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Functional Correlation of Seagrass Meadows and Ichthyofauna in the Coastal Waters of the Lampung Bay, Indonesia

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Abstract: This article describes the roles of seagrass meadows used by fish in different ways, as a feeding ground, spawning ground, and hiding shelter from predators, based on the density of seagrass, sizes of fish, and trophic levels of ichthyofauna. It is discovered that the lengths of specific ichthyofauna occupy different seagrass densities and trophic levels. The study was performed from October 2018 to March 2019 in the Bay of Lampung, Lampung Province. The study included eight different stations, which were determined by purposive sampling. The data collection regarding seagrass density was performed by the quadrate transect method, and the sample collection of ichthyofauna was conducted with gill nets. The seagrass density was correlated with the classes of ichthyofauna sizes and the trophic levels were correlated with the classes of ichthyofauna sizes using Correspondence Analysis (CA). The study results show that the trophic groups of ichthyofauna species are dominated mainly by the trophic group of the carnivore, followed by omnivore, and herbivore as the least trophic group. The results of the correspondence analysis show the correlation of the seagrass density with the ichthyofauna's length. In contrast, the large-size ichthyofauna prefers the seagrass meadows with a high-density level, as the small-size ichthyofauna prefers the seagrass meadows with a low level of density. The correlation of seagrass density with the trophic group shows that the herbivore trophic group ichthyofauna has smaller sizes than the carnivore and omnivore ichthyofauna.

Keywords: density, meadow, ichthyofauna, Bay of Lampung.

印度尼西亚楠榜湾沿岸水域海草草甸和鱼类群落的功能相关性

摘要：本文根据海草的密度、鱼类的大小和鱼群的营养水平，描述了鱼类以不同方式使用的海草草甸的作用，如觅食地、产卵地和躲避捕食者的庇护所。发现特定鱼群的长度占据不同的海草密度和营养水平。该研究于2018年10月至2019年3月在楠榜省的楠榜湾进行。该研究包括八个不同的站点，这些站点是通过有目的的抽样确定的。海草密度数据采集采用方形样线法，鱼群样品采集采用刺网法。海草密度与鱼群大小的类别相关，营养水平与使用对应分析(认证机构)的鱼群大小的类别相关。研究结果表明，鱼类物种的营养组以食肉动物的营养组为主，其次是杂食动物，草食动物的营养组最少。对应分析的结果显示了海草密度与鱼群长度的相关性。相比之下，大型鱼群更喜欢密度高的海草草地，而小型鱼群则更喜欢密度低的海草草地。海草密度与营养群的相关性表明，食草动物营养群鱼群的体型比肉食性和杂食性鱼群小.

关键词： 密度，草地，鱼群，楠榜湾。

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1. Introduction

Seagrass ecosystem occupies the coastal areas as the confluence of the land and ocean waters, and therefore it derives dynamic and heterogeneous ecosystems [27]. This ecosystem plays a role as the recycler of the organic substances of nitrate and phosphate [33], in addition to its function as vegetation that entraps the sediment containing organic matters. Therefore, it can provide the habitats for the growth and breeding of algae and epiphytic fauna [3]. Abundant organic substances can be utilized as energy sources for food webs present in the seagrass ecosystem. Furthermore, seagrass with complex morphologic structures provides a wide range of microhabitats, which support the highly diverse ichthyofauna. The thick rhizome and canopy of seagrass leaves may serve as hiding shelters for ichthyofauna's protection against predation and attract ichthyofauna to associate with seagrass [3, 10, 14, 24]. The high density and diversity of seagrass vegetation can contribute to the abundance of ichthyofauna [20, 28].

Seagrass meadows, as one of the primary coastal ecosystems, have a high level of productivity ranging between 500 – 1000 g C/m^2 per year [4], as well as have a vital role as nursery or raising, protection, and feeding grounds [1], and support for the ichthyofauna's food web [30]. The seagrass ecosystem significantly supports the existence and the life cycle and habitat of a wide variety of ichthyofauna species, especially for those of high economic value [5]. Thus, it also significantly contributes to the fishery and benefits the communities living in the coastal regions [8]. Currently, the seagrass ecosystem suffers from substantial pressures, and there has been a disturbing anthropogenic degradation [23].

