CEK-SANI

by M D Sani M D Sani

Submission date: 06-Apr-2023 10:20AM (UTC+0800)
Submission ID: 2057142182
File name: SANI.pdf (683.73K)
Word count: 3065
Character count: 15778

PAPER • **OPEN ACCESS**

The dominance and proportions of plankton in Pacific white shrimp (*Litopenaeus vannamei*) ponds cultivated with the intensive system in Bulukumba Regency, South Sulawesi, Indonesia

To cite this article: M D Sani *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **1036** 012057

View the article online for updates and enhancements.

You may also like

- The plankton abundance fluctuation in traditional ponds by the use of organic fertilizer from poultry manure
Yusnaini and I Nur
- Development of segmentation algorithm for determining planktonic objects from microscopic images
E Prakasa, A Rachman, D R Noerdjito et al.
- The utilizations of solid waste originating from super intensive shrimp farm as organic fertilizers for natural feed productions
H S Suwoyo, A Tuwo, Haryati et al.

This content was downloaded from IP address 36.68.223.87 on 12/08/2022 at 19:22

The dominance and proportions of plankton in Pacific white shrimp *(Litopenaeus vannamei)* ponds cultivated with the intensive system in Bulukumba Regency, South Sulawesi, Indonesia

M D Sani[1], P A Wiradana[2], A Y Maharani[1], R E Mawli[1], and A T Mukti[3,4]

[1]Department of Biology, Faculty of Science and Technology, Universitas Airlangga, Kampus C Jalan Mulyorejo, Surabaya (60115), East Java, Indonesia
[2]Study Program of Biology, Faculty of Health, Science, and Technology, Universitas Dhyana Pura, Jalan Raya Padangluwih, Badung Regency, Bali (80351), Indonesia
[3]Department of Aquaculture, Faculty of Fisheries and Marine, Universitas Airlangga, Surabaya 60115 Indonesia

[4]Corresponding author: akhmad-t-m@fpk.unair.ac.id

Abstract. This study aimed to evaluate plankton in Pacific white shrimp *(Litopenaeus vannamei)* cultivation in Bulukumba Regency, South Sulawesi. The study was conducted in six intensive ponds for 84 days from November 2019 to February 2020. Plankton samples were collected every 10 days for 8 weeks based on the day of culture (DOC) of Pacific white shrimp since the first rearing in the pond using plankton net (mesh size of 25 μm). Then, planktons were preserved to 5% formalin buffer in 250 mL of sterile plastic. Next, the plankton densities and compositions were analyzed quantitatively and qualitatively. The results showed that plankton dominance in Chlorophyta species and the presence was evenly distributed across all shrimp ponds in the field. The number was relatively stable in all shrimp DOCs and was the highest proportion as well; Chlorophyta (73 to 83%), Diatom group (7.75 to 15.63%), and blue-green algae (BGA) group (7.13 to 13.50%). Plankton can be used as a biomonitor of pollution and shrimp health in dominance and the percentage proportion of each species. Regular monitoring is highly recommended to minimize plankton growth, especially the BGA type that can harm shrimp health in the intensive system.

1. Introduction

Shrimp production has increased by 6.09 million tonnes with USD 17.2 million. It indicates the higher shrimp consumption worldwide in 2015 [1]. The cultivation of Pacific white shrimp (*Litopenaeus vannamei*) is the most cultivated aquaculture commodity globally, reaching up to 90% [2]. Indonesia is one of the countries in Southeast Asia with excellent potential for Pacific white shrimp cultivation and can increase foreign exchange through the aquaculture sector [3].

Plankton (phytoplankton and zooplankton) is microscopic organism living in the water. The existence of plankton has an essential role in maintaining the food chain stability in aquatic ecosystems [4]. Phytoplankton is the primary producer of changing solar energy into chemical energy and nutrient producers in the water cycle. Meanwhile, zooplankton transmits this energy to a higher trophic level as a link between energy producers and consumers [5,6]. However, plankton communities can continuously change temporally and spatially. It encourages a study to explain the effect of these

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.
Published under licence by IOP Publishing Ltd

changes on water quality in aquatic ecosystems [7]. The dynamics of phytoplankton community change are often associated with the bottom-up influence of environmental variables such as temperature [8], light and nutrients, [9] and phytoplankton-zooplankton interactions [10].

