International Journal of Zoology and Applied Biosciences **ISSN: 2455-9571**
Volume 4, Issue 1, pp: 11-16, 2019
https://doi.org/10.5281/zenodo.2548546
http://www.ijzab.com

Research Article

AN ASSESSMENT OF PHYTOPLANKTON DIVERSITY AND ABUNDANCE OF KADALUNDI ESTUARY, KERALA , SOUTH INDIA

Ali Akshad, M., *Sathick, O., Shaheer Ansari and A. Amsath

Department of Zoology, Khadir Moideen College, Adirampattinam 614701, Tamil Nadu, India

Article History: Received 4th July 2018; Accepted 4th January 2019; Published 23rd January 2019

ABSTRACT

An assessment of phytoplankton diversity and abundance of Kadalundi estuary, Kerala, South India with was studied during the period of July 2016 to June 2017. There are 24 species of phytoplankton were reported from the 3 selected stations. The more species was reported in three stations in the month of April and minimum species was reported in the month of July. The phytoplankton species were varied during different months in station-A (39-218), B (46-228) and B (42-233).

Keywords: Kadalundi river, Phytoplankton, Species richness, Species evenness.

INTRODUCTION

Many of the chemicals from various sources significantly damage the biodiversity of aquatic ecosystems like oceans, rivers, lakes, canals, ponds, etc. (Sinha, D.K., *et al.*, 1990). The loss of biological diversity and its consequences are very high in aquatic environment than terrestrial environments. India is an agricultural country, ¾ of our population live in villages and depending agriculture for their livelihoods. The maintenance of healthy river ecosystem is depended on the physico-chemical properties and biological diversity of the river. The phytoplankton is similar to those of terrestrial plants because they contain chlorophyll for photosynthesis (Gaarder, T. and Gran, H.H., 1927). The most of the phytoplankton are float on the surface of ponds, lakes, rivers and oceans. It has been estimated that, on a global scale, 50-60 % of all photosynthesis is performed by phytoplankton. Phytoplankton is at the base of the food web supporting higher organisms within water ecosystem. The phytoplankton requires inorganic nutrients such as nitrates, fats, and carbohydrates (Jones & Barrington, 1985).

Kadalundi estuary is a notable one formed by Kadalundi river and Arabian sea in Kerala. In the present study, phytoplanktons were assessed for diversity and abundance of Kadalundi estuary.

MATERIALS AND METHODS

The areas selected for the study were three different stations of Kalalundi estuary, borderline of Malappuram and Kozhikkode district of Kerala. The stations are Heros Nagar (Station-A), Palakkal (Station-B) and Keezhayil (Station-C). Kadalundi-Vallikkunnu Community Reserve has been constituted as per G.O. (MS) No. 66/2007 F & WLD dated 17.10.2007 under Section 36(c) of Wildlife Protection Act 1972. The water samples were taken every month for the study and it continued up to 12 months. Phytoplankton samples were collected from the surface waters by towing a plankton net (mouth diameter 0.35 m) made of bolting silk (No. 25 mesh size 48 µm) for half an hour. These samples were preserved in 5% neutralized formalin and used for qualitative analysis. Numerical plankton analysis was carried out using Utermohl's inverted plankton microscope. Fixed samples were enumerated using a Sedgwick–Rafter counting slide on a light microscope. Counting of plankton was done with the help of "Sedgwick– Rafter counting cell" as per the procedure given by Wetzel & Likens (2000).

*Corresponding Author: Dr. O. Sathick, Assistant Professor, Department of Zoology, Khadir Mohideen College, Adirampattinam 614 701, Tamil Nadu, India, Email: osathick@yahoo.com, Mobile: +91 9865722467

RESULTS AND DISCUSSION

There are 24 species of phytoplankton were reported from the 3 selected stations. There are 12 species of Bacillariophyceae, 4 species of Dinophyceae, 3 species of Cynophyceae and 2 species of Coscinodiscophyceae. The other classes are Cryptophyceae, Trebouxiophyceae and Zygonematophyceae were reported one species. In Bacillariophyceae, *Odontella sp.* was reported maximum. *Nitzschia sp.* and *Thallassinema sp.* was reported minimum in station-A. *Nitzschia sp.* was reported minimum in station-B and station-C. The maximum *Odontella sp*. was reported from station-C (232) followed by station-A (205) and station-B (182). The maximum *Nitzschia sp.* was reported from station-A (12) followed by station-C (10) and station-B (9). The *Thallassinema sp.* was reported in station-A and station-C (12) followed by station-B. Among Dinophyceae, *Ceratium sp.* was as reported maximum and *Pyrophacus sp.* was reported minimum in 3 stations. The maximum *Ceratium sp*. was reported from station-B and station-C (38) followed by station-A (29).

