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THERMAL RESPONSE TO PROSOBRANCH SNAILS AT DESERT REGION OF RAJASTHAN (NORTH INDIA)

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Thermal tolerance of prosobranch snails namely pond *Bellamyabengalensis*, *Gabbiaorcula* and *Digoniostoma pulchella* were studied in freshwater ponds namely Gajner and Kodemdesar pond situated near Bikaner, Rajasthan (Indian desert) as well as under laboratory conditions. Prosobranch snails were more sensitive to low temperature. The absolute lethal temperature for *B. bengalensis*, *G. orcula* and *D. pulchella* was noted as 10^0C, 5^0C and 15^0C or less respectively, while these could survive at higher range of even 45^0C, though under stress. None of prosobranch snail was found to be active below 5^0C and above 45^0C. In field also the population was reduced close to nil in January extremely low and extremely high during June; when water temp. was noted as 16^0C and 38^0C respectively during the study hours. However, the minimum and maximum temperatures over diurnal cycle during these months are expected to be still more extreme as evident from meteorological records of the region.

Keywords: Thermal tolerance; temperature; BOD incubator; survive; range; active; inactive.

1. INTRODUCTION

Molluscs are common component of the benthic community and they play important role in the dynamics of aqaticecosystem. Phyllummollusca is a large assemblage of animal groups having diverse shapes, size, habits and occupy different habitats [1]. Prosobranch snails constitute macroscopic invertebrate communities in freshwater and often subscribe to the biotectonic community. Prosobrancia is a large taxonomic subclass of a sea snails and freshwater snails. Prosobranchs, mostly herbivore or

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detritivore, play a significant role in both grazing and detritus type of food chain. Many of prosobranchs are known to act as intermediate host of helminthes parasites and are, therefore, vector of veterinary and human diseases.

The temperature is highly variable and the most important limiting factor in desert environment. Due to scarcity and tough physical conditions freshwater ecosystems are stressed in a hot desert. Molluscs are common component of the benthic community and they play important role in the dynamics of aquatic ecosystem. Prosobranch snails are often badly ignored in aquatic studies. Prosobranch snails are usually faced with an annual dry season, particularly in the arids. Presence or absence of snails in a body of water may be used as an index of condition of existence.

1.1 The Study Site

The India is the second largest country of the Asia. The country lies to the north of the equator between $8^0$4' and $37^0$6' North latitude and $68^0$7' and $97^0$25' East longitude. The state of Rajasthan situated at the north western part of India. It is the biggest state in the country of India and lies between $23^0$30' and $30^0$11' North latitude and $78^0$17' East latitude .The Gajner pond is located at $27^0$57' N latitudes, $73^0$03' E longitudes and 233 MSL altitude. The Kodemdesar pond is located at $28^0$2'45" North Latitude and $73^0$4'50" east (Fig. 1).