The fast-growing human activities along the coastal areas have created some impacts, both directly and indirectly, on the seagrass ecosystem [9]. Three main threats or hazards posed by human activities to the seagrass ecosystem are eutrophication, overfishing, and physical habitat destruction, resulting in various impacts in the form of reducing seagrass productivity, which will eventually cause the decreasing productivity of the associated ichthyofauna [10].

Hence, this study aims to analyze the contribution of the seagrass ecosystem to ichthyofauna in the Bay of Lampung waters.

2. Methodology

2.1. Time and Location of Sampling

This study was conducted from October 2018 to March 2019 in the Bay of Lampung, Lampung Province, Indonesia (Figure 1). We collect the data of the seagrass and ichthyofauna communities at eight study stations which were determined by purposive sampling, which are the island of Tangkil (1TL), Sari Ringgung Beach (2SRL), Bay of Hurun (3THLM), Lahu (4LLM), Kapuran Beach (5KPLT and 7KPLMT), the island of Mahitam (6MLT) and the island of Kelagian (8KGLMT).

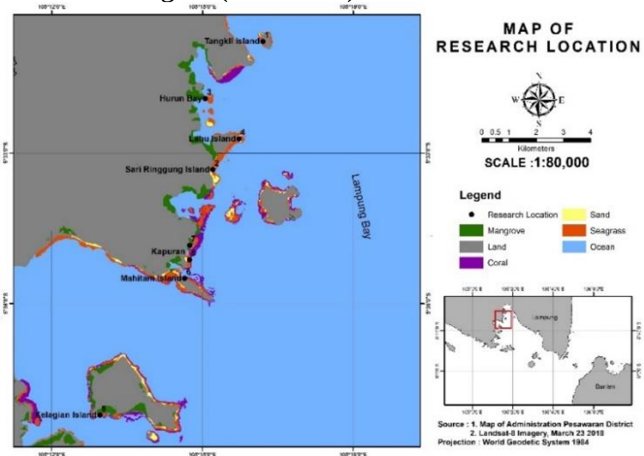


Fig. 1 Study locations in the coastal waters of the Bay of Lampung

2.2. Seagrass Data Collection

The seagrass data collection was performed at each study station using a quadrate transect of 50 cm x 50 cm in size. The quadrate transect was placed in 3 (three) transect lines, every 100 m in length, stretched perpendicular to the coastal lines [4, 11]. The distance between the quadrate transects placed alternatingly along the transect lines is as far as 25 m. In each quadrate transect, the seagrass species found were identified [21], and the number of buds of each seagrass species found was determined.

2.3. Ichthyofauna Data Collection

The sampling of ichthyofauna was carried out at each study station using gill nets. The sample collection of ichthyofauna was conducted twice a month throughout the study period of six months. The trips made for the capture activity started from the fishing base to the fishing ground at 4.00 PM and returned to the fishing base at 05.00 AM on the following day. The samples of the ichthyofauna collected from the nets were then stored in the cool box. Upon arrival at the fishing base, the fish samples were measured for their Standard Lengths/SL and weights and further preserved with 40% formalin solution. Subsequently, the identification of ichthyofauna species was conducted at the Laboratory of Macro Biology, Study Program of Water Resource Management, Faculty of Fishery and Marine Science, IPB University.

2.4. Data Analysis

2.4.1. Density of Seagrass

Seagrass density is the total number of individuals of one particular seagrass species present in one area unit previously measured. The density of seagrass species can be determined by [11]:

$$K_i = \sum_{i=1}^{p} \frac{n_i}{A}$$

where:

K_i = the density of the i^{th} species (ind/m^2); n_i = total number of individuals or saplings within transect I^{th} (ind.); A= total area of sample collection of (m^2)

The density of seagrass species in all the study stations was then determined according to the respective density classes as presented in Table 1.