The maximum *pyrophacus sp.* was reported from station-B (12) followed by station-C (9) and station-A (4). Among Cynophyceae *Oscillatoria sp.* was reported maximum in 3 stations and *Polycystis sp.* was reported minimum in third station and *Tricodesmium sp.* was reported minimum in first station. The maximum *Oscillatoria sp*. was reported in station-C (94) followed by station-A (85) and station-B (84). The maximum *Polycystis sp*. was reported in station-B (31) followed by station-A (19) and station-C (16). The maximum *Tricodesmium sp*. was reported in station-C (22) followed by station-B (21) and station-A (14). In Coscinodiscophyceae, *Coscinodiscus sp.* was reported maximum in 3 stations and *Ditylum sp.* was reported minimum in 3 stations.

The maximum *Coscinodiscus sp.* was reported in station-A (102) followed by station-B (99) and station-C (91). The maximum number of *Ditylum sp*. was reported in station-C (49) followed by station-A and station-B (29). Among Cryptophyceae only *Cryptomonad sp.* was reported. The maximum *Cryptomonad sp.* was reported in station-A (78) followed by station-C (69) and station-B (54). Among Trebouxiophyceae only *Chlorella sp.* was reported. The maximum *Chlorella sp*. was reported in station-B (75) followed by station-C (62) and station-A (49). In Zygonematophyceae only *Spirogyra sp.* was reported. The maximum *Spirogyra sp*. was reported in station-C (96) followed by station-B (94) and station-A (80). The total population density of station-A, B and C was 1255, 1359 and 1390 respectively (Table 1-3). The maximum number of species was reported in three stations in the month of April and minimum species was reported in the month of July. The maximum species was reported in station-A (218) and minimum number of species was reported in station-A (39). The maximum species wasreported in station-B (228) and minimum number of species was reported in station-B (46). The maximum species was reported in station-C (233) and minimum species was reported in station-C (42).

The species richness maximum was reported in station-A (3.178) in the months of April and May. The minimum species evenness was reported in station-A (2.397) in the months of July and June. The species richness maximum was reported in station-B (3.178) in the months April and May. The minimum species evenness was reported in station-B (2.564) in the months of July and June. The species richness maximum was reported in station-C (3.178) in the months of April and May. The minimum species evenness was reported in station-C (2.484) in the month of July (Table 4-6). The species evenness maximum was reported in station-A (0.96) in the month of August. The minimum species evenness was reported in station-A (0.89) in the months of January, March and March. The species evenness maximum was reported in station-B (0.97) in the month of July.

The minimum species evenness was reported in station-B (0.84) in the month of June. The species evenness maximum was reported in station-C (0.95) in the months of July, October and May. The minimum species evenness was reported in station-C (0.82) in the month of September (Table 4-6). The Shannon-Wiener index maximum was reported in station-A (2.95) in the month of May. The minimum Shannon-Wiener index was reported in station-A (2.13) in the month of June. The Shannon-Wiener index maximum was reported in station-B (3.02) in the month of September. The minimum Shannon-Wiener index was reported in station-B (2.16) in the month of June. The Shannon-Wiener index maximum was reported in station-C (3.02) in the month of May. The minimum Shannon-Wiener index was reported in station-C (2.35) in the month of August (Table 4-6).

An assessment of phytoplankton diversity and abundance of Kadalundi estuary, Kerala, South India with was studied during the period of July 2016 to June 2017 (Figure 1). There are 24 species of phytoplankton were reported from the 3 selected stations. The water is more polluted throughout the year. The Kadalundi River showing the much pollution because of dumping the large number of kitchen wastes, polythene, net remains, poultry wastes, and other effluents reached in water body directly or indirectly (Leena Singh and Choudhary, 2013). The three stations more polluted due the presence of human excreta. When there is an abundance of algae, water quality diminishes because water filtration process becomes more difficult as filters get clogged more easily (Nautiyal, 1986). Increase in algae also increases chlorine demand and disinfection byproducts formation. The plankton of rivers has been investigated by scores of workers in temperate countries but in tropics especially in India, the work on river limnology is still scanty and mention could be made of (Chacko & Ganapati, 1949).

