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The Plankton Composition from the Lagoon to the Marine Entrance at the West Part of Segara Anakan Mangrove Ecosystem in Cilacap

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Abstract. There was a unique brackish water ecosystem and affected a chance in the plankton composition at lagoon and riverside in Segara Anakan Cilacap. This study aimed to map phytoplankton and zooplankton composition consisting of freshwater and marine plankton from the lagoon to the marine entrance in the west part of Segara Anakan Cilacap. The survey method was taken with purposive random sampling in fourteen stations and four replicates with new and full moon conditions from March to April 2018 in a wet season. The result showed 52 species of plankton. All species belonged to phylum Cyanophyta (9 species), Chlorophyta (13 species), Chrysophyta (19 species), Euglenozoa (2 species), Rotifera (2 species) and Arthropoda (7 species). Of the 52 species collected in all stations and replicates, phytoplankton has a greater species richness (41 species) than zooplankton (11 species). And also, freshwater plankton (47 species) has a higher species richness than marine plankton (5 species) due to the wet season condition causing freshwater enters brackish water. The largest freshwater of River Citanduy enters the brackish water of Segara Anakan mangrove ecosystem in Cilacap and causing the freshwater phytoplankton abundance, especially *Staurastrum* sp. in inland waters of Segara Anakan Cilacap.

1. Introduction

Segara Anakan Cilacap is the lagoon and riverine area with mangrove forests located in Cilacap Regency. Nusakambangan Island protects it from direct exposure to the Indian Ocean waves. Mangrove forests play a role as feeding, spawning and nursery ground for many biotas. As for feeding ground, it makes this region rich in planktonic organisms such as phytoplankton and zooplankton, whose existence is influenced by water quality. Phytoplankton also has a characteristic that is sensitive to environmental changes so that it is used as a bioindicator. Segara Anakan Cilacap experienced massive sedimentation originating from various anthropogenic activities and flowed through several major rivers, especially River Citanduy, Cibeureum, Cikonde [1]. Based on another reference [2], River Citanduy accounted for the most sediment by 40 thousand $m^3.year^{-1}$, whereas River Cikonde deposited sediment by 260 thousand $m^3.year^{-1}$. Therefore, there was sediment total at the lagoon by 1 million $m^3.year^{-1}$. Other research also reported the bad condition in water quality [3-6]. It could affect phytoplankton composition, abundance, and temporal variation of polluted brackish waters [7]. In Segara Anakan Cilacap, human activities affected ecological status [8] and plankton [9].

Sedimentation conditions were followed by some rivers such as River Donan and Sapuregel and from the northeast side. In River Donan, sediments were dredged in periodically to overcome this problem [10-11].

The brackish water organism is also affected by the marine entrance at the west and east part of Segara Anakan, coming from the south part of Nusakambangan Island. Based on this background, research was done from lagoon to marine entrance at the west part of Segara Anakan mangrove ecosystem in Cilacap. Therefore, all these conditions affect plankton composition.

The research purpose was to map plankton composition consisting of phytoplankton and zooplankton together with freshwater and marine plankton from the lagoon to the marine entrance in the west part of Segara Anakan Cilacap.

2. Methods

2.1 Study Site

Research locations are in two areas such as lagoon (7°0'-7°35' S and 180°45'-109°3' E) near terrestrial areas and riverine (7°40'-7°41' S and 180°47'-108°48' E) near marine areas in West Cilacap. The survey method was taken with purposive random sampling in fourteen stations (Table 1) and four replicates with new and full moon conditions from March to April 2018 in a wet season. All stations were located from the east of the lagoon to the west of the marine entrance areas (Figure 1). The research stations are part of the Science for the Protection Indonesian Marine Coastal Ecosystems, SPICE, research [12].

