

Effect of Desiccation on Mangrove Prosobranch: *Tympanotonus fuscatus var fuscatus* (Linnaeus, 1758) under Laboratory Condition

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Abstract: This study was undertaken in order to determine the effect of desiccation on the survival of *Tympanotonus fuscatus var fuscatus*. The experiment was conducted in the laboratory for a period of six weeks. The snails kept in feed bags survived longer periods of six weeks than those in polythene bags (4 weeks), and those in plastic tray (3 weeks). The organisms during the period became inactive and withdraw into its shell, the behavior reduces water loss. Results however showed that *T. fuscatus var fuscatus* can survive for weeks of starvation and desiccation. *T. fuscatus var fuscatus* is amphibious and can survive long period without water making use of their reserved food. Fisher folks and fish traders have exploited these biological attributes of the animal as it is preserved over long period in perforated sac bags, transported to market for trade. The different condition of exposure was designed to imitate the conditions that the periwinkles are exposed to during their transportation to the market.

Key words: Snails, starvation, survive, withdraw

INTRODUCTION

Organisms that live in the intertidal zone frequently need to deal with changing environmental extremes. Species living in this environment are alternately exposed to air during periods of emersion and to the sea water during immersion. Temperature extremes and stress due to desiccation are much more intense higher in the zone, where periods of emersion are much longer (Sokolova and Berger, 2002). Desiccation is differentiated from dehydration as desiccation also takes into account the stress caused by lack of nutrients present when organisms are exposed to air (Wilmer *et al.*, 2000). Desiccation can also be a much more dire physiological stress than thermoregulatory stress (Vermeij, 1973). It is one factor that frequently mediates the vertical zonation of intertidal species such as the prosobranch gastropod *Littorina*. Consequently, one would expect *Littorina* species that exist in the intertidal zone would exhibit physiological and behavioral adaptations that will allow them overcome stress caused by prolonged periods of emersion (Sokolova *et al.*, 2002).

Tympanotonus is a prominent gastropod mollusk that exists in the intertidal swamps of the brackishwater ecosystem of West Africa. The shells are spiral shape and mantle covers the visceral mass which is contained within the shell. Head and foot are often exposed ventrally at the

shell opening. Most gastropods crawl or glide by means of their muscular foot, which is lubricated by mucus glands. They are euryhaline and survive in a saline range of 0.5 to 27.5 ppt and inhabit quiet waters, where the substratum is muddy and rich in detritus. Salinity, nature of bottom deposits, water depth and currents are factors that affect their distribution in the coastal areas of West Africa (Deekae, 1987). The genus *T. fuscatus* comprises of a single species which has two varieties, *T. fuscatus var fuscatus* and *T. fuscatus var radula*. *T. fuscatus var fuscatus* is characterized by turreted, granular and spiny shells with tapering ends. *T. fuscatus var radula* is distinguished from the other variety by absence of spiny tubercle on the shell. The occurrence of each form has been shown to be related to habitat factor (Binder, 1957) and a change in shell growth pattern from one form to the other has been successfully experimented by transplanting snails from one habitat to another (Routeilet, 1979; Gabriel, 1981). *Tympanotonus* species provide a relatively cheap source of animal protein and its shell can be used as a source of calcium in animal feeds and for construction purposes. They are collected from the wild and their marketing form an important industry in the Niger Delta area, Nigeria. Presently, the market demand for this mollusc is high (Alfred-Ockiya, 1999). It is only through increased production by means of appropriate culture

Table 1: Results of the desiccation experiment of *T. fuscatus var fuscatus*

Container used	Experimental state of the periwinkle					
	After 1 week	After 2 weeks	After 3 weeks	After 4 weeks	After 5 weeks	After 6 weeks
Polythene bag (Partial shade)	Quiescent and withdrawn. All recovered in sea water (19‰)	Quiescent and withdrawn. All recovered in sea water	Remained Quiescent 90% recovered in sea water.	Remained Quiescent 70% recovered in sea water	Quiescent 60% recovered in saline water	50% Remained quiescent 50% recovered in sea water
Plastic tray exposed	Quiescent and withdrawn. All recovered in sea water (19‰)	Quiescent and withdrawn 80% recovered in sea water	Quiescent and withdrawn 70% recovered in sea water	Inactive and withdrawn 60% recovered in sea water	Inactive and withdrawn 50% recovered in sea water	Inactive and withdrawn 40% recovered in sea water
Empty feed bag (Woven polythene bag).	Quiescent and withdrawn. All recovered in sea water (19‰)	Quiescent and withdrawn. All recovered in sea water	Inactive and withdrawn. All recovered in sea water	Quiescent and withdrawn 80% recovered in sea water	Quiescent and withdrawn 70% recovered in sea water	Remained quiescent and withdrawn 70% recovered in sea water

techniques that these species can meet demand for the market.

Large quantities of *Tympanotonus* species are harvested and transported from the mangrove swamps of the Niger Delta daily to other parts of Nigeria in feed bags. They can remain in these bags for more than five weeks without water. During the transportation process the snails are subjected to desiccation, lack of food and water.