Table 1. The total phytoplanktons density in station-A of Kadalundi estuary from July, 2016 to June, 2017.

Phytoplankton	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	%
Asterionella sp.	0	2	2	2	2	2	2	0	3	3	2	0	20	1.593
Bellerochea sp.	0	2	2	2	2	0	0	0	2	4	4	0	18	1.434
Chaetoceros sp.	0	0	2	2	2	0	0	2	2	3	2	0	15	1.195
Cyclotella sp.	0	1	2	2	2	2	2	2	3	4	2	0	22	1.752
Hemidiscus sp.	0	2	2	2	1	0	0	1	4	8	6	1	27	2.151
Navicula sp.	3	6	6	7	5	4	6	7	10	24	12	14	104	8.286
Nitzschia sp.	0	0	0	1	1	1	1	0	2	2	4	0	12	0.956
Odontella sp.	9	12	18	14	10	8	15	18	20	32	14	12	182	14.501
Pleurosigma sp.	3	4	6	7	9	5	8	10	13	19	22	13	119	9.482
Rhizosolenia sp.	3	3	8	8	7	5	5	6	10	13	11	2	81	6.454
Thallassinema sp.	0	1	2	2	1	0	0	0	2	2	2	0	12	0.956
Triceratium sp.	4	5	9	10	11	9	10	12	13	19	14	8	124	9.880
Coscinodiscus sp.	2	6	7	7	6	4	8	10	11	19	16	6	102	8.127
Ditylum sp.	0	0	2	2	0	2	1	2	6	6	8	0	29	2.310
Cryptomonad sp.	3	6	8	8	6	4	4	2	8	12	14	3	78	6.215
Oscillatoria sp.	4	5	8	6	4	6	8	10	9	10	12	3	85	6.772
Polycystis sp.	2	2	2	0	0	2	0	2	2	4	3	0	19	1.513
Tricodesmium sp.	0	0	2	2	2	0	0	0	2	4	2	0	14	1.115
Ceratium sp.	0	0	2	2	4	3	2	3	3	5	5	0	29	2.310
Noctiluca sp.	0	0	2	2	3	2	3	2	2	2	4	0	22	1.752
Peridinium sp.	0	0	0	0	0	0	0	2	2	3	1	0	8	0.637
Pyrophacus sp.	0	0	0	0	0	0	0	0	0	2	2	0	4	0.318
Chlorella sp.	2	3	5	5	3	3	2	5	5	8	6	2	49	3.904
Spirogyra sp.	4	6	8	6	6	5	5	8	4	10	14	4	80	6.374
Total Population Density	39	66	105	99	87	67	82	104	138	218	182	68	1255	

Table 2. The total phytoplanktons density in station-B of Kadalundi estuary from July, 2016 to June, 2017.

Phytoplankton	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Total	%
Asterionella sp.	0	0	2	2	2	1	0	1	2	2	0	0	12	0.883
Bellerochea sp.	0	0	1	2	2	0	1	1	2	2	1	0	12	0.883
Chaetoceros sp.	0	0	0	2	2	2	2	0	2	3	2	1	16	1.177
Cyclotella sp.	0	2	2	2	0	2	2	2	4	4	3	0	23	1.692
Hemidiscus sp.	0	2	2	2	0	0	2	2	3	6	5	2	26	1.913
Navicula sp.	2	6	6	8	6	4	8	10	20	24	18	8	120	8.830
Nitzschia sp.	0	0	2	0	0	0	0	0	0	4	3	0	9	0.662
Odontella sp.	8	14	22	12	10	8	13	18	24	31	25	20	205	15.084
Pleurosigma sp.	4	8	8	14	12	6	10	9	14	24	20	12	141	10.375
Rhizosolenia sp.	4	6	8	10	4	4	3	6	8	14	10	14	91	6.696
Thallassinema sp.	0	2	2	0	0	0	0	0	2	2	2	0	10	0.735
Triceratium sp.	4	6	8	8	6	5	8	12	14	19	13	5	108	7.947
Coscinodiscus sp.	4	6	7	6	5	4	6	8	13	18	14	8	99	7.284
Ditylum sp.	0	2	3	2	2	2	2	3	3	6	4	0	29	2.133
Cryptomonad sp.	3	6	6	5	6	6	3	3	3	6	5	2	54	3.973
Oscillatoria sp.	4	8	8	6	6	6	5	8	10	13	8	2	84	6.181
Polycystis sp.	2	2	4	4	3	2	2	2	3	3	4	0	31	2.281
Tricodesmium sp.	0	0	2	2	2	2	2	2	3	4	2	0	21	1.545

