

STUDY OF ZOOPLANKTON POPULATION IN VALVAN LAKE (MS), INDIA.

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ABSTRACT

Zooplankton are tiny animals suspended in the water column. Zooplankton encompass a wide range of both unicellular and multicellular animals. These are vital component of freshwater food webs. The present study was conducted at four different sites, site A, site B, site C and site D in different seasons in Valvan Lake. Samples were collected from each site between June 2015 to May 2016. The collected samples were identified using standard references. In present study five groups of zooplankton were studied viz, Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda.

Keywords: Zooplankton, Valvan Lake

INTRODUCTION

Zooplanktons are important component of an aquatic ecosystem and are microscopic, free floating organisms which are non-motile and flat at the mercy of the water movements. Zooplanktons are primary consumers and they play an important role as they are principal food for fish and other aquatic organisms. They graze on algae, bacteria, protozoa and other organisms.

Zooplanktons are considered to be the ecological indicators of water bodies stated by (Gajbhiye and Desai, 1981). They occupy intermediate position between phytoplankton and other aquatic animals. Zooplankton mediate the transfer of energy from lower to higher trophic level (Waters, 1977) Zooplankton perform an important link in aquatic organisms for food chain and provide secondary production in the fresh water ecosystem (Sharma, 1998).

Zooplanktons are highly sensitive to environmental modifications and their variation in occurrence indicates a major transmission of the ecological condition of water body. Zooplankton population also useful to estimate the fishery potential of water body because these respond quickly to environmental changes. They are important indicators for evaluating the ecological capacity of aquatic ecosystems. Protozoa, Rotifers, Cladocerans, Copepods and Ostracods constitute the major groups of zooplankton. Zooplankton population is affected by light intensity, food availability, dissolved oxygen, pH, salinity, temperature, pollution and interaction between biotic communities.

MATERIAL AND METHOD

The water samples were collected from the four sites of Lake site A, site B, site C and site D. The samples were collected in the morning hours between 8.30 a.m. to 10.30 a.m. 50 ltr. of water sample was filtered through the plankton net made of bolting silk number 25 with mesh size 64 μ m. The collected samples were allowed to settle down by adding Lugol's iodine. Sedimentation requires 24 hrs after which supernatant was removed and concentrate was to 50 ml depending on the number of plankton and preserved in 5% formalin for further studies. For the quantitative study, the concentrated sample was shaken and one drop of sample was taken on a clear micro slide with the help of a standard dropper, the whole drop was carefully covered with the cover glass and observed. Plankton identification up to genera and whenever possible up to species level was classified according to keys given by Edmonson (1959), Adoni (1985) and APHA (1985) and standard analysis was undertaken as per Zar (2005).

Quantitative study of plankton was done by Sedgwick - Rafter Cell method.

Sedgwick-Rafter Cell Method The Sedgwick Rafter Cell is a special kind of slide similar to the Haemocytometer. The cell has a 50mm x 20 mm x 10 mm rectangular cavity that holds 1 ml sample. The cell is moved in horizontal directions on the stage of an inverted microscope and planktonic species encountered in the field are enumerated. A number of replicate samples are enumerated to calculate plankton / ltr.

Plankton (Units /ltr.) = $n \times c / v$

Where, n = number of plankton in 1 ml.

c = volume of concentrate.

v = volume of sample in ltr.

RESULT AND DISCUSSION

During the present investigation, maximum zooplankton density was recorded in site A and minimum in site C followed by site B and site D During present study zooplankton shows maximum growth in winter season and minimum in rainy season.

In zooplankton five groups were studied viz, Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. Among this group Rotifera was dominant in all the four sites while Copepoda and Ostracoda showed least appearance. Although within the Zooplankton group Rotifera was dominant but other groups showed variability in their appearance at different sampling sites of the pond under study.

AT SITE A

In the present investigation during the year 2015-2016, Rotifera was dominant followed by Protozoa, Cladocera, Ostracoda and Copepoda.

