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Influence of Pond Dryness on Behavioural Changes in Freshwater Snail, Lymnaea stagnalis

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Abstract

Environmental factors are involving dryness of the pond due to less precipitation and excessive heat radiation that are highly challenging the survival of pond snails. The present study investigated the Changes in the movements of the snail, Lymnea stagnalis as the water level in the pond completely dried up. Even at pond water levels as low as one foot to 6 inches, normal movement of snails was observed without any changes in horizontal movement. As the water level decreases below 3 inches in the pond, the snails deviate from their normal horizontal movement and move downwards into the soil. It is adapted to horizontal movement while searching for the most suitable habitat. However, the water level in the pond dries up completely, a passion for survival developed by snails rushes to move towards the moisture in the soil. It starts burrowing into the bottom sediments of the pond which are more humid and cooler, increases the survival of gastropods and allows them to wait for better environmental conditions.

***Keywords*:** Environmental, Lymnaea stagnalis, Horizontal, Vertical and Burrowing

I.INTRODUCTION

Environmental variations are involving deficiency of precipitation, variations in nutrient distribution and dewatering in water bodies that influence changes in behaviour of various species of snail (Johnson et al. 2010; Altizer et al. 2013; Budria 2017). Lymnaea stagnalis is a mollusc belonging to the class Gastropoda and family Lymnaeidae. It is known by two names, commonly known as large pond snail and freshwater snail: it thrives in freshwater shallow ponds, lakes, streams with slow flowing, densely vegetated shallow pond margins and also in stagnant water (Meshcheryakov,1990). As it is a submerged pulmonate snail can inhale and exhale oxygen from the surrounding water through the lungs by moving often to the top to inhale air accessed by a respiratory operture called the pneumostome. It absorbs oxygen directly from the highly oxygenated surrounding water across their body wall; but when dissolved oxygen levels drop, they switch to breathing via a lung (Lukowiak et al., 1996). It has a very simple central nervous system with well-defined circuits and distinct individual neurons in the brain to perceive environmental change, feeding, locomotion, learning, and memory, as well as specific individual neurons that produce paternal behavioural patterns (Wood et al., 2021).

The impact of variations in the water column of ponds and lakes where animals and plants can live depends not only on their extent, duration, regularity and frequency, but also on season and climate. (Poznańska et al., 2010). The foot of water snails helps them move upside down beneath the water's surface by creating small ripples in the mucus-water interface (Lee et.al.2008). As water levels in ponds and lakes begin to recede in summer, bottom dwellers such as freshwater snails, like other aquatic organisms, are at risk of desiccation, anoxia, and starvation (Akande et al., 2010). Climate change is the main factor especially because the summer season causes sudden changes in the water level of the pond due to the scorching of sun that leads to the dryness of the water body which affects the movement of freshwater snails beneath the water surface. Due to the presence of a high number of snails in this climate and at the same time the water level in the pond is low, the

snail tries to survive by using its adaptations as much as possible and deviating from its usual movement. The reason for this study is that it is interesting to see how the change in nature can change the snail's normal movement and encourage it to survive. In the present investigation, the movement is one of the behaviours beneath the water surface in the freshwater snail, Lymnaea stagnalis was recorded from the water level of one foot in the pond until the pond was completely drained.

II. MATERIAL AND METHODS

Periyakulam pond is situated near the Valavadi division, about 5 km from Udumalaipettai town, Tirupur district of Tamil Nadu, India. The water holding area is 405 acres. Fish culture is dominant here and the water is left open for crop irrigation. The water stock is obtainable through rainwater reaping and drainage from Thirumoorthy Dam. Due to the high-water accessibility in the pond during the monsoon season, not only other fish species but also various species of snails are found in substantial numbers. The water contributed to the pond is accessible only in the months of August, September, October, November, December and January, after which there is no water supply from nowhere. In the summer, a small amount of water is left in the pond. Hence, the months of April and May are selected as the best weather conditions for conducting the present study.

