SUMMARY
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STUDIES ON THE BIODIVERSITY OF FRESHWATER MOLLUSCAN FAUNA OF DAMOH AND SAGAR DISTRICTS

The present investigation was done on the 5735 specimens of Malacofauna which were collected seasonally from the freshwater bodies of Damoh and Sagar districts for two calendar years i.e. 1999-2000 to 2000-2001 by hand or scoop nets or by hand picking from the specific sites of molluscan habitat as follows:-

I. POND AND LAKE :-

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<thead>
<tr>
<th>S.No.</th>
<th>NAME</th>
<th>LOCATION</th>
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<tbody>
<tr>
<td>(i)</td>
<td>Belatal</td>
<td>Damoh (M.P.)</td>
</tr>
<tr>
<td>(ii)</td>
<td>Futeral</td>
<td>Damoh (M.P.)</td>
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<td>(iii)</td>
<td>Purena Talab</td>
<td>Damoh (M.P.)</td>
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<td>(iv)</td>
<td>Quidi pond</td>
<td>Damoh (M.P.)</td>
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<td>(v)</td>
<td>Rajnagar Pond</td>
<td>Damoh (M.P.)</td>
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<td>(vi)</td>
<td>Ramji Ki Talliya</td>
<td>Damoh (M.P.)</td>
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<td>(vii)</td>
<td>Sagar lake</td>
<td>Sagar (M.P.)</td>
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II. RIVERS :-

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<tr>
<th>S.No.</th>
<th>NAME</th>
<th>LOCATION</th>
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<tbody>
<tr>
<td>(i)</td>
<td>Kopra</td>
<td>Damoh (M.P.)</td>
</tr>
<tr>
<td>(ii)</td>
<td>Sunar</td>
<td>Damoh (M.P.)</td>
</tr>
<tr>
<td>(iii)</td>
<td>Bebas</td>
<td>Sagar (M.P.)</td>
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All the molluscan specimens were classified up to species by the method adopted by Tonapi (1980), Subba Rao (1989) and Hall (1996).
The entire collection of Malacofauna may be classified into two major classes as follow:-

1. Class - Gastropoda

2. Class - Bivalvia or Pelecypoda

Gastropoda fauna was the major group and form about $\frac{3}{4}$ part of the total collection while Bivalves molluscan fauna exhibited $\frac{1}{4}$ part of the total collection.

In class-Gastropoda: Member of only two subclasses were abundant while no specimen of “Opisthobranch” has been observed.

The temperature of all water bodies season to season varies. The minimum temperature was $12^\circ$C and maximum was $38-40^\circ$C. The pH of the water bodies also season to season varies, it ranges from pH 6.4 to pH 8.5.

All the collected Gastropod molluscan fauna is classified as follows:-

1. CLASS : GASTROPOD

   Subclass

   $\downarrow$

   1. Prosobranchiata = (Ctenobranchiata)
   Or Pectinobranchiata (Tonapi)

      $\downarrow$

      Order

      Mesogastropoda

      $\downarrow$

      Family

1. Family - Viviparidae
   Subfamily - Bellamyinae
   1. Genus - Bellamya Jousseaume
      Species - 1. Bellamya bengalensis (Lamarck)
                  2. Bellamya nepalensis (Kobeltt)
                  3. Bellamya crassa (Benson)
                  4. Bellamya dissimilis (Mueller)

2. Family - Pilidae (=Ampullariidae) (Tonapi)
   1. Genus - Pila Roeding
      Species - 1. Pila globosa (Swainson)

3. Family - Hydrobiidae (=Amnnicolidae) (Tonapi)
   Subfamily - Hydrobiinae
   1. Genus - Alocinma (Benson)
      Species - 1. Alocinma orcula
                  2. Hydrobioides Nevill
      Species - 2. Hydrobioides avarix (Annandale)

4. Family - Bithyniidae
   Subfamily - Bithyniinae s. str.
   1. Genus - Bithynia
      Species - 1. Bithynia stenothyroides (Dohm)
                 2. Digonistostom AAnnandale
      Species - 2. Digonistostoma cerameopoma (Benson)
                 3. Digonistostoma pulchella (penson)

