Reef fish community on Sabira Island, Kepulauan Seribu Regency, DKI Jakarta

M W Taqiyuddin, E S Srimariana*, and N Cakasana
Department of Marine Science and Technology, Faculty of Fisheries and Marine Sciences, IPB University, Dramaga, Bogor 16680, West Java, Indonesia

*E-mail: endangsunarwatis@apps.ipb.ac.id

Abstract. Sabira Island is an island close to Jakarta Province but still has good water conditions and a coral reef ecosystem with a high level of diversity. The condition of the coral reef ecosystem affects the community structure of the reef fish there. This study aims to determine the community structure of the reef fish on Sabira Island. The research was conducted in August 2019 on Sabira Island, Kepulauan Seribu Regency, DKI Jakarta Province. Observations of reef fish were carried out using the Underwater Visual Census method at four observation stations. There were 47 species of reef fish found on Sabira Island from 12 families. The total reef fish found were 1315 individuals, consisting of 79 indicator fish, 417 individual target fish, and 819 major fish. The highest diversity index value on Sabira Island was found at the South Station, with a diversity index value of 2.39. Based on the community structure index at the four observation stations, the reef fish community's condition on Sabira Island is still good ranging from unstable to stable condition with moderate diversity and low dominance index values.

Keywords: Community structure, diversity, reef fish, Sabira Island.

1. Introduction
Coral reefs provide critical ecosystem services, including fisheries and coastal protection. This ecosystem constitutes an essential biological resource in its complex biodiversity and is the basis for tropical fisheries and marine ecotourism industries [1]. On the other hand, tourism is a growing industry, and most of its development occurs in coastal areas and activities such as diving and snorkeling [1-2]. Despite their global importance, protection is currently inadequate, and consequently, key indicators of reef health, such as coral cover, are declining [3-4]. This reef degradation is driven by anthropogenic impacts, including overfishing, global climate change, coral disease, sedimentation, extensive coastal development, invasive species, and the release of pollutants. The loss of coral cover and the complexity caused by these stressors affect reefs' ecosystem services [5].

Sabira Island is a small island located at the northern tip of Seribu Island, DKI Jakarta, at coordinates 5°12′6.6″ S and 106°27′47.1″ E. Sabira Island area is estimated to be around 8,83 hectares. The Location of Sabira Island is at the crossing of the Indonesian Moonson Current [6]. Sabira Island is known as the farthest island towards the open sea compared to other islands of the Seribu Islands. Therefore, the position of this island, which is further towards the open sea, has specific environmental characteristics that may affect coral's life and fish communities that live in the coral ecosystem [7]. Corals create complex reef structures that provide both habitat and food for many fish species [8]. Due to numerous
natural and anthropogenic threats, many coral reefs are being degraded, endangering the fish assemblages they support [4-5]. The current affects the condition of the waters on Sabira Island, including the water temperature. Water temperature is one of the critical factors for the life of aquatic organisms. Temperature changes can affect water's physical, chemical, and biological factors, including coral reefs and fish that live in them [9-10].

Based on ecological and production functions, coral reefs in Seribu Island become a potential habitat for various fisheries resources, especially reef food fishes. Based on utilization function and environmental aspects, reef fish were classified into three groups: target, indicator, and major reef fish [11]. Target reef fish are a group of consumable fish species and are usually caught by fishermen. Artisanal fishers have exploited target reef fish in Seribu Island for a long time, and this activity continues to increase because of market demand and local consumption needs [2, 7]. Reef fish are fish whose life cycle cannot be separated from coral reefs as their primary habitat. Reef fish often cluster on specific corals, form distinct communities, and generally have limited movement compared to other marine vertebrates of the same size. They utilize corals as a territory source of food, a place of refuge, and reproduction. Importantly, reef fish make coral reef ecosystems as a feeding ground, nursery ground, and spawning ground [12-13]. Reef fish are categorized into target fish, indicator fish, and major fish based on their function. Reef fish have many benefits, such as being a source of food and livelihoods of coastal communities. Some reef fish, such as family Caesionidae, Serranidae, Scaridae, Lutjanidae, and Siganidae, are good commodity fisheries whose existence must be preserved [12-14].

