Trends in Life Sciences
An International Peer-Reviewed Journal
www.sciencejournal.in

AGE RELATED CHANGES IN REPRODUCTIVE ACTIVITY AND GROWTH IN *INDOPLANORBIS EXUSTUS*

Mantale A. B.* and Patil M. U.**
*Department of Zoology, Shri Muktanand College, Gangapur, Aurangabad (M.S.) India
**Department of Zoology, B. A. M.U. Aurangabad, M.S. India
(E-mail: archana.virkar2812@gmail.com)

ABSTRACT
In many animal species reproductive activity ceases at old age. In mammals during senescence profound changes take place in the endocrine system that controls reproductive activity. These changes either result from oocytes depletion in the ovaries or from changes in brain centers that control reproductive activity. In mammals as yet experimental results are not decisively in favor of one or the other hypothesis. Reproductive cessation also occurs among the lower animals. Molluscs, especially several gastropods species, provide suitable model systems for studies on neuroendocrine control of reproduction.

KEY WORDS: age related changes, *Indoplanorbis exustus*, Reproduction.

INTRODUCTION

There are a number of reasons to assume that aging, reproduction, and growth are processes that interact with each other (Comfort, 1979; Kirkwood, 1985; Merry and Holehan, 1985) moreover, the neuroendocrine system, which regulates functions such as reproduction and growth, is of importance to aging processes (Finch 1976, Finch et al 1984, Meites 1987; Merry and Holehan 1985; Sapolsky et. al., 1986). Thus, for an understanding of aging processes in the CNS, knowledge on age-related changes in reproduction and growth of that organism is indispensable. Janse et al (1988) described age related changes in *L. stagnalis*. These properties make molluscs also suitable for the study of age-related changes in CNS (Janse and Joosse, 1989). Age- related changes in neuroendocrine centers involved in the regulation of reproduction and growth have been described.

Both body growth and reproduction, especially the frequent production of egg masses, demand large quantities of metabolites and energy. When the availability of metabolites becomes a limiting factor, high rates of the two processes cannot take place simultaneously. Growth rate becomes lower at the onset of female sexual maturation and at increased egg mass production, (Russell- Hunter 1978; Geraerts and Mohamed, 1981). Obviously the two processes need to be coordinated. In the presence of the lateral lobes and the gonad, female reproduction is favored at the expense of body growth, and apparently a large quantity of nutrients is channeled into the female reproductive system. This may point to an involvement of both structures in the co-ordination of growth and reproduction.

Recently neurological aging studies were started in *Lymnaea stagnalis*. Survival studies have shown that aging occurs in *Lymnaea* (Janse *et. al.*, 1988; Slob and Janse,1988). Previously (Janse *et. al.*, 1988) it was reported that reproduction and growth in *Lymnaea* cease at old age. Age related neuronal changes in the brain are often amplified through Cascade like processes (Sapolsky *et. al.*, 1986). From this it follows that the expression of aging at the level of functioning of the brain depends on the complexity of neuronal connections. This implies that age related neuronal changes in complex brains; such as in vertebrates are most likely the result of Cascade like process. At the cellular level aging process in vertebrates and invertebrates are fundamentally compatible (Mitchell and Johnson, 1984). Thus the relative simplicity of the invertebrate nervous system may provide an opportunity to study cellular origins of age related changes in the brain. In vertebrates, reproductive cessations as well as loss of growth have been related to changes in the reproductive neuroendocrine control system. These changes in the turn are thought to originate from changes in higher brain centers (Finch, 1976; Finch *et. al.*, 1984; Meites, 1987). The origin of age related changes in these centers are still unknown. This hampers the study of the primary causes of aging of neuroendocrine control of growth and reproduction in these animals.

MATERIAL AND METHOD

The snails *Indoplanorbis exustus* were collected from local pond near Aurangabad, Maharashtra, India. The snails were maintained in tap water in laboratory for acclimatization. The snail population ranged between 5-15 mm shell lengths was maintained in large plastic troughs with continuous water refreshment and aeration. Snails were provided with fresh vegetative food like algae, mulberry leaves etc., twice a day.

