Fish community structure based on density and coverage of seagrass meadows_Bioflux Journal

by Rignolda Djamaluddin 18

Fish community structure based on density and coverage of seagrass meadows in North Oba, Tidore Islands, North Maluku

[1]Darmawaty, [1]Salim Abubakar, [2]Rene C. Kepel, [2]Rignolda Djamaluddin, [1]Nurhalis Wahidin, [1]Rina, [1]Riyadi Subur, [1]Mesrawaty Sabar, [1]Masykhur A. Kadir, [1]Nebuchadnezzar Akbar

[1] Faculty of Fisheries and Marine Sciences, Khairun University, Ternate, North Maluku, Indonesia; [2] Faculty of Fisheries and Marine Sciences, Sam Ratulangi University, Manado, Indonesia. Corresponding author: N. Akbar, nezzarnebuchad@yahoo.co.id

Abstract. The high density and diversity of seagrass meadows help fish communities, because seagrass vegetation is utilized as a direct food source for herbivore fish, as foraging area for various fish species, nursery ground, protected area and spawning ground. This study aims to characterize the fish community structure based on seagrass meadows ecological condition. The methods used are the line transect and different fishing methods. The results of the study showed a healthy seagrass condition in Sibu Island and Tanjung Gosale, while the seagrass in Guraping Village is unhealthy and in Galala Village is poor. The density of seagrass species in Sibu Island and in Tanjung Gosale is categorized as solid, while the category in Guraping Village is sparse and in Galala Village very rare. Fish abundance is highest in Sibu Island (21 species, 286 individuals) with a good healthy condition. Tanjung Gosale (18 species, 188 individuals) had a good healthy condition of seagrass and Guraping Village (13 species, 93 individuals) presented damaged conditions. Abundance of fish in Galala Village was comprised of 8 species, 63 individuals, with a damaged condition. Fish community structure showed a medium diversity of fish, low dominance and normal distribution.
Key Words: aquatic, condition, diversity, niche, habitat.

Introduction. Seagrass meadows have ecological and economic functions. Ecologically, they serve as a source of primary productivity, sediment trapping, shelter, spawning grounds, nursery grounds, feeding grounds for marine biota (Rina et al 2018), but also as coastal guards, oxygen generators and CO_2 reducers. The economic function is indirectly related to fish, because there is more catch in seagrass meadows, which also help the development of fisheries (Iftinaan et al 2017). The fish abundance in seagrass meadows is higher with sand, coral rubble or mud (Pratiwi & Ernawati 2018; Tebaiy et al 2021). Seagrass meadows have an ecological role in the life cycle of fish (Abubakar & Achmad 2013). The composition of fish in seagrass meadows has a high diversity depending on time and area. Some fish use seagrass as a permanent habitat, while some species of fish live there temporary, in the juvenile phase, as seasonal inhabitants or in migration patterns (Latuconsina & Rappe 2014; Lensun et al 2019).

The abundance and diversity of fish in seagrass meadows depends on the composition of seagrass species (Lensun et al 2019). Previous research reported the composition of fish in Wakatobi Marine National Park, with 18 species (Nanto et al 2016), in Kendari Waters, Southeast Sulawesi, with 73 species and 1815 individuals (Rahmawati et al 2012), in Bali (Tanjung Benoa), with 21 fish families (Faiqoh et al 2017), in South Bangka, with 25 species of fish associated with 6 species of seagrass (Febrina et al 2018). The growth and density of seagrass is influenced by tidal patterns, turbidity, salinity and water temperature (Ahmad-Kamil et al 2013; Bulmer et al 2018). Human activities such as fisheries, housing development, harbor and recreation affect seagrass life. Fauna associated with seagrass is affected by siltation and low levels of dissolved oxygen due to the high biological oxygen demand in the seagrass area. Changes in coastal areas due to human activity have already caused disruption of seagrass ecological function, namely the loss environmental elements such as spawning and nursery grounds (Tangke 2010).

The seagrass meadows in North Oba are degraded due to human activities. Development activities damage the seagrass ecosystem, thereby reducing the area of seagrass fields. The impact of seagrass degradation is indicated by the decrease in the diversity of marine biota. Fish research on seagrass meadows in the waters of North Maluku was reported by Kaeli et al (2016) in the waters of Loleo, South Vedic District of Central Halmahera Regency, with 19 species of fish and by Rina et al (2018) on Sibu Island, with 16 species of fish. Previous research has provided data on fish species, but there is little information on fish community structures based on density and cover of seagrass. Given the importance of the role of seagrass resources for the diversity of fish living in seagrass ecosystems, further studies of fish abundance are needed in various conditions and densities of seagrass. The goal of this research is to characterize fish community structure based on density and coverage of seagrass meadows in Tidore Islands.

Material and Method. The research was conducted from April to July 2020 in North Oba, Tidore Islands (Galala Village, Guraping Village, Sibu Island and Tanjung Gosale) (Figure 1). Galala Village is a transport link for ferries and a port for adjacent traditional markets. Guraping village is a speadboat transportation location and beach reclamation area. Sibu Island is an uninhabited island with coastal ecosystems (mangroves, seagrasses and coral reefs). Tanjung Gosale is a bay where fishing boats land and has coastal ecosystems (mangroves, seagrasses and coral reefs).

