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JURNAL PENELITIAN PERIKANAN INDONESIA
Volume 30 Nomor 4 Desember 2024
p-ISSN: 0853-5884
e-ISSN: 2502-6542
Nomor Akreditasi RISTEK-BRIN: 148/M/KPT/2020

PENGARUH PENGGUNAAN WARNA LAMPU UFLPLUS *(UNDERWATER FISH LAMP PLUS)* YANG BERBEDA TERHADAP KELIMPAHAN PLANKTON DI PERAIRAN PULAU WAWONII

THE EFFECT OF USING DIFFERENT UFLPLUS (UNDERWATER FISH LAMP PLUS) LIGHT COLORS ON THE ABUNDANCE OF PLANKTON IN THE WATERS OF WAWONII ISLAND

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Teregistrasi I tanggal: 03 Oktober 2024; Diterima setelah perbaikan I tanggal: 23 April 2025; Disetujui terbit tanggal: 24 April 2025

ABSTRAK

Plankton merupakan organisme kecil yang mempunyai peranan penting dalam kelangsungan hidup berbagai organisme di perairan. Kelimpahan plankton, khususnya fitoplankton, bergantung pada keberadaan cahaya. Penelitian ini bertujuan untuk mengetahui pengaruh perbedaan warna cahaya UFLPlus (kuning dan hijau) terhadap kelimpahan dan indeks biologis plankton di Perairan Pulau Wawonii. Penelitian dilakukan dengan metode purposive sampling yang terdiri dari 4 trip. Pengambilan sampel dilakukan dengan menggunakan jaring plankton sebanyak 3 kali pengulangan pada setiap trip. Data perbedaan warna cahaya yang diperoleh ditentukan dengan menggunakan rumus kelimpahan dan indeks biologis. Semua data dianalisis menggunakan uji Mann Whitney Non Parametrik. Hasil penelitian menunjukkan bahwa genus Oscillatoria sp dan Chaetoceros sp merupakan genus yang paling banyak ditemukan pada semua trip. Rata-rata kelimpahan plankton di Perairan Pulau Wawonii, Kepulauan Konawe dengan menggunakan cahaya UFLPlus hijau sebesar 4699 Ind/L, lebih tinggi dibandingkan dengan rata-rata kelimpahan plankton dengan menggunakan cahaya UFLPlus kuning sebesar 3115 Ind/L. Indeks keanekaragaman plankton menunjukkan kategori rendah (1,2), sedangkan indeks keseragaman berada pada kategori rendah (0,4) dan tidak terdapat dominasi (0,23) (p=0,2). Perbedaan warna lampu UFLPlus (kuning dan hijau) tidak memberikan pengaruh yang nyata terhadap kelimpahan dan indeks hayati plankton (kategori rendah untuk indeks keanekaragaman dan keseragaman, sedangkan tidak terdapat spesies yang dominan), khususnya untuk Oscillatoria sp dan Chaetoceros sp di Perairan Pulau Wawonii.

KATA KUNCI: Kelimpahan; Warna Cahaya; Plankton; UFLPlus

ABSTRACT

Plankton are small organisms that have an important role in the survival of many organisms in the waters. The abundance of plankton, especially phytoplankton, depends on the presence of light. This study aim to determine the effect of different colors of UFLPlus light (yellow and green) to the abundance and biological index of plankton in the Waters of Wawonii Island. The research was conducted using a purposive sampling method which consisted of 4 trips. Sampling was carried out using a plankton net for 3 repetitions in each trip. The obtained data of light color differences were determined using the abundance formula and biological index. All data was analyzed using the Mann Whitney Non-Parametric test. The results showed that the genus Oscillatoria sp and Chaetoceros sp were the most common genera found in all trips. The average abundance of plankton in the waters of Wawonii Island, Konawe Islands using green UFLPlus light was 4699 Ind/L, higher than the average abundance of

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DOI: http://dx.doi.org/10.15578/jppi.30.4.2024.168-179

plankton using yellow UFLPlus light of 3115 Ind/L. The plankton diversity index showed low category (1,2), while the evenness index is low category (0,4) and there is no dominance (0,23) (p=0,2). The different colors of UFLPlus light (yellow and green) did not give a significant impact on the abundance and biological index of plankton (low category for diversity and uniformity index, while has no dominance species), especially for Oscillatoria sp and Chaetoceros sp in the Waters of Wawonii Island.

