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Some Biological Characteristics of River Yamuna at Agra

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Abstract: The biological characteristics of the River Yamuna at Agra were studied in terms of Planktons. It was found that Yamuna waters have a distribution of planktons; phytoplanktonic forms (microflora) and zooplanktonic forms (microfauna), bottom and marginal fauna and fish fauna at different sampling stations. The microflora and microfauna have been described here. It was found that mostly the microflora is represented by the members of three main families of algae viz. Chlorophyceae, Myxophyceae and Bacillariophyceae in the Yamuna River waters at different sampling stations. The microfauna is represented by the planktonic forms of Protozoa, Rotifera and Crustaceans.

Keywords: Microflora, Microfauna, Zooplankton, Phytoplankton, Algae.

1. Introduction

The biological characteristics of the River water include the distribution of planktons; phytoplanktonic forms (microflora) and zooplanktonic forms (microfauna), bottom and marginal fauna and fish fauna at different sampling stations. Mostly the microflora is represented by the members of three main families of algae viz. Chlorophyceae, Myxophyceae and Bacillariophyceae. Their brief account is given here. The microfauna is represented by the planktonic forms of Protozoa, Rotifera and Crustaceans in the Yamuna river water at different sampling stations.

2. Materials and Methods

For studying planktons of River Yamuna in Agra, six study sites, *viz;* Hathi Ghat (Site-I), Mantola (Site-II), Taj Tannery (Site-III), Garhi Mahavan (Site-IV), Dayalbagh (Site-V) and Pohia Ghat (Site-VI) were selected on the banks of river Yamuna. Water analysis was done according to APHA (1989). The planktons were studied for evaluation of water quality as biological components of the aquatic ecosystem along with the total number of specimens and genera of families at different sampling stations. They were identified up to family level. The value of Shannon-Weaver function ($\bar{}$H) and Margalef's diversity index ($\bar{}$d) were calculated.

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3. Observations and Results

3.1 Microflora

Mostly the microflora is represented by the members of three main families of algae *viz.* Chlorophyceae, Myxophyceae and Bacillariophyceae. Their brief account is as under:

3.1.1 Chlorophyceae

This family is represented by the 11 genera namely *Eudorina, Chlamydomonas, Volvox, Zygnema, Closterium, Actinastrum, Pediastrum, Trachelomonas, Staurstrum, Scenedesmus* & *Spirogyra.* The maximum genera (11) were recorded at site III and V and the minimum (04) from location II during 2005-06. During 2006-07 the maximum genera (11) were recorded at location V and the minimum (03) at location II. The total specimen count was the highest (120) at station IV and least (40) at location II during 2005-06 and highest (129) at location V and minimum (38) at station III during 2006-07. The highest value for Margalef's diversity index ($\bar{}$d) 2.82 in 2005-06 and 2.96 in 2006-07 recorded at location III. The value of Shannon-Weaver function ($\bar{}$H) and Margalef's diversity index ($\bar{}$d) along with the total number of specimens and general of family Chlorophycea eat different sampling stations has been compiled in Table 1.

Table 1. Seasonal Fluctuation in Phytoplanktons-family Chlorophyceae (Total No. of Specimens and Genera per liter of water), Shannon-Weaver Function (¯H) and Margalef's Index (¯d).

	Hathi Ghat		Mantola		Taj Tannery		Garhi Mahavan		Dayalbagh		Pohia Ghat	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Winter												
2005-2006	33-59		21-40		28-52		43-133		30-94		46-129	
2006-2007	30-55		20-36		23-40		38-100		40-111		45-128	
Summer												
2005-2006	49-99	52	32-68	40	38-84	43	70-186	120	53-161	95	72-192	120
2006-2007	45-88	43	25-50	29	35-75	38	58-168	96	63-170	129	74-178	114
Rainy												
2005-2006	25-42		18-32		22-38		32-52		20-43		25-47	
2006-2007	23-40		08-18		20-33		24-51		23-57		32-58	
Total Specimen's												
2005-2006	52		40		43		120		95		120	
2006-2007	43		29		38		96		129		114	
Total Genera												
2005-2006	09		04		08		08		11		10	
2006-2007	09		03		09		09		11		09	
Shannon-Weaver Function (¯H)												
2005-2006	3.10		1.66		2.30		3.06		3.24		2.84	
2006-2007	3.12		1.54		3.30		3.16		2.90		2.35	
Margalef's diversity index (¯d)												
2005-2006	2.40		1.00		2.82		1.90		2.20		1.90	
2006-2007	2.56		0.90		2.96		2.00		1.85		1.70	