In site A, during 2015-2016, 18 species of rotifera were recorded among which *Branchionusbidentata* (84 no./ltr.) was dominant followed by *Filiniaopoliensis* (60 no./ltr.) *Brachionusforticula* (40 no./ltr.), *Testidinellamacroneta* (10 no./ltr.) *Horaellabrehmi* (38 no./ltr.), *Polyarthra vulgaris* (32 no./ltr.), *Platylasquadricornis* (14 no./ltr.), *Lecaneluna* (16 no./ltr.), *Asplanebopusmyrmeleo* (13 no./ltr.), *Brachionuscalyciflorous* (36 no./ltr.), *Branchionusquadridentatus* (35 no./ltr.), *Branchionuscaudatus* (26 no./ltr.), *Keratellavalga* (32 no./ltr.), *Trichocercatigris* (24 no./ltr.), *Brachionusformadivergens* (26 no./ltr.), *Lepadella ovalis* (15 no./ltr.), *Esophoraanthadis* (14 no./ltr.), *Philodinaroseota* (16 no./ltr.), *Asplanchna intermedia* (15 no./ltr.), *Keratellatropica* (09 no./ltr.) and *Trichocercarattus* (28 no./ltr.)

Protozoa were recorded among which *Urocentrum turbo* (50 no./ltr.), was dominant followed by 31 species *Spirastromumambiguum* (35 no./ltr.), *Diffflugialobostoma* (31 no./ltr.), *Amoeba proteus* (30 no./ltr.), *Vorticella campanula* (24 no./ltr.), *Actinophrys sol.* (23 no./ltr.), *Euplotes sp.* (25 no./ltr.), *Porodon teres* (26 no./ltr.), *Difflugia corona* (19 no./ltr.), *Difflugia pyriformis* (22 no./ltr.), *Spathidiumspathula* (18 no./ltr.), *Homalozoonvermicularoe* (14 no./ltr.), *Centropyxisaculeata* (15 no./ltr.), *Holophrya simplex* (11 no./ltr.), *Campanella umbellaria* (21 no./ltr.), *Difflugiaalveolata* (15 no./ltr.), *Amphileptusclaparedie* (14 no./ltr.), *Arcella vulgaris* (17 no./ltr.), *Chamydomonasangulosa* (18 no./ltr.), *Epistyllisplacatilis* (14 no./ltr.), *Nassulaornata* (16 no./ltr.), *Spasmotomaviride* (17 no./ltr.), *Centropyxisaculata* (14 no./ltr.), *Pelomyxa palustris* (16 no./ltr.), *Diffflugialebes* (18 no./ltr.), *Megalotrocha colony* (9 no./ltr.), *Actinosphaeriumeichhornil* (10 no./ltr.), *Carchesiumpolypinum* (12 no./ltr.), *Paramecium caudatum* (13 no./ltr.), *Centropyxishemisphaerica* (11 no./ltr.), *Arcelladiscoides* (8 no./ltr.) and *Bryomometopussphagni* (6 no./ltr.)

8 species of Cladocera were recorded among which *Bosminalongirostris* (58 no./ltr.) is dominant followed by *Macrothrixrosea* (33 no./ltr.), *Pleuroxusprocurvus* (26 no./ltr.), *Sida crystalline* (24 no./ltr.), *Moinadubia* (23 no./ltr.), *Alona nana* (14 no./ltr.), *Kurzialatissima* (12 no./ltr.) and *Daphnanosoma sp.* (8 no./ltr.).

In Ostracoda the 2 species were recorded *Stenocypris sp.* (84 no./ltr.) and *Cypris sp.* (31 no./ltr.).

In Copepoda 4 species were recorded among which *Copepod nauplius* (36 no./ltr.) was dominant followed by *Cyclops sp.* (28 no./ltr.), *Halicyclops sp.* (22 no./ltr.), and *Diaptomusforbesi* (12 no./ltr.)

AT SITE B

In the present investigation during the year 2015-2016. Protozoa was dominant followed by Copepoda, Cladocera, Ostracoda and Rotifera.