INTRODUCTION

Plankton as a marine organism has a very important role as a natural food source for fish and other marine organisms or as a biotic component that determines components in the sea and its presence can influence the primary productivity of waters (Stoń-Egiert et al., 2010). Plankton community composition varies spatially and temporally at different scales, and influences higher levels of marine food webs and marine biogeochemical cycles (Mangolte et al., 2022). The diversity of an ecosystem impacts its productivity and stability (Tilman et al., 2014). Abiotic interactions such as temperature, light nutrition and biotic interactions in the form of competition (Barton et al., 2010), predation (Prowe et al., 2012; Vallina et al., 2014), and dispersion in the form of transport and mixing by ocean currents (Ward et al., 2021) affects the diversity of planktonic ecosystems. There are plant plankton or phytoplankton and animal plankton or zooplankton, both of which are tiny organisms that float freely in the waters (Mangolte et al., 2022). Phytoplankton are the main autotrophic organisms in marine life. Through the process of photosynthesis, phytoplankton are able to become a source of energy for all marine biota in the food pyramid in the sea (Yosi et al., 2023), mediate carbon fixation, play a major role in biogeochemical cycles and contribute significantly to the collection of organic matter in the sea. sea (Mangolte et al., 2022), while zooplankton are herbivores that prey on phytoplankton or are the first consumers and are one of the main variables in playing an ecological role (Bettinetti & Manca, 2013). Plankton, especially phytoplankton, need light for photosynthesis. This makes phytoplankton easy to find in the surface water column.

Light is the most important energy source for the growth of autotrophic organisms, especially phytoplankton microalgae (Maltsev et al., 2021). Optimal ecosystem function must be supported by lighting that is appropriate to the growth conditions of microalgae (Raqiba & Sibi, 2019; Airs et al., 2014). A good ecosystem must be able to support life in it. The measure of the quality of an ecosystem can be known from the implementation of the production process or primary productivity which can take place if there is light to support the photosynthesis process (Le et al., 2010). Research results (Metsoviti et al., 2020; Pal et al., 2011; Xu et al., 2018; Palanisamy et al., 2020) showed that light affects the growth characteristics and production of microalgae. According to (Rezai et al., 2018) the intensity of sunlight causes chlorophyll to carry out the photosynthesis process effectively. Light has an intensity and wavelength that can influence cell metabolism and biomass composition (Katam et al, 2022). The amount of light intensity affects the chlorophyll a and b content in microalgae, research by Amelia et al., (2023) shows that the chlorophyll a and b content is higher in cultures with a light intensity of 3000 lx compared to a light intensity of 6000 lx. Thus, the presence of light is very necessary for the continued life of organisms in waters.

The use of light in the field of capture fisheries is something that is very important because it really helps the fishing process both during the day and at night, this is because fish generally have positive phototaxis and there is a food source in the form of plankton which is natural food in the sea (Fajriah et al 2020; Fajriah et al 2022; Hikmawati et al., 2014). Phytoplankton and zooplankton influence the catch of anchovies, which is also supported by findings on the food composition of anchovy stomachs (Hikmawati et al., 2014). At night, fishing activities require fishermen to use artificial light due to the low intensity of light received. One of the artificial lights comes from the Underwater Fish Lamp Plus (UFLPlus) designed by the researcher, where the productivity of fishing for boat lift nets using UFLPlus is 41% higher than using surface lights on boat lift nets (Fajriah et al., 2020). There were two main components of UFLPlus technology including light-emitting diode (LED) as a fish attractants and light frame as an UFLPlus protector (Fajriah et al., 2022).

The artificial light that comes from UFLPlus uses green and yellow light. Research results show that there are significant differences in fish catches with the use of different light colors (Fajriah et al., 2022). The UFLPlus technology is a new and indispensable for the development of marine fishing technology and management of fishery resources. It was capable as an underwater immersion lamp that attracts fish attention and directly monitors the arrival of fish in the water in the fishing area (Fajriah et al., 2022).

Wawonii Island are one of the capture fisheries centers in Southeast Sulawesi. This is as disclosed by Ahmad et al (2018) that Wawonii waters are fishing centers and as transit areas for fish caught by fishermen before being marketed to Kendari. However, there is no researchs about the phytoplankton in the waters of Wawonii Island. Therefore, the objective of this study was to determine the effect of different colors of UFLPlus light (yellow and green) to the abundance and biological index of plankton in the Waters of Wawonii Island.

