and fourth epiphragm secretion. The retraction was higher with the secretion of 9th epiphragm. However, retraction of visceral mass was a must prior to secretion of each epiphragm. The distance between the lip of the shell and the last i. e. the 17th epiphragm was 24 mm (Text-fig. 2).

The average body weight of the snail in Group—III was 32.83g. Of the 15 selected snails in this group 3 individuals died following secretion of 14th, 23rd and 26th epiphragm respectively. The remaining snails secreted as many as 30 epiphragms in 241 days and the process was continuing. The loss in body weight was recorded between first and



Text-fig. 3. Relation between the number of epiphragm secretion and the loss of body weight (A), and retraction of visceral mass (B) inside the shell cavity in *A. fulica* when supplied both food and water.

third epiphragm secretion and again following the 9th one. A gradual higher loss of body weight has been recorded from the secretion of the 10th epiphragm onwards. The total weight was 20.33g (Text-fig.3) at 30th epiphragm secretion stage. There was no retraction of visceral mass up to the 9th epiphragm secretion stage. A gradual higher rate of retraction of visceral mass was observed following the secretion of 10th epiphragm and onwards. The distance between the shell lip and the point of attachment of the 30th epiphragm was 12.5 mm (Text-fig. 3).

Discussion

Results of the experiments on the potentiality of epiphragm secretion in *A. fulica* suggest that a number of factors influence this process. The prime need for the secretion of mucocalcareous substance is water. Food materials also play significant role but possibly next in order. It

seems that usually a snail is able to produce 10 epiphragms with its reserves. The capacity may be doubled if the loss of body fluid alone is compensated by some means. It appears that the essential components (Mead, 1961) for epiphragm secretion stored in the snail's body are sufficient for the formation of at least 10 epiphragms in *A. fulica*. In nature the snails regain temporary activity due to occasional rains. Such situations offer the scope to compensate loss of body fluid and also certain amount of nutrients and calcic materials through food and from eating the earlier epiphragms. Unlike *A. fulica*, the replacement of transparent epiphragm by calcified epiphragm with the progress of aestivation has also been recorded in *Otala lactea* (Rokitka and Herreid, 1975). It is probable that the snails lose their body water more and more with the progress of aestivation which influences the condensation of the fluid of the secretory organs. The snails while compelled to produce next epiphragm obviously cells will secrete thick mucoid fluid.

The loss of body weight with the successive epiphragm secretion is most probably associated with the rate of evaporation of body water of the snail. However, the materials secreted by the snails as listed by Mead (1961) for the production of epiphragms, though very little in quantity are undoubtedly play a significant role with the weight loss. The gradual loss of water and other materials from the snails in Group —I enforced them to retract more and more inside the shell cavity. The less retraction and no retraction of visceral mass with the progress of epiphragm secretion in the snails of Group—II and III respectively is probably due to the compensatory mechanism of body weight either through the absorption of water or both by water and food. As both water (due to rain) and food are easily available to the snails in their natural habitat, during temporary arousal from their seasonal slumber they regain the necessary requirements for successive epiphragm secretion. This phenomenon put them in advantagious position to overcome a long dry period.

It is already established that epiphragm secretion in land snails is primarily concerned with the conservation of water during drought (Grassé, 1968 ; Machine, 1967). From the present study it is clear that the frquency of epiphragm secretion in aestivating snail depends on the amount of water and reserve materials present in the tissues rather than the environmental factors.

SUMMARY

Epiphragm secretion in *A. fulica* is influenced by water and food. Normally, with the reserves, the snails are able to produce at least 10