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DIVERSITY OF MOLLUSCAN FAUNA FROM FRESHWATER BODIES OF SANGLI DISTRICT: A COMPREHENSIVE STUDY IN RELATION TO ENVIRONMENTAL VARIABLES

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ABSTRACT: Molluscs as a second largest phyla includes snails, slugs, clams, oysters, scallops, cuttlefish, squid and octopus. Present study revealed, diversity of molluscan fauna from three sites i.e Khanderajuri lake, Mhaishal lake and Krishna river in the period of January, 2011 to December, 2013. Among collected molluscs 10 species were identified from seven families i.e. *Physidae, Lymnaeidae, Viviparidae, Corbiculidae, Thiaridae, Planorbidae* and *Littorinidae* included in class Gastropods and Bivalve. Seasonal variations showed quantitative difference in gastropods, Quantity was observed to be minimum in mansoon season as compared to premansoon and postmansoon season. Physicochemical alterations were showed influence on the biodiversity at the various sites.

INTRODUCTION: Aquatic ecosystem is the most diverse in the world. Benthic macro invertebrates are common inhabitants of fresh water bodies as they transfer energy through food webs [1.] Among invertebrate diversity molluscs constitute the second largest phylum next to arthropods. Many molluscan species are also good bio-indicators for water quality or pollution on the basis of their tolerance power against extremes of physico - chemical components of water [2, 3, 4]. Molluscs are found to be important economically, medicinally and ecologically [5]. The biological communities that are exposed to pollutants act as integrators of multiple past and present environmental effects in any ecosystem.

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All attribute makes them suitable to act as bioindicators [6]. Molluscs occupy a prominent place among aquatic organisms suitable for biological monitoring [7]. Scientists have reported that, certain gastropods and pelecypods were ideal bio-indicators for trophic stages (eutrophic, mesotrophic and oligotrophic) of lakes as well as for lotic environments [8, 9, 10]. Clarke attempted to show the utility of molluscs in primary classification of the lakes in their various trophic stages. Freshwater macro invertebrates are used for lake monitoring and different indexes were prepared to assess the ecological status of lentic ecosystems.

Benthic macro invertebrates constitute an important part of aquatic organisms in aquatic environments. At present aquatic organisms are exposed to anthropogenic disturbance as well as natural changes in their habitats which are to be responded in various ways. Therefore, aquatic organisms also have an important role in biomonitoring [11, 12].

Freshwater molluscs forms relationship between other organisms and environment [13]. They play an important role in aquatic ecosystems, providing food for many fish species and vertebrates [14]. Water hardness, conductivity, pH, altitude, substrates (plants), food resources (plants) and biotic interactors have been reported as important environmental predictors of molluscs [15, 16].

Rao and Dey and Garg *et al*. studied a correlation between the molluscan diversity with physiochemical parameter with effect of water from Ramasagar reservoir located in north way site of Dhatia city, Madhya Pradesh[17, 18]. Piola and Johnston studied the influence of pollution on the native diversity of invertebrates of new southwales, Australia[19]. They may be used to understand the response, adaptation and recovery of an ecosystem and its inhabitants to both natural and anthropogenic disturbances. Molluscan fauna can be investigated from several perspectives, i.e. zoological diversity, biogeographical distribution, palaeontology, veterinary, agricultural plagues, invasive exotic species, conservation, as an alimentary resource (fishing and malacoculture), as bio-indicators of environmental quality and, last but not least, as a health hazard (as vectors or transmitters of human parasitic diseases). Molluscs are also found economically important as some of them are edible. The soft bodies of molluscs are used as a medium for fishing in the form of bait, hard shells are used for making various items such as buttons, decoration of door curtains, knife handles, ornaments etc. also used in the form of poultry food[20].

Molluscs showed appropriate position among local invertebrate biodiversity. Taking in to account present study designed to investigate the molluscan biodiversity changing with seasonal physicochemical parameters. Many researchers have studied the molluscan diversity [21 to 26].

MATERIALS AND METHODS:

Study Area:

Sangli district is situated at western site of Maharashtra. Geographically located at 16.8670˚N latitude and 74.5670˚E longitude. Sangli district is situated around river basins of the Warna and Krishna. Sangli is the district headquarters and total area is 8,578 km² (3,312 sq mi). The district is 24.51% urban.