MATERIALS AND METHODS

Research Location and Design

The research took place from May to July 2022 including field and laboratory procedure. The field procedure was conducted in the waters of Wawonii Island, Konawe Regency, Southeast Sulawesi Province, by applying the UFLPlus tool with green and yellow lights at different hauling times in boat fishing operations, measuring temperature and the waters of Wawonii Island, Konawe Islands Regency. Field sampling was carried out on a boat chart measuring 17 m x 17 m for 4 consecutive nights (trips) with the same sampling coordinate points on each trip, namely 04 11.503' South Latitude and 122 57.807' East Longitude. In the first night, 3 repetitions were carried out every hauling time so that 12 repetitions were obtained for each green and yellow color treatment at the same sampling point. Sampling was carried out in this way with the consideration that the same season and sampling location would minimize the influence of differences in the abiotic conditions of the location and currents. The abundance of phytoplankton fluctuates influenced by seasons,

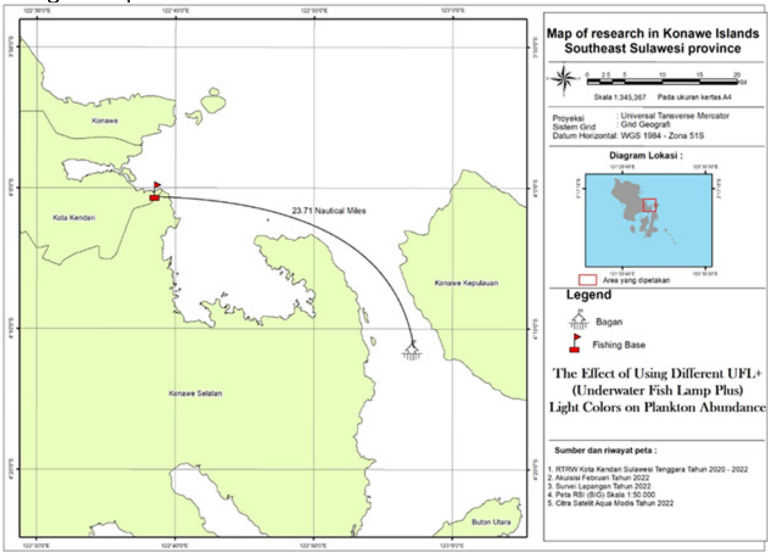

Figure 1. Map of Research Location

Research Material

The equipment used in this study include; 1unit UFLPlus green light and 1 unit UFLPlus yellow light (UFLPlus specifications: LED type lamp, electric power 30 watts and a power source voltage of 12 – 60 Volt DC (Fajriah et al., 2021), digital camera, plankton net with mesh size 200 m, sample bottle 50 ml, rope, meter, volume pipette, dropper pipette, coolbox, thermometer, refractometer, pH meter, GPS, microscope, SRC and plankton identification guide book. The materials used are sample water from surface waters at the location point and lugol.

Data Collection

The research method used is exploratory research which aims to find out a certain event or the relationship between two or more variables. As for the data collection method using purposive random sampling method, namely the placement of sampling points intentionally by considering the location of the boat chart that operates around current movement (up welling), dissolved oxygen and differences in abiotic conditions at each station, especially salinity and temperature (Orizar et al., 2024). Water sampling is also used to measure oceanographic parameters in the field such as temperature using a thermometer, salinity using a refractometer, water acidity using a pH meter, and sampling locations using GPS. Sampling was carried out horizontally and actively pulled beside the ship for 2 minutes using a plankton net and filtering 30 liters of water. The water sample was stored in a 50 ml sample bottle and preserved with Lugol's solution then labeled according to the treatment and sample repetition then stored in a coolbox to laboratory procedure.

Data Analysis

Identification of plankton

Sample identification was carried out at the Water Productivity and Environment Laboratory, Faculty of Fisheries and Marine Sciences, Haluoleo University. Identification was carried out using a microscope with the help of Sedgwick Rafter Counting (SRC). Each plankton observed was photographed, then morphological identification was carried out at the class and genus level using the help of the Phytoplankton identification catalog book, Saldanha Bay, South Africa and the Marine zooplankton identification book practical guide vol. 1-2 (Al-Yamani et al., 2014).

Calculation of Plankton Abundance and Analysis of Plankton Biological Index (Diversity Index), Uniformity Index, Dominance Index.

The abundance, diversity and uniformity of plankton was conducted based on Evita et al., (2021), the formula that can be used to determine the abundance of plankton is calculated based on the APHA formula (Rice et al., 2005), and the formula that can be used to determine the diversity index (H') and uniformity index (E') is using the index equation Shannon-Wiener. While the dominance index (C) can be calculated using the Simpson dominance index. Abundance of Plankton:

$$\mathrm{N} = \frac{T}{L} + \frac{p1}{p2} + \frac{v1}{v2} + \frac{1}{w}$$

Where:

N: abundance of plankton (eng/L)
T: Number of squares in SRC (1000)
L: Number of squares in one field of view
P1: Number of plankton observed
P2: Number of SRC boxes observed
V1: Volume of water in the sample bottle
V2: Volume of water in SRC box
W: Volume of filtered water

Diversity Index (H'):

$$\mathrm{H} = -\sum_{t=0}^{1} \mathrm{pi} \ln pi$$

Information:

H: Diversity Index
pi: ni/N
ni: Number of individuals of type i
N: Total number of individuals