The snails between 8mm to 15mm showed reproductive activity. Hence these groups of snails were watched carefully to observe egg mass deposition. On each day the numbers of egg masses were counted in each trough, over a period of 30 days and at the end of experiment, the shell measurements were done. The numbers of egg masses were counted as measure of the frequency of the animals. The numbers of eggs per egg mass were counted to measure the reproductive effort. Egg laying activity of animal was monitored daily by counting the number of egg masses. Animal that did not lay eggs of period of 3-4 weeks were considered to have stopped egg-laying activity. Data on the life cycle parameters viz. the growth rates, the age of attainment of sexual maturity, the duration of reproductive period, the rate of egg production, the rate and the life span of the snails was collected regularly. Measurements of growth in shell length, shell width and total body weight were taken every two weeks, from ten individuals, selected at random, from the total population. But, when the number was ten or less, all were considered for data collection. In the case of the study of egg laying potential, the total number eggs present in these capsules was also counted and recorded. In all cases the average was calculated for presentation of final data in respect to the life cycle parameters considered for study.

RESULTS

It was found that egg-laying activity ceases in *Indoplanorbis exustus* at old age. This was presently studied in a population of 100 snails. The experiment was set with different size snails. *Indoplanorbis exustus* shows egg-laying activity at size of about 9-10 mm shell length. The egg laying activity in animals having size 10 mm shell was very low rate. They lay the egg masses in less numbers, and the eggs present in egg mass were also less. From snails having shell length 12mm, egg laying activity increased with size but began to decreased gradually at about shell length 15mm, and at very old age, it ceased completely. The animals in oldest groups (16-17 mm shell length) especially, had a very low egg laying frequency and produced few masses. At shell length 17 mm, animals ceased completely, Fig.

From the experiment, it was concluded that in *Indoplanorbis* e*xustus* starting at size between 15-16 mm shell lengths the frequency of oviposition as well as the amount of energy invested in female reproductivity decreased with age. Egg laying frequency increased from 12-14 mm, shell length animals. The egg frequency in older animals decreased and finally ceases completely. In this experiment measurements of shell length and body weight were also made. It shows that both parameters leveled off at size of about 15-16mm shell length. It was concluded that *Indoplanorbis* e*xustus* had a distinct period of growth.

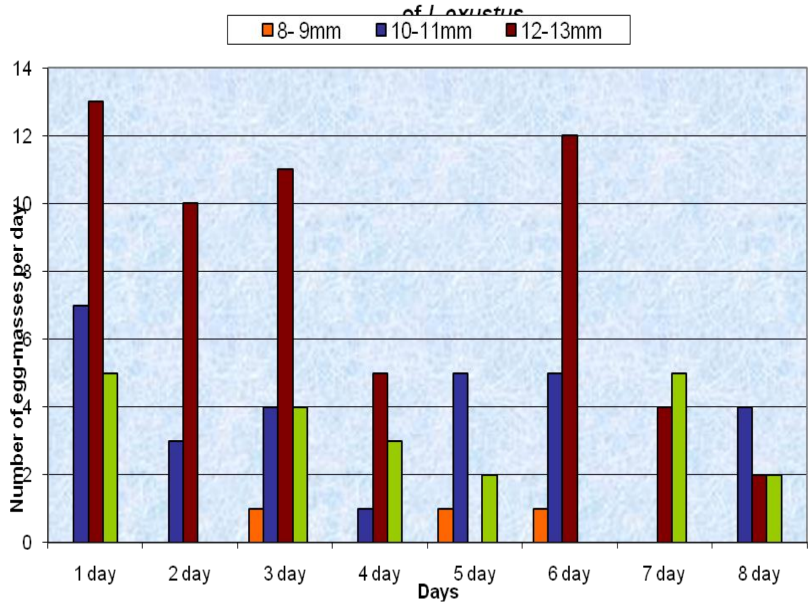
The mean number of egg masses produced per animal decreased significantly with age. The first decrease was observed in the group with age of about 8mm. This indicates that the decrease started between the ages of 8mm to 9mm. In a similar way, the number of eggs produced per animal decreased with age. The animals in the oldest groups, especially, had a very low egg-laying frequency and produced few eggs. Fig showed that the number of eggs per egg mass changed significantly with age. The fig also showed that the first decrease was observed in the group with an age of about 14mm. probably the decrease started at an age between 14mm. Egg masses of the very old snails contained a relatively high number of eggs. From this experiment it was concluded that in *I. exustus* at length 14mm the frequency of oviposition as well as the amount of energy invested in snail reproductivity decrease with age. Growth rate was faster in smallest size snails. A strong drop in growth rate occurred between shell length 10mm up words and the 2nd and 3rd size class followed by a gradual decline through the remaining size classes.