Table 1 The classes of seagrass meadows by density [7], [13]

Class	Density (ind/m^2)	Condition
5	> 175	Very dense
4	125 – 175	Dense
3	75 – 125	Fairly dense
2	25 – 75	Scarce
1	< 25	Very scarce

2.4.2. The Composition of Ichthyofauna Size

The composition of the sizes of each ichthyofauna species is divided into three phases. The first phase determines lengths and sizes classes, the second phase determines the intervals of the classes, and the third phase determines the percentage of each length and sizes class.

2.5. Analysis of Ichthyofauna's Stomach

Each sample of ichthyofauna species preserved was then analyzed to the composition of their stomach's content using the frequency method of occurrence to identify and record each organism found in the fish's digestive system, quantified in percentage. The identification was conducted at the Laboratory of Macro Biology, Study Program of Water Resource Management, Faculty of Fishery and Marine Science, IPB University. The analysis on the content of their stomach is intended to identify the trophic group of each ichthyofauna species: the "herbivore" group consumes seagrass, epiphyte, algae; the "carnivore" group consumes fish and benthic invertebrate; and the "omnivore" group consumes benthic invertebrate, fish, plankton, seagrass, epiphyte, and algae.

2.6. Statistical Analysis

Data collected consist of the density of seagrass species, and the size classes of ichthyofauna species and the trophic groups are presented in the form of a table with the assistance of MS Exel. The correlation of the seagrass density with the size class of ichthyofauna and the trophic level with the size class of ichthyofauna were then analyzed using Correspondence Analysis/CA [6].

3. Results and Discussion

3.1. Distribution and Density of Seagrass Species

The seagrass species found in the Bay of Lampung waters consist of 6 species; one is categorized as the type of large seagrass comprising three species, which are *Cymodocea serulata*, *Enhalus acoroides*, and *Thalassia hemprichii*, as the type of small seagrass consists of 3 species, which are *Halodule ovalis*, *Halodule pinifolia* and *Halodule uninervis* (Table 2). The diversity of seagrass species in the Bay of Lampung waters is 46% of the seagrass species found throughout the waters of Indonesia, totaling 13 species of seagrass [17]. It is consistent with the study results by [26], who recorded six seagrass species identified in the Bay of Lampung waters. Additionally, based on the study by [16] in the waters of Lampung, seven seagrass species were found.

Table 2 Distribution of seagrass species at the study stations in the waters of the Bay of Lampung

Seagrass species	Type of seagrass	Station							
		1TL	2SRL	3THLM	4LLM	5KPLT	6MLT	7KPLMT	8KGLMT
Cymodocea serulata	LS	-	-	-	-	x	-	x	-
Enhalus acoroides	LS	x	x	x	x	-	x	x	x
Halodule ovalis	SS	-	-	-	-	-	x	x	x
Halodule pinifolia	SS	-	-	-	-	x	-	x	-
Halodule uninervis	SS	x	-	-	x	x	-	x	-
Thalassia hemprichii	LS	x	x	-	-	x	x	x	x

Notes: LS - large seagrass; SS - small seagrass; x - found; - - not found.

The analysis results on the average density of seagrass species at each of the observatory stations in the Bay of Lampung waters (Figure 2) are 152 individuals/m^2 at the island of Tangkil (1TL) station, 214 individuals/m^2 at Sari Ringgung beach (2SRL) station, 100 individuals/m^2 at Bay of Hurun (3THLM) station, 123 individuals/m^2 at Lahu (4LLM) station, 50 individuals/m^2 at Kapuran (5KPLT) station, 73 individuals/m^2 at the island of Mahitam (6MLT) station, 53 individuals/m^2 at Kapuran (7KPLMT) station, and 69 individuals/m^2 at the island of Kelagian (8KGLMT) station. According to [7] in [13], the conditions of seagrass can be divided into five classes by their density, namely more than 175 individuals/m^2 (very dense), 125 – 175 individuals/m^2 (dense), 75 – 125 individuals/m^2 (fairly dense), 25 – 75 individuals/m^2 (scarce) and less than 25 individuals/m^2 (very scarce). As a result, the density of the seagrass on the island of Tangkil is categorized as dense; at Sari Ringgung beach, the density of seagrass is categorized as very dense; at the Bay of Hurun and Lahu, it is categorized as fairly dense, as the seagrass meadows in Kapuran, the island of Mahitam, and the island of Kelagian are categorized as scarce. The widely varied conditions of the density and distribution of the seagrass are affected by, among other things, the physical factor, which is available substrates that contain substantial amounts of organics [15, 18].