Table 1. Sampling stations

No.	Station (SPICE)	Coordinate	Note
1.	I (SA-2-22)	7°40'35.48" S 108°52'03.32" E	Lagoon (east lagoon)
2.	II (SA-2-32)	7°39'57.50" S 108°51'49.93" E	Lagoon (in between)
3.	III (SA-2-23)	7°39'29.04" S 108°51'15.98" E	Lagoon (in between)
4.	IV (SA-2-24)	7°39'25.04" S 108°50'58.06" E	Lagoon (central lagoon)
5.	V (SA-2-34)	7°39'30.24" S 108°50'27.56" E	Lagoon (in between)
6.	VI (SA-2-19)	7°39'50.33" S 108°49'59.52" E	Lagoon (in between)
7.	VII (SA-2-18)	7°40'19.57" S 108°49'18.62" E	Lagoon (west lagoon)
8.	VIII (SA-2-36)	7°40'34.26" S 108°48'50.62" E	Riverine (creek from lagoon)
9.	IX (SA-2-0)	7°40'03.34" S 108°48'48.74" E	Riverine (River Cikonde)
10.	X (SA-1-5)	7°40'02.52" S 108°48'20.02" E	Riverine (River Cibeureum)
11.	XI (SA-1-11)	7°40'08.14" S 108°48'03.74" E	Riverine (River Citanduy)
12.	XII (SA-1-10)	7°40'55.77" S 108°48'37.30" E	Riverine (east zone of river crossing)
13.	XIII (SA-1-9)	7°40'43.88" S 108°48'10.51" E	Riverine (river crossing)
14.	XIV (SA-1-8)	7°41'20.63" S 108°47'53.52" E	Riverine (marine entrance)

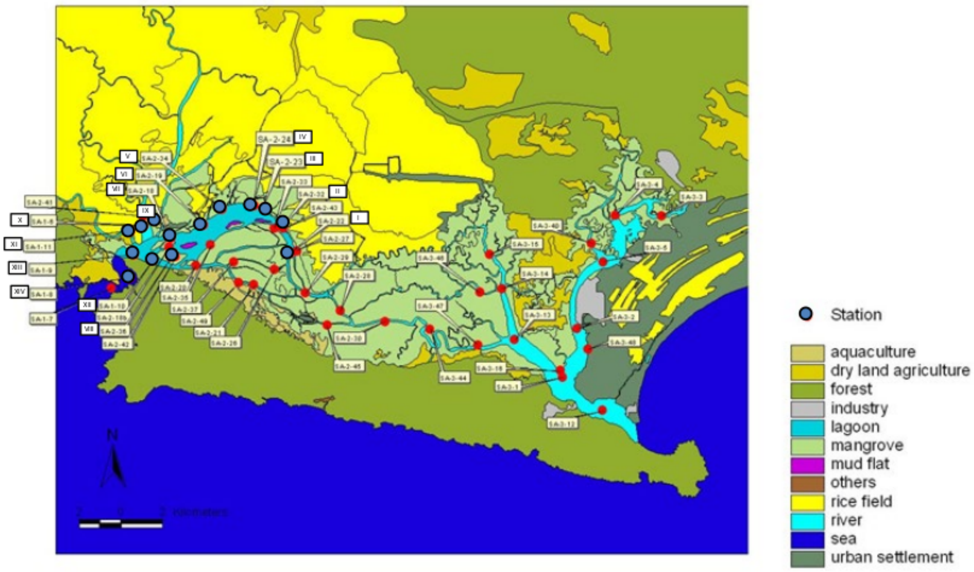

Figure 1. Research stations

2.2 Plankton Sampling and Measurement

Plankton net, mesh size of 60 µ, was placed in a vertical position and their bottle was placed parallel to the waters so that water can enter this plankton net. The water sample was preserved by formaldehyde 40% at a ratio of 9:1 [13]. Plankton identification used a binocular microscope and some books [13–15]. The abundance of plankton was calculated in individual/l according to the below formula [13]:

$$Abundance = \frac{Plaktonnet\ bottle\ volume}{Cover\ glass\ sample\ volume} x \frac{Cover\ glass\ area}{number\ of\ visual\ fields} x \frac{Individual\ number}{Filtered\ water\ volume}$$

2.3 Water quality Sampling and Measurement

All water quality samples were taken directly in waters. Temperature, salinity, dissolved oxygen and free carbon dioxide were used as an international standard [16] whereas pH and light penetration using an academic standard [17].

2.4 Data analysis

Plankton and water quality were analyzed as descriptively, especially for water quality using a national standard [18]. The IBM SPSS Statistics Versi 25, 2017 program was used for analyzing their relationship (Spearman's rank correlation) and the map plankton (dendrogram) [19].