DISCUSSION

The present study showed that in *I. exustus*, the egg laying activity and growth decrease at a particular age and finally cease. In young animal having shell length 12mm, egg laying activity initially increased with age. This phenomenon is well known and can be described to development process (Bohlken and Joosse, 1982; Geraerts and Joosse, 1975). At old age egg laying activity decreased and later on ceased completely and animals are in their post reproductive period. Bohlken and Joosse (1982) showed that, in *L. stagnalis* up to an age of 140 days the number of egg masses produced per snail and number of eggs per egg mass increased with age. In very old animals egg-laying activity ceased completely. It is concluded that during senescence, energy investments in growth and female reproduction decrease and finally cease completely. Shell growth and increased in body weight cease at old age of about 16mm – 17mm shell length. Conspicuously, this cessation of growth occurs at about the same age as the beginning of the decrease in egg laying activity.

The present results show that *I. exustus* stops growth and ceases reproduction at about the same age. Cessation of growth at a particular age occurs throughout the animal kingdom (Kooijman, 1988). In mammals, growth usually ceased at the start of reproduction, but in lower vertebrates and invertebrates, growth may continue for beyond the start of reproductive activity (Comfort 1979). In the vertebrates, especially in the mammals (Finch, 1976; Meites, 1987) a distinct post reproductive period occurs. Among invertebrates in molluscs especially pulmonate (Comfort, 1957, 1979), and nematodes (Klass, 1977) such a distinct period has been described. It has been reported that the prosobranch mollusk *Aplysia* dies shortly after cessation of reproduction (Van Heukelem, 1979). In the freshwater pulmonates, the growth rate becomes lower at the onset of female sexual maturation and during egg mass production (Bohlken *et. al.*, 1978; Geraerts and Mohamed, 1981). In octopus a special situation exists: animal reproduce only once and then die. In this species death is related to activity of the optic glands, which control reproductive activity (Wodinsky, 1977). The number of eggs per capsule depends of the size of the adult snail but there are great variations (Geraerts and Joosse, 1984) the wide variation in capsule size has been noted by Bondesen (1950) and Gaten (1986). Capsule size decreased later in the egg laying period in *L. peregra* and this agrees with the figures given by Calow (1978). He noted a range of 12-200 egg/capsule in *L. peregra*. The egg capsules of the commonest brackish water snail rarely contained more than 20eggs, 8 to 13 eggs per capsule was the commonest number (Jackson, 1915). Russell – Hunter (1961a) reported that the total egg production per adult *Lymnaea* under natural conditions is complicated by the presence of two distinct types of *Lymnaea* egg masses.

Fig. Depict the number of egg-masses in different group of snail of *L. exustus*



ACKNOWLEDGEMENT

The authors express their sincere thanks to Molluscan Neuroendocrinology and Physiology Laboratory and Head, Department of Zoology, Dr. Babasaheb Ambedkar Marathawada University, Aurangabad for providing all necessary facilities during this research work

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