Collection Site:

a) Khanderajuri Lake,

b) Mhaishal Lake and

c) Krishna river

Sampling and analysis of water:

Water samples were collected at morning 9.00 am to 10.00 am for physicochemical analysis by monthly intervals in the period of January, 2011 to December, 2013. Physicochemical parameters such as temperature, pH, Total alkalinity, Turbidity, Chloride, Hardness, CO_2, DO, Calcium and Phosphate were analyzed regularly during all the three seasons by following the standard methods [27, 28]. Stastiscal analysis of data was made by Standard deviation and Standard Error. Finally readings were interpreted to find out pollution status in the lake.

Sampling of molluscs:

Molluscan species were collected by simple hand picking method, with the help of forceps and containers from all along the marginal area. Samplings were carried out up to depth of 1 to 2 meters from water level. Stratified random quadrate sampling method was applied for quantitative assessment of molluscan fauna at selected sampling stations[29]. However, five replicates at each sampling stations were performed to overcome the problem of random sampling. All the species were carried to laboratory, cleaned neatly and used for identification. Identification of animal was done by using standard keys of Zoological survey of India.

Stastical Analysis:

Statistical analysis of quantified data was carried out by calculating various indexes as Shannon-Weaver Index, Simpson Index, and Evenness Index[30] to interpret species richness, species abundance. All the variables were statistically analyzed and graphically interpreted.

RESULTS:

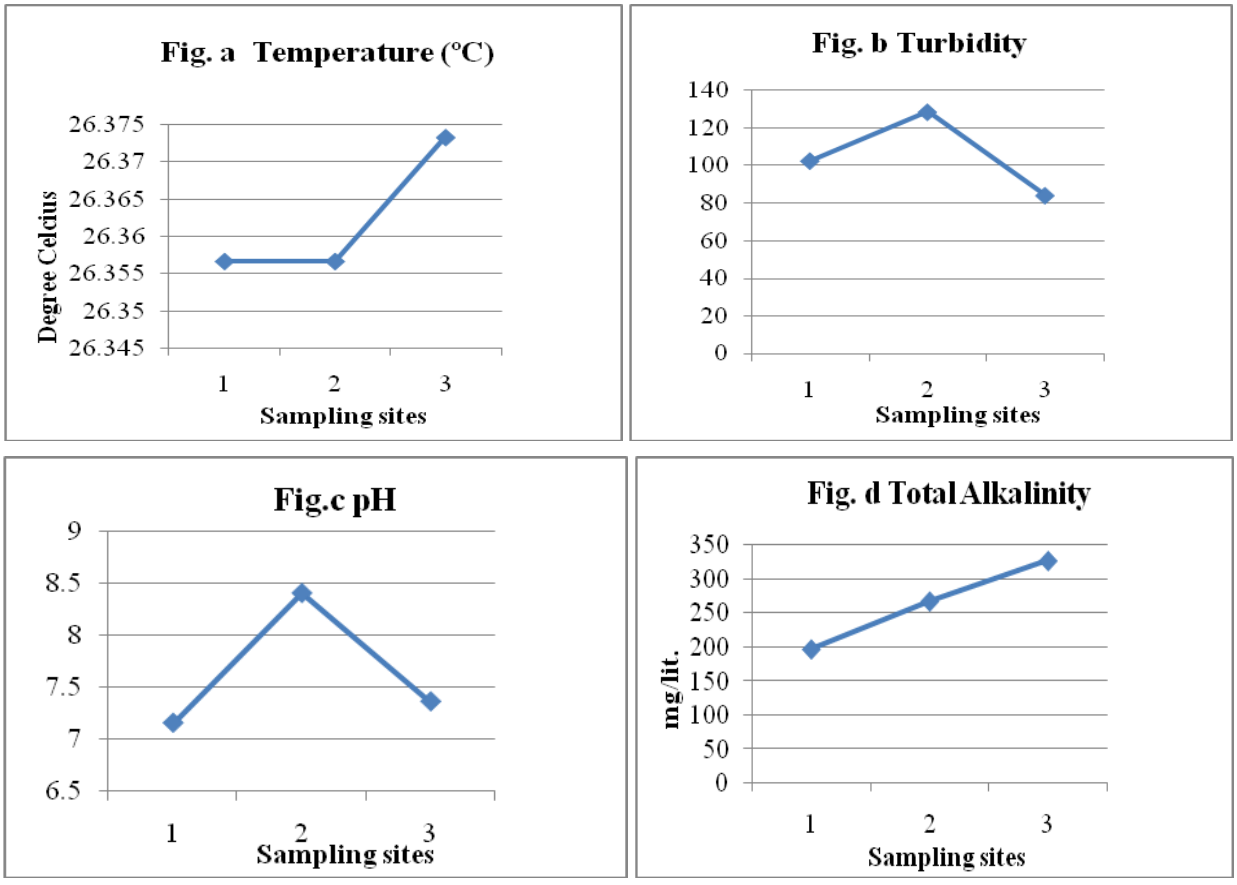
In the present study considerable changes in molluscan diversity was observed in the three different sites of Sangli district. The impact of physicochemical parameters on the diversity was