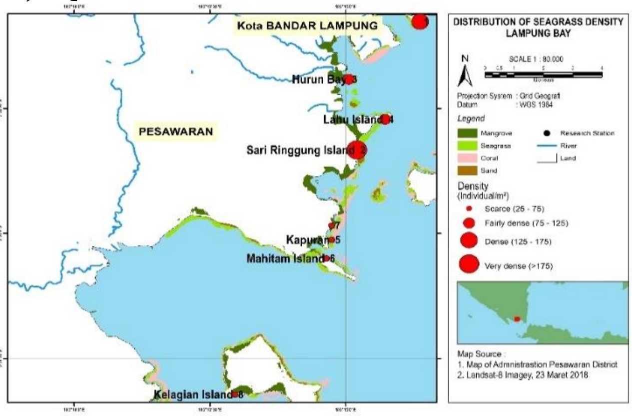


Fig. 2 Map on the distribution of seagrass density condition at the study stations in the Bay of Lampung waters. Remarks: 1TL (the island of Tangkil); 2SRL (Sari Ringgung beach); 3THLM (Bay of Hurun); 4LLM (Lahu); 5KPLT (Kapuran); 6MLT (the island of Mahitam); 7KPLMT (Kapuran); 8KGLMT (the island of Kelagian)

3.2. Types and Trophic Levels of Ichthyofauna

The study results on the seagrass meadows in the waters of the Bay of Lampung found 235 fish captured, consisting of 54 species classified in 31 families. Based on Table 3, three dominant species were found at the study stations: *Siganus fuscescens*, *Trachinotus blochii*, and *Siganus guttatus*, with the total catches of 42 fish 41 fish, and 23 fish, respectively, and they are classified in Singanidae and Carangidae families. If compared to the study results in the waters of the seagrass meadows of the National Ocean Parts of Wakatobi, four dominant species were captured, namely *Atherinomorus lacunosus Cheilodipterus quinquelineatus*, *Apogon hartzfeldii*, and *Sphaeramia orbicularis* [34]. In the waters of Tanjung Merah, North Sulawesi, the dominant species found are *Apogon margaritophorus* and *Apogon hartzfeldii* [31]. The dominant species found in the Bay of Sikao, Trang Province, Thailand are *Atherinomorus duodecimal*, *Sillago sihama*, and *Pelates quadrilineatus* [25]. According to [21], the presence of the mangrove and seagrass ecosystems can increase the biomass of the fish species as the presence of the coral reefs can provide nursery habitats.

Table 3 Species and trophic groups of ichthyofauna in the seagrass meadows of the Bay of Lampung waters

No	Fish Family and Species	Station								Number (fish)	Length (cm)	Trophic Group
		1TL	2SRL	3THLM	4LLM	5KPLT	6MLT	7KPLMT	8KGLMT			
	Atherinidae											
1	*Atherinomorus lineatus*	-	-	-	x	-	-	-	-	1	8.7	C
	Balistidae											
2	*Balistoides viridescens*	-	-	-	-	-	x	-	-	1	12	C
	Belonidae											
3	*Tyolosurus crocodilus*	x	-	-	-	-	-	-	-	1	85.6	C
	Carangidae											
4	*Carangoides oblongus*	-	-	-	x	x	x	-	-	4	14.5 - 18	C
5	*Carangoides praeustus*	x	-	-	-	-	-	-	-	1	29	C
6	*Caranx ignobilis*	-	-	-	-	x	-	x	-	2	17 & 21	C
7	*Caranxsex fasciatus*	-	-	-	-	-	x	-	-	5	17 - 19.5	C
8	*Selar boops*	x	-	-	-	-	-	-	-	9	17 - 20.3	C
9	*Selaroides leptolepis*	-	-	-	-	-	x	-	-	5	6 - 9	C
10	*Trachinotus blochii*	-	x	x	x	x	-	x	-	41	11.9 - 25	C
	Chaetodontidae											
11	*Parachaetodon ocellatus*	-	-	-	-	x	-	-	-	1	7.5	O
	Canidae											
12	*Chanos chanos*	-	-	-	-	-	x	-	-	1	46	O
	Dasyatidae											
13	*Pteroplatytrygon violacea*	-	-	-	-	-	-	x	-	1	128	C
	Drepaneidae											
14	*Drepane punctata*	-	-	-	-	-	-	x	-	2	9.5 & 9.5	C
	Echeneidae											
15	*Echeneis naucrates*	-	-	-	x	-	-	x	-	2	42 & 50	C
	Elapidae											
16	*Elops hawaiensis*	-	-	-	-	x	-	-	-	1	32	C
	Ephippidae											
17	*Platax batavianus*	-	-	-	-	-	x	-	-	1	9.5	O