We presume that the fish communities on the coral reefs of Sabira Island, which are close to the open sea, have particular characteristics in terms of coral conditions, types of reef fish, and community structure. So far, there has been no research conducted, specifically, on the reef fish related to community structure around Sabira Island. Therefore, this research can be a preliminary study that aims to determine the reef fish communities, including their distribution, type of fish, and community structure index of dominancy, diversity, and evenness in the coral reef of Sabira Island. Due to the territorial behavior and abundance in reef fish, communities have been considered as the most useful indicator for assessing coral reef conditions [15]. Hopefully, the results of this study will be useful as a database of reef fish in the Seribu Islands, mainly in Sabira Island.

2. Materials and methods

2.1. Research location and time
The research was conducted on August 6-7, 2019, in Sabira Island, Harapan Subdistrict, North Seribu Island, DKI Jakarta. Data was taken from 08.00 to 12.00 at four observation station locations. North Station (5°11′59″ S and 106°27′50″ E), North West Station (5°12′04″ S and 106°27′34″ E), West Station (5°12′15″ S and 106°27′27″ E), and South Station (5°12′31″ S and 106°27′48″ E). The location of the station can be seen in Figure 1.

2.2. Reef fish data collection
Reef fish data taken using underwater visual census (UVCs) method with 50 meters long transect line with three replays and viewing are of 2.5 meters right and left. Data collection of reef fish communities, including identifying fish species and calculating estimated numbers of fish. The title of reef fish refers to Fishbase [16]. The types of reef fish identified are distinguished into three groups: indicator fish, major fish, and target fish [2, 15-16].

2.3. Reef fish community analysis
Reef fish data were analyzed using the Shannon-Wiener diversity index (H’), the Evenness index (E), and the Simpson dominance index (C). The analysis was done using a formula in Odum [17].
2.3.1. Diversity index.

\[ H' = - \sum p_i \ln (p_i) \]  

where: \( p_i = \frac{n_i}{N} \), \( n_i \) = individu number of i-species, \( N \) = total individu of all species, \( H' \) = Diversity index.

Diversity index criteria as follows, if:
- \( H' \leq 1 \) : low diversity
- \( 1 < H' \leq 3 \) : medium diversity
- \( H' > 3 \) : high diversity

2.3.2. Evenness index.

\[ E = \frac{H'}{H_{max}} \]  

where: \( E \) = Evenness index, \( H_{max} = \ln S \); \( S \) = number of number of fish genera

Evenness index criteria as follows, if:
- \( 0 < E \leq 0.5 \) : depressed community
- \( 0.5 < E \leq 0.75 \) : labile community
- \( 0.75 < E \leq 1 \) : stable community

2.3.3. Dominance index.

\[ C = \sum p_i^2 \]  

where: \( C \) = dominance index, \( p_i \) = proportion of fish

Dominance index criteria as follows, if:
- \( 0 < C \leq 0.5 \) : low dominance
- \( 0.5 < C \leq 0.75 \) : medium dominance
- \( 0.75 < C \leq 1 \) : high dominance

Figure 1. Station location map.
3. Result and discussion

3.1. Reef fish distribution

Reef fish observation conducted in four stations at Sabira Island obtained 47 species of reef fish from 12 families, namely Acanthuridae (one species), Apogonidae (one species), Caesionidae (three species), Chaetodontidae (5 species), Labridae (9 species), Lutjanidae (four species), Nemipteridae (three species), Phemperididae (one species), Pomacentridae (13 species), Scaridae (four species), Serranidae (two species), dan Zanclidae (one species). The number of individual reef fish found as many as 1315 individual fish. The distribution of fish from each family that was found in Sabira Island is presented in Figure 2.

The result shows that the highest number of reef fish was found in the South Station (550 individuals), and then in North Station (329 individuals), in Northwest Station (226 individuals), and the least in West Station (210 Individuals). The number of reef fish individuals, including their family, at all stations around Sabira Island is illustrated in Figure 2. The highest number of reef fish families in coral reef areas around Sabira Island primarily belongs to Pomacentridae (45.7%), Caesionidae (27.22%), and Labridae (8.06%). Overall, in this study, the number of fish families observed in the reef area of Sabira Island was 12 families, such as Pomacentridae, Caesionidae, Chaetodontidae, Labridae, Nemipteridae, Lutjandae, Serranidae, Scaridae, Phemperididae, Acanthuridae, Apogonidae, and Zanclidae. The number of fish found in reef areas is strongly influenced by coral conditions, such as the percent cover of live coral and food availability [18-19]. Muniaha et al. [20] found that fish distribution in reef areas in Tanjung Tiram, correlates with the percent cover of live coral. In this study, the percent cover of live coral in Sabira Island ranged from 53.5 % to 89%. Percent cover of live coral in South Station reach 81%, in North Station reach 89%, then in West Station reach 73%, while in Northwest Station reach 53,3%. Another factor that causes differences in the number and type of fish is food availability and the time of observation [9]. Many factors can influence the number of fish found in the reef areas, primarily water temperature and current [10, 21-23], and interaction among fish groups of indicator fish, major fish, and target fish [24-25].