3.1.2 Myxophyceae

The family Myxophyceae is represented by several genera *viz*., *Spirulina*, *Nostoc*, *Anabaena*, *Oscillatoria*, *Phormidium*, *Merismopedia*, *Microcystis* and *Arthrospira*. In total the stretch of Yamuna River in Agra, *Nostoc* was the dominating genus during 2005-07. The maximum genera (6) were found at station I, III and V. It was minimum (5) at sites II, IV and V during 2005-06. The highest specimen number (146) was found at station VI and least (24) observed at location II. The highest value for Shannon-Weaver function (¯H) 2.60 in 2005-06 at station III and 2.48 during 2006-07 at the station I and III were recorded. The maximum values for Margalef's diversity index (¯d) were 1.42 at the station I during 2005-06 and 1.52 on location I during 2006-07 was recorded. Total number of specimens and genera of Myxophyceae at different sampling stations along with the values of Shannon-Weaver function (¯H) and Margalef's diversity index (¯d) are given in Table 2.

Table 2. Seasonal Fluctuation in Phytoplanktons-family Myxophyceae (Total No. of Specimens and Genera per liter of water), Shannon-Weaver Function (¯H) and Margalef's Index (¯d).

	Hathi Ghat		Mantola		Taj Tannery		Garhi Mahavan		Dayalbagh		Pohia Ghat	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Winter												
2005-2006	28-56		20-38		38-90		42-108		50-140		45-129	
2006-2007	25-48		22-43		42-86		45-129		58-142		35-99	
Summer												
2005-2006	39-89	41	30-49	24	59-172	87	66-168	95	70-262	146	70-180	94
2006-2007	35-78	36	34-59	36	53-154	75	70-180	94	79-252	138	60-150	71
Rainy												
2005-2006	23-38		18-28		30-68		32-56		38-99		35-80	
2006-2007	11-22		18-31		30-58		35-80		46-100		25-56	
Total Specimen's												
2005-2006	41		24		87		95		146		94	
2006-2007	36		36		75		94		138		71	
Total Genera												
2005-2006	06		05		06		05		05		05	
2006-2007	06		05		06		05		05		06	
Shannon-Weaver Function (¯H)												
2005-2006	2.50		2.05		2.60		2.02		2.15		1.96	
2006-2007	2.48		2.20		2.48		1.96		1.96		2.08	
Margalef's diversity index (¯d)												
2005-2006	1.42		1.50		1.12		0.90		0.08		0.88	
2006-2007	1.52		1.40		1.28		0.88		0.80		1.20	

Table 3. Seasonal Fluctuation in Phytoplanktons-family Bacillariophyceae (Total No. of Specimens and Genera per liter of water), Shannon-Weaver Function (¯H) and Margalef's Index (¯d).

	Hathi Ghat		Mantola		Taj Tannery		Garhi Mahavan		Dayalbagh		Pohia Ghat	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Winter												
2005-2006	25-48		21-40		30-55		40-72		48-95		48-90	
2006-2007	20-38		20-36		33-59		38-85		45-106		40-98	
Summer												
2005-2006	35-78	36	32-68	40	45-88	43	56-145	77	75-240	181	70-266	203
2006-2007	30-49	24	28-50	29	49-99	52	50-160	83	75-278	190	68-362	206
Rainy												
2005-2006	11-22		18-32		23-40		25-48		35-70		38-98	
2006-2007	18-28		08-18		25-42		29-52		38-73		35-58	
Total Specimen's												
2005-2006	36		40		43		77		181		203	
2006-2007	24		29		52		83		190		206	
Total Genera												
2005-2006	06		04		10		11		07		11	
2006-2007	05		03		10		13		08		12	
Shannon-Weaver Function (¯H)												
2005-2006	2.48		1.66		3.12		3.05		2.45		2.40	
2006-2007	2.05		1.54		3.10		3.60		2.44		2.55	
Margalef's diversity index(¯d)												
2005-2006	1.52		1.00		2.56		2.36		1.15		1.80	
2006-2007	1.50		0.90		2.40		2.70		1.32		2.04	

3.1.2 Bacillariophyceae

The station-wise distribution of various genera of family Bacillariophyceae has been studied. The genera found were *Cyclotella*, *Gomphonema*, *Stauroneis*, *Nitzschia*, *Fraqillaria*, *Syndora*, *Navicula*, *Nilocera*, *Epithemia*, *Rhoicosphenia*, *Frustularia*, *Brebisoonia* and *Amphera*. The highest specimen's number (203) a station IV and minimum number (36) were observed at the station I during 2005-06. Highest specimen number (206) at station VI and least (24) was observed at the station I during 2006-07 were recorded. The highest genera (11) at IV and VI were observed. The minimum number of genera (04) at station II during 2005-06 and highest genera (12) at station VI and least (3) at station III during 2006-07 were recorded. The values of Shannon-Weaver function (¯H) ranged between 3.42 and 1.66 during 2005-06 and between 1.50 and 3.60 during 2006-07. The values of Margalef's diversity index (¯d) ranged between 1.00 and 2.56 during 2005-06 and between 0.90 and 2.70 during 2006-07. The values of Shannon-Weaver function (¯H) and Margalef's diversity index (¯d) along with the total number of specimens and genera have been compiled in Table 3.