3. Results

The result showed 52 species of plankton. All species belonged to phytoplankton and zooplankton groups. Phytoplankton group consists of Phylum Cyanophyta, Phylum Chlorophyta, Phylum Chrysophyta, whereas the zooplankton group consists of Divisio Euglenozoa, Divisio Rotifera, and Divisio Arthropoda. For grouping their origin, there were freshwater phytoplankton, marine phytoplankton, freshwater zooplankton, and marine zooplankton. In general, the species richness of freshwater plankton was higher than marine plankton. Freshwater phytoplankton of *Staurastrum* sp. dominated in abundance (Table 2).

Table 2. Plankton in each station

No		Spesies	Plankton Abundance													
		Phytoplankton	Station I	Station II	Station III	Station IV	Station V	Station VI	Station VII	Station VIII	Station IX	Station X	Station XI	Station XII	Station XIII	Station XIV
		Cyanophyta														
1	F	*Anabaena* sp.										32	32		32	32
2	F	*Chroococcus limneticus*			32		128		96							
3	F	*Lyngbya birgei*			96					64		160		32		
4	F	*Oscillatoria brevis*			64	64		64	224						96	
5	F	*Oscillatoria limnosa*		64	64	192	96	32	192	96	96	384	32	64	160	96
6	F	*Oscillatoria princeps*						64	192							
7	F	*Oscillatoria* sp.										576		64		
8	F	*Pseudanabaena limnetica*	224	384	128	64	160	480	64							
9	F	*Spirulina plantesis*		32	32	32				128					64	32
		Chlorophyta														
1	F	*Actinastrum hantzschii*									32					
2	F	*Chlorella vulgaris*	544	192	352	480	320	800	128							
3	F	*Closterium lanceolatum*	64	128	64	128		32	96							
4	F	*Closterium rectimarginatum*									32		32			
5	F	*Closterium strigosum*									32	32				
6	F	*Haematococcus pluvialis*	64	96	32	128	128	224	160							
7	F	*Hyalotheca undulata*										64			32	
8	F	*Pediastrum duplex*													32	
9	F	*Pediastrum simplex*				32				64						
10	F	*Scenedesmus quadricauda*		32		32	32	96								32
11	F	*Scenedesmus longispina*	32	64		32	32	32								
12	F	*Spirogyra* sp.										32				
13	F	*Staurastrum* sp.											2656			
		Chrysophyta														
1	F	*Asterionella formosa*					32					960				
2	F	*Cyclotella* sp.	96	64	224	32	32	96	128				32	128	32	
3	F	*Diatoma vulgare*	96		64	128	128	160				32			64	96
4	F	*Gyrosigma attenuatum*								32			32			
5	F	*Gyrosigma hassallii*										32				
6	F	*Lemnicola hungarica*								64			32			
7	F	*Melosira granulata*									32		288	32		32
8	F	*Melosira varians*	416	192	544	64	448	576	192	64	64	896		224	288	128
9	F	*Navicula maculata*	96	160	160	32	128	64	128		32			32		
10	F	*Navicula radiosa*									32					
11	F	*Nitzschia acucilaris*										32				
12	M	*Nitzschia closterium*												32	32	64
13	F	*Nitzschia dissipata*								64		32				
14	F	*Nitzschia longissima*	96	64					64							
15	F	*Nitzschia vermicularis*													32	32
16	F	*Pleurosigma angulatum*	96	96	480	224	64	64	288	96		64		64	32	64
17	F	*Pleurosigma elongatum*			576	128	32		352	288	64	32		128		
18	M	*Skeletonema costatum*	352	288	1120	576	416	704	128							
19	F	*Synedra ulna*	64		32			64				32			32	
		Phytoplankton abundance	2240	1856	4064	2368	2176	3552	2432	960	416	3392	3136	800	928	608
		Zooplankton														
		Euglenozoa														
1	F	*Euglena acus*													64	
2	F	*Phacus* sp.										32		32		
		Rhotifera														
1	F	*Brachionus falcatus*										32				
2	F	*Brachionus plicatilis*												96		
		Arthropoda														
1	F	*Apocyclops dengizicus*			64											
2	F	*Cyclops fimbriatus*	384		32		32									
3	F	*Cyclops sp.*										32		32		
4	F	*Cyclops sternuus*								32	32	96	32	64	32	32
5	F	*cyclops vicinus*				32			128	64		96		32	64	32
6	F	*Eucyclops elegans*	32				32									
7	M	*Euterpina acutifrons*										32				32
		Zooplankton abundance	416		96	32	64		128	96	32	320	32	256	160	96
		Total abundance	2656	1856	4160	2400	2240	3552	2560	1056	448	3712	3168	1056	1088	704
		Total species richness	15	14	19	19	17	16	16	12	10	22	9	15	16	13