26 species of Protozoa were recorded, *Nassulaornata* (50 no./ltr.) was dominant followed by *Spirostromum sp.* (47 no./ltr.), *Spathidiumspathula* (46 no./ltr.), *Vorticella campanula* (45 no./ltr.), *Chlamydomonas angulosa* (41 no./ltr.), *Spasmotomaviride* (38 no./ltr.), *Pelomyxa palustris* (35 no./ltr.), *Chrysamoeba radians* (30 no./ltr.), *Bursaria truncatella* (28 no./ltr.), *Arcella vulgaris* (27 no./ltr.), *Paramecium caudatum* (24 no./ltr.), *Centropyxisaculeata* (24 no./ltr.) *Campanella umbellaria* (21 no./ltr.), *Difflugiacorona* (20 no./ltr.), *Euplotes sp.* (19 no./ltr.), *Diffflugialebes* (18 no./ltr.), *Amoeba proteus* (17 no./ltr.), *Diffflugialobostoma* (16 no./ltr.), *Amphileptusclaparedie* (15 no./ltr.), *Arcelladiscoides* (15 no./ltr.), *Chilodonella sp.* (13 no./ltr.), *Actinophrysol.* (11 no./ltr.), *Centropyxishemisphaerica* (10 no./ltr.), *Holophryasimplex* (9 no./ltr.), *Amphileptusclaparedie* (7 no./ltr.) and *Carchesiumpolypinum* (07 no./ltr.).

In Copepoda 3 species were recorded among which *Diaptomusforbesi* (60 no./ltr.) was dominant followed by *Halicyclops sp.* (42 no./ltr.) and *Copepodnauplius* (37 no./ltr.)

5 species of Cladocera were recorded among which *Bosminalongirostris* (61 no./ltr.) is dominant followed by *Macrothrixlaticornis* (25 no./ltr.), *Kurzialatissima* (14 no./ltr.), *Alonellanana* (11 no./ltr.), and *Moinadubia* (10 no./ltr.)

In Ostracoda 2 species recorded were *Stenocypris sp.* (75 no./ltr.) and *Cyclops sp.* (54 no./ltr.),

22 species Rotifera, were recorded among which *Cephalodellagibba* (74 no./ltr.) was dominant followed by *Brachionusfalcatus* (63 no./ltr.), *Brachionusforficula* (64 no./ltr.), *Trichoceratigris*(30 no./ltr.), *Asplanchna intermedia* (45 no./ltr.), *Esophoraanthadis* (47 no./ltr.), *Brachionusbidentata* (62 no./ltr.), *Polyarthra vulgaris* (52 no./ltr.), *Brachionusplicatilis* (49 no./ltr.), *Filinia longiseta* (50 no./ltr.), *Horaellabrehi*(52 no./ltr.), *Lepadella ovalis* (50 no./ltr.), *Keratellavalga*(14 no./ltr.), *Testudinellamacroneta* (44 no./ltr.), *Philodinaroseola* (41 no./ltr.), *Platiasquadricornis* (40 no./ltr.), *Lecaneluna* (32 no./ltr.), *Tripleuchlarisplacata* (38no./ltr.), *Brachionusquadridentatus* (30 no./ltr.), *Aspaanehnopusmyrmeleo* (35 no./ltr.), *Keratellatropica* (34 no./ltr.) and *Brachionus angularis* (41 no./ltr.)

AT SITE C

In the present investigation during the year 2015 -16 Rotifera was dominant followed by Protozoa, Cladocera, Copepoda and Ostracoda.

23 species of Rotifera, were recorded among which *Cephalobdellagibba*(81 no./ltr.) was dominant followed by *Lecaneluna* (70 no./ltr.), *Horaellabrehi* (60 no./ltr.), *Polyarthra vulgaris* (61 no./ltr.), *Brachionuscalyciflorus* (55no./ltr.), *Brachionuspilcatilis* (52 no./ltr.), *Esophoraanthadis* (58 no./ltr.), *Filiniaopliensis*(51 no./ltr.), *Lepadella ovalis* (50 no./ltr.), *Trichocercatigris*(51no./ltr.), *Brachionusquadridentatatus*(53 no./ltr.), *Keratellatropica*(48 no./ltr.), *Asplanchna intermedia* (47 no./ltr.), *Brachionusfalcatus* (45 no./ltr.), *Brachionus angularis* (42 no./ltr.), *Brachionusbidentata*(39 no./ltr.), *Keratellvalga*(49 no./ltr.), *Trichocercarattus*(41 no./ltr.), *Tripleuchlarisplacata*(26 no./ltr.), *Asplanehnopusmyrmeleo*(14 no./ltr.), *Monostyla bulla* (13 no./ltr.), *Philodinaroseota* (10 no./ltr.) and *Rotarianeptunia* (09 no./ltr.)