3.2 Microfauna

The microfauna were represented in the planktonic forms of Protozoa, Rotifera and Crustaceans in the Yamuna river water at different sampling stations. Their brief account is as under:

3.2.1 Protozoans

The Protozoans in River Yamuna in Agra are represented by *Arcella*, *Centropyxis*, *Difflugia*, *Nebela*, *Euglena*, *Paramecium*, *Phacus* and *Epistylis*. The total specimen count was maximum (127) at station VI and least (24) at station III during 2005-06 and maximum specimens (144) at station VI and least (31) at station III during 2006-07. The presence of a few Protozoan forms in a polluted stretch of river is suggestive that the genera possess the high tolerance power. The values of Shannon-Weaver function (¯H) ranged between 2.02 and 2.70 during 2005-06 and between 1.40 and 2.80 during 2006-07. The values of Shannon-Weaver function (¯H) and Margalef's diversity index (¯d) along with the total number of specimens and genera are shown in Tables 4.

3.2.2 Rotifers

Filina, *Brachionus*, *Monostyla*, *Distyla*, *Philodina*, *Anapus*, *Testudinella*, *Eucholina* and *Triarthra* represent the Rotifers in the Yamuna river water at Agra. The maximum number (75) at station VI and least (24) at station III during 2005-06 and the highest number of specimens (87) at station VI and least (29) at the station I during 2006-07 were recorded. The highest genera (6) were recorded at stations IV, V and VI. (03) Genera were present at location II during 2005-06. The highest number of genera (6) was recorded from locations IV, V and VI. (03) Genera were recorded from location I and II during 2006-07. The values of Shannon-Weaver function (¯H) ranged between 1.54 and 2.50 during 2005-06 and between 1.54 and 2.60 during 2006-07. The values of Margalef's diversity index (¯d) ranged between 0.90 and 1.52 during 2005-06 and between 0.90 and 1.42 during 2006-07. The values of Shannon-Weaver function (¯H) and Margalef's diversity index (¯d) along with the total number of specimens and genera are shown in Tables 5.

Table 4. Seasonal Fluctuation in Zooplanktons-Protozoans (Total No. of Specimens and Genera per liter of water), Shannon-Weaver Function (¯H) and Margalef's Index (¯d).

	Hathi Ghat		Mantola		Taj Tannery		Garhi Mahavan		Dayalbagh		Pohia Ghat	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Winter												
2005-2006	38-100		21-40		30-32		30-48		35-70		40-70	
2006-2007	35-99		20-36		25-42		28-50		33-84		45-119	
Summer												
2005-2006	58-154	91	32-68	40	30-46	24	42-100	59	63-178	105	78-253	127
2006-2007	60-150	71	28-50	29	36-60	31	43-118	69	69-192	111	75-274	144
Rainy												
2005-2006	14-38		18-32		17-25		23-37		30-55		35-72	
2006-2007	25-56		08-18		20-33		26-40		34-62		38-82	
Total Specimen's												
2005-2006	91		40		24		59		105		127	
2006-2007	71		29		31		69		111		144	
Total Genera												
2005-2006	06		04		07		07		07		07	
2006-2007	06		03		08		07		07		07	
Shannon-Weaver Function (¯H)												
2005-2006	2.02		1.66		2.70		2.40		2.55		2.58	
2006-2007	2.08		1.54		2.80		2.40		2.52		2.65	
Margalef's diversity index (¯d)												
2005-2006	1.90		1.00		2.25		1.52		1.30		1.22	
2006-2007	1.20		0.90		2.24		1.45		1.28		1.20	

Table 5. Seasonal Fluctuation in Zooplanktons-Rotifers (Total No. of Specimens and Genera per liter of water), Shannon-Weaver Function (¯H) and Margalef's Index (¯d).