Where: F = freshwater
M = marine

All parameters belonged to physical and chemical variables. The physical variable consists of temperature, whereas chemical variables include pH, light penetration, salinity, dissolved oxygen, and free carbon dioxide. From east lagoon to riverine near the marine entrance at the west part of Segara Anakan Cilacap, there were the increasing temperature and salinity values, but pH values were constant. In general, all stations were turbid, especially in River Citanduy, so why their light penetration became low in value (Table 3).

Table 3. Water quality in each station

No	Parameter	unit	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV
1	Temperature	°C	29.8±0.9	29.8±0.6	29.9±0.6	30.1±0.9	30.4±0.5	30.6±1.3	31.0±0.8	30.8±0.9	30.9±0.9	31.0±0.8	30.1±0.3	30.8±0.9	30.8±0.5	31.0±0.1
2	pH		7	7	7	7	7	7	7	7	7	7	7	7	7	7
3	Light Penetration	cm	45.0±5.8	35.0±9.1	43.0±15.4	43.8±16.0	45.0±17.3	48.8±23.9	45.0±22.4	35.0±12.3	41.3±20.1	43.8±21.2	31.3±10.3	45.0±16.8	41.3±20.1	38.8±17.5
4	Salinity	‰	3.3±0.5	3.5±0.6	3.8±0.5	4.0±0.8	4.8±0.9	6.5±3.3	13.3±1.1	10.3±4.5	7.3±3.8	7.3±3.7	2.3±0.9	6.0±2.5	14.8±6.8	18.3±10.1
5	Dissolved Oxygen	mg/l	6.1±1.1	3.0±0.6	3.4±1.5	3.5±1.6	3.5±1.2	3.3±1.1	3.4±1.1	5.3±1.5	3.9±1.2	4.3±0.9	4.6±0.9	4.8±0.4	3.9±0.9	4.7±0.4
6	Free Carbon Diaoxide	mg/l	4.5±2.2	2.8±0.9	2.9±1.4	3.8±1.4	3.1±1.5	3.8±1.7	3.4±1.7	2.8±0.9	2.9±1.4	2.5±0.9	2.9±1.2	3.5±0.6	2.5±0.6	1.8±0.5

4. Discussion

A total of 52 species have been collected in all stations and replicates. Species richness of phytoplankton (41 species or 78.9%) was higher than zooplankton (11 species or 21.1%, Figure 2a1) whereas the abundance of phytoplankton (2,066.3 individual/l or 94.4%) was higher than zooplankton (123.4 individual/l or 5.6%, Figure 2b1). Both species richness and abundance of phytoplankton were higher than zooplankton. Another research reported that phytoplankton was higher than zooplankton in the usual sense of a food pyramid [20].

Species richness of Chrysophyta (19 species or 36.5%) was highest and followed by Chlorophyta (13 species or 25%), Cyanophyta (13 species or 25%), Arthropoda (7 species or 13.4%), Rhotifera (2 species or 3.9%) and Euglenozoa (2 species or 3.9%, Figure 2a2) whereas the abundance of Chrysophyta (1,124.6 individual/l or 51.4%) was highest and followed by Chlorophyta (546.3 individual/l or 24.9%), Cyanophyta (395.4 individual/l or 18.1%), Arthropoda (105.1 individual/l or 4.8%), Rhotifera (9.1 individual/l or 0.4%) and Euglenozoa (9.1 individual/l or 0.4%, Figure 2b2). Species richness and abundance of Chrysophyta were higher than others. Other researchers also found this condition [21, 22]. In this research, species richness and abundance of Arthropoda was higher than other zooplankton [23].