22 species of Protozoa, were recorded among which *Spasmostomaviride* (56 no./ltr.) was dominant followed by *Bryometopussphagni* (55 no./ltr.), *Homalzoonvermiculare* (54 no./ltr.), *Arcellavulgaris* (51 no./ltr.), *Chlamydomonasangulosa* (47 no./ltr.), *Euplote* sp. (42 no./ltr.), *Parameciumcaudatum* (41 no./ltr.), *Campanellaumbellaria* (40 no./ltr.), *Vorticellacampanula* (39 no./ltr.), *Centropyxishemisphaerica* (38 no./ltr.), *Chrysamoebaradians* (38 no./ltr.), *Arcelladiscoides* (36 no./ltr.), *Actinosphariumeichhornii* (29 no./ltr.), *Centropyxisaculeata* (27 no./ltr.), *Actinophyrssol.* (22 no./ltr.) and *Carchesiumpolypinum* (20 no./ltr.). *Amoebaproteus* (19 no./ltr.), *Epistylisplacatilis* (18 no./ltr.), *Holophyrasimplex* (17 no./ltr.), *Diffflugialebes* (16 no./ltr.), *Diffflugiacorona* (15 no./ltr.) and *Amphileptusclaparedei* (15 no./ltr.)

8 species of Cladocera, were recorded among which *Bosminalongirostris* (108 no./ltr.) was dominant followed by *Daphnialongiremis* (46 no./ltr.), no./ltr.), *Ceriodaphniaquadrangular* (32 no./ltr.), *Pleuroxuprocureus* (25 no./ltr.), *Kurzialatissima* (24 no./ltr.), *Macrothrixrosea* (15 no./ltr.), *Alonellanana* (13 no./ltr.) and *Moinadubia* (12 no./ltr.),

In 4 species Copepoda the were recorded among which Copepod *nauplius* (62 no./ltr.) was dominant followed by *Halicyclops* sp. (41 no./ltr.), *Cyclops* sp. (33 no./ltr.), *Diaptomussiciloides* (22 no./ltr.) and *Diaptomusforebesi* (16 no./ltr.).

In Ostracoda the 2 species were recorded *Stenocypris* sp. (69 no./ltr.) and *Cypris* sp. (41 no./ltr.).

AT SITE D

In the present investigation during the year 2015-2016. Protozoa was dominant followed by Copepoda, Cladocera, Ostracoda and Rotifera.

24 species of Protozoa were, recorded, *Nassulaornata* (56 no./ltr.) was dominant followed by *Spirostromum* sp. (52 no./ltr.), *Spathidiumspathula* (49 no./ltr.), *Chlamydomonas angulosa* (48 no./ltr.), *Spasmostomaviride* (48 no./ltr.), *Euplotes* sp. (39 no./ltr.), *Diffflugialebes* (38 no./ltr.), *Amoeba proteus* (37 no./ltr.), *Diffflugialobostoma* (26 no./ltr.), *Amphileptusclaparedei* (25 no./ltr.), *Arcelladiscoides* (25 no./ltr.), *Chilodonella* sp. (23 no./ltr.), *Pelomyxa palustris* (21 no./ltr.), *Chrysamoeba radians* (20 no./ltr.), *Bursaria truncatella* (18 no./ltr.), *Arcella vulgaris* (17 no./ltr.), *Paramecium caudatum* (14 no./ltr.), *Centropyxisaculeata* (14 no./ltr.) *Campanella umbellaria* (11 no./ltr.), *Diffflugiacorona* (10 no./ltr.), *Actinophyrssol.* (10 no./ltr.), *Centropyxishemisphaerica* (8 no./ltr.), *Holophyrasimplex* (8 no./ltr.), *Amphileptusclaparedei* (7no./ltr.) and *Carchesiumpolypinum* (06 no./ltr.).

In Copepoda 4 species were recorded among which *Diaptomusforbesi* (58 no./ltr.) was dominant followed by *Halicyclops* sp. (52 no./ltr.), *Copepodnauplius* (47 no./ltr.) and *Cyclops* sp. (43 no./ltr.).