observed. Total ten species of molluscs belonging to class Gastropoda and bivalve were recorded during the study period. **(Table 1)**. Amongst the Gastropoda group *Thiara scabra* belonging to family Thiaridae was dominant followed by other eight species as *Thiara lineata* belonging to family Thiaridae, *Physella acuta* belonging to family Physidae, *Melanoides tuberculata* belonging to family Thiaridae, *Lymnaea acuminata* belonging to family Lymnaeidae, *Bellamya bengalensis* belonging to family Viviparidae, *Indoplanorbis exustus* belonging to family Planorbidae, *Cremnoconchus conicus* belonging to family Littorinidae, *Tarebia granifera* belonging to family Thiaridae and one species i.e. *Corbicula striatella* belonging to family Corbiculidae, class bivalve was observed.

TABLE 1: LIST OF MOLLUSCAN SPECIES WITH TAXONOMICAL CLASSIFICATION

Sr.No.	Phylum	Class	Order	Family	Species
1.	Mollusca	Gastropoda	Hygrophila	Physidae	*Physella acuta*
2.	Mollusca	Gastropoda	Hygrophila	Lymnaeidae	*Lymnaea acuminata*
3.	Mollusca	Gastropoda	Architaenioglossa	Viviparidae	*Bellamya bengalensis*
4.	Mollusca	Bivalve	Veneroida	Corbiculidae	*Corbicula striatella*
5.	Mollusca	Gastropoda	Sorbeoconcha	Thiaridae	*Thiara scabra*
6.	Mollusca	Gastropoda	Hygrophila	Planorbidae	*Indoplanorbis exustus*
7.	Mollusca	Gastropoda	Littorinimorpha	Littorinidae	*Cremnoconchus conicus*
8.	Mollusca	Gastropoda	Sorbeoconcha	Thiaridae	*Tarebia lineata*
9.	Mollusca	Gastropoda	Sorbeoconcha	Thiaridae	*Melanoides tuberculata*
10.	Mollusca	Gastropoda	Sorbeoconcha	Thiaridae	*Tarebia granifera*

Physicochemical parameters were observed namely Temperature (26ºC), Turbidity (84 – 128 cm), pH (7.1 – 8.4), Total Alkalinity (197 – 327 mg/lit.), Carbon dioxide (12 - 39 mg/lit), Dissolved oxygen (11 – 27 mg/lit.), Biological Oxygen Demand (9 – 25 mg/lit.), Chemical oxygen demand (22 – 77 mg/lit.), Phosphate (0.4 - 0.9 mg/lit), Chloride (64 - 160 mg/lit), Hardness (202 - 394 mg/lit.), Total Solid (285 - 491 mg/lit), Total dissolved solid (278 - 471 mg/lit). **(Fig.1 (a-l)**



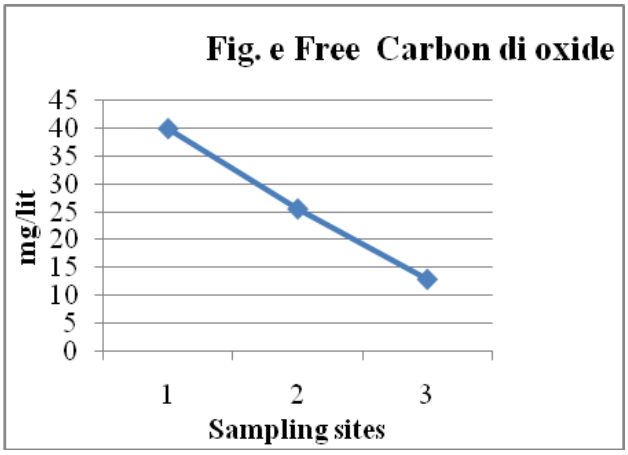


Fig. e Free Carbon di oxide
mg/lit
45
40
35
30
25
20
15
10
5
0
1
2
3
Sampling sites