Species richness of freshwater phytoplankton (39 species or 75%) was highest and followed by freshwater zooplankton (10 species or 19.2%), marine phytoplankton (2 species or 3.9%), and marine zooplankton (1 species or 1.9%, Figure 2a3) whereas the abundance of freshwater phytoplankton (1,801.1 individual/l or 83.3%) was highest and followed by freshwater zooplankton (118.8 individual/l or 5.4%), marine phytoplankton (265.2 individual/l or 12.1%), and marine zooplankton (4.6 individual/l or 0.2%, Figure 2b3). Both species richness and abundance of freshwater phytoplankton were higher than others. The wet season caused freshwater to enter brackish water. The largest freshwater of River Citanduy enters the brackish waters of Segara Anakan Cilacap and creating the dominant species of phytoplankton, especially freshwater phytoplankton in this area of inland waters. In India, the abundance of freshwater phytoplankton was higher than others also during wet season [24].

Based on class III in Government Regulation Number 82 Year 2001 [18], water quality was in the permissible surface water quality standard at all stations in temperature, pH, and dissolved oxygen (Table 3 and Figure 4a), especially at Station X in River Cibeureum. This river had the highest species richness. Conserve, the coastal environmental profile of Segara Anakan showed that River Citanduy had the highest average flow as much 24.45 million m^3/day in the wet season and followed by River Cikonde and Cibeureum as much 1.50 million m^3/day and 0.17 million m^3/day, respectively. It made a sedimentation process leading to the lagoon became narrow and shallow conditions [25]. This condition was showed that light penetration was the lowest value as much 31.3±0.3 cm (Table 3) and the highest freshwater phytoplankton abundance of *Staurastrum* sp. (Figure 3) as much 2,656 individual/l at Station XI in River Citanduy (Table 2). It means that the decrease of light penetration tends to the increasing in this plankton abundance ($p < 0.05$; $r = - 0.454$; Figure 4b) because sedimentation and floating materials

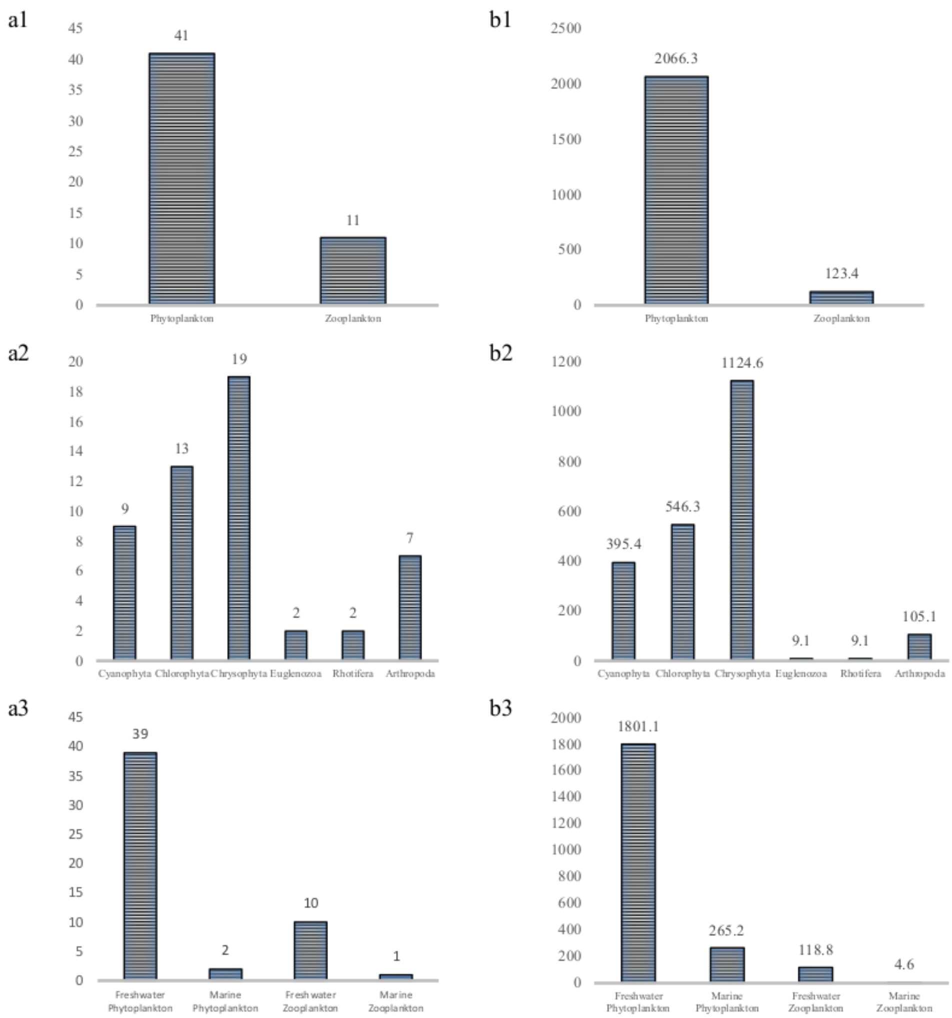

Figure 2. The presence of plankton group in (a) species richness (b) abundance

were too high in this river. This condition was in bad water quality [4]. Other plankton was no consistent effect of light penetration.