5. Family - Thiaridae
   Subfamily - Thiarinae s. str.
   1. Genus - Thiara Roding
      Subgenus - Thiara s. str.
      Species - 1. Thiara (Thiara) scabra (Muller)
Subgenus  -  Stenomelania
Species  -  1.  Thiara (Stenomelania) punctata
           (Lamarck)
Subgenus  -  Tarebia H. and A Adams
Species  -  1.  Thiara (Tarebia) granifera (Lamarck)
           2.  Thiara (Tarebia) lineata (Grays)
Subgenus  -  Melanoides Olivier
Species  -  1.  Thiara (Melanoides) tuberculata
           (Muller)
           2.  Thiara (Melanoides) tuberculata crebra (Lea)
           3.  Thiara (Melanoides) tigrina raoi
Subfamily  -  Melanatriinae
2.  Genus  -  Brotia H & A. Adams
Subgenus  -  Antimelania (Crosse and Fischer)
Species  -  1.  Brotica (Antimelania) costula (Rafinesque)
Subfamily  -  Melanopsinae
3.  Genus  -  Faunus (Montford)
Species  -  1.  Faunus ater (Linnaeus)
Subfamily  -  Paludominae
4.  Genus  -  Paludomus Swainson
Subgenus  -  Paludomus s.str.
Species  -  1.  Paludomus (Paludomus) obesus (Philippi)
5.  Genus  -  Melania
Subgenus  -  Striatella
Species  -  1.  Melania (Striatella) tuberculata (Muller)
Subgenus  -  Plotica
Species  -  1.  Melania (Plotica) scabra (Muller)
           -  2.  Melania (Plotica) scabra var elegans
           (Hutton)
Class: GASTROPODS

Subclass

2. PULMONATA

Order

Basommatophora

1. Family - Lymnaeidae

1. Genus - Lymnaea (Lamarck)

Subgenus - Pseudosuccinea Baker

Species - 1. Lymnaea (Pseudosuccinea) acuminata (Lamarck)
           - 2. Lymnaea (Pseudosuccinea) acuminata rufescens (Gray)
           - 3. Lymnaea (Pseudosuccinea) biacuminata (Annandale & Rao)
           - 4. Lymnaea (Pseudosuccinea) luteola (Lamarck)

Subgenus - Radix Montfort

Species - 5. Lymnaea (Radix) auricularia (Linnaeus)

Subgenus - Lymnaea s. str.

Species - 6. Lymnaea (Lymnaea) stagnalis (Linnaeus)

2. Family - Planorbidae

Subfamily - Bulininae

1. Genus - Indoplanorbis (Annandale & Prashad)

Species - 1. Indoplanorbis exustus (Deshayes)

Subfamily - Planorbinae s.str.

2. Genus - Gyraulus Charpentier

Species - 1. Gyraulus convexiusculus (Hutton)
           - 2. Gyraulus labiatus (Benson)
           - 3. Gyraulus rotula (Benson)
           - 4. Gyraulus velifer (Annandale)
3. **Family** - Ariophantidae  
   1. **Genus** - Macrochlamys  
      **Species** - 1. *Macrochlamys pedina* (Benson)  
      2. *Macrochlamys infausta* (Blanford)  
   2. **Genus** - Ariophanta  
      **Species** - 1. *Ariophanta bistrialis* (Beck)  
   3. **Genus** - Sitala  
      **Species** - 1. *Sitala denselirata* (Preston)  
   4. **Genus** - Kaliella  
      **Species** - 1. *Kaliella bullula* (Hutton)  
   5. **Genus** - Xesta  
      **Subgenus** - **Species** - 1. *Xesta (Fretum) semirugata* (Beck)  
4. **Family** - Helicidae (=Pleurodontidae)  
   1. **Genus** - Eulota  
      **Species** - 1. *Eulota sculpturita* (Benson)  
5. **Family** - Subulinidae  
   1. **Genus** - Subulina  
      **Species** - 1. *Subulina octona* (Bruguiere)  
   2. **Genus** - Opeas  
      **Species** - 1. *Opeas gracile* (Hutton)  
6. **Family** - Glessulidae  
   1. **Genus** - Glessula  
      **Subgenus** - **Species** - 1. *Glessula (Glessula) notigena*(Benson)  