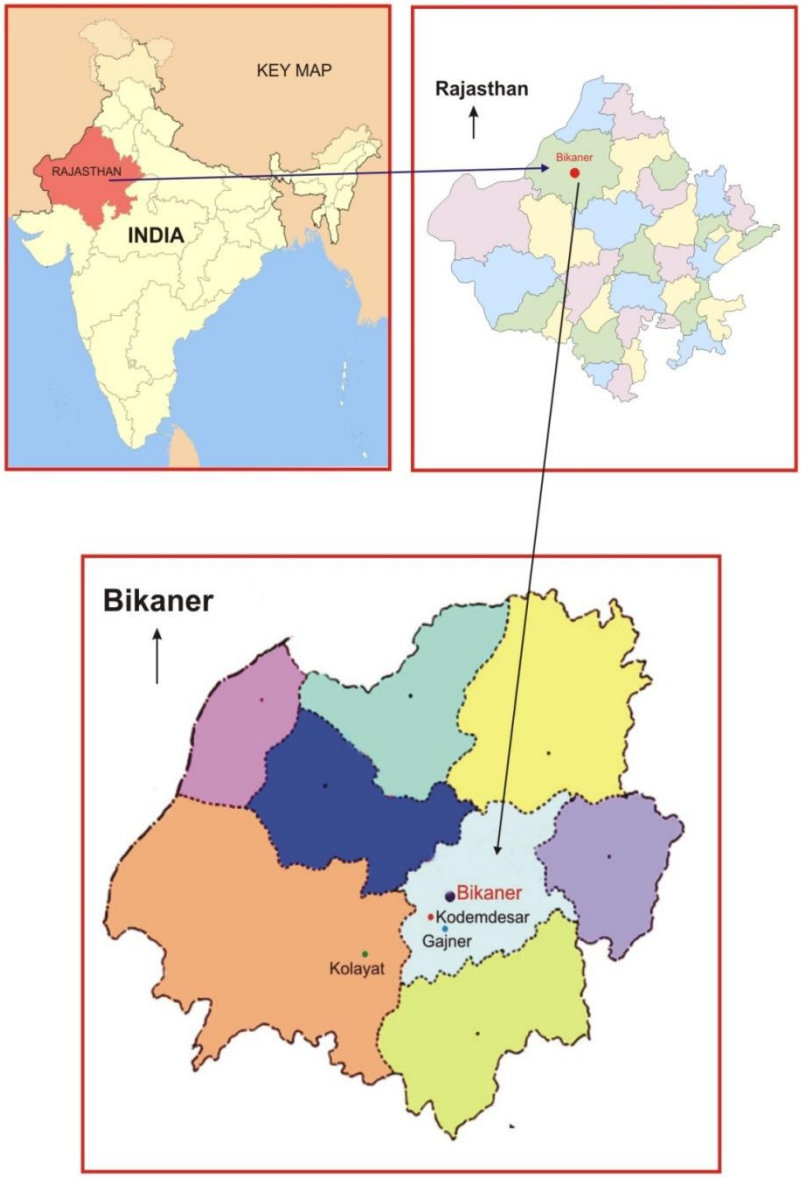

Fig. 1. Location of the study area

2. MATERIALS AND METHODS

A year-round study (May 2009 to April 2010) was carried out on thermal tolerance of prosobranch snails at two fresh water ponds namely Gajner pond located 25 km south-west of Bikaner city (Depth approximately 6.7m) and Kodemdesar pond (Depth approximately 6m.) situated about 30km south-west of Bikaner city in the Indian desert region. During the study period three species of prosobranch snails were found at Gajner pond namely *Bellamya bengalensis*, *Gabbia orcula*, *Digoniostoma pulchella* and two species at Kodemdesar pond namely *Gabbia orcula* and *Digoniostoma pulchella* were recorded.

To study the thermal tolerance of individual prosobranch species, experiments were also set in the laboratory. Glass troughs of two litre capacity placed in a BOD incubator were used for this purpose. In the trough gravel substrate was provided and it was filled with pond water. Oxygenation was provided by external source of aerator. In the trough 10 healthy specimens of a prosobranch snails were released. The temperature in the incubator was at 5^0C to 50^0C allowing an increased of 5^0C daily. Thus the each experiment lasted for 10 days. Daily, after making observations on the activity or survival of the specimens, half litre water was removed and replenished by fresh pond water so as to ensure food supply to the fauna. Results were recorded as the number of individuals active or inactive and live or dead. The whole experiments for each species was performed twice and average values were taken into account.

3. RESULTS AND DISCUSSION

Temperature is highly variable and the most important limiting factor in desert environment. It influences terrestrial as well as aquatic communities. Thermal tolerance of the prosobranch snail were adjusted both field and laboratory. The results of simulated experiments in the laboratory are projected in Fig. 2 to 4. The percentage of active and inactive individuals of each prosobranch snails are plotted against temperature. The salient conclusion derived through the perusal of the above figures are presented in Table 1.