Ceratium sp.	2	3	3	2	2	2	2	2	6	8	6	0	38	2.796
Noctiluca sp.	1	2	3	3	2	2	2	2	2	5	4	1	29	2.133
Peridinium sp.	0	2	2	2	2	1	1	1	2	4	3	0	20	1.471
Pyrophacus sp.	0	2	2	2	1	1	0	0	0	2	2	0	12	0.883
Chlorella sp.	4	6	8	8	5	6	4	6	8	10	7	3	75	5.518
Spirogyra sp.	4	6	6	6	10	8	7	8	11	14	11	3	94	6.916
Total Population Density	46	91	117	110	90	74	85	106	159	228	172	81	1359	

Table 3. Station- The total phytoplanktons density in station-C of Kadalundi estuary from July, 2016 to June, 2017.

Phytoplankton	Jul	Aug	Sep	Oct	Nov	Dec.	Jan.	Feb	Mar.	Apr	May	Jun	Total	%
Asterionella sp.	0	0	2	2	2	1	1	1	3	3	3	0	18	1.294
Bellerochea sp.	0	1	2	2	1	0	1	1	3	4	3	0	18	1.294
Chaetoceros sp.	0	0	2	2	1	1	2	1	2	4	5	1	21	1.510
Cyclotella sp.	0	0	2	2	2	1	1	2	3	4	3	0	20	1.438
Hemidiscus sp.	0	1	2	2	1	0	0	2	6	10	8	2	34	2.446
Navicula sp.	3	6	10	8	4	2	2	8	17	22	18	11	111	7.985
Nitzschia sp.	1	2	2	0	0	0	0	0	1	2	2	0	10	0.719
Odontella sp.	10	25	31	16	14	12	17	14	22	30	22	19	232	16.690
Pleurosigma sp.	4	4	12	8	12	8	10	12	14	20	18	8	130	9.352
Rhizosolenia sp.	2	4	8	8	6	6	8	9	12	16	9	4	92	6.618
Thallassinema sp.	0	2	2	1	0	0	0	0	2	2	3	0	12	0.863
Triceratium sp.	4	6	8	8	7	12	10	14	16	18	12	5	120	8.633
Coscinodiscus sp.	3	4	6	9	6	5	2	8	14	18	14	2	91	6.546
Ditylum sp.	0	0	2	2	2	3	3	4	10	12	8	2	48	3.453
Cryptomonad sp.	3	4	6	3	4	6	5	10	8	12	6	2	69	4.964
Oscillatoria sp.	2	8	12	8	6	5	6	8	11	12	10	6	94	6.762
Polycystis sp.	0	0	2	2	0	1	2	1	2	3	2	1	16	1.151
Tricodesmium sp.	0	0	2	2	1	2	2	2	3	4	3	1	22	1.582
Ceratium sp.	4	4	3	4	2	2	1	2	4	6	5	1	38	2.733
Noctiluca sp.	0	0	2	2	2	0	1	2	2	4	2	0	17	1.223
Peridinium sp.	0	1	2	0	0	0	0	0	1	2	2	2	10	0.719
Pyrophacus sp.	0	1	2	0	0	0	0	1	0	2	2	1	9	0.647
Chlorella sp.	2	2	6	5	4	2	3	6	9	12	8	3	62	4.460
Spirogyra sp.	4	6	8	9	7	8	9	10	13	11	8	3	96	6.906
Total Population Density	42	81	136	105	84	77	86	118	178	233	176	74	1390	

Table 4. Monthly variations of Species Richness, Species Evenness and Shannon and Wiener diversity index of phytoplanktons in different Station-A of Kadalundi estuary from July 2016 to June 2017.

Months	Species Richness (H_{max})	Species Evenness (E)	Shannon-Wiener Index (H^1)
Jul.	2.397	0.95	2.28
Aug.	2.772	0.96	2.66
Sep.	3.044	0.95	2.88
Oct.	3.044	0.93	2.82
Nov.	2.995	0.92	2.75
Dec.	2.833	0.95	2.68
Jan.	2.772	0.89	2.48
Feb.	2.890	0.92	2.67
Mar.	3.135	0.89	2.78
Apr.	3.178	0.93	2.94
May	3.178	0.93	2.95
Jun.	2.397	0.89	2.13

Table 5. Monthly variations of Species Richness, Species Evenness and Shannon and Wiener diversity index of phytoplanktons in different Station-B of Kadalundi estuary from July 2016 to June 2017.