The data showed that freshwater mollusca is the diversified group found in each and every lentic and lotic water bodies. Only member of
All the collected bivalve molluscan fauna is classified as follows:

2. Class- BIVALVIA
   1. Subclass - Palaeoheterodonta
      1. Order - Unionida
         Superfamily- Unionacea
         family
         1. Unionidae
         2. Amblemidae

Subfamily - Unioniae
1. Genus - Lamellidens (Simpson)
   Species - 1. Lamellidens corri anus (Lea)
   2. Lamellidens marginalis (Lamarck)

Subfamily - Parreysiinae
1. Genus - Parreysia (Conrad)
   Subgenus - Parreysia s.str.
   1. P.(P)rajahensis (Lea)
   2. Radiatula (Simpson)
   Species - 1. P. (R.) occata (Lea)

2. Class- BIVALVIA
   1. Subclass - Heterodonta
   1. Order - Veneroida

Family

1. Corbiculidae “or” Cyrenidae (Tonapi)
   1. Genus - Corbicula (Magerle von muehfeld)
   Species - 1. Corbicula striatella (Deshayes)
   2. Genus - Villorita (Griffith and Pidgeon)
   Species - 1. Villorita corbiculoides (Prashad)

2. Pisidiidae or Sphaeriidae (Tonapi)
   1. Genus - Pisidium Pfeiffer
   Species - 1. Pisidium clarkeano n (Nevill)
               2. Pisidium nevillianum (Theobald)
   Subgenus - Pisidium s.str.
   Species - 1. P. (P) casertanum (Poli)
               2. Afropisidium (Kuiper)
   Species - 1. P. (A.) nevillianum (Theobald)
Gastropods and Bivalves are found in the collected malacofauna which are identified into 15 families, 28 Genera and 54 species in the present investigation. About 5, families, 11 genera and 23 species were of “Prosobranch”, 6 families, 12 genera and 21 species were of “Pulmonata” while 4 families with 5 genera and 10 species are of class Bivalvia have been identified, so overall 15 families, 28 genera and 54 species have been surveyed in the present investigation.

After identification of diversified molluscan fauna some significant point have been investigated as follows:-

1. **Gastropod Species were collected both in lentic and lotic habitats of Damoh and Sagar districts e.g. Prosobranch :- Bellamya nepalensis, Bellamya dissimilis, Alocinma orcula (Damoh district) and Digoniostoma cerameopoma, Digoniostoma pulchella, (Sagar district) were abundant and that is why they are identified as “Common species”.

2. **PROSOBRANCH :- Pila globosa**, species was only procured from Kopra river of Damoh district and neither this genera nor their species were found at any lentic or lotic freshwater bodies of Damoh and Sagar districts so it could be indentified as “UNCOMMON” species. It is called as “rare species”.

3. A few Gastropod species were procured from some lentic and lotic freshwater bodies e.g. prosobranch :- Bellamya bengalensis, Bithynia stenothyroides, Digoniostoma cremeopoma, Digoniostoma pulchella, Hydrobioides avarix, (Damoh district) hence known as not so “common species”.

4. Some Gastropod species exhibited their presence only in “lentic freshwater
habitat" e.g. Bellamya crassa (Damoh district), all surveyed species of Bellamya (Sagar district) some species of Thiaridae e.g. Paludomus obesus, Melania (Striatella) tuberculata, Melania (Plotica) scabra, Melania (Plotica) var eleganus, (Sagar district).

5. All investigated species of Pulmonates e.g. of family Lymnaeidae, Planorbidae, Ariophantidae, Helicidae, Subulinidae and Glessulidae, have been procured only from lentic freshwater bodies of Damoh and Sagar districts and none member was procured from lotic freshwater bodies of Damoh and Sagar districts.

6. All investigated species of prosobrach e.g. Thiaridae were collected from Sunar and Kopra (Damoh districts) and Bebas rivers of Sagar district while species Paludomus obesus, Melania (Striatella) tuberculata, Melania (Plotica) scabra, Melania (Plotica) var eleganus were collected from Sagar lake and University Botanical garden ponds of Sagar district.