The Shannon diversity index value can be classified as follows

2 = low diversity
2 < H'≤ 3 = moderate diversity
H' ≥ 3 = High diversity

Evenness index (E) or Uniformity Index

$$E = \frac{H'}{Hmaks}$$

Information:

E: Evenness index (E) or Uniformity Index
H': Shannon Wiener diversity index
Hmax: Ln S (maximum diversity index)
S: Number of genera found

The category of uniformity index value (E) is if the value:
0.00 - 0.50 = community is in a depressed condition,
0.50 - 0.75 = community is in unstable condition and
0.75 - 1.00 = community is in stable condition

Dominance Index (D)

$$\mathrm{D} = -\sum_{i=0}^{i} \left(\frac{ni}{N}\right) 2$$

Information:

C: Simpson dominance index
ni: Number of individuals of type i
N: Total number of individuals

The range of values of the Simpson dominance index can be classified as follows:

0 = no dominant species (stable community structure)
1 = there is one species that dominates the population (unstable community structure, ecological pressure occurs)

Statistical Analysis

All data were analyzed using SPSS type 21. Data analysis to determine the effect of using different colors of UFLPlus lamps on the abundance of plankton was analyzed by the Mann Whitney Non-Parametric test.

RESULTS AND DISCUSSION

Identification of Plankton

The results of the identification of the type and total number of plankton based on the class and genus found on each trip in the research area both in the treatment using UFLPlus yellow light and green light were found as shown in Table 1. The number of plankton species in the study site in the 2 treatments were found 17 species, consisting of 15 types of phytoplankton (yellow light Ind/L; green light Ind/L), including; Oscillatoria sp. (2250; 2976), Protoperidinium sp. (12 ; 21), Ceratium sp. (9; 18), Dinophysis sp. (0; 27), Coscinodiscus sp. (424; 42), Rhizosolenia sp. (15; 39), Melosira sp. (273; 348), Chaetoceros sp. (603; 2013), Coconeis sp. (3; 3), Diatoma sp. (3; 12), Eunotia sp. (15; 12), Navicula sp. (12; 6), Synedra sp. (30; 21), Pinnularia sp. (15; 0) Thallasionema sp. (0; 15), and 2 types of zooplankton, among others ; Copepods sp. and Codonellopsis sp. The 15 types of phytoplankton identified were from the classes Bacillariophyceae, Cyanophyceae, Dinophyceae and Coscinodiscophyceae. While the 2 types of zooplankton found were from the Crustacea class (6;19) and the Cilliata class (0; 9). percentage of plankton in the use of yellow UFL+ light was found in plankton of the Oscillatoria sp type of 65.96%, while the highest percentage of plankton in the use of yellow UFL+ light was found in plankton of the Chaetoceros sp type of 38.07%.

The results of abiotic observations of the aquatic environment as plankton habitat are shown in Table 2, while the analysis of the abundance of plankton and the biological index of plankton consisting of

Table 1. Identification of Types and Total Number of Plankton Based on Class and Genus on Each Trip Using UFLPlus Yellow light and Green light

Plankton	Class	Genus	Amount of Plankton (Ind/L)	
			UFL+ Yellow light	**UFL+ Green Light**
Phytoplankton	Cyanophyceae	*Oscillatoria sp*	2250	2976
	Dinophyceae	*Protoperidinium sp*	12	21
		Ceratium sp	9	18
		Dinophysis sp	0	27
	Coscinodiscophyceae	*Coscinodiscus sp*	424	42
		Rhizosolenia sp	15	39
		Melosira sp	273	348
	Bacillariophyceae	*Chaetoceros sp*	603	2013
		Coconeis sp	3	3
		Diatoma sp	3	12
		Eunotia sp	15	12
		Navicula sp	12	6
		Synedra sp	30	21
		Pinnularia sp	15	0
		Thallasionema sp	0	15
zooplankton	Crustacea	*Copepoda sp*	6	19
	Cilliata	*Codonellopsis sp*	0	9
Amount			3670	5581

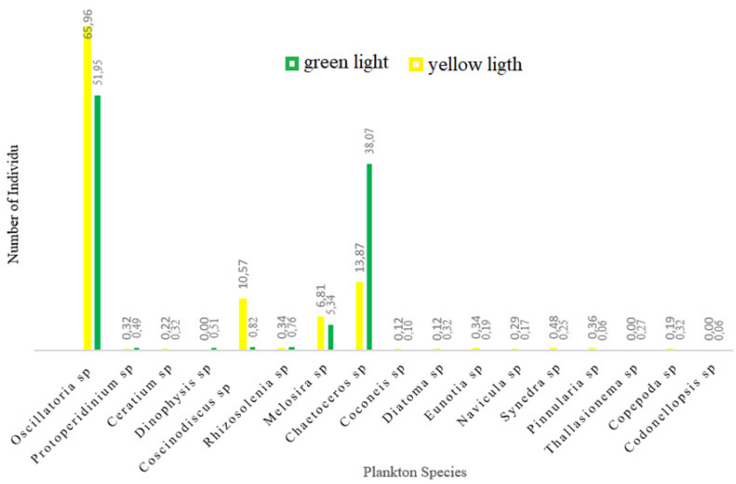

Figure 2. Percentage of the Number of Plankton Species Obtained Both in the Use of Yellow and Green UFLPlus Lights