Months	Species Richness (H_{max})	Species Evenness (E)	Shannon-Wiener Index (H^l)
Jul.	2.564	0.97	2.50
Aug.	2.944	0.95	2.80
Sep.	3.135	0.96	3.02
Oct.	3.091	0.95	2.94
Nov.	2.995	0.93	2.78
Dec.	2.995	0.95	2.84
Jan.	2.995	0.89	2.68
Feb.	2.995	0.92	2.75
Mar.	3.091	0.90	2.79
Apr.	3.178	0.93	2.96
May	3.135	0.91	2.84
Jun.	2.564	0.84	2.16

Table: 6. Monthly variations of Species Richness, Species Evenness and Shannon and Wiener diversity index of phytoplanktons in different Station-C of Kadalundi estuary from July 2016 to June 2017.

Months	Species Richness (H_{max})	Species Evenness (E)	Shannon-Wiener Index (H^l)
Jul.	2.484	0.95	2.36
Aug.	2.833	0.83	2.35
Sep.	3.178	0.82	2.60
Oct.	3.044	0.95	2.88
Nov.	2.944	0.88	2.60
Dec.	2.833	0.90	2.55
Jan.	2.944	0.85	2.50
Feb.	3.044	0.92	2.81
Mar.	3.135	0.93	2.91
Apr.	3.178	0.94	2.99
May	3.178	0.95	3.02
Jun.	2.890	0.85	2.47

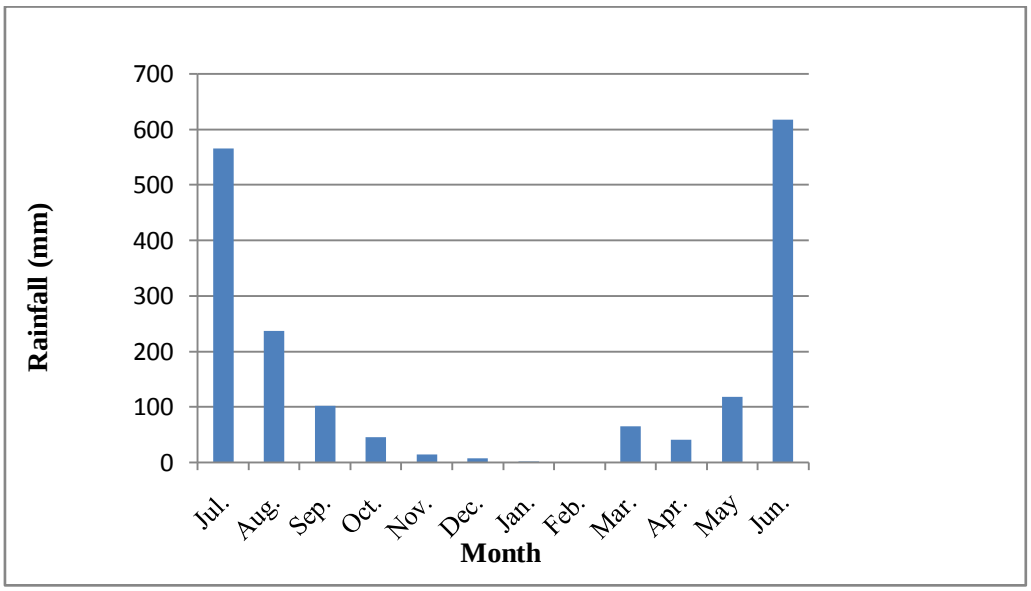

Figure 1. Monthly variations of phytoplankton in different stations of Kadalundi estuary from July, 2016 to June, 2017.

In fresh water ecosystems, carbon, nitrogen and phosphorous are the most significant nutrients for the growth and reproduction of phytoplankton. The enrichment of phytoplankton in the water may change the taste of drinking water. Seasonal variation in dissolved oxygen content is related to temperature and biological activities (Chapman & Kimstach, 1992).

CONCLUSION

The phytoplankton species diversity and abundance were varied during different months in different stations of Kadalundi estuary. This baseline data will be useful for the further line of research.

ACKNOWLEDGEMENT

The authors are thankful to the Principal and HOD of Zoology, Khadir Mohideen College, Adirampattinam for providing the necessary laboratory facilities to carry out this work.

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