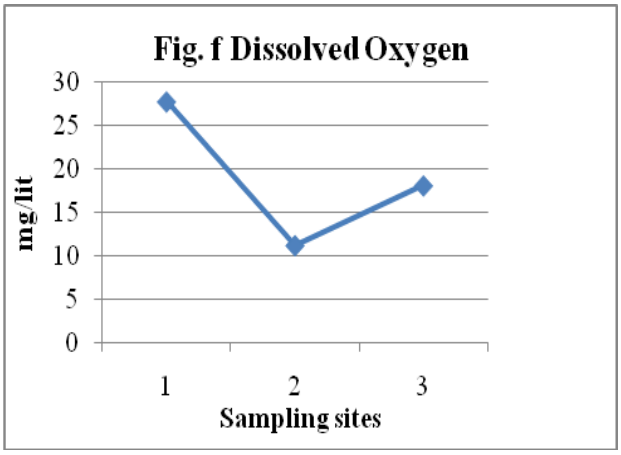


Fig. f Dissolved Oxygen
mg/lit
30
25
20
15
10
5
0
1
2
3
Sampling sites

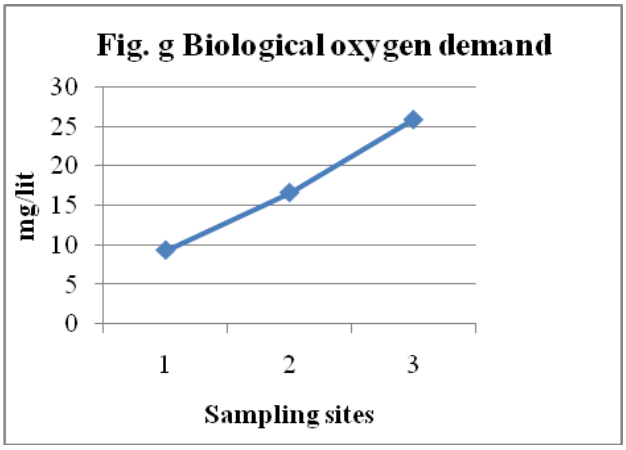


Fig. g Biological oxygen demand
mg/lit
30
25
20
15
10
5
0
1
2
3
Sampling sites

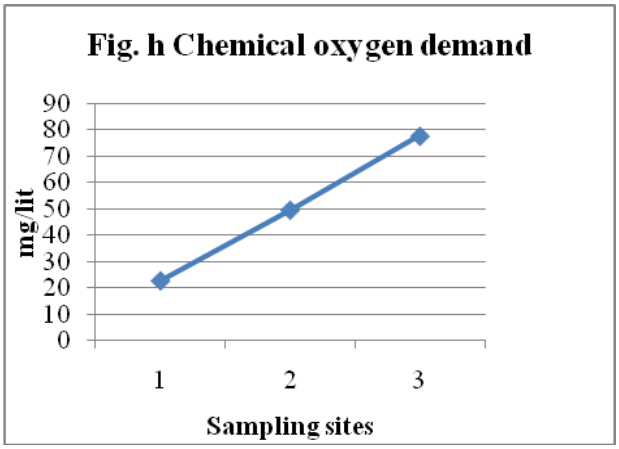


Fig. h Chemical oxygen demand
mg/lit
90
80
70
60
50
40
30
20
10
0
1
2
3
Sampling sites

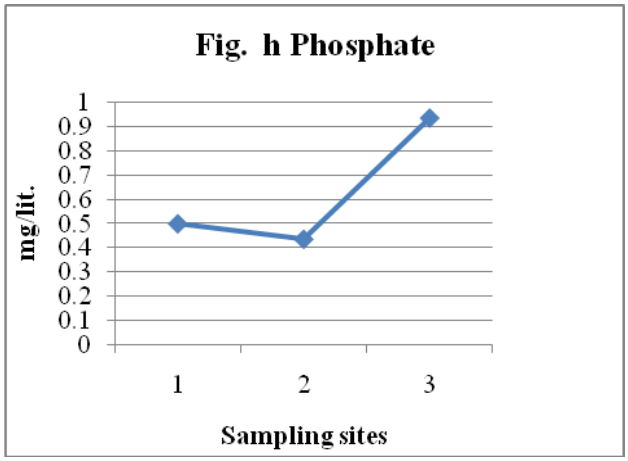


Fig. h Phosphate
mg/lit.
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1
2
3
Sampling sites