Continuation of Table 3

18	*Platax orbicularis*	-	-	-	-	-	-	x	-	1	12	O
	Gerreidae											
19	*Gerres macracanthus*	-	-	-	-	x	-	-	-	2	8.7 & 10	C
20	*Gerres oyena*	x	-	x	-	-	x	x	-	7	9.5 - 16.3	C
	Haemulidae											
21	*Diagramma pictum*	x	-	-	-	-	x	x	-	3	18.6 - 21	C
22	*Plectorhinchus gibbosus*	-	-	-	-	-	-	x	-	4	17 - 23.5	C
23	*Plectorhinchus gibbosus*	-	-	-	-	x	-	0	-	2	16 & 17.5	C
	Holocentridae											
24	*Monacanthus chinensis*	x	-	-	-	x	-	-	x	8	9 - 14.2	O
25	*Neoniphon sammara*	x	x	-	-	-	-	-	-	3	11.4 - 17	C
	Lethrinidae											
26	*Lethrinus erythracanthus*	x	-	-	-	-	-	-	-	1	15.8 & 16.2	C
27	*Lethrinus harak*	-	x	-	-	x	x	-	x	6	12 - 18.5	C
28	*Lethrinus olivaceus*	-	-	x	-	-	-	-	-	1	10.1	C
29	*Lethrinus ornatus*	x	-	-	-	x	-	-	-	5	14 - 15.5	C
	Lutjanidae											
30	*Lutjanus gibbus*	x	-	-	-	-	-	-	-	1	25	C
31	*Lutjanus russellii*	-	-	-	-	-	-	x	-	1	13.5	C
32	*Lutjanus* sp.	-	-	-	-	x	x	-	-	2	14 & 27.5	C
	Megalopidae											
33	*Megalops cyprinoides*	-	-	-	-	x	-	-	-	1	23	C
	Monacanthidae											
34	*Pseudomonacanthus macrurus*	x	-	-	-	-	-	-	-	1	12.4	O
	Mugilidae											
35	*Planiliza subviridis*	-	-	-	x	x	-	-	-	10	17.5 - 32	H
	Mullidae											
36	*Upeneus sundaicus*	-	-	-	-	-	-	-	x	1	20.5	C
	Nemipteridae											
37	*Scolopsis ciliata*	-	-	-	-	x	x	-	-	2	10.5 & 15	C
38	*Scolopsis lineata*	x	-	-	-	-	-	-	-	1	8	C
	Ostraciidae											
39	*Lactoria cornuta*	-	-	x	x	-	x	-	-	3	8 - 15.3	O
	Paralichtyidae											
40	*Pseudorhombus elevatus*	-	-	-	-	x	x	-	-	3	15 - 18.5	C
	Plotosidae											
41	*Plotosus lineatus*	-	x	-	-	-	x	-	-	4	20 - 27.5	C
	Pomacentridae											
42	*Abudefduf septemfasciatus*	-	-	-	-	x	-	-	-	1	10.5	O
	Scombridae											
43	*Scombrops boops*	-	x	-	-	-	x	-	-	2	8 & 13.1	C
	Serranidae											
44	*Epinephelus areolatus*	-	-	-	-	x	-	-	-	1	21.5	C
45	*Epinephelus fuscoguttatus*	-	-	-	-	x	-	-	-	1	20	C
46	*Epinephelus sexfasciatus*	-	-	x	-	-	-	x	-	2	16.6 & 20.5	C
	Siganidae											
47	*Siganus fuscescens*	x	x	-	x	x	x	-	x	42	10.5 - 20.2	H
48	*Siganus guttatus*	x	x	x	x	x	x	x	x	23	10.4 - 23.5	H
49	*Siganus javus*	x	-	-	-	-	-	-	-	1	21	H
50	*Siganus stellatus*	-	-	-	-	x	-	-	-	1	21	H
51	*Siganus vermiculatus*	-	-	-	-	-	x	x	-	4	15 - 26	H
	Soleidae											
52	*Pardachirus pavoninus*	x	-	-	-	-	-	x	x	3	13 - 29	C
	Tetraodontidae											
53	*Arothron immaculatus*	-	-	x	-	-	-	-	-	1	13.8	O
54	*Chelonodon patoca*	-	-	-	-	-	x	-	-	1	16.5	C