3 species of Cladocera were recorded among which *Bosminalongirostris* (58 no./ltr.) is dominant followed by *Macrothrixlaticornis* (55 no./ltr.) and *Moinadubia* (20 no./ltr.)

In Ostracoda 2 species recorded were *Stenocypris* sp. (65 no./ltr.) and *Cyclops* sp. (44 no./ltr.).

21 species Rotifera, were recorded among which *Brachionusformadivergens*(62 no./ltr.) was dominant followed by *Brachionusforficula*(46 no./ltr.), *Platiasquadricornis* (44 no./ltr.), *Testudinellamacroneta*(43 no./ltr.), *Esophoraanthadis* (36 no./ltr.), *Brachionusquadridentatatus* (34no./ltr.), *Lecaneluna*(33no./ltr.), *Brachinuscalyciflorus* (22 no./ltr.), *Brachionushavanaesis* (22 no./ltr.), *Keratellavalga*

(20 no./ltr.), *Trichocercatigris* (12 no./ltr.), *Brachionus angularis* (11 no./ltr.), *Tripleuchlarisplicata* (07 no./ltr.) *Brachionusplicatillis* (42 no./ltr.), *Brachionusfalcatus* (41 no./ltr.), *Asplanchna intermedia* (20 no./ltr.), *Trichocercatigris* (15 no./ltr.), *Brachionusformadivergens* (44 no./ltr.), *Esophoraanthadis* (36 no./ltr.), *Philodinaroseola* (25 no./ltr.) and *Keratelltropica* (24 no./ltr.).

Kedar (2002) observed 34 species of Protozoas in Rishi lake of Karanja (Lad) of Maharashtra. Sharma, et.al., (2007) reported four species in Pichhola lake of Jaipur, Rajasthan.

In the present investigation, seasonally maximum Protozoan was recorded in the summer and minimum during the monsoon season. Kedar (2002) recorded minimum population of Protozoa during the rainy season in Rishi lake of Karanja (Lad) of Maharashtra

In the present study, the dilution of water caused by rain water which results in lower population of Protozoan in monsoon. The maximum population of protozoa during summer season indicates a positive relation with temperature and also may be due to lower DO contents in this season and abundance of sulphates and phosphates to this site.

During the present study rotifera was found the most dominant group among all the zooplanktons. Taxonomic dominance of rotifers was observed by several researchers like Nogueira (2001), Sampaio, et.al., (2002) and Kudari, et.al., (2005).

In the present investigation, maximum rotifera during the winter is probably due to availability of suitable food and favorable temperature, more entry of domestic sewage and minimum density in monsoon season which could be due to dilution of water resulting in fewer nutrients or could be due to reduction of transparency and dissolved oxygen. Similar observations also found by Goswami, A.P. and Mankodi, P.C. (2012).

In the present investigation, Cladocera was maximum during the winter season and minimum during the monsoon season. Edmondson (1992) and Baker (1979), were of the opinion that the maximum density of cladocera in winter may be due to favorable temperature and availability of food in the form of bacteria, nanoplankton and suspended detritus however in monsoon the factors like water temperature, dissolved oxygen, turbidity and transparency play an important role in controlling the diversity and density of cladocera. Jayabhaye and Madalpure (2006) recorded maximum population in winter in Parola dam of Hingoli District of Maharashtra. In the present investigation, maximum Cladocerans in winter is linked to to favorable temperature and availability of abundant food in the form of bacteria, nonplanktons and suspended detritus and minimum in monsoon due to the factors like water temperature, dissolved oxygen, turbidity and transparency play an important role in controlling the diversity and density of cladocera. Edmondson (1992); Baker (1979).

In the present investigation, copepods are abundance during the winter season due to organic matter, entry of domestic sewage thus indicating that the preponderance in higher trophic state of water. Similar observations are also made by Somani and Pejavar (2004) and Gajanan Sontakke and Satish Mokashe (2014).

In the present investigation, ostracods density is maximum during the winter and minimum during the monsoon. G.P. Patil (2008) founded the maximum population of ostracodes during the summer and minimum during the monsoon. Nirmal Kumar, J.I. et.al., (2011) recorded maximum population of ostracodes during the summer and minimum during the monsoon of a Varasda wetland system. Shashikant R. Sitre (2014) recorded maximum ostracod population was recorded in summer months while minimum in rainy season in Sunkadin Naik lake of Nagpur city (M.S.).