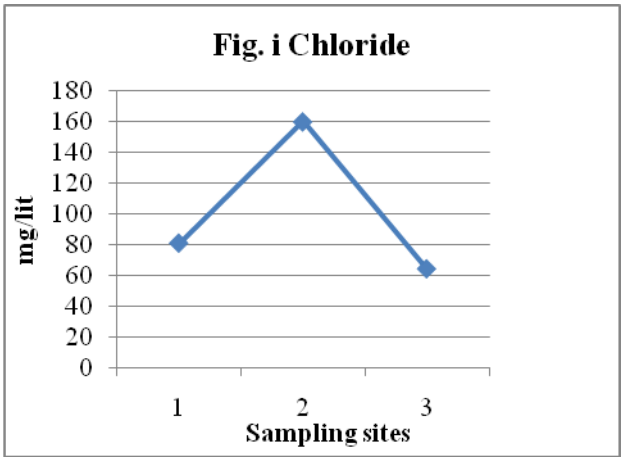


Fig. i Chloride
mg/lit
180
160
140
120
100
80
60
40
20
0
1
2
3
Sampling sites

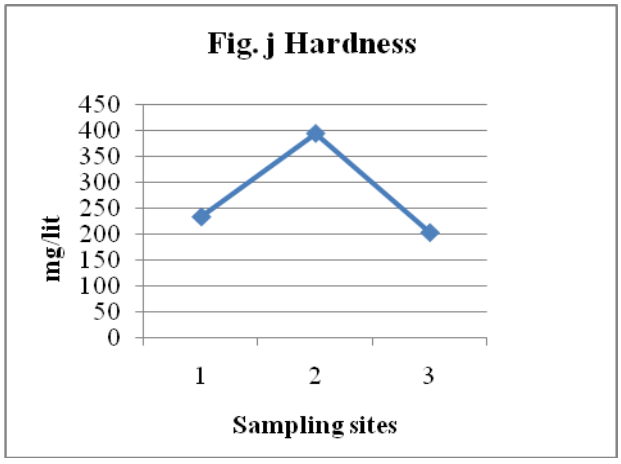


Fig. j Hardness
mg/lit
450
400
350
300
250
200
150
100
50
0
1
2
3
Sampling sites

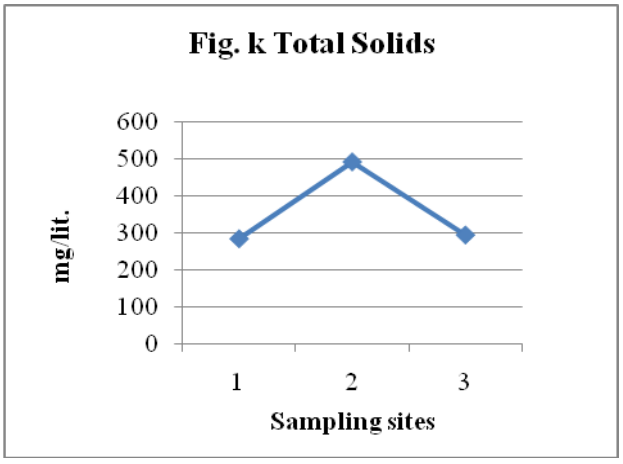


Fig. k Total Solids
mg/lit.
600
500
400
300
200
100
0
1
2
3
Sampling sites

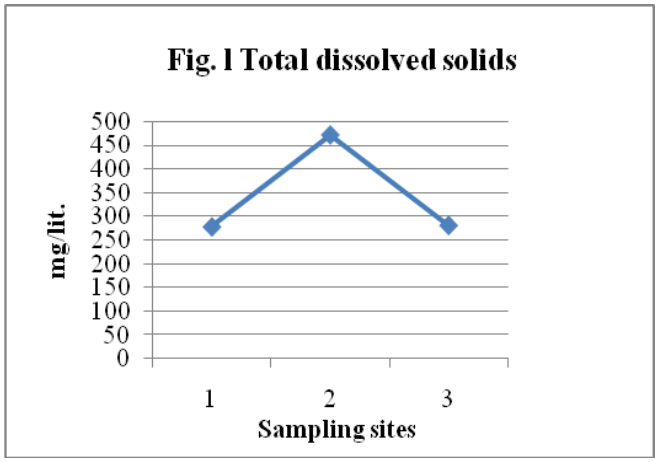


FIG.1 (a-l): AVERAGE ENVIRONMENTAL VARIABLES OF WATER COLUMN FROM THREE SAMPLING STATIONS OF SANGLI DISTRICT

Malacofaunal diversity of Krishna river, Mhaishal Lake and Brahmanath lake was noted Simpson index as 0.84, 0.82, 0.83 respectively. As per Shannon index, species abundance at Mhaishal lake site was 1.84 with least abundance where as Krishna river site and Brahmanath lake Site was 1.94 and 1.95 respectively. Evenness shown at three sites was 0.9, 0.8 and 0.8 respectively. Among the three sites Mhaishal lake showed least abundance as compared to Krishna river and Brahmanath lake may be due to human interference and pollution level. **(Fig.2)**