The percentage of the number of species of all types of plankton obtained both with the use of yellow and green UFLPlus lamps is shown in Figure 2. Based on Figure 2, the highest diversity, uniformity and dominance in the fishing chart area using yellow and green UFLPlus lights is obtained as shown in Table 3. Table 2 showed that salinity around 35-36 o/oo, pH around

7,3-7,8 ppt, and temperature around 25-26°C.

Table 2. Measurement Results of the Average Value of Abiotic Parameters for Each Trip of the Aquatic Environment

Parameter	Average Value of Each Trip			
	Trip 1	Trip 2	Trip 3	Trip 4
Salinity ($^o/_{oo}$)	36	35	35	36
pH (ppt)	7,6	7,5	7,3	7,8
Temperature (°C)	25	25	26	26

Table 3. Analysis of Plankton Abundance and Plankton Biological Index Using Yellow and Green UFLPlus Lamps

Plankton	Class	Genus	Treatment: UFLPlus Yellow Light – Average Number of Individuals on Trip (Ind/L)				UFLPlus Green Light – Average Number of Individuals on Trip (Ind/L)			
			1	2	3	4	1	2	3	4
Phyto plankton	Cyanophyceae	*Oscillatoria* sp	532	-	166	52	107	647	158	80
	Dinophyceae	*Protoperidinium* sp	-	1	2	1	4	2	1	-
		Ceratium sp	-	-	1	2	5	-	1	-
		Dinophysis sp	-	-	-	-	4	3	-	2
	Coscinodiscophyceae	*Coscinodiscus* sp	4	95	26	15	9	-	1	4
		Rhizosolenia sp	-	1	4	-	9	-	3	1
		Melosira sp	9	53	4	25	37	28	41	10
	Bacillariophyceae	*Chaetoceros* sp	104	1	46	50	287	142	142	100
		Coconeis sp	-	-	-	1	1	-	-	-
		Diatoma sp	-	-	-	1	1	-	2	1
		Eunotia sp	3	1	-	1	1	2	1	-
		Navicula sp	3	-	-	1	1	-	-	1
		Synedra sp	-	2	8	-	6	-	1	-
		Pinnularia sp	-	-	4	1	-	-	-	-
		Thallasionema sp	-	-	-	-	3	-	-	2
zoo plankton	Crustacea	*Copepoda* sp	-	-	1	1	4	-	1	-
	Cilliata	*Codonellopsis* sp	-	-	-	-	3	-	-	-
Abundance (N) (Ind/L)			5240	1386	2227	3608	4284	7407	2896	4208
Average Abundance (Ind/L)			3907							
Diversity Index (H')/Trip (Ind/L)			0,6005	0,85	1,2016	1,115	1,3245	0,651	1,241	1,339
Diversity Index (H')/ (Ind/L)			1,2							
Uniformity Index (E)/ Trip (Ind/L)			0,3352	0,44	0,5219	0,44	0,4475	0,364	0,499	0,31
Uniformity Indeks (E) / (Ind/L)			0,4195							
Dominant Index (D) / Trip (Ind/L)			0,5	0,13	0,2	0,1	0,26	0,4	0,2	0,1
Dominant Index (D) / (Ind/L)						0,2363				

Based on the calculation of the abundance of plankton in Table 3, it is known that the average abundance of plankton in the use of yellow UFLPlus light is 3115 Ind/L and the average abundance of plankton in the use of green UFLPlus light is 4699 Ind/L. In general, there are differences in the number of plankton from both phytoplankton and zooplankton types. The big difference is found in the genera Oscillatoria sp. and Chaetoceros sp., while in the other genera they are almost the same in number. In the genera Oscillatoria sp and Chaetoceros sp., a greater number of plankton was found using green UFLPLus light than yellow UFLPLus light. The percentage of abundance in the genus Oscillatoria sp. was 66% in the use of yellow UFLPLus light and 52% in the use of green UFLPLus light, while in the Chaetoceros sp. plankton was found to be 13.8% in the use of yellow UFLPLus light and 38.07% on the use of green UFLPlus light. In addition, based on the results of the total abundance of plankton, the highest abundance of plankton was found on the 2nd trip with the use of green light of 7407 ind/L and the lowest was on the 2nd trip with the use of yellow