7. All investigated Bivalve species were abundant only in lotic freshwater bodies of Damoh and Sagar districts.

8. No. Bivalve species was collected from any lentic freshwater bodies of Damoh and Sagar districts. So in the present investigation only the “Bivalve” molluscan fauna was specific and it is only found in running water of all the freshwater rivers e.g. Sunar, Kopra (Damoh district) and Bebas river (Sagar district)

9. All the identified species of Bellamya also have been collected from University Botanical Garden ponds of Sagar district.

10. Only Alocinma orcula was collected from Bebas river of Sagar district and
it has not been collected from any lentic freshwater bodies of Sagar district while it was of lentic and lotic in habitat of Damoh district.

11. The number of specimens of Thiaridae family was very high and has been collected about 1350 in the present investigation and that is why is the “Common Species” of lotic freshwater habitat of Damoh and of Sagar district while Pila globosa which was the rare species was procured only from Kopra river of Damoh district.

12. Overall the total number of Pulmonate specimens were very high i.e. 2264 in the present investigation on mean basis, next to Pulonomates the 2nd highest specimens were of Prosobranchs i.e. 2100 while the total Bivalve number was lesser than the above investigated Gastropods and i.e. 1371, in the present investigation.

13. Member of family Lymnaeidae and Planorbidae (Pulmonates) were abundant and easily reared in the laboratory while members of other families have not been survived in the laboratory and were died within 24 hrs. and their mortality rate was very high in the laboratory so it is very difficult to do researches on any aspect in the laboratory while the egg masses of Lymnaeidae, Planorbidae provided good ideal material for the study of Developmental Biology.

14. Most of the members of Gastropods are herbivorous e.g. family pilidae, Hydrobidae, Lymnaeidae, planorbidae, Ariophantidae (kaliella bullula), Xestra (fretum) semirugata), Helicidae (Eulota sculpturita) are act as “pestiferous snails” because they decline the productivity of the valuable
vegetations of the corresponding area while those species fed on organic matter e.g. members of family Viviparidae, Thiaridae, Subulinidae and Glessulidae are not act as pestiferous snails.

15. Members of some families act as intermediate host in the life history of “Trematode” parasites like liver and blood flukes, so they act as bioindicators, showed the probable presence of parasitic trematodes and causes infections e.g. “Schistosomiasis” and “Bilharizasis” and Bellamya bengalesis, Pila globosa, Lymnaea auricularia, Lymnaea acuminata, Lymnaea luteola, Lymnaea stagnalis, Indoplanorbis exustus, Gyraulus Covexiusculus etc. act as intermediate hosts while the other remaining species of Gastropods and all Bivalve surveyed in this present investigation were not causes any infection (i.e. not provided as intermediate host) that is why they were known a “NON PATHOGENIC” species.

16. Generally Bivalve shell fisheries e.g. members of family Unionidae, Amblemidae and Corbiculidae due to large size provide very good source of protein and will solve the problem of protein malnutrition in India and should be cultured for food purposes.

17. Pisidium species (Bivalve) members also provided “Palatable” dishes to natives.

18. These species which were rare and nonpestiferous e.g. members of family Viviparidae (Bellamya dissimilis); Hydrobidae (Alocinma orcula and Hydrobioides avarix); Bithyniidae. (Bithynia stenothyroides); Thiaridae (Thiara (Stenomelania) punctata, Melania (Plotica) scabra); Panorbidae
(Gyraulus rotula) and Glessulidae (Glessula notigena) etc. (because the number of these members is 50 or less than 50 in the total collection of 5735 specimens in the present investigation) should need conservation from the ecological point of view.

19. Specimens of "Thiaridae" showed beautiful coloured shell with very beautiful sculpture and hence are used for ornamental and decorative purposes.

20. Member of Pulmonates e.g. family Lymnaeidae were survived in most polluted water due to the presence of haemoglobin in the plasma.

So the present investigation suggested that shell fisheries might be the alternative or substitute of Pisciculture which should solve the problem of protein malnutrition in the developing country just like India.

Some important aspects concerning with molluscan fauna diversity were also investigated which are quite significant are as follows :-

I. HABIT and HABITAT :- Varied habits and habitats were found in Gastropods while Bivalves were found in and near by river banks. The data regarding this matter was investigated and summerized in table No. 1 to 8.

