A STUDY ON VARIATIONS IN POPULATION DENSITY OF GASTROPODS IN A VILLAGE POND NEAR BIKANER, RAJASTHAN

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ABSTRACT

Most of Thar Desert of India spread over Rajasthan and because of this it is known as state of desert. Because of harsh and inhospitable environmental conditions Rajasthan is well known in all over the world. Bikaner, district which is located in northern western part of Rajasthan are also well known for its violent climatic conditions and scarcity of water resources. Present study was focused on monthly as well as seasonal variations in gastropods population density in a village pond namely Nal village. The study was carried out from September, 2010 to November, 2011. This finding of study suggested the presence of three gastropods species viz. *Digoniostoma pulchella*, *Gabbia orcula* and *Indoplanorbis exustus* belongs to two subclasses namely pulmonata and prosobranch during whole study period. Highest population density of gastropods was recorded in the month of March, while minimum in July. Among all studied season highest population of gastropods density of all three reported species were recorded in summer season. Minimum population density of *Digoniostoma pulchella*, *Gabbia orcula* was recorded in monsoon season, while minimum population density of *Indoplanorbis exustus* was recorded in winter season. Many gastropods act as intermediate host of platyhelminthic parasites and play significant role in public and veterinary health and also used in many biomonitoring programs to assess the water quality level.

KEYWORDS

- Rajasthan
- Bikaner
- Nal Village pond
- Gastropods
- Seasonal population density

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1 Introduction

Rajasthan, the largest state of India and also honored with title of desert state because of presence of Thar region, which spread in North – West of Rajasthan. State having geographical location ranges between $23^\circ 3' \text{ to } 30^\circ 12' \text{ N}$ latitudes and $69^\circ 30' \text{ to } 78^\circ 17' \text{ E}$ longitudes. District Bikaner, is located in northern western part of Rajasthan having geographical location between $28^\circ \text{N}$ and $73^\circ 17' \text{ E}$ and MSL 228m, and occupies central positions in desert region. The climatic conditions of this region is very harsh, hostile and inhospitable to life because of high temperature fluctuations, intense sun radiations, low precipitation, scarcity of underground as well as surface water, sand storm and lack of canopy. Most of water bodies in this region are in the form of village ponds, tanks, reservoirs and lakes, which are small and ephemeral in nature.

Among invertebrate diversity molluscs, constitute the second largest phylum next to arthropods, recorded in marine water, fresh water and also in terrestrial habitat. According to Subba rao (1993) marine molluscs have received more attention because of their aesthetic and gastronomic appeal. Present study is focused on fresh water molluscs of class gastropods. Members of class gastropods also known as snails, having single shell (Univalve) mostly simple coiled and are found in habitats like river, streams, springs, swamps, lakes and temporary water bodies.

Members of class gastropods are also known as macrobenthic animals, because of their sedentary life span and lived on aquatic vegetations, rocks and other solid, soft sediments. These are capable to with stand for long dry periods and some time their presence was recorded at depth of 100 feet. Gastropod constitutes important and integral part of aquatic environment and having ability to convert low quality and low energy detritus in to better quality food. Gastropods are intermediate host for Platyhelminthic parasites and playing a significant role in public and veterinary health especially in desert region, because in this region animals and villagers share common water sources. Dairy farming plays a significant role in economy of Western Rajasthan. These Platyhelminthic parasites cause morbidity and some time mortality of pets and cause stress on economy and stock holders and with this these animals are also important macrobenthic fauna, and act as bioindicator of water quality because of low vagility, adequate size, often large population number and easy collection and identification. By comparing past and present and future results regarding community structure and status, it is easy to detect any changes in water quality.

Gastropods study in desert region were carried out by various researcher like Singh (2000) carried out malacological investigations in surrounding desert pond with special reference to ecology and population dynamics, while Rathore (2003) studied the diversity and also population dynamics of gastropods with special reference to *Bellamya bengalensis*. Singh et al. (2006), Singh and Saxena (2006) investigated the population dynamics, growth rate, diversity and ecology of gastropods recorded in some desert waters respectively. Rathore et al. (2012), Khanam (2012) and Khanam and Singh (2012 a, b) investigated the host specificity, diversity, ecology, population density and biometry of some fresh water gastropods. Here present study has been taken out for the finding out the gastropods population of Nal pond of Bikaner.