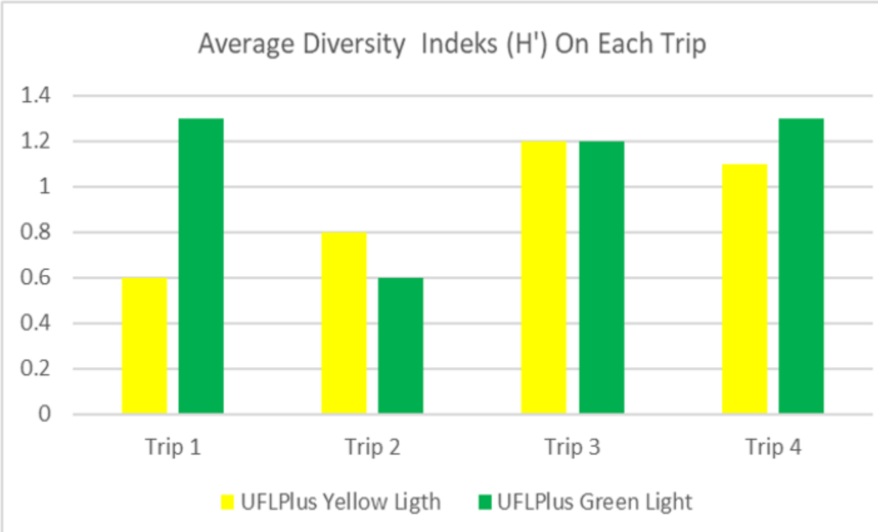

Figure 3. Diversity Index (H')

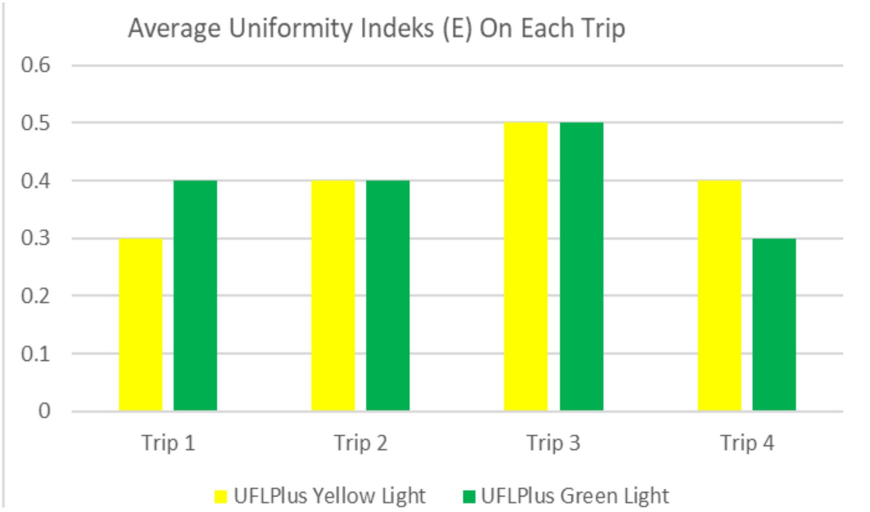

Figure 4. Uniformity Index (E)

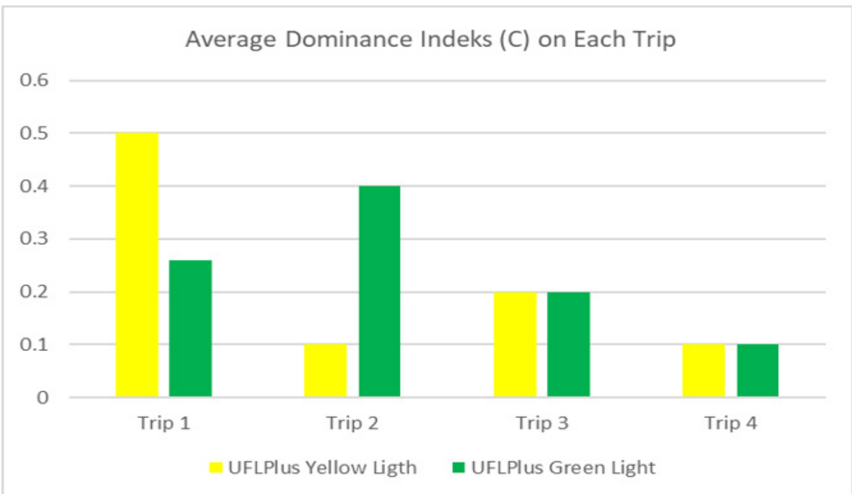

Figure 5. Dominance Index (C)

light of 1386 ind/L. The existence of this difference is thought to have something to do with the attraction of plankton to the color of light as fish, especially in the genus Oscillatoria sp. and Chaetoceros sp.