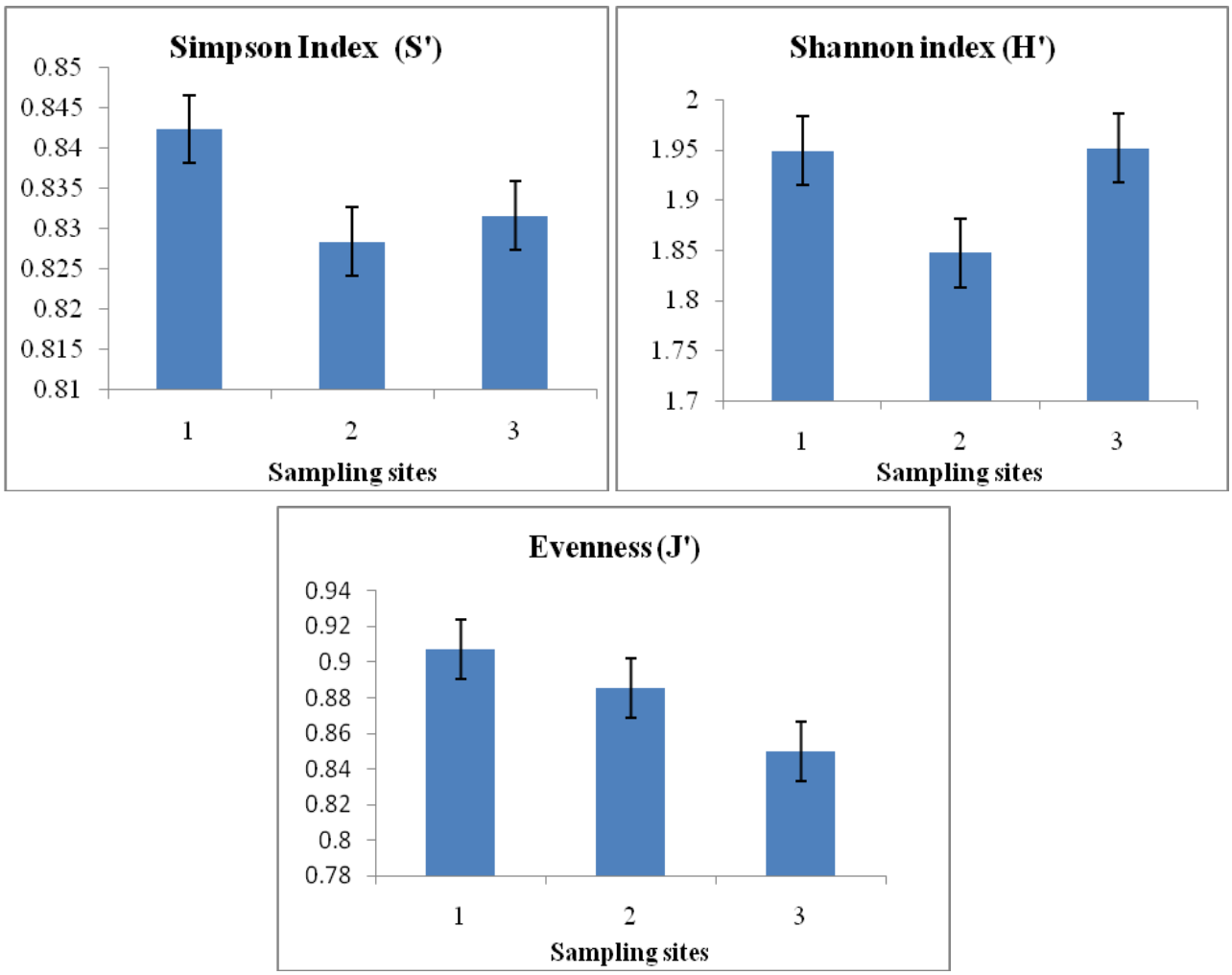
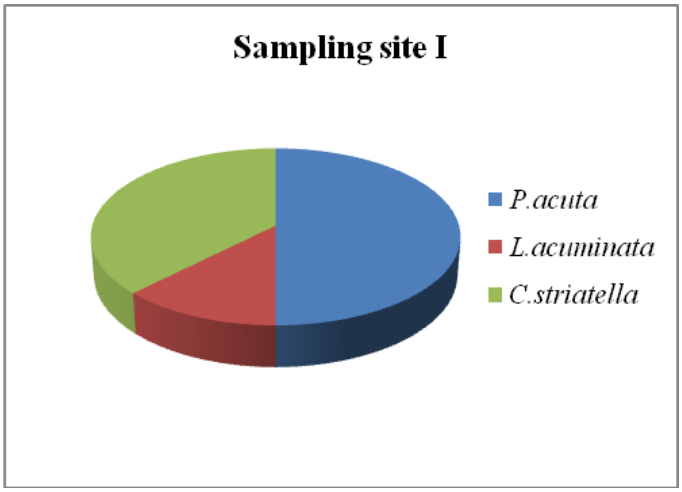