Five groups of zooplanktons were recorded viz, Protozoa, Rotifera, Cladocera, Copepoda and Ostracoda. Seasonally, Protozoan diversity was found maximum during the summer season and minimum during the monsoon season, indicating a positive relation with temperature and ph. Among zooplankton dominance of Rotifera as well as *Brachionus* sp. in all four sites of lake indicates its eutrophic nature. Maximum Rotifera are reported during the winter season is due to availability of suitable food, more entry of domestic sewage. Occurrence of Cladocerans, Copepod and Ostracods in the four sites of lake during the winter months is linked to favorable temperature and availability of abundant food. Ostracods show least appearance.

Table No.1: Seasonal variation of zooplankton in Valvan Lake at Site-A during year 2015-2016

S.N.	Parameters	Summer	Monsoon	Winter	Total
1	Protozoa	19.36 ± 8.93	55.25 ± 6.89	77.45 ± 14.13	50.68 ± 3.04
2	Rotifera	8.30 ± 5.87	92.29 ± 10.34	70.14 ± 27.62	56.97 ± 9.37
3	Cladocera	8.14 ± 6.17	27.57 ± 3.10	16.85 ± 18.08	17.52 ± 6.46

4	Copepoda	3.10 ± 1.76	17.87 ± 6.45	2.98 ± 2.17	7.98 ± 9.99
5	Ostracoda	6.14 ± 6.10	13.80 ± 7.09	8.89 ± 6.07	9.61 ± 0.46

Table No. 2: Seasonal variation of zooplankton in Valvan Lake at Site-B during year 2015-2016.

S.N.	Parameters	Summer	Monsoon	Winter	Total
1	Protozoa	28.12 ± 13.88	70.40±11.89	106.35 ± 32.88	68.29±9.46
2	Rotifera	24.64±4.97	138.32±28.74	81.15±35.65	81.37±13.13
3	Cladecera	5.20±3.87	21.05±5.85	6.12±13.19	10.79±4.00
4	Copepoda	10.19±6.87	30.41±5.46	11.13±6.49	17.24±1.02
5	Ostracoda	6.20±3.14	23.80±13.25	7.23±6.11	12.41±4.24

Table No. 3: Seasonal variation of zooplankton in Valvan Lake at Site-C during year 2015-2016.

S.N.	Parameters	Summer	Monsoon	Winter	Total
1	Protozoa	25.42 ± 17.21	72.54 ± 14.52	120.43 ± 30.72	72.79 ± 7.08
2	Rotifera	35.26 ± 25.12	156.74 ± 25.47	96.80 ± 35.62	96.26 ± 4.86
3	Cladecera	11.82 ± 10.46	31.14 ± 10.98	26.10 ± 18.23	23.02 ± 3.54
4	Copepoda	6.89 ± 5.98	24.10 ± 6.12	7.52 ± 4.98	12.83 ± 0.25
5	Ostracoda	5.98 ± 4.67	14.85 ± 5.46	7.33 ± 2.92	9.38 ± 1.12

Table No.4: Seasonal variation of zooplankton in Valvan Lake at Site-D during year 2015-2016

S.N.	Parameters	Summer	Monsoon	Winter	Total
1	Protozoa	19.46 ± 10.21	54.76 ± 6.87	77.52 ± 14.33	50.58 ± 3.53
2	Rotifera	25.45 ± 5.27	136.51 ± 9.67	56.38 ± 25.23	72.78 ± 8.56
3	Cladecera	8.14 ± 6.13	25.90 ± 3.10	16.85 ± 18.23	16.96 ± 6.53
4	Copepoda	3.10 ± 2.02	17.60 ± 5.94	3.10 ± 1.47	7.93 ± 1.98
5	Ostracoda	6.25 ± 5.86	15.30 ± 6.98	7.86 ± 6.17	9.80 ± 0.46

Graphical representation of Seasonal variation of parameter Protozoa of Zooplankton in Valvan lake at various sites is presented below.