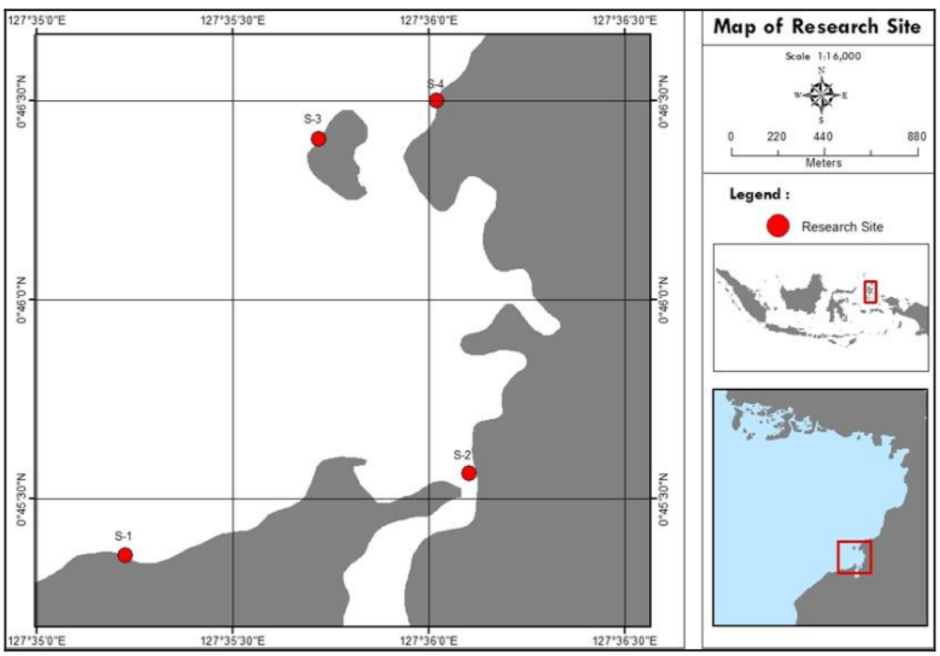

Figure 1. Research location.

Samples collection. Data collection of seagrass was conducted in the low tide using the line transect method (Abubakar & Achmad 2013). 3 transect lines with a length of 100 m were placed with a distance between them of 20 m. From each transect, 10 squares of

50x50 cm were selected randomly. The percentage of seagrass coverage and seagrass species was determined (Hutomo & Nontji 2014) (Figure 2).

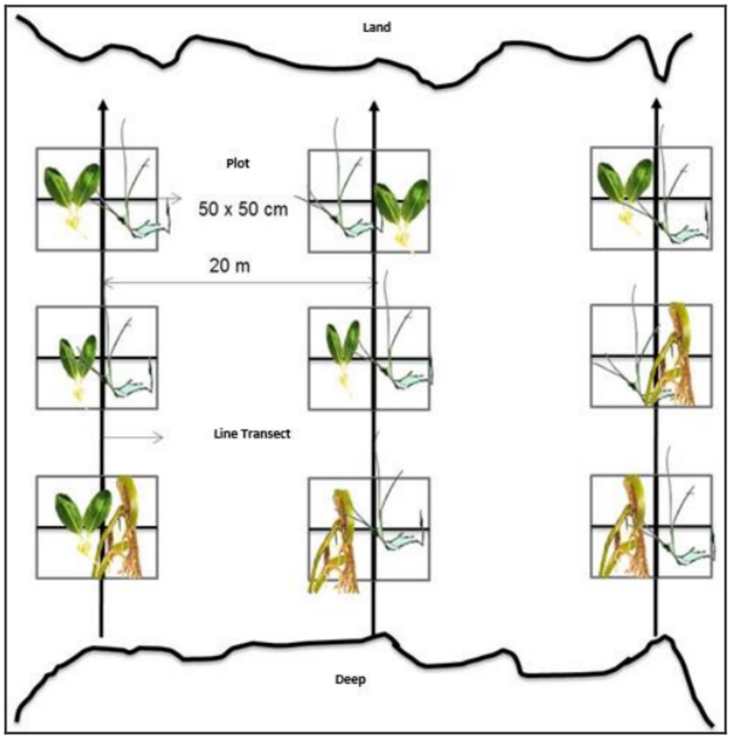

Figure 2. Seagrass sampling.

Fish sampling was carried out in the low and high tide phases using the swept area method. Fish samples were collected using a 50 m beach trawl. Fish caught were placed in sample bags and recorded according to the date and research station. The bags were placed in a cool box, transported to a laboratory and placed in a freezer. Fish were identified using the guidelines of Peristiwady (2006).