Monitoring the activities of the dynamics of the plankton community is necessary for supporting the success of the intensive system of pacific white shrimp cultivation [11–13]. The shrimp intensive farming system severely affects the environment, shrimp, and farmers. Several studies showed that intensive farming systems could cause problems such as wetlands degradation, local pollution, water salination, anoxic sediments accumulation, benthic communities changes, and waters eutrophication [14]. In terms of shrimp health, the application of an intensive system may reduce the immunity system of shrimp due to the high stocking density [15], an increase in infectious diseases such as bacteria [16], [17], fungi [14], viral [18], [19], and parasitic [20], ammonia from leftover feed that may affect shrimp physiology [21].

Monitoring biotic factors such as plankton (phytoplankton and zooplankton) in the intensive system of shrimp ponds helps to understand environmental factors that control shrimp health to maximize shrimp productivity [22]. It is essential because plankton can be the bioindicator for ecological health in aquaculture. For example, microalgae such as diatoms in shrimp ponds are temporary. Cyanobacteria can eventually replace them due to an increase in the concentration of nutrients in the pond, which is actually beneficial for cyanobacteria. In addition, a decrease in water quality parameters such as dissolved oxygen (DO) can also be caused by microalgae, which could affect shrimp growth and physiology. The monitor must be conducted regularly to avoid the occurrence of this microalgae bloom [23].

This study aimed to evaluate plankton as a biological factor based on plankton's dominance, and percentage proportion in Pacific white shrimp farmed using the intensive system in Bulukumba Regency, South Sulawesi. This study was conducted to provide information on biological factors for guidance in maintaining plankton stability in shrimp ponds to increase productivity.

2. Materials and methods

2.1. Study area

The study was conducted in intensive ponds for 84 days from November 2019 until February 2020 in Bulukumba Regency, South Sulawesi, Indonesia (see Figure 1). A total of six shrimp ponds with intensive systems were used as research objects with pond sizes ranging from 2,900 to 4,000 m^2 and stocking density of Pacific white shrimp averaging 208 fry/m [17]. Since the first time spread in the pond, samples were taken every 10 days for 8 weeks based on the day of culture (DOC) of Pacific white shrimp. Plankton was collected on the pond water surface using a plankton net (mesh size: 25 μm) and preserved in 5% buffered formalin at 250 mL of sterile plastic [24].

2.2. Sampling procedure

The dominance and proportion of plankton were analyzed quantitative and qualitatively using a microscope (Olympus CX23) at 100× and 400× magnifications. Pond water samples were dripped on a Neubauer hemocytometer and calculated using the cell counting method, the number of each type of plankton that had been observed on one grid multiplied by 10^4 cells/mL [25]. The plankton obtained was identified referring to the book titled Phytoplankton Identification, Marine Phytoplankton Atlas of Kuwait's Waters, and Identifying Marine Phytoplankton [26].

IOP Conf. Series: Earth and Environmental Science 1036 (2022) 012057 doi:10.1088/1755-1315/1036/1/012057