In the same other tendency, salinity was also in the lowest value as much 2.3±0.9 ‰ (Table 3) and the highest plankton abundance (Table 2). It means that the decreasing of salinity tends to the increasing of *Staurastrum* sp. ($p < 0.05$; $r = -0.448$). Another research reported that there was a relationship between salinity and plankton in freshwater, brackish water and marine [20]. Otherwise, salinity was in the highest value as much 18.3±0.1 ‰ (Table 3) and no marine phytoplankton abundance of *Skeletonema costatum* abundance in riverine, especially in the marine entrance (Table 2). It means that the increasing of salinity tends to no this marine phytoplankton abundance but the low salinity as much 3.8±0.5 ‰ (Table 3) and the highest this plankton as much 1,120 individual/l between east and central lagoon (Table 2). It means that the decreasing of salinity tends to the increasing in this plankton abundance ($p < 0.05$; r = - 0.463). *Skeletonema costatum* is marine phytoplankton, but it can survive in freshwater and brackish water [26–28]. Another case of salinity, the highest salinity as much 18.3±0.1 ‰ (Table 3) and the highest marine phytoplankton abundance of *Nitzschia closterium* as much 64 individual/l near the marine entrance (Table 2). It means that the increasing of salinity tends to the increasing of *Nitzschia closterium* ($p < 0.05$; r = - 0.519). *Nitzschia closterium* always tends to need a high salinity in the marine entrance as much 18.3±0.1 ‰ or they can live in brackish water salinity of 6–18.3 ‰ at the west part of Segara Anakan (Table 2). Another research showed it live at a wide array in inland saline waters [29–32].

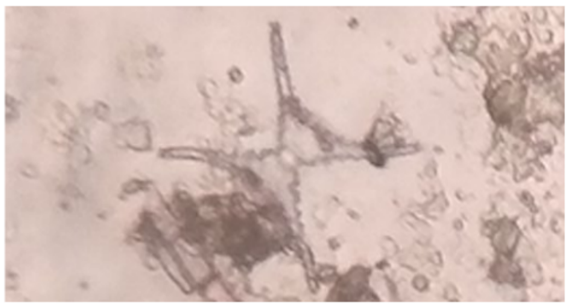

Figure 3. *Staurastrum* sp.

Another parameter of temperature was the lowest value as much 29.8±0.9ºC (Table 3) and the highest freshwater zooplankton abundance of *Cyclops fimbriatus* as much 384 individual/l in the east lagoon (Table 2). It means that the decreasing of temperature tends to the increasing of this plankton abundance ($p < 0.05$; r = - 0.539). In the same station, the highest freshwater phytoplankton abundance of *Nitzschia longissima* as much 96 individual/l. Another research was also found that it was negatively correlated to water quality [33]

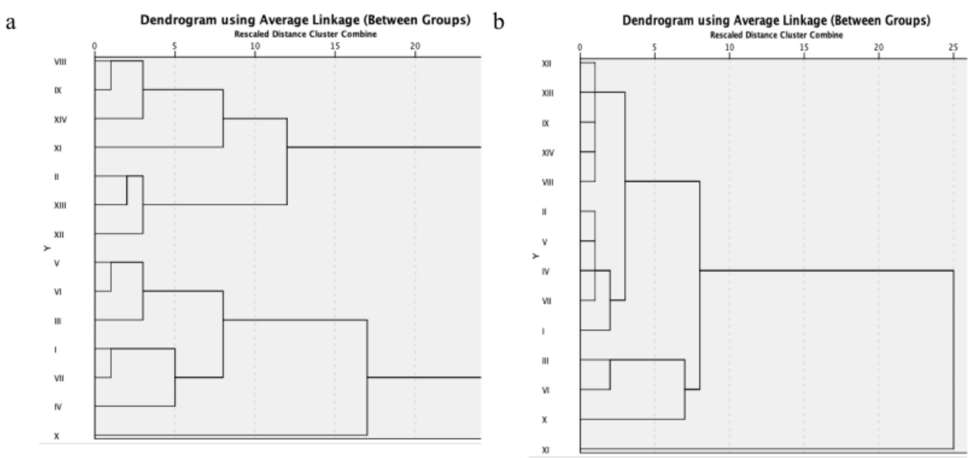

Figure 4. Plankton similarity in (a) species richness (b) abundance [19]