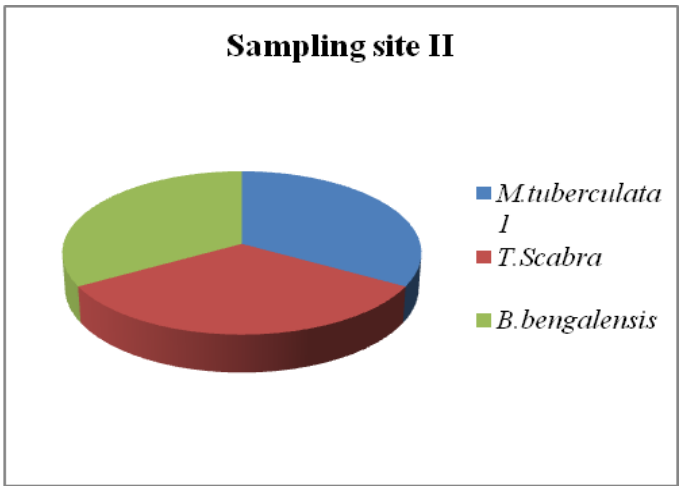
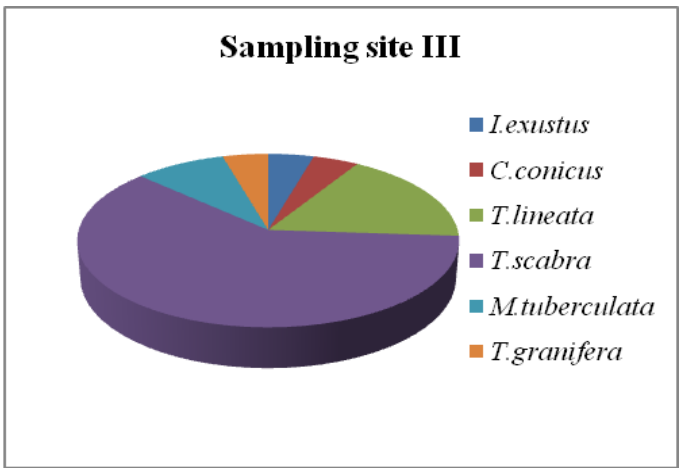