Notes: x = found; - = not found; C = carnivore; H = Herbivore; O = omnivore.

The trophic groups of ichthyofauna species identified from the analysis results on the stomach of the ichthyofauna samples reveal that the trophic groups of ichthyofauna associated with the seagrass in the Bay of Lampung waters are dominated by the carnivore trophic group of 72.2%, and then followed by, the trophic group of omnivores for 16.7% and as the least, the trophic group of herbivores for 11.1% (Table 3). The feeds found in *Trachinotus blochii* species are carnivores consisting of chunks of fish meats, crabs, and shrimp larvae. The feeds found in the fish *Siganus fuscescens* herbivore group consist of seagrass pieces and some phytoplankton species (*Navicula* sp, *Nitzchia* sp, *Diatoma* sp). The feeds found in fish *Lactoria cornuta* species of omnivore consist of algae pieces, gastropods, sponge, and soft coral pieces.

Several studies in the waters of the seagrass meadows throughout Indonesia were related to the trophic group of ichthyofauna. One of them was done in the waters of Tanjung Luar, East Lombok, which was dominated by ichthyofauna under the trophic groups of carnivores 58.62%, herbivores 17.64%, planktivores 17.64%, and omnivores 5.88% [32]. In the waters of the National Ocean Parks of Wakatobi, the total quantity of the ichthyofauna trophic groups from both invertebrate and ichthyofauna groups are found to be the most abundant, in both night-time catch and daytime catch. It is followed by the omnivore group, which is found to be more abundant during the daytime catch than that of the night-time; as for the trophic group of herbivores, it has a minor level of abundance, both during night-time catch and daytime catch [34]. Based on the trophic groups in the Bay of Lampung waters, it shows that the catch yield of the ichthyofauna carnivore group is abundant during nighttime. According to [34], the availability of food sources for the invertebrate group is more abundant during the nighttime. The seagrass ecosystem provides the food sources for various ichthyofauna species, where the growing epiphytes and microalgae attach to the seagrass, and the invertebrate organisms use the burrows or holes in the sediments and thick seagrasses for their hiding places [12].

The fish species captured during the sample collection shows varied sizes based on the ichthyofauna species. The maximum length of species caught is 50 cm, as the minimum length is 6 cm. The size distribution by the lengths of ichthyofauna consists of 10 classes, with the most dominant and frequent class of the ichthyofauna species caught to be 16 – 20 cm (44%) (Figure 3).