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5. Conclusion

The species richness was dominated by freshwater phytoplankton, especially Chrysophyta, due to their water quality and wet season conditions. In contrast, its abundance was dominated by the freshwater phytoplankton of *Staurastrum* sp. in River Citanduy. This river was high in sedimentation and made the lagoon became narrow and shallow conditions.

References

[1] Utami F P, Prasetyo Y dan Sukmono A 2016 Analisis Spasial Perubahan Luasan Mangrove akibat Pengaruh Limpasan Sedimentasi Tersuspensi dengan Metode Penginderaan Jauh (Studi Kasus: Segara Anakan Kabupaten Cilacap, Jawa Tengah) *Jurnal Geodesi* **5** 305–15

[2] Sujastani T and Purba M 1989 *Geography and Physical Setting In White A T, Martosubroto P and Sadorra M (Editors): The Coastal Environmental Profile of Segara Anakan-Cilacap, South Java, Indonesia* (ICLARM Technical Report 25. Manila: International Centre for Living Aquatic Resources Management)

[3] Sastranegara M H 1996 Kecenderungan Peningkatan Eutrofikasi di Segara Anakan Cilacap *Biosfera* **4** 29–35

[4] Sastranegara M H 2004 *The Impact of Forest Use on the Intertidal Crab Community in Managed Mangroves of Cilacap, Central Java, Indonesia (*Göttingen: Cuvillier)

[5] Parwali E, Trisakti B, Carolila I, Kartika T, Harini S and Dewanti K 2006 Analisis Hubungan Penutup/Penggunaan Lahan dengan Total Suspended Matter (TSM) Kawasan Perairan Segara Anakan Menggunakan Data Inderaja *Jurnal Penginderaan Jauh* **3** 87–97

[6] Sastranegara M H, Yuwono E and Sukardi P 2007 Illegal Logging of Mangroves in Segara Anakan Cilacap: A Conservation Constraint Yuwono E, Jennerjahn T, Sastranegara M H and Sukardi P (Editors) *Synopsis of Ecological and Socio-Economic Aspects of Tropical Coastal Ecosystem With Special Reference to Segara Anakan (*Purwokerto: Research Institute The University of Jenderal Soedirman)

[7] Onyema C 2007 The Phytoplankton Composition, Abundance and Temporal Variation of a Polluted Estuarine Creek in Lagos, Nigeria *Turkish Journal of Fisheries and Aquatic Sciences* **7** 89–96

[8] Yuwono E, Jennerjahn T C, Nordhaus I, Ardli E R, Sastranegara M H and Pribadi R 2007 Ecological Status of Segara Anakan, Indonesia: A Mangrove-fringed Lagoon Affected by Human Activities *Asian Journal of Water, Environment and Pollution* **4** 61–70

[9] Lukman A N, Sastranegara M H and Piranti A S 2018 Plankton Community during Maximum Tidal Range Related to Water Quality in Segara Anakan Cilacap *Proceeding of The SEA+ Conference on Biodiversity and Biotechnology 2018* Purwokerto 17 October 2018

[10] Sastranegara M H and Lestari S 2009 Kajian Kualitas Air Pasca-Pengerukan Alur Pelayaran Batu Kapur di Sungai Donan Cilacap *Biosfera* **26** 14–24

[11] Pamungkas Y, Sahirman S dan Sastranegara M H 2014 Kualitas Air Pasca Pengerukan Alur Transportasi Batu Kapur di Sungai Donan Cilacap *Biosfera* **31** 27–32

[12] Nordhaus I, 2009 Spatio-temporal Variation of Macrobenthic Communities related to Environmental Conditions Paper presented at the *International Workshop on Progress and Plan of SPICE Cluster 2 Phase II (2008-2010)* Jenderal Soedirman University Purwokerto 25th February 2009