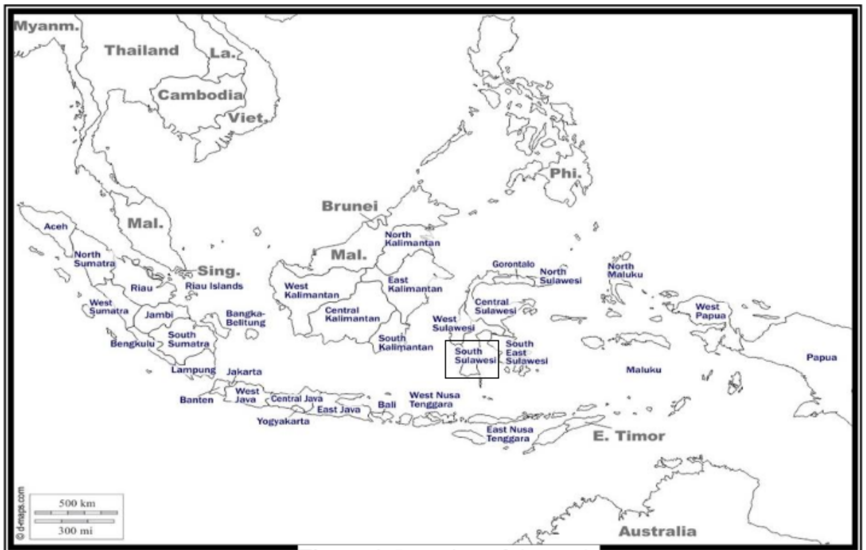

Figure 1. Location of the study

2.3. Data analysis

Data of plankton obtained were collected, identified, and processed in Ms. Excel 2019 (Microsoft Office). Furthermore, the data were inputted in SPSS 22.0 (IBM, USA) with the ANOVA test to determine the difference in each parameter of each pond, followed by Duncan's test with a confidence interval of 95%.

3. Results and discussion

The results of plankton dominance showed that the Chlorophyta species had high dominance and were present in all shrimp ponds, with the number was relatively stable in all shrimp DOC. The next dominant plankton group was diatom, whose presence was stable and increased, especially at 20 and 30 DOC of shrimp in ponds 4, 5, and 6 (Figure 2). Meanwhile, the other four types of plankton, namely dinoflagellates, Cyanophyta, protozoa, and blue-green algae (BGA), did not show high dominance. However, in ponds 2 and 6, BGA's presence appeared higher than other shrimp ponds. Table 1 showed that generally, the plankton found at the intensive ponds of Pacific white shrimp in Bulukumba Regency dominated by Chlorophyta (73 to 83%), followed by the diatom group (7.75 to 15.63%) and the BGA group (7.13 to 13.50%).