Changes in the abundance of particular fish groups or fish community composition have been used as indicators for reef habitat quality [26]. The spatial variability and complexity of coral reefs affect the trophic structure of the fish community. For instance, depletion in coral reefs directly affects the abundance of fishes that exclusively feed on coral [14]. However, only a few species found in a coral reef ecosystem depend specifically on scleractinian corals [27]. On the other hand, a reduction of coral cover, either by natural or anthropogenic factors, is often accompanied by increases in algal abundance, which may trigger the appearance of herbivorous fishes. Consequently, the presence or absence of specific indicator species can detect environmental impact and change [28-29].
3.2. Reef fish communities

Figure 3 shows the distribution of the three types of reef fish at all stations in Sabira Island. The three types of reef fish, such as indicator, major, and target fish, are distributed at all stations around Sabira Island. The highest number of reef fish is observed at South Station. The location of this station is closer to Seribu Island. The number of indicator fish at all stations around Sabira Island is 79 individuals or 6% of the total fish observed, and the number of target fish is 417 individuals or 31.72%, the number of major fish is 819 individuals, or 62.28% of the total fish observed. The occurrence of these three types of reef fish at all stations may indicate that the condition of coral reefs can be categorized in good condition [30].

We found the indicator fish mainly belongs to family of Chaetodontidae, such as Chaetodon octofasciatus, Chelmon rostratus, Heniochus acuminatus, Heniochus chrysopterus, and Chaetodon vagabundus. This indicator fish is usually used as a benchmark showing the reef condition is good or bad [30]. The target fish is a group that is generally caught for human consumption and has economic value. We found five members of target fish such as Acanthuridae (Acanthurus auranticavus), Caesionidae (Caesio cuning, Caesio lunaris, and Caesio teres), Lutjanidae (Lutjanus decussatus, Lutjanus gibbus, Lutjanus kasmira, Lutjanus lutjanus), Scaridae (Scarus dimidiatus, Scarus niger, Scarus tricolor, Scarus ghobban), and Serranidae (Cephalopholis boenak, Cephalopholis miniata). It was identified major fish mainly belong to the family Apogonidae (Apogon moluccensis), Labridae (9 species), Nemipteridae (Scolopsis lineata, Pentopodus setosus, Scolopsis bilineata), Phempheridae (Pempheris adusta), Pomacentridae (13 species), and Zanclidae (Zanclus cornutus). Table 3 shows the list of the family and species of reef fish found around Sabira Island.
Table 2 shows the results of calculating community indexes of reef fish at all reef stations around Sabira Island. The South Station has the highest value of diversity index (H': 2.39) with stable evenness (E: 0.86) and a low value of dominance index (C: 0.13). West Station show medium value of diversity index (H': 2.14) with stable evenness (E: 0.78) and low dominance value (C: 0.20). North Station have medium value of diversity index (H': 2.05) with stable evenness (E: 0.81) and low dominance value (C: 0.19). Northwest station shows a moderate value of diversity index (H': 1.91) with stable evenness (E: 0.64) and low dominance value (C: 0.29).

The reef fish community index expressed as diversity (H') ranged from 1.91-2.39. The range of values for this index indicates that the community structure of reef fish in Sabira Island is moderate or relative stable. The evenness index (E) ranges from 0 – 1. The value of the evenness index (E) indicates the reef fish community is in relatively good condition. This evenness index value indicates that the distribution of fish is rather distributed evenly or the similarity of the number of individuals between species in a community is relatively similar, where no species is more dominant or predominant. The smaller the value of E, the smaller the value of H', which indicates the dominance of a species. The E value close to 1 indicates that fish distribute evenly, which means the ecosystem is relatively good. The maximum E value in Sabira Island is 0.86, showing the community balance between fish species in these reefs areas is relatively good, or the ecosystem has not yet experienced significant disturbances [31].