[13] Sachlan M 1982 *Planktonologi* (Semarang: Universitas Diponegoro)

[14] Davis C C, 1955 *The Marine and Fresh-Water Plankton* (Michigan: Michigan State University)

[15] Hartoko A, 2013 *Oceanographic Characters and Plankton Resources of Indonesia (*Yogyakarta: Graha Ilmu)

[16] APHA, AWWA and WEF 1992 *Standard Methods for the Examination of Water and Wastewater (*New York: American Public Health Association, American Water Works Association, Water

Environment Federation)
[17] Wetzel R and Likens G, 2000 *Limnological Analyses (*New York: Springer)
[18] Presiden Republik Indonesia 2001 *Peraturan Pemerintah Republik Indonesia Nomor 82 Tahun 2001 tentang Pengelolaan Kualitas Air dan Pengendalian Pencemaran Air* (Jakarta: Sekretaris Negara Republik Indonesia)
[19] IBM 2017 *IBM SPSS Statistics Version 25* (New York: IBM Corporation)
[20] Bazin P, Jouenne F, Friedl T, Deton-Cabanillas A F, Roy B L and Véron B 2014 Phytoplankton Diversity and Community Composition along the Estuarine Gradient of a Temperate Macrotidal Ecosystem: Combined Morphological and Molecular Approaches *PLoS ONE* **9** e94110
[21] Brock T D 1988 A Eutrophic Lake: Lake Mendota, Wisconsin *Journal of the Royal Society of New Zealand* **18** 342
[22] Sihombing V S, Gunawan H and Sawitri R 2017 Diversity and Community Structure of Fish, Plankton and Benthos in Karangsong Mangrove Conservation Areas, Indramayu, West Java, Indonesia *Biodiversitas* **18** 601–8
[23] Jose E C, Furio EF, Borja V M, Gatdula N C and Santos M D 2015 Zooplankton Composition and Abundance and its Relationship with Physico-chemical Parameters in Manila Bay Oceanography **3** 136
[24] Malik D S and Bharti U 2012 Status of Plankton Diversity and Biological Productivity of Sahastradhara Stream at Uttarakhand, India *Applied and Natural Science* **4** 96–103
[25] White, A.T., Martosubroto, P., and Sadorra, M.S.M., 1989. The Coastal Environmental Profile of Segara Anakan - Cilacap, South Java, Indonesia (ICLARM Technical Report 25. Manila: International Centre for Living Aquatic Resources Management)
[26] Berthet B 2015 Reference Species In Claude A T, Amiard J C and Mouneyrac C (Eds) *Aquatic Ecotoxicology: Advancing Tools for Dealing with Emerging Risks* (Cambridge: Academic)
[27] Shevchenko O G and Ponomareva A A 2015 The Morphology and Ecology of the Marine Diatom Skeletonema marinoi Sarno et Zingone, 2005 from the Sea of Japan *Marine Biology* **41** 490–4
[28] Huang J, Cheng J and Yi J 2016 Impact of Silver Nanoparticles on Marine Diatom *Skeletonema costatum*: Silver Nanoparticles are Phototoxic to Marine Diatom *Applied Toxicology* **30**1343–54
[29] Hulburt E M and Rodman J 1963 Distribution of Phytoplankton Species with Respect to Salinity between the Coast of Southern New England and Bermuda *Oceanogr* **8** 263–9
[30] Hulburt E M and Corwin M 1968 Influence of the Amazon River Outflow on the Ecology of the Western Tropical Atlantic *Marine Research* **27** 55–72
[31] Harris J M and Vinobaba P 2012 Impact of Water Quality on Species Composition and Seasonal Fluctuation of Planktons of Batticaloa Lagoon, Sri Lanka *Journal of Ecosystem & Ecography* **2** e1000117
[32] Zhang Q, Gradinger R and Spindler M 1999 Experimental Study on the Effect of Salinity on Growth Rates of Arctic-sea-ice Algae from the Greenland Sea *Boreal Environment Research* **4** 1–8
[33] Rahman A A 2006 Plankton Communities in Hypersaline Waters of Indian Solar Saltworks Proceedings of the *1st International Conference on the Ecological Importance of Solar Saltworks (CEISSA 06)* Santorini Island, Greece, 20-22 October 2006 pp 256–68

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