There were two different conditions of the pond that were essential to lead the experiment. Among these two conditions, the first phase of the experiment was carried out in the pond whose water holding capacity did not affect the usual direction of snail movements (Horizontal movements). Moreover, the environment of the pond where the snails live should be unstressed, and such an environment was convenient for recording the movement of the snails without causing any risk to the study. The snail movements were studied only when the pond water level had not completely dried up and the moisture had been assumed to be constant over the surface of the pond that was essential to carry out the second phase of the experiment. The results of snail movements in the first and second phase of the experiment were recorded by photography and were analysed.

The snail movements related to the study were conducted for 30 consecutive days in a pond. Before the water in the pond is completely dry, the water in the pond is divided into different parts and can be seen isolated. During the experimental period, the Snail movements were monitored in a 10×10 feet size of isolated flooded area in the pond. The first phase of experiment was conducted and typical movements of the snails were studied in a 10×10 feet size enclosure in a pond with approximately 1 feet height to 6 inches height of water level. The snail did not deviate from normal movements which were recorded and photography was made as required to discuss with the results of movements that were going to do in the final phase of the experiment which was carried out in a water level from 3 inches to complete drying. Subsequently we waited for a week to notice the drying up of the pond for the final phase of the experiment. The time period when the water seeps below the soil level of the pond, the water begins to descend downwards. In this situation, the snails deviated from their normal locomotion for survival that was observed. The dried-up pond forced the snail to move in the opposite direction which was recorded and the photography was made to support the final phase of the experiment and ensure the results of the experiment whether the direction of snail moves in a usual or unusual pathway.

III. RESULTS AND DISCUSSION

The present research was conducted directly in ponds with less than 1 foot of water due to natural drought, and it was known what defence movements the snails make to save their lives in the pond. The previous studies have shown that snails make their movements only for three main reasons when water is present in sufficient levels of the pond: to protect themselves from predators, to search for food, and to consume oxygen. Lymnaea stagnalis is an aquatic pulmonate snail and named as a bimodal breather. They are capable of breathing via its skin (cutaneous respiration) or through a simple lung (aerial respiration). They were forced to lead a life in a hypoxic environment when they live in stagnant water where the dissolved oxygen is limited. Then the snail comes up to the upper surface of water for aerial respiration and breathes through the lung (Lukowiak et al., 1996).

In the present investigation, the aquatic snail, Limnaea stagnalis was found to be difficult for their survival when the pond's water level begins to come down from one foot. At the beginning, the snails followed their regular movements which were in the form of horizontal movements from higher level of water to lower level and they halted their horizontal movement in a place where it was exposed to the atmospheric environment (Fig 1). lt was noticed that they were appreciated the ordinary existence even quantity of water maintained above 6 inches than usual one foot (Fig 2). Due the continuation of hot weather conditions that prevailed for 10 to 15 days made the pond switch over to permanent drying which made life threatening

alteration in the movement behaviour from horizontal movement to vertical movement of snails in the native place. The vertical movement and the aggregation of snails were noticed only when the water sank into the soil. The quarter of the snail's body surface sank to the soil as the water receded into the soil (Fig 3). As the immobility was noticed that leads to alteration in body posture was observed. During horizontal movement, the body posture was at 45^{o} that declined as the water began to dry. The body posture was at 90^{o} as the water sank to the bottom of the soil. The spiral shell of the snail was oriented towards the upper part and the mantle buried downwards into the soil (Fig 4).

Freshwater snails found in freshwater bodies uptake their food by crawling on the bottom surfaces using their foot organs and some snails make use of buoyancy of their shell to move along the underside of the water and graze on algae (kuroda and Abe, 2020). In the present investigation, horizontal movement was noticed in Lymnaea stagnalis along the surfaces of the pond in search of food and protection. The above result was supported by Poznańska et al (2015) and (kuroda and Abe, 2020). They observed that horizontal migrations permit snails to energetically disperse seeking for more favourable areas to survive. The existence and migration were not disturbed even though the height of water level came down to 6" (inches) in the zone where observation was noticed throughout the present experimental period. Similar results were noticed by Gulanicz et al (2018) observed the horizontal migration at shorter distances in Physa acuta during gradual dewatering and the ability to migrate empowered P. acuta to carry over in harsh environments.