Data analysis. The seagrass coverage was obtained based on the 50 x 50 cm quadrant data (Figure 3), and used the guidelines of Hutomo & Nontji (2014):

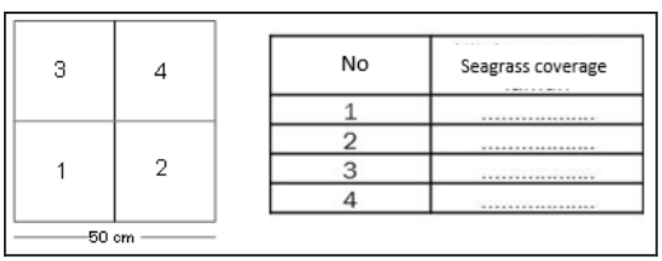

Figure 3. Box number on quadrant 50 x 50 cm.

Table 1

Seagrass coverage categories

Categories	Coverage (%)
Full coverage	100
Coverage ¾ Quadrant	75
Coverage ½ Quadrant	50
Coverage ¼ Quadrant	25
Empty	0

Note: 0–25% - rare; 26–50% - medium; 61–75% - solid; 76–100 - very solid.

The following formula calculates the percentage of seagrass cover in each transect plot:

$$\text{Seagrass coverage in plot } (\%) = \frac{\text{total coverage}}{4}$$

The seagrass condition criteria (Ministry of Environment Law No. 200/2004) is presented in Table 2.

Table 2

Seagrass condition assessment

Status		Coverage (%)
Good	Rich/Healthy	>60
Damaged	Less rich/less healthy	30–59.9
	Poor	<30

Seagrass density was analyzed after Fajarwati et al (2015).

Table 3

Scale of seagrass conditions based on density (Martha et al 2019)

Scale	Density (ind m^{-2})	Criteria
5	>175	Very high
4	125–175	High
3	75–125	Normal
2	25–75	Rare
1	<25	Vey rare

Fish abundance calculated using the formula of Sarisma et al (2017). The diversity of the fish was determined using the Shannon-Wiener index (Rondo 2015). Species dominance was determined based on Rondo (2015). The percentage was used to determine the spread of each organism in an occupied habitat after Wibisono (2005). According to Rondo (2015), if H'<1, the species diversity is low, and if H'>3, the species diversity is high. If C is close to 0, no species dominates, while if the value of C is close to 1, there is at least one dominating species. The density of seagrass is determined based on the scale from Table 3.

Results and Discussion

Composition and distribution of seagrass species. The seagrass composition consisted of 2 families, each with 5 species: family Potamogetonaceae (*Cymodocea rotundata*, *Cymodocea serrulata*, *Holodule uninervis*, *Halodule pinifolio* and *Syringodium isiotifolium*) and family Hydrocaritaceae (*Enhalus acoroides*, *Thalassia hemprichii*, *Halophila minor*, *H. ovalis*) (Table 4).

Table 4

Composition and distribution seagrass species

No	Family	Species	Stations			
			A	B	C	D
1	Potamogetonaceae	*Cymodocea rotundata*	-	-	√	√
2		*Cymodocea serrulata*	-	-	√	√
3		*Halodule uninervis*	-	√	√	-
4		*Halodule pinifolia*	√	-	-	√
5		*Syringidium isiotifoilium*	√	√	√	√
7	Hydrocaritaceae	*Enhalus acoroides*	√	√	√	√
8		*Thalassia hemprichii*	√	√	√	√
9		*Halophila minor*	-	√	√	√
10		*Halophila* ovalis	-	-	√	-

Note: A - Galala Village; B - Guraping Village; C - Sibu Island; D - Gosale; √ - present.

The composition of seagrass species is abundant in Sibu Island because seagrass grows on varied substrates namely sand, mud, coral rubble. It also prefers high water brightness, for photosynthesis. On the other hand, there are anthropogenic activities in Galala village (near seaports and traditional markets), so the waters are murky and the substrates muddy. Some of the limiting factors on seagrass growth are low water transparency and light penetration, salinity, temperature and anthropogenic activities (eutrophication, sedimentation, water pollution) (Tangke 2010).

S. isiotifilium, *E. acoroides* and *T. hemprichii* were found in all locations, forming hetero-species seagrass fields. *T. hemprichii* is a common species and can interact with other seagrass species (Dewi et al 2017). *T. hemprichii* is the dominant species compared to *H. ovalis*, *H. uninervis* and *C. serrulata* on sand and corral rubble substrates. *T. hemprichii* normally lives on muddy sand substrates associated with *C. serrulata*, *E. acoroides*, *H. uninervis*, *S. isoetifolium*, and *H. ovalis*.

Seagrass coverage. Seagrass coverage in Sibu Island is between 81.88-93.21%, in Gosale it is between 70.97- 81.12% and in Guraping Village is between 27.33-45.51%. Low seagrass coverage was observed in Galala Village 20.67-34.75%. Sibu Island and Tanjung Gosale have the highest coverage (healthy), while Guraping Village and Galala Village entered the unhealthy category regarding seagrass coverage. The cause of the difference in seagrass conditions is mainly due to anthropogenic activity. Sibu Island and Tanjung Gosale have healthy seagrass conditions because they are situated far from residential areas, while in Galala Village and Guraping Village anthropogenic activity is very high in the form of disposal of solid and liquid waste into the water, ship and speed boat transportation lines, as well as reclamation activities, inhibiting photosynthesis. Seagrass cover is affected by environmental pressure and brightness level (Alhaddad & Abubakar 2016). Human activities in coastal areas such as fisheries, residential development areas, harbors and recreation areas affect seagrass life (Tangke 2010).