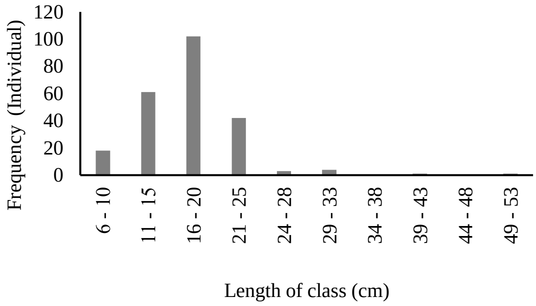


Fig. 3 The size distribution by the lengths of ichthyofauna catches in the Bay of Lampung waters

The size distribution by the lengths of ichthyofauna of each trophic group has different captures frequencies with varying sizes of ichthyofauna (Figure 4). For the trophic group of herbivores, the most dominant frequency of species captures is under the length class of 11 – 15 cm (10.3%), as for the carnivore trophic group, it is under the length class of 16 – 20 cm (30.2%), and similarly, for the omnivore trophic group, it is under the length of 16 – 20 cm (6.5%).

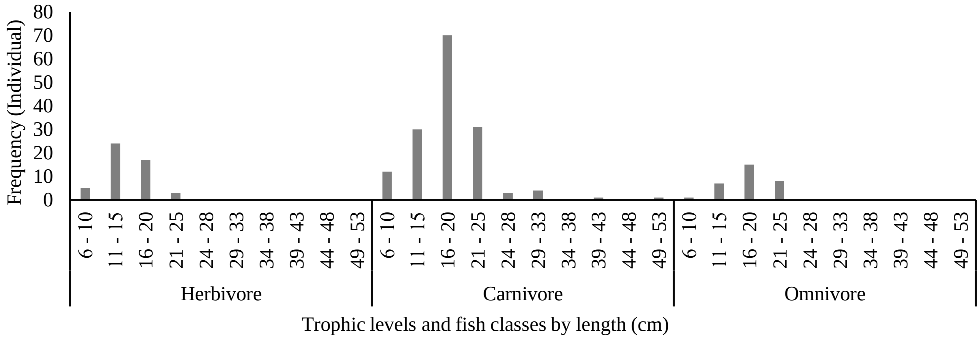


Fig. 4 The size distribution of fish caught by length for each trophic group in the Bay of Lampung waters

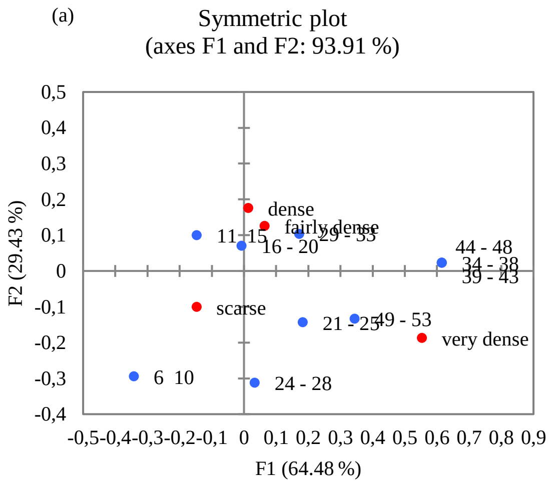
3.3. Correlation of the Ichthyofauna Size Class with Seagrass Density and Trophic Group

The correlation of seagrass density class with the length class of ichthyofauna's size is shown as having a pattern (Figure 5a). The length class of ichthyofauna is associated with the conditions of the seagrass meadows, which density is either very dense or dense. On the other hand, the short-size class of ichthyofauna is related to the seagrass meadows, which density is scarce. It means that the long-size mature ichthyofauna prefers seagrass meadows with high-density levels. In the meantime, the small/short size of ichthyofauna prefers seagrass meadows which density is low. Based on Figure 2, the higher levels of the seagrass density are found at stations 1TL (the island of Tangkil), 2SRL (Sari Ringgung), 3THLM (Bay of Hurun) and 4LLM (Lahu). At such observatory stations, the distribution of long-size seagrass species is more dominant, composed of *Enhalus acoroides* species and *Thalassia hemprichii* species. The seagrass density found at stations 5KPLT (Kapuran), 6MLT (Mahitam), 7KPLT (Kapuran), and 8KGLMT (the island of Kelagian) dominantly consists of the small/short seagrass species, such as *Halodule ovalis*, *Halodule pinifolia*, *Halodule uninervis* (Table 2). It is consistent with the study results [2] that the smaller ichthyofauna prefers to occupy the dense pioneer seagrass species, which are dominantly small in size (*Halodule uninervis*). By growing the ichthyofauna, they will move to the large-size seagrass meadows (*Tahassia hemprichii* and *Enhalus acoroides*). A similar tendency is found in *Micropogonias undulatus* species and *Sciaenops ocellatus* species, which have smaller sizes found in the small seagrass habitats (*Haladule wrightii*) and bigger sizes found in the large seagrass habitats (*Thalassia testudium*) [29].