The purpose of this study is to investigate the behavioral adaptations on desiccation shown by *Tympanotonus fuscatus var fuscatus* during transportation. The experiment is however aimed at determine how long the specimen could withstand exposure and desiccation during neeaptides and starvation when being transported over long distances. This will provide further information for the effective management and culture of the species in natural and artificial environment. The data will serve as an important input into fish stock assessment and conservation upon which sustainable management and development of the resources can be achieve.

MATERIALS AND METHODS

Tympanotonus fuscatus var fuscatus specimens were handpicked at ebb tide weekly along the mangrove swamps of the upper Bonny River, Niger Delta of Nigeria. One meter square quadrants were marked out in the mud flat and 0.5mm sieve were used in collecting all snail specimens within the quadrant. Specimens were identified using keys (Knudsen, 1952; Buchanan, 1954; Longhurst, 1958). In the laboratory, three sets of *T. fuscatus var fuscatus* were subjected to exposure and starvation. The first set of 200 specimens was placed in polythene bag and kept in partial shade. The second set of 200 specimens was placed in a plastic tray and kept beside the laboratory. The third set of 200 specimens was tied up in an empty feed bag and kept in a plastic tank

beside the laboratory. Samples from each set were collected weekly, tested for survival and recovery when placed back in saline water.

RESULTS

The results on the effect of desiccation on *T. fuscatus var fuscatus* are shown in Table 1. The results show that after one week all the specimens kept in the polythene bag, plastic tray and empty feed bag were observed quiescent and withdrawn. However, when placed in sea water for about four hours they became active. Also, at the end of the second week, all specimens in polythene bag and empty feed bag were observed inactive and withdrawn. All specimens, however, recovered when placed in sea water for about four hours, whereas specimens in plastic tray were inactive and withdrawn, but 80% recovered in sea water in about four hours immersion. At the end of the third week, specimens in polythene bag remained quiescent and 90% recovered in sea water; while those in the plastic tray were also quiescent and withdrawn, but only 70% recovered in sea water. The periwinkles in the empty feed bag, were inactive and withdrawn after 3 weeks, but recovered in sea water in about four hours immersion.

At the end of the fourth week, specimens in polythene bag remained quiescent however, 70% of them recovered when placed in sea water for about four hours. Specimens in plastic tray were inactive and withdrawn however, 60% recovered when placed in sea water. Specimens in the empty feed bag were quiescent and withdrawn, but when placed in sea water 80% recovered. After five weeks, specimens in polythene bag were quiescent, but 60% of them recovered when placed in sea water. Specimens in plastic tray were inactive and withdrawn with 50% showing recovery in sea water. Snails in empty feed bag were quiescent and withdrawn but showed 70% recovery in sea water. At the end of the six weeks specimens in polythene bag remain quiescent

but 50% of them recovered when placed in sea water. Specimens in plastic tray remained inactive and withdrawn, however, 40% recovered when placed in sea water. Specimens in empty feed bag remained quiescent and withdrawn but 70% recovered when placed in saline water.

DISCUSSION

One behavior discovered in *Littorina* and common in many intertidal gastropods that have potential to be an adaptation to desiccation stress is that of aggregation. The tendency of *Littorina* species to aggregate has been shown to be higher when the substrate is dry (Rugh, 1997). *Littorina unifasciata* has been found to live high in the littoral zone due to this; they frequently encounter long periods of emersion and consequently desiccation. Chapman and Underwood (1996) reported that this aggregation behavior is more frequently found in *L. unifasciata* that are on horizontal substrate rather than vertical substrate surfaces. This may be due to the fact that horizontal surfaces exact a higher cost of desiccation than the vertical surface environment. Aggregations of *L. unifasciata* have also been found to possess larger water reserves than non-aggregating individuals Chapman (1995). One might then expect that aggregation is an adaptation for desiccative stress or resistance, though it may be advantageous in order to escape desiccation stress. Considering the differing physical conditions found between microhabitats, one might expect that *Littorines* would be selective in what habitats they choose. Britton (1995) reports that *Littorines* seek the shelter of cervix pit and other topographical irregularities in the substrata in order to avoid tissue and shell contacts with the substratum.

Powell *et al.* (1985) reported that *T. fuscatus* is an amphibious and can survive long period without water, making use of their reserved food. *T. fuscatus* were found to be adequately adapted to the constantly fluctuating ecological condition of the brackish water environment thus they were found occurring in the habitat all through the year. Fisher folks and fish traders have exploited these biological attributes of *T. fuscatus* as it is preserved over a long period in perforated sac bags transported to market for trade. Conservation policies should therefore be developed to protect the mangrove swamps as a means of sustaining the species richness of the area.

CONCLUSION

The experiment of desiccation shows that *T. fuscatus* can survive at least four weeks starvation and desiccation. It was observed that *T. fuscatus var fuscatus* kept in feed bags survived longer periods of six weeks than those in polythene bags (four weeks), and those exposed in plastic

tray (three weeks). The species during this period become inactive and withdraws into the shell; this behavior reduces water loss. Fisher folks and fish traders have exploited these biological attributes of *T. fuscatus* as it is preserved over a long period in perforated sac bags transported to market for trade.

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