Seagrass density. The average seagrass densities in Sibu Island, Gosale and Guraping Village were 130 ind m^{-2}, 127 ind m^{-2} and 66 ind m^{-2}, respectively. The lowest density was observed in Galala Village (an average of 24 ind m^{-2}). *T. hemprichii* had the highest density, while *H. ovalis* had the lowest density (Table 5). Seagrass density was higher for *T. hemprichii*, as it can grow on diverse subtrates. This species has small leaves, so it has a higher percentage of standing when compared to species that have large shapes and morphology such as *E. acoroides*.

T. hemprichii can form a single community. It often dominates mixed vegetation with spreads of up to 25 m and can grow on various substrates. A larger size of seagrass means a lower number of individuals that can inhabit a certain area (Bratakusuma et al 2013). *H. ovalis* is very sensitive to environmental changes, being difficult to find in polluted areas, and almost absent in where it can be covered by sediment derived from community waste (Fajarwati et al 2015).

Table 5

Seagrass density

No	Species	Stations			
		Galala	Guraping	Sibu Island	Gosale
1	*Cymodocea rotundata*	0	0	135	46
2	*Cymodocea serrulata*	0	0	165	62
3	*Halodule uninervis*	0	27	149	0
4	*Halodule pinifolia*	14	0	0	178
5	*Syringidium isiotifoilium*	17	90	154	144
6	*Enhalus acoroides*	13	60	135	140
7	*Thalassia hemprichii*	53	150	275	313
8	*Halophila minor*	0	2	12	9
9	*Halophila ovalis*	0	0	14	0
	Total	98	329	1039	891
	Average	24	66	130	127

The density of seagrass species is related to seagrass condition. Sibu Island and Tanjung Gosale both present a density of seagrass. Guraping village has a rare seagrass density and Galala Village has a very rare seagrass density. Martha et al (2019) categorize densities as follows: solid density - 175 ind m^{-2}; tight density - 125-175 ind m^{-2}; normal density - 75-125 ind m^{-2}; rare density - 25-75 ind m^{-2}; and very rare density - <25 ind m^{-2}.

Fish community structure. Fish species composition showed 4 orders (Perciformes, Beloniformes, Gonorhynchiformes, Mugiliformes), 14 families (Siganidae, Lethrinidae, Lutjanidae, Scaridae, Serranidae, Labridae, Achanturidae, Carangidae, Pomancentridae, Mullidae, Hemiramphidae, Belonodae, Chanidae, Mungilidae) and 23 species (*Siganus canaliculatus*, *S. doliatus*, *Lethrinus ornatus*, *L. lencam*, *L. harak*, *Lutjanus carponotatus*, *Leptopcarus vaigiensis*, *Scarus quoyi*, *S. dimidiatus*, *Chlorus japanensis*, *Epinephelus quoyanus*, *Pseododax mallucanus*, *Cheilio inermis*, *Acanthurus bariene*, *Caranx melampygus*, *Gnathanodon speciosus*, *Caranx ignobilis*, *Dischistodus perspiciliatus*, *Mulloidichthys flavolineatus*, *Upeneus tragula*, *Hemirhamphus far*, *Tylosurus crocodilus*, *Chanos chanos*, *Chelon subviridis*) (Table 6).

The fish community structure in Galala Village has a diversity index of 2, a dominance index value of 0.15 and an evenness value of 0.96. Guraping Village has a H' value of 2.37, a dominance index of 0.11, and E=0.92. In Sibu Island, H' is 2.83, C=0.07, and E=0.93. Tanjung Gosale presented the following values: H'=2.61, C=0.1, E=0.9. The results showed that all research sites had moderate diversity, low dominance and an even spread (Figure 4).

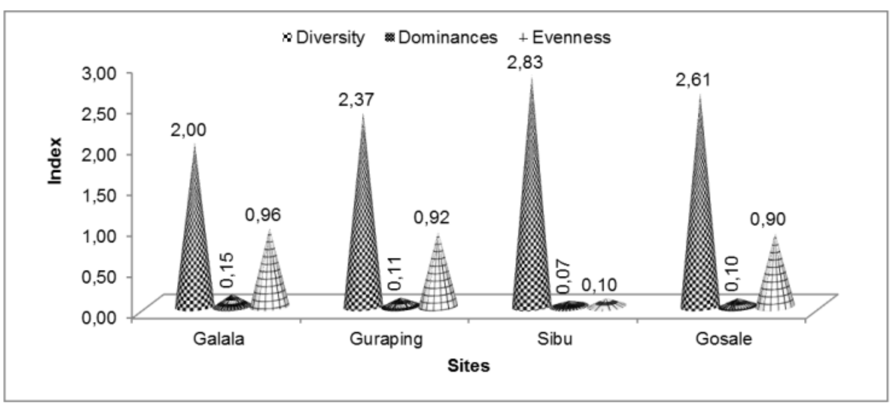

Figure 4. Fish community structure in seagrass meadows.