	Hathi Ghat		Mantola		Taj Tannery		Garhi Mahavan		Dayalbagh		Pohia Ghat	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Winter												
2005-2006	21-40		20-36		20-38		25-48		40-80		42-86	
2006-2007	20-36		20-36		22-43		28-56		38-84		38-90	
Summer												
2005-2006	32-68	40	28-50	29	30-49	24	35-78	36	52-139	60	53-154	75
2006-2007	28-50	29	28-50	29	34-59	36	39-89	41	50-148	64	59-172	87
Rainy												
2005-2006	18-32		08-18		18-28		11-22		30-52		30-58	
2006-2007	08-18		08-18		18-31		23-38		28-62		30-68	
Total Specimen's												
2005-2006	40		29		24		36		60		75	
2006-2007	29		29		36		41		64		87	
Total Genera												
2005-2006	04		03		05		06		06		06	
2006-2007	03		03		05		06		06		06	
Shannon-Weaver Function (¯H)												
2005-2006	1.66		1.54		2.05		2.48		2.50		2.48	
2006-2007	1.54		1.54		2.20		2.50		2.54		2.60	
Margalef's diversity index (¯d)												
2005-2006	1.00		0.90		1.50		1.52		1.26		1.28	
2006-2007	0.90		0.90		1.40		1.42		1.22		1.12	

3.2.3 Entomostraca

Among the Entomostracan, Cladocera (*Moina, Bosmina, Daphnia*), Copepoda (*Cyclops*) and Ostracoda (*Cypris* sp., *Stenocypris*) were recorded at different sampling stations of River Yamuna in Agra. These forms were widely distributed at all the stations. Maximum number of specimens (70) at station VI and least (29) at station II were recorded during 2005-06. During 2006-07 the maximum number of specimens (69) at station VI and least (24) at the station I were recorded. The total (5) genera have been observed at all the sampling stations during 2005-07. The values of Shannon-Weaver function (¯H) ranged between 1.54 and 2.30 during 2005-06 and between 1.66 and 2.30 during 2006-07. The values of Margalef's diversity indeed (¯d) ranged between 0.90 and 1.40 during 2005-06 and between 0.95 and 1.55 during 2006-07. The values of Shannon-Weaver function (¯H) and Margalef's diversity index (¯d) along with total genera and total numbers of specimens have been compiled in Table 6.

Table 6. Seasonal Fluctuation in Zooplanktons-Entomostraca (Total No. of Specimens and Genera per liter of water), Shannon-Weaver Function (¯H) and Margalef's Index (¯d).

	Hathi Ghat		Mantola		Taj Tannery		Garhi Mahavan		Dayalbagh		Pohia Ghat	
	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range	Average
Winter												
2005-2006	22-43		20-36		30-50		20-35		23-40		34-54	
2006-2007	20-38		21-40		29-54		21-39		26-40		32-52	
Summer												
2005-2006	34-59	36	28-50	29	40-102	63	35-49	34	30-65	41	47-125	70
2006-2007	30-49	24	32-68	40	45-113	68	30-62	39	39-74	40	43-119	65
Rainy												
2005-2006	18-31		08-18		20-35		16-26		18-27		25-38	
2006-2007	18-28		18-32		23-37		17-28		21-34		21-33	
Total Specimen's												
2005-2006	36		29		63		34		41		70	
2006-2007	24		40		68		39		40		69	
Total Genera												
2005-2006	05		03		05		05		05		05	
2006-2007	05		04		05		05		05		05	
Shannon-Weaver Function (¯H)												
2005-2006	2.20		1.54		2.30		2.24		2.28		2.30	
2006-2007	2.05		1.66		2.28		2.22		2.24		2.30	
Margalef's diversity index (¯d)												
2005-2006	1.40		0.90		1.00		1.22		1.12		0.94	
2006-2007	1.50		1.00		0.90		1.55		1.10		0.95	

The development of aquaculture depends upon the status of aquatic biota (Khanna, 2006). The impact of tannery effluents on the water quality of river Yamuna revealed marked changes in the physicochemical characteristics which in turn affects first population (Chaturvedi, 1998) Variation in zooplankton occurrence in different months of the year is due to temperature variance. The dominance of one group over other may be correlated with the natural food chain relationship (Suman Kumar Singh and Iqbal Ahmad, 2006). Some aspects of zooplankton have been dealt from time to time (Das and Srivastava, 1956; Bhowmik and Moitra, 1970; Chacko and Krishnamurty, 1954).

Variation in zooplankton occurrence in different months of the year is due to temperature variance (Arora, 1931; Brady, 1986). The dominance of one group over other may be correlated with the natural food chain relationship (Suman Kumar Singh and Iqbal Ahmad 2006). Victor and Fernando (1979) described the planktonic Crustaceans, the Ostracods. Some aspects of zooplankton have been dealt from time to time (Das and Srivastava, 1956; Bhowmik and Moitra, 1970; Chacko and Krishnamurty, 1954). Ecological studies of river Yamuna were conducted by Rawat and Grover, 1978. Zwat and Trivedi (1995) came up with taxonomical Key for biological water quality determination.

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