2. Materials and Methods

2.1 Study area

Nal village located at 12 km away from Bikaner city on North-West direction near Bikaner- Jaisalmer highway (NH-15), having geographical location at longitude $E73^\circ 12' \text{ and latitude } N28^\circ 4' \text{ and MSL } 229 \text{ m}$. This pond is ephemeral in nature and at least face dry period in two months of summer every year. Pond covers an area of 2300 $m^2$ and maximum depth of pond is approximately 20 feet. This pond is situated in low land, so rain water from surrounding reaches in the pond, which is the only source of water.

2.2 Methodology

Soil samples were collected from the three stations (single quadrature from each station) of pond with the help of quadrature having dimensions $25 \times 20 \times 10 \text{ cm}$. Polythene bags were used to carry samples to laboratory where samples were sieved with mesh (grill size 2 mm). Molluscs were picked up with the help of forceps. For identification gastropods were examined by using stereo microscope, bull lens and compare with standard keys given by Subba rao (1989). For quantitative analysis, numbers of picked living snails were counted quadrature wise and also species wise and then average should be taken. Populations per $m^2$ were calculated by using formula described by Saxena (2001):

\[
\text{Gastropods No./m}^2 = \frac{N/A \times 10^4}{A}\]

N= Number of gastropods per sample
A= Area of sampler ($cm^2$)

3 Results and Discussion

Table 1 and 2 revealed that three gastropods species *D. pulchella, G. orcula* and *I. exustus* belonging to two subclasses prosobranch and pulmonata were recorded from village pond and during the month of May and June pond face dry period.
Table 1 Diversity and Population density (No./m²) of gastropod fauna at Nal Village Pond, Bikaner during Sep. 2010 – Nov. 2011. Values are monthly averages of three study stations.

<table>
<thead>
<tr>
<th>Months→</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prosobranchia</strong></td>
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<td></td>
</tr>
<tr>
<td><em>Digoniostoma pulchella</em></td>
<td>140</td>
<td>140</td>
<td>230</td>
<td>200</td>
<td>90</td>
<td>160</td>
<td>260</td>
<td>220</td>
<td>-</td>
<td>120</td>
<td>170</td>
<td>220</td>
<td>170</td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Gabbia orcula</em></td>
<td>160</td>
<td>230</td>
<td>270</td>
<td>260</td>
<td>220</td>
<td>150</td>
<td>280</td>
<td>260</td>
<td>DRY</td>
<td>120</td>
<td>70</td>
<td>90</td>
<td>120</td>
<td>230</td>
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<tr>
<td><strong>Pulmonata</strong></td>
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<td></td>
</tr>
<tr>
<td><em>Indoplanorbis exustus</em></td>
<td>110</td>
<td>120</td>
<td>100</td>
<td>50</td>
<td>20</td>
<td>70</td>
<td>140</td>
<td>150</td>
<td>100</td>
<td>100</td>
<td>60</td>
<td>20</td>
<td>20</td>
<td></td>
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</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>410</strong></td>
<td><strong>490</strong></td>
<td><strong>600</strong></td>
<td><strong>510</strong></td>
<td><strong>330</strong></td>
<td><strong>380</strong></td>
<td><strong>680</strong></td>
<td><strong>630</strong></td>
<td><strong>220</strong></td>
<td><strong>290</strong></td>
<td><strong>320</strong></td>
<td><strong>360</strong></td>
<td><strong>420</strong></td>
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</tr>
</tbody>
</table>

Table 2 Seasonal (Sep.2010- Nov.2011) and annual (Sep.2010- Aug.2011) means of gastropod population at Nal Village Pond, Bikaner.

<table>
<thead>
<tr>
<th>Seasons→ (Sep.2010- Nov.2011)</th>
<th>Winter</th>
<th>Summer</th>
<th>Monsoon</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prosobranchia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Digoniostoma pulchella</em></td>
<td>170</td>
<td>240</td>
<td>131.66</td>
<td>156</td>
</tr>
<tr>
<td><em>Gabbia orcula</em></td>
<td>226</td>
<td>270</td>
<td>131.66</td>
<td>202</td>
</tr>
<tr>
<td><strong>Pulmonata</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Indoplanorbis exustus</em></td>
<td>52</td>
<td>145</td>
<td>85</td>
<td>96</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>448</strong></td>
<td><strong>655</strong></td>
<td><strong>348.33</strong></td>
<td><strong>454</strong></td>
</tr>
</tbody>
</table>