The diversity of species in Sibu Island is due to the higher number of families (12), species (21), and individuals (286). Galala Village presented 8 families, 8 species and 63 individuals. Based on the number of individuals, *S. canaliculatus* was in a moderate category, with 40 individuals in Sibu Island and 37 in Tanjung Gosale, while other species are in the low category. Gosale presented 18 species (188 individuals), and Guraping Village 13 species (93 individuals) (Table 6). The difference in the abundance of fish species of each research station shows a relationship with the condition and density of seagrass from each research station. The good condition of seagrass (Sibu Island) with with a density of tight category has more fish species (21 species). The lowest number of fish species (8) was found in the site with the seagrass in very rare condition.

Table 6

Fish species composition

No	*Family*	*Species*	*Stations*			
			Galala	*Guraping*	*Sibu Island*	*Gosale*
1	*Siganidae*	*Siganus canaliculatus*	√	√	√	√
2	*Siganidae*	*Siganus doliatus*	-	-	√	√
3	*Lethrinidae*	*Lethrinus ornatus*	-	√	-	√
4	*Lethrinidae*	*Lethrinus lencam*	√	-	√	-
5	*Lethrinidae*	*Lethrinus harak*	-	√	√	√
6	*Lutjanidae*	*Lutjanus carponotatus*	-	-	√	√
7	*Scaridae*	*Leptopcarus vaigiensis*	-	-	√	-
8	*Scaridae*	*Scarus quoyi*	-	√	-	√
9	*Scaridae*	*Scarus dimidiatus*	-	√	√	√
10	*Scaridae*	*Chlorus japanensis*	-	-	√	-
11	*Serranidae*	*Epinephelus quoyanus*	-	-	√	√
12	*Labridae*	*Choerodon anchorago*	√	√	√	-
13	*Labridae*	*Pseododax mallucanus*	-	-	√	√
14	*Labridae*	*Cheilio inermis*	√	√	√	√
15	*Acanthuridae*	*Acanthurus bariene*	-	-	-	√
16	*Carangidae*	*Caranx melampygus*	√	-	√	√
17	*Carangidae*	*Gnathanodon speciosus*	-	√	√	-
18	*Carangidae*	*Caranx ignobilis*	-	-	√	√
19	*Pomacentridae*	*Dischistodus perspicillatus*	-	-	-	√
20	*Mullidae*	*Mulloidichthys flavolineatus*	-	-	√	-
21	*Mullidae*	*Upeneus tragula*	√	√	√	√
22	*Hemiramphidae*	*Hemiramphus far*	√	-	√	√
23	*Belonidae*	*Tylosurus crocodilus*	-	-	√	-
24	*Chanidae*	*Chanos-chanos*	-	√	√	√
25	*Mungillidae*	*Chelon subviridis*	√	√	√	√

S. canaliculatus is a species of fish that has a higher abundance at all research stations (Figure 5). The fish with the lowest abundance in Galala Village was *C. melampygus* (6%), and in Guraping Village it was *S. dimidiatus* (2%). *L. carponotatus*, *S. dimidiatus*, *E. quoyanus*, *C. ignobilis*, *H. far* and *T. crocodilus* each comprised 2% of the fish structure in Sibu Island. In Gosale, *C. ignobilis* comprised only 1% of the fish structure. *S. canaliculatus* has a higher abundance because it is herbivorous, utilizing seagrass meadows for feeding. The species with the lowest abundance were generally coral-dweller and off shore fish species. The results of this study are also supported by Rahmawati et al (2012), who also found *Siganus* spp. as the most abundant in seagrass habitats.