The value of species dominance index (C) of fish among coral reef stations in the Sabira Islands ranged from 0.13 to 0.29. Based on assessment criteria of the species dominance index, the dominance of reef fish species in the community of each coral reef station is low. This dominance index value indicates that the distribution of the number of fish individuals between species in a community is relatively similar, where no species is more dominant or predominant.

Diversity, evenness, and dominance index values show that the coral reef fish community at Sabira Island is in good condition. The condition of this reef fish community is affected by the percent cover of live coral that has a perfect condition [32]. Moreover, fisheries activity in Sabira Island does not use destructive tools such as bombs or poison. Usually, fisheries activities that use bombs or poison as tools could affect the condition of the coral reef community [28].

**Figure 3.** Distribution of reef fish group types in Sabira Island.
| Family            | Species                        | Station       |
|-------------------|--------------------------------|---------------|
|                   |                                | West | North West | South | North |
| Acanthuridae      | *Acanthurus auranticavus*       | 3    | 3          |       |       |
| Apogonidae        | *Apogon moluccensis*           | 10   |            |       |       |
| Caesionidae       | *Caesio cuning*                | 10   | 40         |       |       |
|                   | *Caesio lunaris*               | 15   |            |       |       |
|                   | *Caesio teres*                 | 50   | 70         | 85    | 88    |
| Chaetodontidae    | *Chaetodon octofasciatus*      | 8    | 10         | 28    | 10    |
|                   | *Chaetodon vagabundus*         | 2    |            |       |       |
|                   | *Chelmon rostratus*            | 2    | 3          | 1     |       |
|                   | *Heniochus acuminatus*         |      |            |       | 4     |
|                   | *Heniochus chrysostomus*       | 4    | 3          | 4     |       |
| Labridae          | *Chelinus fasciatus*           | 2    |            |       |       |
|                   | *Chelinus trilobatus*          | 4    | 6          |       |       |
|                   | *Halichoeres hortulanus*       | 3    | 1          | 8     | 4     |
|                   | *Halichoeres melanurus*        | 2    | 1          | 1     | 3     |
|                   | *Halichoeres richmondii*       | 2    | 8          | 6     | 2     |
|                   | *Halichoeres solorensis*       | 1    | 1          |       |       |
|                   | *Hemigymnus melapterus*        | 2    | 2          | 3     |       |
|                   | *Labroides dimidiatus*         | 4    | 6          | 3     | 1     |
|                   | *Thalassoma lunare*            | 7    | 6          | 15    | 2     |
| Lutjanidae        | *Lutjanus decussatus*          | 1    | 3          | 4     | 3     |
|                   | *Lutjanus gibbus*              | 1    |            |       |       |
|                   | *Lutjanus kasmira*             | 1    | 2          |       |       |
|                   | *Lutjanus lutjanus*            | 3    | 4          | 5     |       |
| Nemipteridae      | *Pentapodus setosus*           | 5    |            |       |       |
|                   | *Scolopsis bilineata*          | 2    | 1          |       |       |
|                   | *Scolopsis lineata*            | 12   | 5          | 12    |       |
| Phempherididae    | *Pempheris adusta*             | 25   | 20         | 15    |       |
| Pomacentridae     | *Abudeifdaq septemfasciatus*   | 2    | 1          |       |       |
|                   | *Abudeifdaq sexfasciatus*      | 21   | 21         | 35    | 17    |
|                   | *Abudeifdaq vaigiensis*        | 25   | 2          | 77    | 10    |
|                   | *Acanthochromis polycanthurus* | 3    | 4          |       |       |
|                   | *Amblyglyphidodon aureus*      | 10   | 2          | 6     | 14    |
|                   | *Amblyglyphidodon curacao*     | 5    | 14         | 75    | 23    |
|                   | *Amphiprion akallopisos*       | 4    |            |       |       |
|                   | *Amphiprion ocellaris*         | 3    |            |       |       |
|                   | *Chromis dimidiata*            | 2    |            | 20    |       |
| Scaridae           | *Chromis viridis*              | 1    | 12         | 55    | 30    |
|                   | *Dascyllus trimaculatus*       | 3    |            |       |       |
|                   | *Dischistodus pseudochrysopecaulus* | 20 |       |       |       |
|                   | *Pomacentrus brachialis*       | 7    | 4          | 12    | 61    |
|                   | *Scarus dimidiatus*            | 1    | 1          |       |       |
|                   | *Scarus ghobban*               | 2    |            |       |       |
### Table 2. Value of Diversity (H’), Uniformity (E), and Dominance (C).