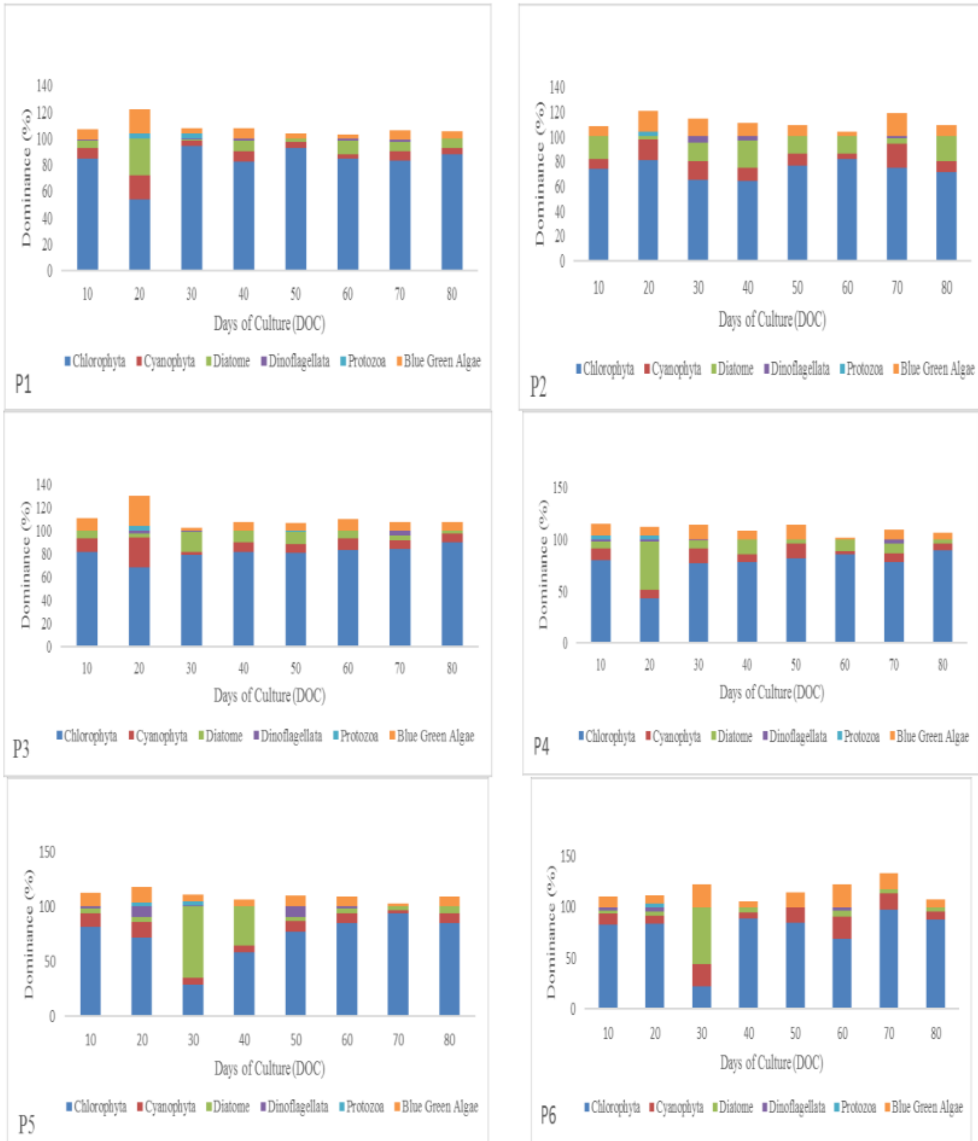

Figure 2. The dominance of plankton types (%) in pond 1 (P1), pond 2 (P2), pond 3 (P3), pond 4 (P4), pond 5 (P5), and pond 6 (P6)

Table 1. Percentage proportion (%) of plankton (mean ± SD, n = 8) in the medium for raising Pacific white shrimp at intensive ponds in Bulukumba Regency, South Sulawesi

Plankton	P1	P2	P3	P4	P5	P6
Chlorophyta	83.00±12.51	73.63±6.67	81.13±6.19	76.63±14.22	72.63±20.59	77.25±23.73
Cyanophyta	7.13±4.79	11.50±5.07	10.13±6.83	9.13±3.94	8.75±3.69	13.50±6.27
Diatome	8.63±8.33	13.75±6.98	7.75±4.83	13.13±14.12	15.63±22.89	10.13±18.62
Dinoflagellata	1.00±0.92	1.13±1.88	0.88±1.45	1.13±1.45	3.13±4.32	1.25±1.75
Protozoa	1.00±1.85	0.50±1.41	0.63±1.40	1.00±1.85	1.00±1.85	0.50±1.41
Blue-green algae	7.13±4.79	11.50±5.07	10.13±6.83	9.13±3.94	8.75±3.69	13.50±6.27

Note: P1 = pond 1, P2 = pond 2, P3 = pond 3, P4 = pond 4, P5 = pond 5, and P6 = pond 6.

Chlorophyta was the type of plankton that dominated all observation ponds. Similar results were also reported by Cremen et al. [33], who stated that the utilization of green water technology could stimulate the growth of beneficial plankton/microalgae groups such as phytoplankton and maintain pond water quality parameters regardless of the high stocking density in the system. In the application of the multi-trophic aquaculture system (IMTA), phytoplankton has an essential role because it not only increases DO levels and captures excess nutrients from animal manure, but it is also useful as a natural feed for oysters. Likewise, oysters can control the density of microalgae and particulate matter in the pond, providing stability for DO levels and better water column transparency [34].