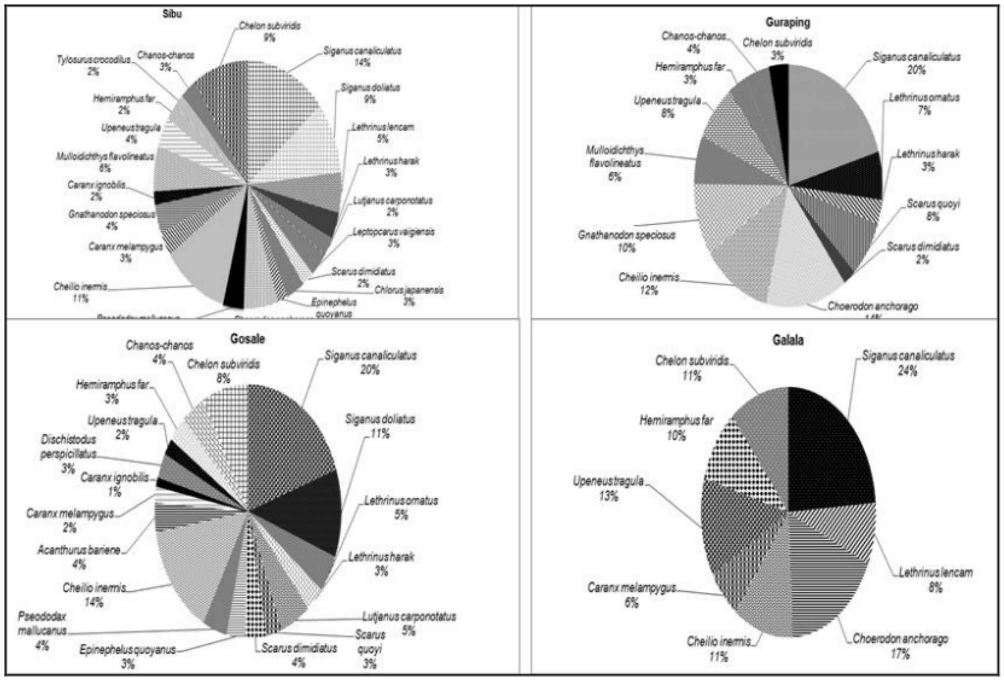

Figure 5. Fish species abundance.

The fish species diversity in seagrass ecosystems is supported by the connectivity of seagrass ecosystems with surrounding ecosystems such as mangroves and coral reefs (Latuconsina et al 2014). Dense seagrass leaves are able to dampen currents and waves, so many organisms make seagrass ecosystems with high density as a place of feeding and growth.

Conclusions. The fish community structure in seagrass meadows has a relatively normal diversity, with low domination and species spread evenly. The seagrass conditions of Sibu Island and Gosale are included in the healthy criteria, while in Guraping Village and Galala Village, the category is damaged. The seagrass density of Sibu Island and Tanjung Gosale is healthy, while in Guraping Village, the coverage is sparse and in Galala Village is very rare. The highest abundance of fish was found in Sibu Island (21 species, 286 individuals). Tanjung Gosale had 18 species, with 188 individuals. Guraping Village presented 13 species and 93 individuals, while Galala Village had 8 species, and 63 individuals.

Conflict of Interest. The authors declare that there is on conflict of interest.

References

Abubakar S., Achmad A., 2013 [Aquatic plants (teaching guide)]. LepKhair, Khairun University, Ternate, Indonesia, 64 p. [In Indonesian].

Ahmad-Kamil E. I., Ramli R., Jaaman S. A., Bali J., Al-Obaidi J. R., 2013 The effects of water parameters on monthly seagrass percentage cover in Lawas, East Malaysia. The Scientific World Journal 2013:892746, 8 p.

Alhaddad M. S., Abubakar S., 2016 [The community distribution of seagrass on Tanjung Gosale waters, Subdistrict of North Oba, Tidore Islands]. Techno Journal 76(5):76-95. [In Indonesian].

Bratakusuma N., Sahami F. M., Nursinar S., 2013 [Composition of species, density and level of seagrass evenness in Otiola Village Ponelo Sub-district of North Gorontalo Regency Islands]. Scientific Journal of Fisheries and Marine Affairs 1(3):139-146. [In Indonesian].

Bulmer R. H., Townsend M., Drylie T., Lohrer A. M., 2018 Elevated turbidity and the nutrient removal capacity of seagrass. Frontiers in Marine Science 5:462, 9 p.

Dewi C. S. W., Subhan B., Arafat D., 2017 [The diversity, density, and covering area of seagrass in Biak Island waters, Papua]. Depik Jurnal Ilmu-Ilmu Perairan, Pesisir dan Perikanan 6(2):122-127. [In Indonesian].

Faiqoh E. D. B, Wiyanto, Astrawan I. G. B., 2017 [The role of Bali's southern seagrass field as a supporter of fish abundance in Bali's water]. Journal of Marine and Aquatic Sciences 3(1):10-18. [In Indonesian].

Fajarwati S. D., Setianingsih A. L., Muzani, 2015 [Seagrass analysis in the waters of the Thousand Islands]. SPATIAL Wahana Komunikasi dan Informasi Geografi 13(1):22-32. [In Indonesian].

Febrina M., Adi W., Febrianto A., 2018 [Bivalve abundance at the seagrass ecology of Puding Beach, South Bangka Regency]. Akuatik: Jurnal Sumberdaya Perairan 12(2):64-75. [In Indonesian].

Hutomo M., Nontji A., 2014 [Seagrass monitoring guide]. COREMAP–CTI, The Indonesian Institute of Sciences, 32 p. [In Indonesian].

Iftinaan A. K. J., Donny J. P., Muhamad U. K. A., Wahyuniar P., 2017 [Potential of seagrass resources to support ecotourism in Menjangan Besar Island, Karimun Java Islands]. Journal of Fisheries and Marine Affairs 8(2):43-49. [In Indonesian].

Kaeli F., Subur R., Abubakar S., 2016 [Comparative study of seagrass and Padang fish community in the early and final stages in the waters of Loleo South, Vedic District, Central Halmahera Regency]. Tropical Biology Journal 16(2):43-55. [In Indonesian].

Latuconsina H., Rappe R. A., 2014 [Daily variability of fish community in sea grassbeds of Tanjung Tiram -Inner Ambon Bay]. Indonesian Journal of Ichthyology 13(1):35-53. [In Indonesian].