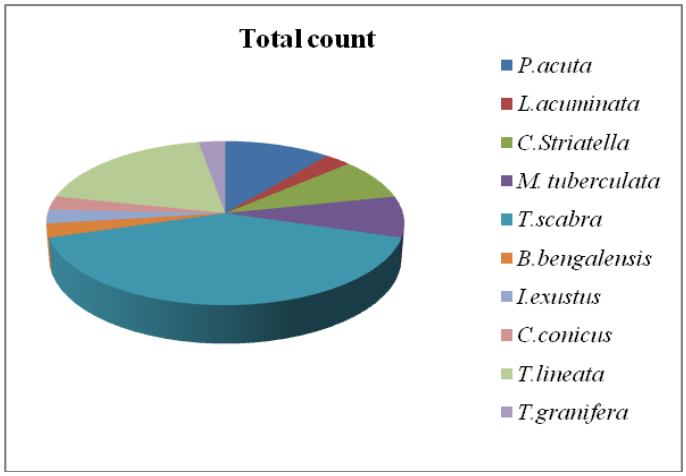
FIG. 2: AVERAGE SPECIES COMPOSITION OF MALACOFAUNA AT SELECTED SAMPLING STATIONS FROM SANGLI DISTRICT.

Percent composition of molluscan diversity throughout the study period showed that *Thiara scabra* as dominant species with 26% followed by *Tarebia lineata* 11%, *Physella acuta* 4%, *Melanoides tuberculata* 4%, *Corbicula striatella* 3%, *Indoplanorbis exustus* 3%, *Lymneae acuminate* 1%, *Bellamya bengalensis* 1%, *Cremnoconchus conicus* 1%, *Tarebia granifera* 1% among the total molluscan population **(Fig.3).**









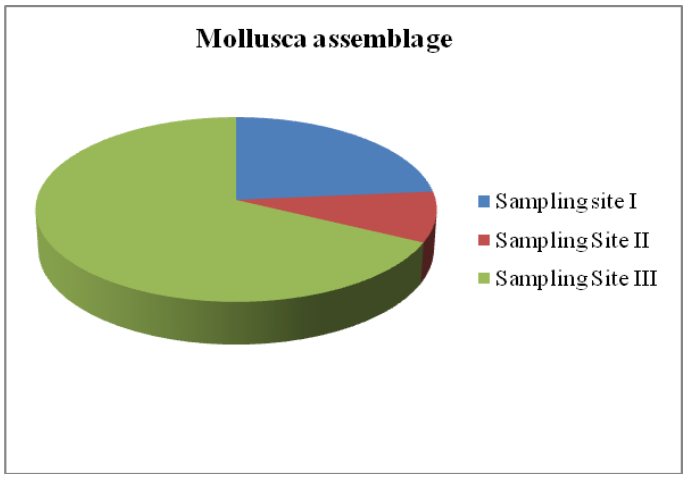


FIG. 3: AVERAGE POPULATION DYNAMICS MEASURED WITH SIMPSON INDEX, SHANNON INDEX AND EVENNESS AT SELECTED SAMPLING STATIONS OF SANGLI DISTRICT.

DISCUSSION: The Molluscan populations are good indicators of localized condition, indicating water quality. They also play important roles in the ecosystem structure and biodiversity. Harman has also pointed out that molluscs are bioindicators of freshwater pollution. Garg studied a correlation between molluscan diversity with physicochemical parameter with affect of water from Ramsagar reserviour. Researchers haves studied sewage pollution impact on microzoobenthic from Kalpi river[31]. Among the three seasons the molluscan species shows lower diversity in mansoon season as compared to summer and rainy season [32].

Species diversity, richness and abundance of molluscan fauna are greatly affected by fluctuation brought about by physicochemical parameters in the water body. Average temperature recorded during the study is 26ºC - 27ºC which is suitable for development of molluscan fauna. A positive

corerelation between molluscs and temperature was recorded[33]. pH ranges from 7.1 – 8.4 which is neutral to acidic and was suitable for molluscs. However, a very weak and insignificant negative correlation between molluscs and pH recorded by Garg and suggests that molluscs were found to be independent of fluctuations with respect to pH value. Total alkalinity has a significant correlation to the population of molluscs. [34] Sakhare and Joshi also supported this point of view by observing the greater molluscan population in alkaline lakes as compared to acidic lakes. CO_2 and DO were within the limiting range some molluscs can also survive in very low oxygen conditions [35]. High DO and less CO_2 are favourable for development of molluscs.

Total Solids, Total Dissolved Solids, and Phosphate show negligible effect on molluscan diversity. However, a positive correlation of chlorides with the gastropods suggests that the chloride content of the water body may favour their survival. Among the three sites Khanderajuri lake showed maximum diversity and population of molluscs as compared to Krishna river site and Mhaishal lake site as it shows sandy shore due to which it is rich in calcium which is favourable for molluscan shell growth. Tonapi, documented richness of molluscs observed due to high calcium content and macrophytic vegetation which provide food and shelter [36]. Several authors showed that calcium concentration is an important factor in controlling the abundance and distribution of molluscs in freshwater[37, 38, 39, 40, 41].

Lowest diversity was observed at Mhaishal lake site as due to moderately polluted with average pH, Turbidity, CO_2, DO, TS, TDS showing only 3 molluscan species during the study period. Khanderajuri lake showed maximum diversity of 23%, Krishna River 8% and Mhaishal lake with lowest diversity of 3%. (**Fig. 3).**

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