Sudden alteration in the horizontal migration was noticed as the dewatering continued below 3". The horizontal migration switches over to vertical migration in bottom sediments of the pond. The vertical movement went upto 2.5 to 5.0 cm in deep bottom sediments and only the spiral shell of the snails was exposed outside. Poznańska et al. (2015) found that the effect of substratum drying on snail burrowing depended on species. He listed out the higher numbers of large and small V. viviparus snails burrowed

in the drying tanks which decreased the desiccation rate. Gulanicz et al. (2018) explored that P. acuta never burrowed in sediments in response to drying of the pond. Hang et al. (2022) reported that Bulinus globosus snail went on vertical migration in desiccated and re-hydrated soils during the summer. Resistance to drying and potentiality to migrate permitted P. acuta to live in brutal environments. The snails never migrated deeply into the sediments, only burrowing just below the substratum. Burrowing into the bottom sediments, which are more humid and cooler, increases the survival of gastropods and allows them to wait for better environmental conditions (Kappes & Haase, 2012). Freshwater snails are a familiar characteristic of the invertebrate fauna of freshwater ecosystems. The appearance of snails in the aquatic environment is indispensable to promote water clarity. The emission of freshwater snails in water bodies facilitate the coagulation of suspended particles (Wei and Pu, 1999), snails may strengthen the growth of submerged plants. Hence the protection of snails especially in summer is indispensable to the aquatic environment.

Fig.1. Horizontal movement of L. stagnalis at a pond.

Fig.2.Horizontal movement of L. stagnalis not altered even at 6" water level prevails in a pond.

one feet water level in

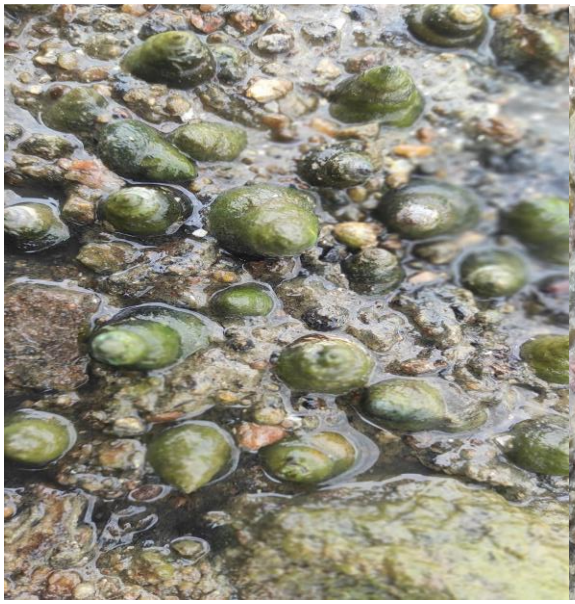

Fig.3. Alteration from horizontal movement to vertical movement of L. stagnalis while. the water level sink into the soil

Fig.4. As the water level in a completely dry pond has gone down deep to the bottom of the soil, half of the shell buried in the soil due to the vertical movement of L. stagnalis.

IV. SUMMARY

Dryness of the pond is influenced by various environmental factors affecting the survival of freshwater snails that are essential characteristics of maintaining water quality of the pond. The present experiment is designed to understand the effect of pond dewatering on behavioural changes in Lymnaea stagnalis. The movement is one of the behaviours of freshwater snails necessary to search for food and protection beneath the water surface in the freshwater pond and was recorded from the water level of one foot in the pond until the pond was completely drained. Although the pond started to dry and the water level reduced from one foot to 6 inches, the snails were maintained usual horizontal movement in search of better habitat to escape from waterlessness of pond. When the water level came down below 6 inches, the snails stopped their horizontal motion and changed their body posture to move towards the sediments of the pond by vertical movement. The spiral shell of the snail was oriented towards the upper part and the mantle buried downwards into the soil. The burrowing of Lymnaea stagnalis into the pond sediments revealed that the snails were seeking humid and cooler places under soil which increases the survival of gastropods and allows them to wait for better environmental conditions.

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