II. FOOD and FEEDING :- Varied types of food and feeding has seen in Gastropod molluscan fauna and summerized as follows :-

(i). Herbivorous mode of feeding was found in the members of most of the families of prosobranch and pulmonate gastropods.

(ii). Organic matter or detersitic mode of feeding was found in the members of family Thiaridae and in some bottom dweller snails.
(iii). While all Bivalves molluscs are microfeeders and they extracted their food from water current by the phenomenon which is known as “FILTER FEEDING” as seen in the present investigation in the member of families:-

1. Palaeoheterodonta :- (i) Unionidae  (ii) Amblemidae

2. Heterodonta :-  (i) Corbiculidae  (ii) Pisidiidae etc.

III. ASSOCIATION WITH OTHER BIOTIC FACTORS :-

Flora and fauna are the two major biotic components of freshwater eco-system. which interact each other while flora provided food for herbivorous freshwater molluscs e.g. some prosobranchs and most of the pulmonate molluscan fauna.

But inter specific and intraspecific competition has been observed in most of the species for food, shelter (habitat), Oxygen and for other life necessities.

Parasitism (ecto and endo both) are common in Pulmonata and Bivalve molluscs where they provide intermediate host for the life history of liver and blood flukes (Endoparasitism) while Glochidian (larvae of Unionidae) showed parasitic mode of feeding and extracted food from the tissue of host fishes.

IV. POPULATION DENSITY :- Generally mixed or multispecies population has seen in the present investigation. Population density was always greater in breeding season while lesser in summer season due to aestivation of most of the
sensitive species. Generally population density of molluscan fauna was calculated as specific or ecological density as per method adapted by Smith (1966) and Odum (1971), and Summerized in $\pi$ diagrams No. 1 to 17.

CONCLUSION AND SIGNIFICANCE OF THE INVESTIGATION:-

It could be concluded from the present investigation that diversified molluscan fauna has been found in freshwater lentic and lotic water bodies of Damoh and Sagar districts indicated the presence of good environmental conditions of the corresponding freshwater bodies. Generally mixed or multispecies population was observed in the present investigation. Although seasonal significant variation in the population density of the species between seasons and between two calendar years (from 1999-2000 to 2000 to 2001) were noticed. The pattern was almost similar during both years. Two peak periods of abundance were recorded, first in premonsoon (February-March-April) and second in early monsoon (June-July-Augst) both due to abundance of newborn individuals. These two periods in most of the malaco species are dominated by juvenile population. The abundance of juveniles during early premonsoon and early monsoon signified the two breeding of the species in a year while most of the species e.g. of family Lymnaeidae and Planorbidae etc. breed round the year and it could be possible to see their juveniles throughout the year, that is why most of the malacologists prefer to do researches on the various aspects on the species of these two families. Most of the research work is going on in our laboratory on the species of these two families.

India is a developing country. Most of the population is suffered
from protein malnutrition, so to overcome to this serious problem “shell fisheries” will be the alternative, which provide most palatable dishes to user. Most of the species of Lamellidens are not only fast growing but also used for “pearl culture” e.g. Lamellidens marginalis while providing flesh to the consumer and solving the problem of protein deficiency to some extent.

Surveyed literature revealed that the species Scaphula celox belongs to family Arcidae Lamarck (1809), Subfamily Anadarinae was abundant in the rivers of Madhya Pradesh (Benson, 1836; Blanford, 1867 and preston, 1915) while the survey on diversified molluscan fauna for two calendar year obviously evidenced about the total diminish of this species from this region. Now one of the alternative is that to search out the habitat of this specific genera and try to introduce this species in the freshwater lotic bodies of Damoh and Sagar districts and periodically a survey shall be made about its population density, otherwise most of the species which are uncommon became endangered or frightened species, so it is better way to conserve them otherwise they become extinct. This investigation will give us an idea about the specificity of diversified molluscan fauna.

Most of the herbivorous snails are pestiferous. Their growth rate, fecundity and survivility is very high, so to control their population below threshold damage their predator and parasites should be introduced as biological control but those predators which destroying the valuable shell fisheries should be removed from the corresponding habitat and apply such precautions, measures or steps which are helpful in the development, management and maintainence of “Shell fisheries” in India.