Diatoms are necessary for the shrimp culture system because of their role in maintaining shrimp's water quality and nutrition [35]. In addition, the application of diatoms in shrimp culture using a biofloc system showed the improvement in shrimp productivity parameters such as higher body weight and a feed conversion ratio of 0.47 [36]. Diatoms have been widely used in commercial and industrial applications, such as biofuels, pharmaceuticals, healthy, food, biomolecules, nanotechnology, and bioremediation in water pollution [37].

During 80 days of observation, BGA also showed a high percentage, especially in ponds 2 and 6, and the proportion of this type of plankton in all ponds showed a high amount. BGA or Cyanobacteria have multiple characters, such as various habitats (freshwater to marine), free-floating, and Periphyton (attached to pond surface) [38]. This study showed that the high BGA dominance in ponds could cause a certain disease syndrome called hemocyte enteritis in *Penaeus stylirostris*. Clinical symptoms of the disease are characterized by necrosis in the epithelial lining of the middle intestine. They may also be in the dorsal cecum and hindgut gland, decreasing shrimp productivity. The findings indicate that certain *Oscillatoria* sp. and other BGA species are also capable of causing this syndrome and are characterized by bacteria such as *Vibrio* spp. The results of this study support previous studies at a similar location that the population of *Vibrio* spp. had a high number in the 2nd pond that was more than 5.8×10^3 CFU/g at DOC 70 [17]. These results confirmed an interaction between the increase in the population of BGA and *Vibrio* spp. in shrimp farms. Apart from this, the presence of feces, metabolic waste, to the application of fermentation products, and dolomite at the beginning, middle, and before harvest can also act as a source of nutrients that accumulate in pond water and stimulate the growth of certain types of plankton [25].

Several solutions to control the explosion of BGA in shrimp ponds are 1) reducing the frequency of excessive feeding, 2) application of probiotics and shrimp immunostimulants, 3) utilization of minerals by eating BGA, which is rich in protein, lipids, and carbohydrates can increase their immunity and help the shrimp body's resistance when the pond environment changes [39].

4. Conclusions

Our study findings showed that the dominance and percentage proportion of plankton in the intensive system cultivated with Pacific white shrimp was dominated by Chlorophyta and diatom, with relatively stable growth in all ponds and shrimp age. However, control of the explosion of blue-green algae should be carefully carried out to optimize the productivity of shrimp farming in South Sulawesi.

5. References

[1] FAO 2016 *The State of Food Insecurity in the World 2015: Meeting the 2015 International Hunger Targets: Taking Stock of Uneven Progress* (Rome: Food and agriculture organization publications)

[2] Lightner D V, Redman R M, Pantoja C R, Tang K F J, Noble B L, Schofield P, Mohney L L, Nunan L M and Navarro S A 2012 *J. Invert. Pathol.* **110**, 174-183

[3] Tran N, Rodriguez U-P, Chan C Y, Phillips M J, Mohan, C V, Henriksson, P J G, Koeshendrajana S, Suri S and Hall S 2017 *Mar. Policy* **79**, 25-32

[4] Hastuti A W, Pancawati Y and Surana I N 2018 *IOP Conf. Ser. Earth Environ. Sci.* **176**, 012042

[5] Yang W, Zhu J, Zheng C, Lukwambe B, Nicholaus R, Lu K and Zheng Z 2020 *Aquaculture* **520**, 734733

[6] Jakhar P 2013 *Int. J. Innov. Res. Stud.* **2**, 490-500

[7] Fuhrman J A, Cram J A and Needham D M 2015 *Nat. Rev. Microbiol.* **13**, 133-146

[8] Chen M, Fan M, Yuan X and Zhu H 2017 *Math. Biosci. Eng.* **14**, 1091-1117

[9] Charalampous E, Matthiessen B and Sommer U 2018 *J. Plankton Res.* **40**, 568-579

[10] Hunt R J and Matveev V F 2005 *Limnologica* **35**, 90-101

[11] Burford M 1997 *Aquac. Res.* **28**, 351-360

[12] Llario F, Rodilla M, Escrivá J, Falco S and Sebastiá-Frasquet M-T 2019 *Int. J. Environ. Sci. Technol.* **16**, 211-222