UFLPlus yellow light was found that the average diversity index value was different on each trip, although the value was not that far away, whereas in the use of green UFLPlus there is one trip, namely the 2nd trip which has a diversity index value that is much smaller than the other 3 trips (Figure 3). While the uniformity index values obtained on each trip both in the use of yellow UFL+ light and green UFL+ light show relatively the same value. The uniformity index (E) of plankton using yellow and green UFLPlus light is shown in Figure 4. Then the domination index value obtained on the use of yellow UFL+ light on trip 1 shows a higher value than the other three trips, and on the use the green UFL+ light on trip 2 shows a higher value than the other three trips. The Dominance index (D) of plankton using light UFLPlus yellow and green are shown in Figure 5.

The results of the analysis of the effect of the use of yellow and green UFLPlus lamp colors on the abundance of plankton based on the Mann-Whitney Test showed that the treatment of using different light colors did not give a significant difference to the abundance of plankton (p=0.2).

Identification, Analysis of Plankton Abundance and Biological Index Using Different UFLPlus Light Colors

Class Bacillariophyceae is a group that has many types of genera that are found both in the use of yellow and green UFLPlus light. This is because the Bacillariophyceae class has a good tolerance for habitat (Becerril et al., 2010) although the amount of plankton found in each genus was dominated by Chaetocerus sp, 603 Ind/L were found in the use of yellow UFLPlus light and as many as 2013 Ind/L in the use UFLPlus light green color. The availability of phytoplankton such as Chaeroceros sp in waters is very important because it is natural food for aquatic biota in the larval and juvenile stages such as shrimp, fish, abalone and mollusks, they are abundant in quantity and very suitable for all warm waters (Vilicic et al., 2009). According to several references, the abundance of Chaeroceros sp is influenced by abiotic parameters such as pH and salinity (Sergio et al., 2017). According to Lampert and Sommer (2007) salinity is a chemical factor that plays an important role in the water balance process in Bacillariophyceae cells such as Chaetoceros sp. This phytoplankton is tolerant to fluctuations in salinity levels ranging between 30-35o/oo (Barsanti and Gualtieri, 2006). pH affects the physiology of Bacillariophyceae cells, the pH value that supports growth is around 7-9 (Barsanti & Gualtieri, 2006). The salinity and pH values measured in the waters of Wawonii Island as in Table 2 are still in accordance with the range values, so it is very natural that there is an abundance of Chaetoceros sp.

In general, the type of plankton that is most often found using green UFLPLus light and yellow UFLPlus light is from the Cyanophyceae class, the genus Oscillatoria sp., at 66% when using yellow light and 52% when using green light as shown in Figure 1. This shows that Oscillatoria sp. is a genus of algae that is very tolerant of the physical conditions of the aquatic environment and has positive phototaxis towards light. Stanca and Parsons (2017) revealed that the abundance of Oscillatoria sp. is 16% of the total microalgae biovolume in Florida waters. This need for light is what makes Oscillatoria widely found, resulting in an abundance in areas where UFLPlus lamps are installed.

In addition to Chaetoceros sp and Oscillatoria sp, there are also genera that appear frequently in almost every trip and repetition as well as when using UFLPLus light, although the numbers are not as numerous as in Table 3, including the genera Coscinodiscus sp., Melosira sp. and Rhizosolenia sp. This is thought to be because each repetition experienced the same treatment starting from the sampling method and time to the relatively similar weather and the abiotic parameter measurement results which tended to be the same as in Table 2, thus allowing the sample water to have almost the same quality tendency. In general, Coscinodiscus sp is a diatom that is cosmopolitan and tolerant of environmental changes that occur. This is in accordance with the opinion of Rigual et al., (2013) that Coscinodiscus sp is a type of phytoplankton that is often found in sediments in the North-West Mediterranean and is able to survive poor water conditions, and can be used as an indicator of material pollution. organic. The genera Melosira sp. and Rhizosolenia sp. often appear because these two types of algae are able to live even in waters that are indicated to be polluted, as stated by Tuo et al., (2017) that algae that live in tropical waters are limited in nitrate, where levels of mild to moderate contamination includes Melosira sp., and Rhizosolenia sp.