| Station   | H’   | E   | C   |
|-----------|------|-----|-----|
| North     | 2.05 | 0.81| 0.19|
| North West| 1.91 | 0.64| 0.29|
| West      | 2.14 | 0.78| 0.20|
| South     | 2.39 | 0.86| 0.13|

### 4. Conclusion

The condition of the reef fish community on Sabira Island was laying between unstable to stable conditions with moderate diversity and low dominance index values. The coral reef fish community at Sabira Island is in good condition. Specifically, the abundant fish were found highest in the South Station, North Station, Northwest Station, and the least in the West Station. The target fish, major fish, and indicator fish were found highest in the Southern part of the Sabira island. This study found 47 species belonging to 12 reef fish families, with 1315 individual fish. The primary reef fishes in the coral reef of Sabira Island mainly belong to Pomacentridae (45.7%), Caesionidae (22.7%), and Labridae (8.06%), respectively. The results indicate that the coral reefs in Sabira Island were still healthy based on the fish number, type of fish, and community structure.

### References

[1] Motta H, Rodrigues M J and Schleyer M H 2000 Coral reef monitoring and management in Mozambique Coral reef degradation in the Indian Ocean. Status Report 2000 Ed D Souter, D Oura et al (Stockholm: Marine Science Program Department of Zoology Stockholm University) p 296

[2] Utomo S P R, Ain C and Suriharyono 2013 Keanekaragaman jenis ikan karang di daerah rataan dan tuber pada ekosistem terumbu karang di Legon Boyo, Taman Nasional Karimunjawa, Jepara Maquares. 2 (4) 81-90

[3] Woodhead A J, Hicks C C, Norström A V, Williams G J and Graham N A 2019 Coral reef ecosystem services in the Anthropocene Funct. Ecol. 33(6) 1023-34

[4] Pratchett M., Hoey A S and Wilson S K 2014 Reef degradation and the loss of critical ecosystem goods and services provided by coral reef fishes Curr. Opin. Environ. Sustain. 7 37-43

[5] Hughes T P et al 2003 Climate change, human impacts, and the resilience of coral reefs Science 301 929-33

[6] Jakartatourism 2020 Sabira Island – Tourism Office #VisitJakarta http://www.jakarta-tourism.go.id/visit/2020/pulau-sabira (in Bahasa Indonesia)

[7] Kusumaningtyas M A, Bramawanto R, Daulat A and Pranowo W S 2014 The water quality of Natuna Sea in transition season Depik 3(1) 10-20 (in Bahasa Indonesia)