Latuconsina H., Sangadji M., Sarfan L., 2014 [Structure of seagrass fish community In the waters of Wael Beach Teluk Kotania West Seram Regency]. Jurnal Ilmiah Agribisnis dan Perikanan 6(3): 24-32. [In Indonesian].

Lensun A., Bataragoa N. E., Rondonuwu A. B., 2019 [Species and abundance of fish in the seagrass beds Napomanuk Island, West Likupang, North Minahasa]. Tropical Marine and Fisheries Journal 10(3):110-120. [In Indonesian].

Martha L. G. M., Rulyantoro P. G. S., Sari A. H. W., 2019 [Seagrass conditions and diversity in the waters of Serangan Island, Bali Province]. Journal of Marine and Aquatic Science 5(1):131-141. [In Indonesian].

Nanto A., Mustafa, Arami H., 2016 [Study on fish community in exploited seagrass ecosystem at Mola waters of Wakatobi Marine National Park]. Jurnal Manajemen Sumber Daya Perairan 1(4):415-426. [In Indonesian].

Peristiwady T., 2006 [Economically important marine fish in Indonesia. Identification instructions]. The Indonesian Institute of Sciences, Jakarta, 270 p. [In Indonesian].

Pratiwi M. A., Ernawati N. M., 2018 [Structure community of seagrass ecosystem in the intertidal region at Sanur Beach, Bali]. Ecotrophic 12(1):50-56. [In Indonesian].

Rahmawati S., Fahmi, Yusup D. S., 2012 [Seagrass and coastal fish communities in Kendari waters, South-East Sulawesi]. Marine Science Journal 17(4):190-198. [In Indonesian].

Rina, Abubakar S., Akbar N., 2018 [Fish community on seagrass ecosystem and coral reefs in Sibu Island North Oba District Tidore Island]. Enggano Journal 3(2):197-210. [In Indonesian].

Rondo M., 2015 [Methodology of population ecology analysis and aquatic biota community]. Postgraduate Program, Samratulangi University, Manado, Indonesia, 93 p. [In Indonesian].

Sarisma D., Ramli M., Ira, 2017 [Relationship by fishing with long density relationship between fish abundance and seagrass density in the Hoga Island, Kaledupa, Wakatobi]. Sapa Laut Journal 2(4):103-112. [In Indonesian].

Tangke U., 2010 [Seagrass ecosystem (benefits, functions and rehabilitation)]. Jurnal Ilmiah Agribisnis dan Perikanan 3(1):9 -29. [In Indonesian].

Tebaiy S., Mampioper D. C., Batto M., Agnestesya M., Tuharea S., Clement K., 2021 The status of seagrass health: supporting sustainable small-scale fisheries in misool marine protected area, Raja Ampat, Indonesia. Indonesian Journal of Marine Sciences 26(3):135-146.

Wibisono M. S., 2005 [Introduction to marine science]. PT Gramedia Widiasarana, Jakarta, 226 p. [In Indonesian].

*** Ministry of Environment of Indonesia, 2004 [The Decree of the Minister of Environment No. 200 about the standard criteria of damage and guidelines for determining the status of seagrass field]. Jakarta. [In Indonesian].

Received: 08 January 2021. Accepted: 20 February 2021. Published online: 20 March 2022.

Authors:
Darmawaty, Faculty of Fisheries and Marine Sciences, Khairun University, Jl. Jusuf Abdulrahman, 97719 Ternate, North Maluku, Indonesia, e-mail: darmawaty.kakalu@gmail.com
Salim Abubakar, Faculty of Fisheries and Marine Sciences, Khairun University, Jl. Jusuf Abdulrahman, 97719 Ternate, North Maluku, Indonesia, e-mail: mylasrinaldy@gmail.com
Rene Charles Kepel, Faculty of Fisheries and Marine Sciences, Sam Ratulangi University, 95115 Manado, North Sulawesi, Indonesia, e-mail: renecharleskepel65@gmail.com
Rignolda Djamaluddin, Faculty of Fisheries and Marine Sciences, Sam Ratulangi University, 95115 Manado, North Sulawesi, Indonesia, e-mail: rignolda@unsrat.ac.id
Nurhalis Wahidin, Faculty of Fisheries and Marine Sciences, Khairun University, Jusuf Abdulrahman St., 97719 Ternate, North Maluku, Indonesia, e-mail: nurhalisw@gmail.com
Rina, Faculty of Fisheries and Marine Sciences, Khairun University, Jl. Jusuf Abdulrahman, 97719 Ternate, North Maluku, Indonesia, e-mail: rinamuhamad79@gmail.com
Riyadi Subur, Faculty of Fisheries and Marine Sciences, Khairun University, Jl. Jusuf Abdulrahman, 97719 Ternate, North Maluku, Indonesia, e-mail: riyadisubur58@gmail.com
Mesrawaty Sabar, Faculty of Fisheries and Marine Sciences, Khairun University, Jl. Jusuf Abdulrahman, 97719 Ternate, North Maluku, Indonesia, e-mail: mesrawatysabar24@gmail.com
Masykhur Abdul Kadir, Faculty of Fisheries and Marine Sciences, Khairun University, Jl. Jusuf Abdulrahman, 97719 Ternate, North Maluku, Indonesia, e-mail: kadirternate@gmail.com
Nebuchadnezzar Akbar, Faculty of Fisheries and Marine Sciences, Khairun University, Jusuf Abdulrahman St., 97719 Ternate, North Maluku, Indonesia, e-mail: nezzarnebuchad@yahoo.co.id