There are 2 classes of zooplankton found during research in the waters of Wawonii Island, namely from the Crustacea class, the genus Copepoda sp., and from the Cilliata class, the genus Codonellopsis sp. Of the genus Copepod sp, 6 Ind/L were identified when using yellow light and 19 Ind/L when using green light. As for the Cilliata class, the genus Codonellopsis sp., it was identified that it was not found when using yellow light and there were 9 Ind/L when using green light. Based on the identification results, the type of crustacean class that dominates is found to have the ability to survive when compared to other classes such as Cilliata sp. Cilliata sp. is able to adapt to estuarine, coastal and open waters (Santoferrara et al., 2018). The low number of zooplankton found in the research area is because, according to their nature, zooplankton will migrate to deeper waters if the light is very high. Because this organism has negative phototaxis, zooplankton will avoid light from UFLPLus. This is as in the research of Leach et al., (2015) that zooplankton carry out Diel Vertical Migration (DVM) to avoid predators and ultraviolet or light.

The genus Oscilatoria sp, which has more individuals than other genera, results in the diversity index (H') obtained in the waters of Wawonii Island being classified as low, both in the use of yellow and green UFLPLus light, which averages around 1.2. The diversity value criteria refer to the Shanon Wienner diversity index value (Bramasta et al., 2020). Based on Figure 3, it can be seen that the value of H' on the use of yellow and green UFLPlus light on each trip tends to fluctuate with the value obtained being classified as moderate. Such H' values tend to be low on each trip due to cloudy waters due to the temporary rainy season during sampling, such water conditions trigger species dominance. High rainfall and waves allow wider turbidity due to silt, soil particles, plant debris or phytoplankton (Evita et al., 2021).

The Evennes index (E) as shown in Figure 4, both in the use of yellow and green UFLPLus light, is in the low category with an average value of about 0.4, but has not yet reached water conditions dominated by certain species, because the uniformity value has not yet reached close to zero. According to (Astuti et al., 2012), if the uniformity index is close to zero, the uniformity between species in the community is low. The uniformity index close to 1 indicates that the uniformity between species is even or equal (Pirzan and Pong-Masak, 2008).

Water dominance index (C) indicates the presence or absence of dominating aquatic biota. C value close to 1 means that there is biota that dominate and can be used as an indicator of pollution or damage to the aquatic environment, while if the C value is equal to zero, there are no extreme species that dominate other species (Astuti et al., 2012; Pirzan and Pong-Masak, 2008). Unpolluted waters have high biota diversity, with high number of species, and low number of individuals per species, while polluted waters have low diversity with abundant number of individuals per species, resulting in dominance (Astuti et al., 2012). Based on Figure 5 shows the average Dominance Index in the waters of Wawonii Island with the use of yellow UFLPLus light on each trip of 0.23 while with the use of green UFLPLus light on each trip it is 0.24. This value indicates that no species dominates or that the community structure is stable. This is because the waters of Wawonii Island are far from densely populated and industrial settlements.

Effect of the use of UFLPlus light color on the abundance of plankton

According to Loupatty (2012) as it is known that the smaller or shorter the wavelength of a light color, the greater the effect of stimulation on fish. Green light with a wavelength of 500 nm has a transmission rate of 90% per meter and yellow light with a wavelength of 600 nm has a transmission rate of 80% per meter. It was also added by Loupatty (2012) that blue and green lights have the ability to penetrate deeper into the water when compared to other colors, because they are less absorbed by the particles in the water. So it can be said that the penetration ability of the green color allows the fish, including the plankton Oscillatoria sp and Chaetoceros sp (Table 3) that are at great distances, both vertically and horizontally to be attracted and come closer to or towards the direction of the green UFLPlus light. This is in accordance with the research results of Prates et al., (2018) that the use of green, red and white LEDs can increase biomass productivity and maximum specific growth rate in various microalgae, especially Spirulina sp.

This is the basis that green UFLPLus light is more effective than yellow. However, because the difference in the number of large plankton is only found in the two genera, so the results of the analysis of the effect of differences in the use of yellow UFLPLus light with the use of green UFLPLus light on the abundance of plankton based on the Mann-Whitney Test conducted indicate that the use of different UFLPLus light colors does not gave a significant difference effect on the abundance of plankton with statistical results $p > 0.05$.

CONCLUSION

The different colors of UFLPlus light (yellow and green) did not give a significant impact on the abundance and biological index of plankton (low category for diversity and uniformity index, while has no dominance species), especially for Oscillatoria sp and Chaetoceros sp in the Waters of Wawonii Island.

ACKNOWLEDGEMENT

The author would like to thank Kendari Muhammadiyah University for facilitating the research and also all parties who have assisted in carrying out this research.

AUTHORS' CONTRIBUTIONS

All authors have contributed to the final manuscript. The contribution of each author as follow, F: Conceptualization, Methodology, Analysis, Data curation, Manuscript writing. KTI: Conceptualization, Methodology, Analysis, Data curation, Manuscript revision. All authors discussed the results and contributed to the final manuscript.

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