[13] Musa M, Lusiana E D, Buwono N R, Arsad S and Mahmudi M 2020 *Biodiver. J. Biol. Divers.* **21**, 10

[14] Kautsky N, Rönnbäck P, Tedengren M and Troell M 2000 *Aquaculture* **191**, 145-161

[15] Nguyen T A T, Nguyen K A T and Jolly C 2019 *Sustainable* **11**, 1-22

[16] Alfiansah Y R, Hassenrück C, Kunzmann A, Taslihan A, Harder J and Gärdes A 2018 *Front. Microbiol.* **9**, 1-15

[17] Sani M D Maharani A Y, Riandy M I, Joko R, Susilo K, Wiradana P A and Soegianto A 2020 *Ecol. Env. Cons.* **26**, 1271-1275

[18] Dieu B, Vlak J and Zwart M 2011 *Dis. Asian Aquac.* **7**, 145-156

[19] Wiradana P A, Mahasri G, Sari R E R, Marwiyah U C and Prihadhana R 2019 *IOP Conf. Ser. Earth Environ. Sci.* **236**, 1

[20] Shinn A P, Pratoomyot J, Griffiths D, Trong T Q, Vu N T, Jiravanichpaisal P and Briggs M. 2018 *Asian Fish. Sci.* **31**, 29-58

[21] Zhao M, Yao D, Li S, Zhang Y and Aweya J J 2020 *Rev. Aquac.* **12**, 2194-2211

[22] Shaari A L, Surif M, Latiff F A, Omar W M W and Ahmad M N 2011 *Trop. Life Sci. Res.* **22**, 51-69

[23] Yusoff F M, Zubaidah M S, Matias H B and Kwan T S 2002 *Aquac. Res.* **33**, 269-278

[24] Sakib Khan N, Islam S, Bin Abdul Bari J and Tisha N A 2020 *Nat. Environ. Pollut. Technol.*, **19**, 1767-1770

[25] Munjaya 2019 *The Dynamics of Suspended Solids Quality in Litopenaeus vannamei Pond Culture Media* (Bogor: IPB University)

[26] Sari L A, Al Diana N, Arsad S, Pursetyo K and Cahyoko Y 2021 *J. Ecol. Eng.* **22**, 29-35

[27] Le C 2011 *Soil Sampling Methods* (Ho Chi Minh: Faculty of Biology, College of Natural Sciences, Ho Chi Minh National University)

[28] MOST 2005 *Soil Quality - Sampling - Part 2: Guidance on Sampling Techniques* (Hanoi: National technical regulation, Ministry of Science and Technology)

[29] Peters J, Laboski C and Bundy L 2007 *Sampling Soils for Testing* (Wisconsin: University of Wisconsin System, Cooperative Extension Publishing)

[30] Putrasamedja S, Setiawati W, Lukman L and Hasyim A 2016 *J. Hortik*. **22**, 349
[31] Prabaningrum L and Moekasan T 2014 *J. Hortik*. **24**, 179-188
[32] Davis F and Williams W 1992 *Visual rating scales for screening whorl-stage corn for resistance to fall armyworm. (No. Technical Bulletin 186)* (Mississippi: Mississippi State University).
[33] Cremen M C M, Martinez-Goss M R, Corre V L and Azanza R V 2007 *J. Appl. Phycol.* **19**, 615-624
[34] Cunha M E, Quental-Ferreira H, Parejo A, Gamito S, Ribeiro L, Moreira M, Monteiro I, Soares F and Pousão-Ferreira P 2019 *Aquaculture* **512**, 734297
[35] Costard G S, Machado R R, Barbarino E, Martino R C and Lourenco S O 2012 *Int. J. Fish. Aquacult*. **4**, 191-201
[36] Godoy L C, Odebrecht C, Ballester E, Martins T G and Wasielesky W 2012 *Aquac. Int*. **20**, 559-569
[37] Bozarth A, Maier U-G and Zauner S 2009 *Appl. Microbiol. Biotechnol*. **8**2, 195-201
[38] Gerba C P 2015 *Environmentally Transmitted Pathogens* in *Environmental Microbiology* (Elsevier) p 550
[39] Han P, Lu Q, Fan L and Zhou W 2019 *Appl. Sci*. **9**, 2377