[8] Kolian S R and Sammarco P W 2019 Densities of reef-associated fish and corals on offshore platforms in the Gulf of Mexico Bull. Mar. Sci. 95 (3) 393–407
[9] Huliselan NV, Sahetapy D, Tuapattinaja MA, and Wawo M 2019 Community structure of target reef fish at four tiny islands coral reefs in inner Kotania bay, Maluku Province, Indonesia IOP Conf. Series: Earth Environ. Sci. 339 (2019) 012015
[10] Rodgersa G G, Rummera J L, Johnsonc L K and McCormick M I 2019 Impacts of increased ocean temperatures on a low-latitude coral reef fish Processes related to oxygen uptake and delivery J. Therm. Biol. 79 (2019) 95–102
[11] Cooper A M, MacDonald C, Roberts T E and Bridge T C L 2019 Variability in the functional composition of coral reef fish communities on submerged and emergent reefs in the central Great Barrier Reef, Australia PLoS ONE 14(5) e0216785
[12] Irnawati R, Simbolon D, Wiryawan B, Murdiyanto B and Nurani T W 2011 Leading commodity analysis of capture fisheries in Karimunjawa National Park Jurnal Sainstek Perikanan 7(1) 1-9
[13] Bengen, D G 2013. Bioecology of Coral Reef, Management, Status and Challenges Coral governance ed V P H Nikijuluwu et al (Bogor: IPB Press) pp 62-74 (in Bahasa Indonesia)
[14] Halford A, Chea A J, Ryan D and Williams D M 2004 Resilience to large-scale disturbance in coral and fish assemblages on the Great Barrier Reef Ecology 85(7) 1892–905
[15] Fishbase 2020 Fish Classification http://www.fishbase.org
[16] English S, Wilkinson and Baker V 1997 Survey Manual for Tropical Marine Resources (Townsville: Australian Institute of Marine Science)
[17] Odum E P 1971 Dasar-dasar Ekologi Translated by T Samingan and B Srigandono Fundamental of Ecology (Yogyakarta: UGM Press)
[18] Graham N A J 2015 Phase shifts and coral reef fishes Ecology of Fishes on Coral Reefs ed C Mora (Cambridge: Cambridge University Press) pp 190-8
[19] Yudha F K, Fahlevy K, Andika W, Saraswati E, Hutami P R, Kamal M M and Samosir A M 2019 Influence of management status on the coral reef fish communities in Ujung Kulon National Park, Banten IOP Conf. Series: Earth Environ. Sci. 278(2019) 012083
[20] Muniaha H, Nur A I and Rahmadani 2016 The study of coral reef fishes abundance based on coral reef condition in Tanjung Tiram Village Kabupaten Konawe Selatan Jurnal Manajemen Sumber Daya Perairan 2(1) 9-19 (in Bahasa Indonesia)
[21] Sutono D 2016 Relationship of cover percentage coral reef and fish abundance in The National Marine Park of Wakatobi Jurnal Perikanan dan Kelautan 6(2) 169-76 (in Indonesia)
[22] Coker D J, Wilson S K and Pratchett M S 2013 Importance of live coral habitat for reef fishes Rev. Fish Biol. Fish. 24 89-126
[23] Muis, Kurnia R, Sulistiono and Taryono 2021 Diversity of coral reef fish in the coastal water of Spelman Straits, Southeast Sulawesi IOP Conf. Ser.: Earth Environ. Sci 420 (1) 012021
[24] Cinner J E and Kittinger J N 2015 Linkages between social systems and coral reefs Ecology of Fishes on Coral Reefs ed C. Mora (Cambridge: Cambridge University Press) pp 2015-20
[25] Sahetapy D, Retraubun A S W, Bengen D G and Abrahamsz J 2018 Coral reef fishes of Tuhaha bay, Saparua Island, Maluku Province Indonesia Int. J. Fish. Aquat. 6(2) 105-9
[26] Madduppa H H, Ferse S C A, Aktani U and Palm H W 2012 Seasonal trends and fish-habitat associations around Pari Island, Indonesia: setting a baseline for environmental monitoring Environ. Biol. Fish 95 383–98
[27] Munday P L, Jones G P, Shieves M, Williams A J and Goby G 2007 Vulnerability of fishes on the Great Barrier Reef to climate change Climate change and the Great Barrier Reef: A Vulnerability Assessment ed Johnson J and Marshall P (Townsville: The Great Barrier Reef Marine Park Authority) pp 357–391
[28] Manlea H, Ledheng L and Sama Y M 2016 Faktor-faktor penyebab kerusakan ekosistem terumbu karang di Perairan Wini Kelurahan Humusu C Kecamatan Insana Utara Kabupaten Timor Tengah Utara Bio-Edu: Jurnal Pendidikan Biologi 1(2) 21-3
[29] Wilson S K, Graham N A J, Pratchett M S, Jones G P and Polunin N V C 2006 Multiple disturbances and the global degradation of coral reefs: are reef fishes at risk or resilient? *Glob. Change Biol.* **12** 2220–34

[30] Rondowunu A B, Rembet U N, Moningkey R D, Tombokan J L, Kambey A D and Wantasen A S 2013 Coral fishes the family Chaetodontidae in coral reef waters of Para Island Sub District Tatoareng, Sangihe Kepulauan Regency *Jurnal Ilmiah Platax* 1(4) 210-5

[31] Huliselan N V, Wawo M, Tuapattinaja M A and Sahetapy D 2017 Present status of grouper fisheries at waters of Kotania Bay, Western Seram District Maluku Province *IOP Conf. Ser.: Earth Environ. Sci.* **89** 012002

[32] Komyakova V, Jones G P and Munday P L 2018 Strong effects of coral species on the diversity and structure of reef fish communities: A multi-scale analysis *Plos One* **13**(8) e0202206