The movement of the ichthyofauna to larger-size seagrass meadows due to the growing size of ichthyofauna is intended to camouflage from their predators [19], and ichthyofauna can choose the habitats where the mortality rate is lower [29].

In Figure 5b, the correlation of the seagrass' density classes with the ichthyofauna trophic groups shows a pattern that the ichthyofauna trophic group of the herbivore tends to have the shorter-size of ichthyofauna by length as, on the other hand, the trophic groups of carnivore and omnivore have longer sizes of ichthyofauna. The ichthyofauna under the trophic groups of herbivore has smaller or shorter sizes than the carnivore and omnivore trophic groups.

The herbivore group in the trophic web is categorized as the first consumer-level consisting of small fish which consume phytoplankton. The ichthyofauna trophic group associated with the seagrass of the Lampung Bay waters is dominated by a carnivore of 78%, followed by omnivore for 15%, and the lowest is the fish under the trophic group of herbivores for 7%. The abundance of the carnivore trophic group, where the seagrass meadows provide the feeding grounds for the fish [14] owing to the biomass abundance of invertebrates in the seagrass meadows [22]. Foods, such as crustaceans and epibenthic found are significantly increasing during the night-time in a significant amount of abundance [34], and ichthyofauna found in the seagrass is generally dominated by fish that consume small fish and crustacean [22].



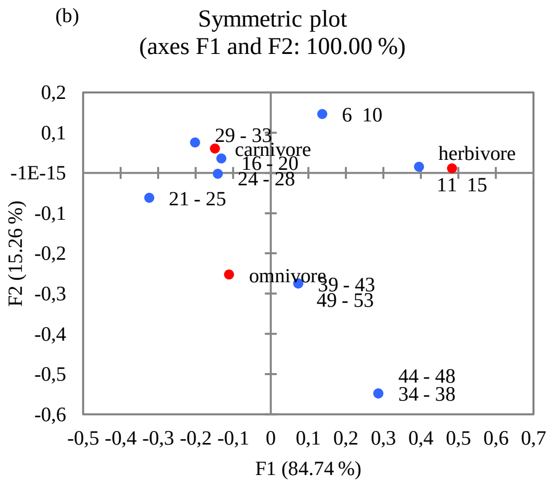


Fig. 5 The results of correspondence analysis (CA): (a) The correlation of seagrass density classes with the size classes of ichthyofauna by length; (b) The correlation of seagrass density classes with the trophic groups in the coastal waters of Bay of Lampung

4. Conclusion

Seagrass species found in the Bay of Lampung waters consist of 6 species. The ichthyofauna consists of 54 species from 30 families with 235 fish *throughout the seagrass meadows of the Bay of Lampung waters*. The most frequent distribution by the captured ichthyofauna's length is dominated by the ichthyofauna class of 16 – 20 cm. The most trophic group of ichthyofauna species is dominated by a carnivore, followed by omnivore, as the least trophic group is an herbivore. The functional correlation of the seagrass meadows with ichthyofauna species shows that the large-size ichthyofauna prefers the seagrass meadows with a high-density level, as the small-size ichthyofauna prefer the seagrass meadows with a low level of density. The correlation of seagrass density with the trophic groups shows a pattern that the ichthyofauna's herbivore trophic group tends to have shorter-size classes of ichthyofauna in terms of their length, as the trophic groups of carnivore and omnivore have greater or longer-size classes of ichthyofauna. However, the study on the height of the seagrass canopy of each type of seagrass is needed since it affects the abundance of ichthyofauna in the seagrass meadows.

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