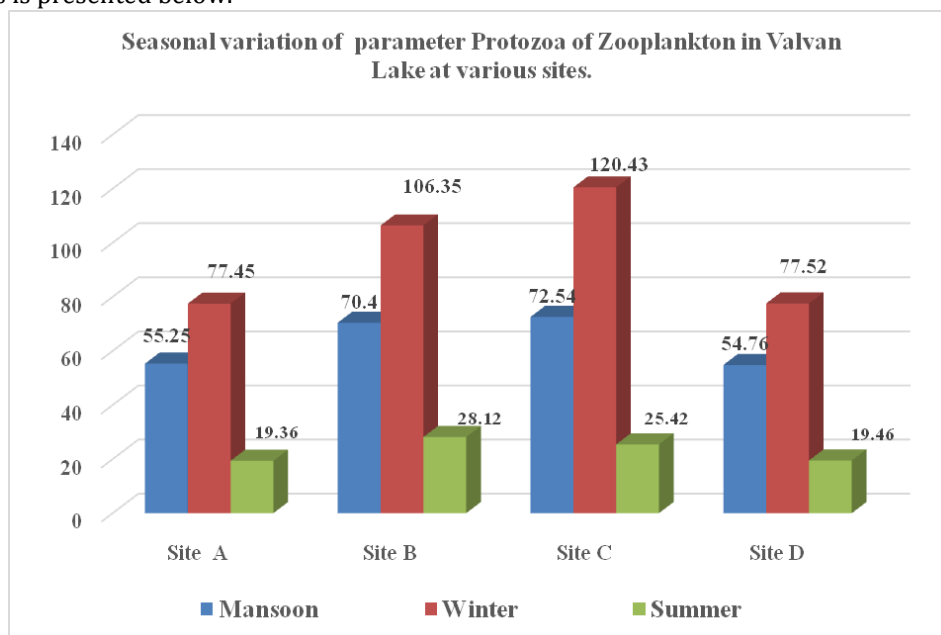


Figure 1

Graphical representation of Seasonal variation of parameter Rotifera of Zooplankton in Valvan lake at various sites is presented below.

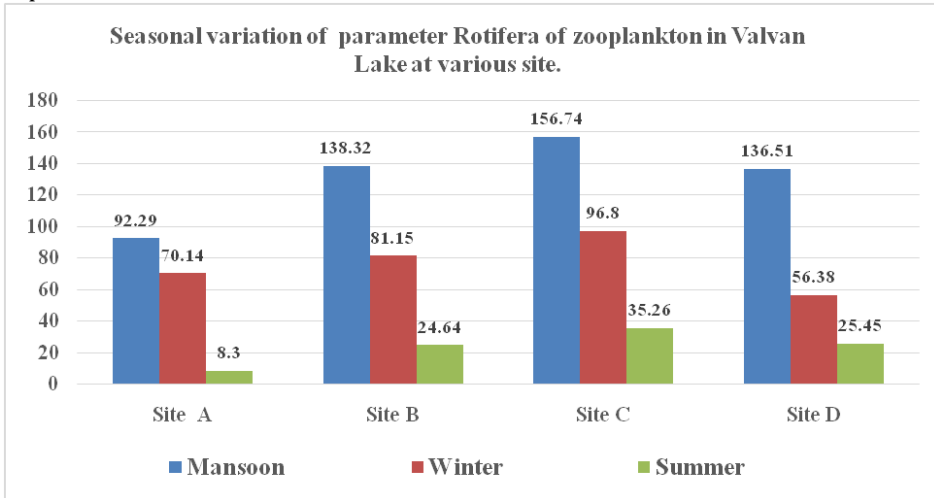


Figure 2

Graphical representation of Seasonal variation of parameter Cladocera of Zooplankton in Valvan lake at various sites is presented below.