The systematic of reported gastropod is as below:

1) **Subclass**: Prosobranch
2) **Order**: Mesogastropoda
   a) **Family**: Bithyniidae
   i) **Genus**: *Gabbia*
   Species: *orcula* (Frauenfeld, 1862)
   Scientific name: *Gabbia orcula* (Frauenfeld, 1862)
   ii) **Genus**: *Digoniostoma*
   Species: *pulchella* (Benson, 1836)
   Scientific name: *Digoniostoma pulchella* (Benson, 1836)

2) **Subclass**: Pulmonata
   **Order**: Basommatophora
   **Family**: Planorbidae
   **Genus**: *Indoplanorbis*
   Species: *exustus* (Deshayes, 1834)
   Scientific name: *Indoplanorbis exustus* (Deshayes, 1834)

Earlier some workers, Singh (2000), Rathore (2003), Rathore (2011), Khanam and Singh (2012a, b) and Sharma et al. (2012) were also reported these species in surrounding desert waters.

Data of table 1 and figure 1 revealed that maximum population density of gastropod were recorded during March i.e. 680 snails/m² while minimum were recorded in July i.e. 220 snails/m². Table 2 and figure 2 indicates that minimum population density was recorded in monsoon season and maximum in summer season. The findings of present study show similarity with the findings of Rathore (2003), who also recorded maximum gastropods population density in summer season in desert water. The reported population densities are not showing similarity with findings of Bugalia (2010).

Bugalia (2010) recorded maximum population density of gastropods in monsoon season. In present study minimum population density were recorded in monsoon season may be because of dry period faced by pond for two months just before monsoonal season, which effects the population density of gastropods and take more time to develop their community. According to Wiggins et al. (1980) two types of animal species survive in ephemeral water bodies. These communities are:

1) Resident specialist species (survive in dry phase as dormant adults, juveniles or in cyst form).
2) Opportunists or migrants (present during the aquatic phase and leave water bodies during dry phase).

Peak population density of *D. pulchella* were recorded in March (figure. 1) and low in winter season (figure.2) with annual average 156 snails/m². These results are in conformity with the findings of Rathore (2003). Results of present study are contradictory with the findings of Singh (2000), those who were recorded maximum population density of *D. pulchella* in summer season. Srivastava (2009) were recorded average population density ranged between 153.33 snails/m² and 180.66 snails/m² in some desert waters and in this manner our results show similarity with this researcher.
Maximum population density of *G. orcula* was recorded in March (summer) and low in August (monsoon) (figure 1 and 2) with highest density 280 snails/m². In summer season water covering area of pond decreased because of high evaporation rate due to intense sun radiations. Intense sun radiation is the main characteristic of desert region. The similar types of trends were reported by Singh (2000). Rathore (2003) were recorded *G. orcula* population density peak in March and recorded extremely low values following summer and then monsoon with highest population density up to 30 snails/m².

Maximum population density of *I. exustus* was recorded in summer season and low in winter season (Figure 2) with annual average 96 snails/m². Highest population density were recorded in April i.e. 150 snails/m². In this manner also findings of present study are in conformity with the findings of Singh (2000) and Rathore (2003). Sharma (2009) also recorded low population density of *I. exustus* in winter season. The results of the present study are not agreement with the findings of Garg et al. (2009), those who recorded high population density during summer season and low during winter season. Singh (2000) recorded *I. exustus* population density up to 80 snails/m².

![Figure 1 Monthly fluctuation of Gastropods population in Nal village pond from Sept. 2010- Nov. 2011.](image1)

![Figure 2 Seasonal and annual variation of gastropods population in Nal village pond from Sep. 2010 to Nov. 2011.](image2)
Climatic conditions of desert region are totally different from humid region regarding temperature fluctuations, precipitation and humidity level. Waters of desert region have high electrolyte concentration because of high evaporation rate as compare to water of humid region. It was interested to note that such high population density of gastropod was recorded in harsh conditions of desert water. It was also noted that these gastropods were able to survive during dry phase of pond. According to Belk and Cole (1975) and Wiggins et al. (1980) animals of temporary water bodies adopted some strategies for survival like early maturity, parthenogenesis, laying of resting eggs or cyst, rapid development and high reproduction potential to withstand the dry periods.

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References