6. Acknowledgments

The authors thank the Universitas Airlangga, Surabaya, East Java and Universitas Dhyana Pura, Bali for supporting our study. We are very grateful to the Pacific white shrimp farmers in Bulukumba Regency, South Sulawesi, who provided support and permission for this study.

CEK-SANI

ORIGINALITY REPORT

16%	12%	10%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	scholar.unair.ac.id Internet Source	2%
2	eprints.utm.my Internet Source	2%
3	Yaoguo Wu, Mengying Yi, Bo Zhou, Zhiyuan Liang, Ran Sun, Sihai Hu, Qian Guo, zhaohui Meng, Erfan ye. "Batch and column tests study on coexistence of TNT and aniline enhancing their Transports in Chinese loess", Research Square Platform LLC, 2022 Publication	2%
4	M Ohashi, G Oomi, H Sakurai. "Effect of pressure on the giant magnetoresistance of Fe/Tb multilayer", Journal of Physics: Conference Series, 2006 Publication	1%
5	ifory.id Internet Source	1%
6	bioone.org Internet Source	1%

7	www.semanticscholar.org Internet Source	1 %
8	www.growingscience.com Internet Source	1 %
9	ijpbs.com Internet Source	1 %
10	bg.copernicus.org Internet Source	1 %
11	ir.lib.nchu.edu.tw Internet Source	1 %
12	www.fisheriesjournal.com Internet Source	1 %
13	M.E. Cunha, H. Quental-Ferreira, A. Parejo, S. Gamito, L. Ribeiro, M. Moreira, I. Monteiro, F. Soares, P. Pousão-Ferreira. "Understanding the individual role of fish, oyster, phytoplankton and macroalgae in the ecology of integrated production in earthen ponds", Aquaculture, 2019 Publication	<1 %
14	Luthfiana Aprilianita Sari, Nabila Al Diana, Sulastri Arsad, Kustiawan Pursetyo, Yudi Cahyoko. "Monitoring of Phytoplankton Abundance and Chlorophyll-a Content in the Estuary of Banjar Kemuning River, Sidoarjo	<1 %

Regency, East Java", Journal of Ecological Engineering, 2021
Publication

15	businessdocbox.com Internet Source	<1 %
16	Elis Indrayanti, Lilik Maslukah, Metya Astariningrum, Muhammad Zainuri. "Impact of Nutrients and Suspended Particulate Matter on Phytoplankton Chlorophyll-a Biomass, in the Estuary of Kendal, Indonesia", Ecological Engineering & Environmental Technology, 2022 Publication	<1 %
17	Norha Constanza Bolívar Ramírez, Marysol Santos Rodrigues, Ariane Martins Guimarães, Cristhiane Guertler et al. "Effect of dietary supplementation with butyrate and probiotic on the survival of Pacific white shrimp after challenge with Vibrio alginolyticus", Revista Brasileira de Zootecnia, 2017 Publication	<1 %
18	www.suaire.sua.ac.tz Internet Source	<1 %
19	Chunpeng Fu, Fajun Li, Chengjiang Xu, Lihua Wang, Mengyu Tian, Yuqing Chang, Yu Xin, Ruiqing Lin. "Transcriptome analysis of the potential molecular mechanism of enteritis in intestine and hepatopancreas of Litopenaeus	<1 %

vannamei", Comparative Biochemistry and Physiology Part D: Genomics and Proteomics, 2022
Publication

20	www.mdpi.com Internet Source	<1 %

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		

CEK-SANI

GRADEMARK REPORT

FINAL GRADE

/0

GENERAL COMMENTS

Instructor

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8