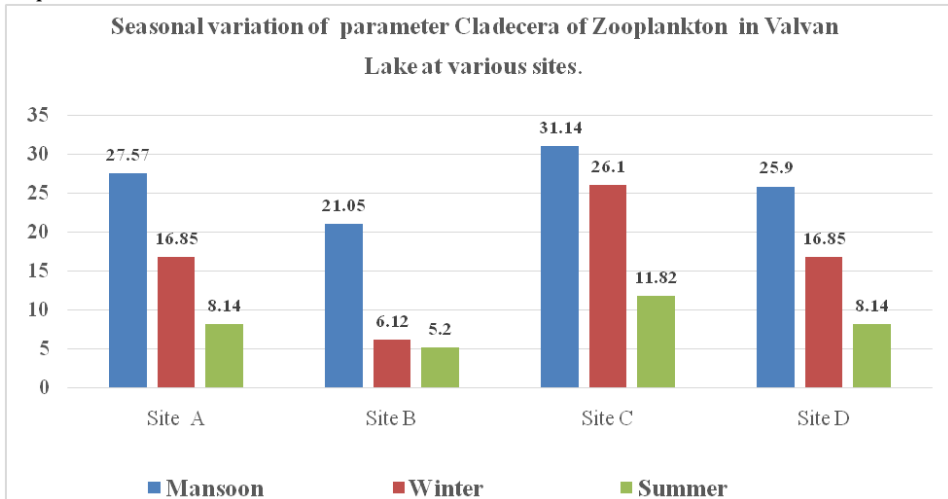


Figure 3

Graphical representation of Seasonal variation of parameter Copepod of Zooplankton in Valvan lake at various sites is presented below.

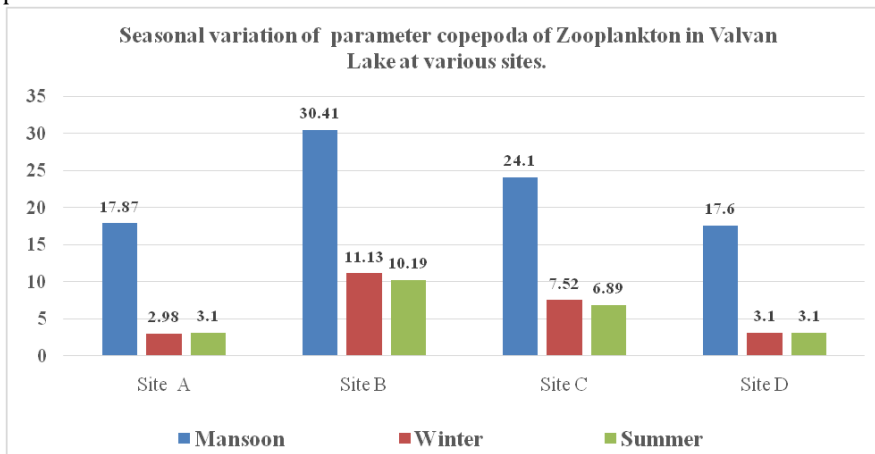


Figure 4

Graphical representation of Seasonal variation of parameter Ostracoda of Zooplankton in Valvan lake at various sites is presented below.

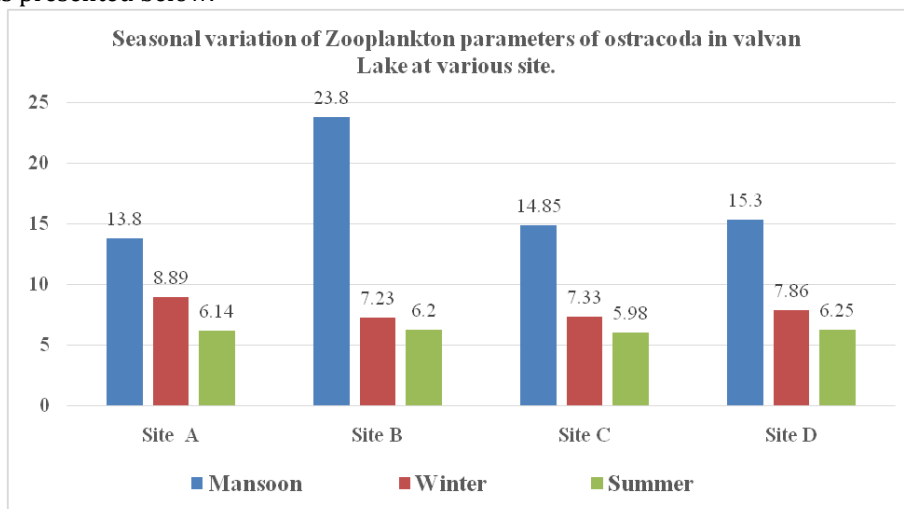


Figure 5

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