How to cite this article:
Darmawaty, Abubakar S., Kepel R. C., Djamaluddin R., Wahidin N., Rina, Subur R., Sabar M., Kadir M. A., Akbar N., 2022 Fish community structure based on density and coverage of seagrass meadows in North Oba, Tidore Islands, North Maluku. AACL Bioflux 15(2):652-661.

Fish community structure based on density and coverage of seagrass meadows_Bioflux Journal

ORIGINALITY REPORT

13%	8%	10%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Submitted to Universitas Brawijaya Student Paper	3%
2	Jérôme Ebagnerin Tondoh, Patrick Lavelle. " Population dynamics of (Oligochaeta, Eudrilidae) in Ivory Coast ", Journal of Tropical Ecology, 2005 Publication	1%
3	Johan Ismail, Abu Hena Mustafa Kamal, Mohd Hanafi Idris, S. M. Nurul Amin et al. "Zooplankton species composition and diversity in the seagrass habitat of Lawas, Sarawak, Malaysia", Biodiversity Data Journal, 2021 Publication	1%
4	pubmed.ncbi.nlm.nih.gov Internet Source	1%
5	R Machrizal, K Khairul, I Chastanti, N F Sari, N Ritonga, Y Sepriani. "A study on the density and the cover of seagrass species along the	1%

West Coast of Natal", IOP Conference Series: Earth and Environmental Science, 2019
Publication

6	Submitted to National Institute of Education Student Paper	1 %
7	biodiversitas.mipa.uns.ac.id Internet Source	1 %
8	Khairul Amri, Supriadi Mashoreng, Dody Priosambodo, Nurjannah Nurdin, Mahatma Lanuru. "Impact of water turbidity to Seagrass (Enhalus acoroides) morphology", IOP Conference Series: Earth and Environmental Science, 2021 Publication	<1 %
9	van Tussenbroek, Brigitta I., Jorge Cortés, Rachel Collin, Ana C. Fonseca, Peter M. H. Gayle, Hector M. Guzmán, Gabriel E. Jácome, Rahanna Juman, Karen H. Koltes, Hazel A. Oxenford, Alberto Rodríguez-Ramirez, Jimena Samper-Villarreal, Struan R. Smith, John J. Tschirky, and Ernesto Weil. "Caribbean-Wide, Long-Term Study of Seagrass Beds Reveals Local Variations, Shifts in Community Structure and Occasional Collapse", PLoS ONE, 2014. Publication	<1 %
10	A F Dewinta, Y T Halomoan, I E Susetya, E Yusni, A Fadhilah. "Diversity and cover	<1 %

percents of macroalgae species in intertidal zone of Pane", IOP Conference Series: Earth and Environmental Science, 2021
Publication

11	www.scielo.br Internet Source	<1%
12	Shesdev Patro, P. Krishnan, V. Deepak Samuel, R. Purvaja, R. Ramesh. "Chapter 5 Seagrass and Salt Marsh Ecosystems in South Asia: An Overview of Diversity, Distribution, Threats and Conservation Status", Springer Science and Business Media LLC, 2017 Publication	<1%
13	Submitted to Universitas Hasanuddin Student Paper	<1%
14	A. Tarya, A.J.F. Hoitink, M. Van der Vegt, M.M. van Katwijk, B.W. Hoeksema, T.J. Bouma, L.P.M. Lamers, M.J.A. Christianen. "Exposure of coastal ecosystems to river plume spreading across a near-equatorial continental shelf", Continental Shelf Research, 2018 Publication	<1%
15	hdl.handle.net Internet Source	<1%
16	www.tandfonline.com Internet Source	<1%

17	IR Poiner. "Seagrass communities of the Gulf of Carpentaria, Australia", Marine and Freshwater Research, 1987 Publication	<1 %
18	González-Castillo. "Arthropods in Natural Communities in Mescal Agave (*Agave durangensis* Gentry) in an Arid Zone", American Journal of Applied Sciences, 2011 Publication	<1 %
19	ejurnal.undana.ac.id Internet Source	<1 %
20	ojs3.unpatti.ac.id Internet Source	<1 %
21	pdfs.semanticscholar.org Internet Source	<1 %
22	repository.unipa.ac.id Internet Source	<1 %
23	doaj.org Internet Source	<1 %
24	Anne Theenhaus, Matthias Schaefer. "The effects of clear-cutting and liming on the soil macrofauna of a beech forest", Forest Ecology and Management, 1995 Publication	<1 %

Exclude quotes	On	Exclude matches	Off
Exclude bibliography	On		