The thermal response of all three prosobranch was found to similar. *B. bengalensis* and *D. pulchella* snails had a wider range of thermal tolerance to the tune of 40^0C being eurythermal. For both of them the optimum temperature was noted as 20-40^0C. The snail *G. orcula* tolerated a relatively narrow thermal range to the tune of 35^0C, being stenothermal. The optimum temperature for *G. orcula* was also narrow in the range of 25-30^0C.

Table 1. Response of prosobranch snails to temperature (^{0}C)

S. No.	Prosobranch snails	Tolerance range	Optimum temperature	Absolute lethal temperature
1.	*Bellamya- bengalensis*	10 – 45	20 – 40	10 and less, 45 and above
2.	*Gabbiaorcula*	5 – 45	25 – 35	5 and less, 45 and above
3.	*Digoniostomapulchella*	15 – 45	20 – 40	15 and less, 45 and above

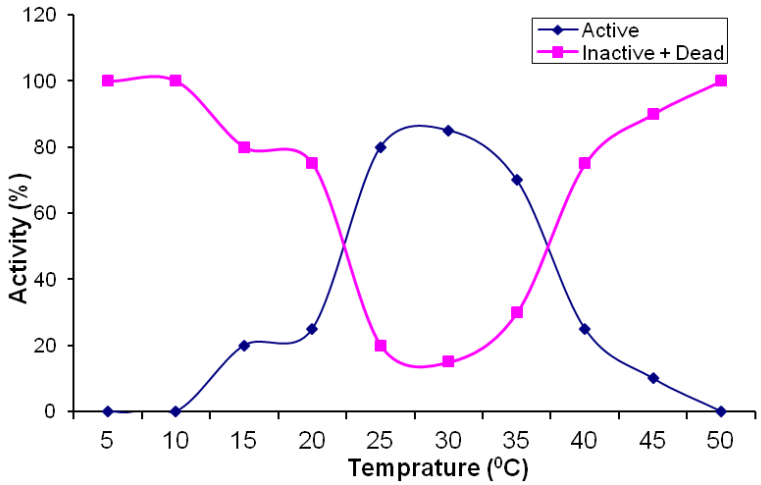

Fig. 2. Thermal tolerance in prosobranch snail *Bellamya bengalensis*

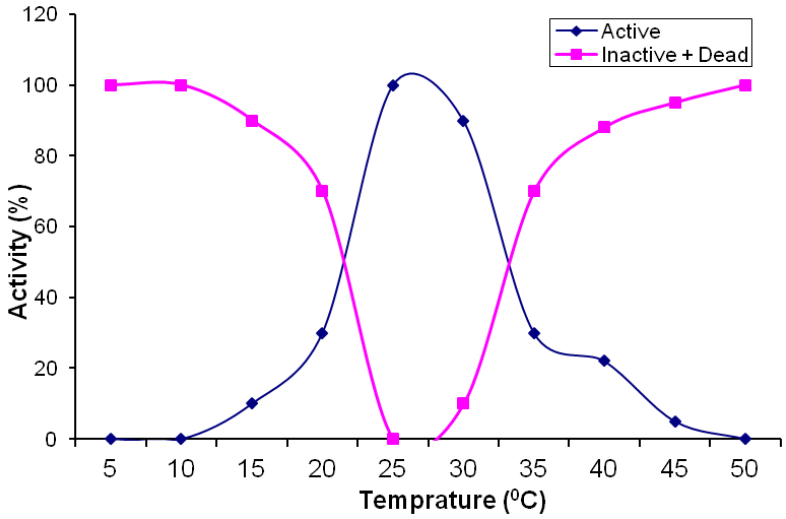

Fig. 3. Thermal tolerance in prosobranch snail *Gabbia orcula*

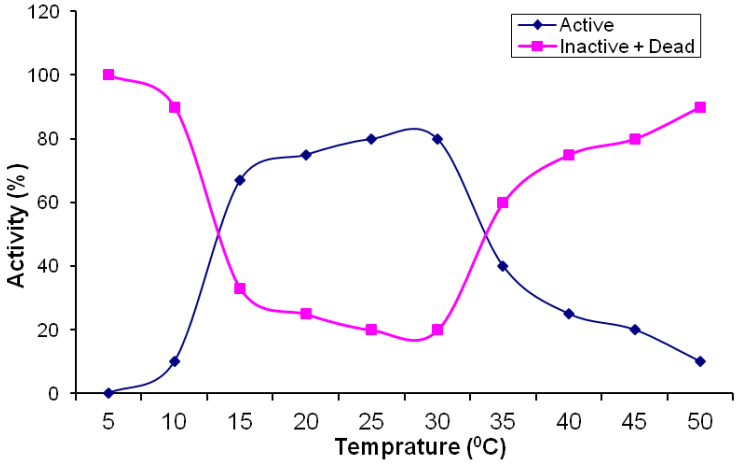

Fig. 4. Thermal tolerance in prosobranch snail *Digoniostoma pulchella*

Singh &Saxena [2] recorded optimum temperature as 20^0 C-40^0 C for both *B. bengalensis* and *D. pulchella* and wider range of thermal tolerance to the tune of 40^0C, beingeurythermal.

The absolute lethal temperature for *B. bengalensis*, *G. orcula* and *D. pulchella* was noted as 10^0 C, 5^0 C and 15^0 C or less and 45^0 C or above respectively. Muley [3] recorded 36.9 ^{0}C as the median heat tolerance limit in freshwater prosobranch *Melania scabra*. According to Segal [4] the warm acclimated animals are relatively heat resistant and cold sensitive, whereas cold acclimated animals are relatively cold resistant and heat sensitive. The Indian Apple snail *Pilaglobosa*, a prosobranch, is reported to be intolerant to a temperature 20 ^{0}C and below and 35^0 C and above at which it underwent dormancy [5]. Singh &Panwar [6] on the contrary found the snails as cryophil. Rathore [7] studied the thermal tolerance and dormancy on banded prosobranch snail *B. bengalensis* and found that it was seems to be eurythermal and better adapted to desert conditions since it remained active for most part of the year and underwent dormancy only under extreme hot and cold conditions as evident during present study. Sharma [8] is also recorded up to 35^0C tolerance range for prosobranch snails *B. bengalensis*, *Thiara tuberculata* and pulmonate snails *Indoplaniorbisexustus* and *Gyraulus rotula* being eurythermal. For these snails she was also noted optimum temperature as 25-35^0 C in Aravalli range water bodies. Brahim A, Marshall DJ [9] studied Differences in heat tolerance plasticity between supratidal and intertidal snails indicate complexe responses to microhabitat temperature variation. Marshall DJ. Brahim A, Mustapha N. Yunwei Dong, Brent J. Sinclair [10] studied Substrate heat tolerance acclimation capacity in tropical thermophilic snails, but to what benefit. Egonmwan

RT. [11] studied Thermal tolerance and evoprative water loss of the mangrove prosobranch *Tympanotonusfuscatus Vas. radula* L. (Cerithiacea: Potamididae). Martha J. Ross, Gordan R. Ultsch. [12] studied Temperature and Substrate Influences on Habitat Selection in Two Pleurocerid snails (Goniobasis).Lah RA, Benkendorff K, Bucher D. [13] studied Thermal tolerance and preference of exploited turbinid snails near their range limit in a global warming hotspot.

4. CONCLUSION

Main purpose of doing above experiments of thermal tolerance in prosobranch snails is to show how snail species can tolerate temperature variations and can survive in temperature stress conditions. Beside this how they can adapt themselves against extreme temperature conditions. Results of this research work have practical significance that whether they can survive or go in a dormant stage in heat stress conditions.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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