

## Species Richness of Coral Reef Fishes in Sedili Kechil, Johor, and Their Importance to Local People

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### Abstract

Coral reef fish is a fish family that occurs on every living coral reef, irrespective of its biogeographical location. However, no studies have been done in the Johor marine area in Sedili Kechil despite their unique characteristics and importance to coral reefs and the overall marine ecosystem. Therefore, this study aimed to record the species of coral reef fish found in Sedili Kechil, Johor. This is part of developing the Malaysian database of coral reef fish species using bait fishing and net methods. This study also documents the local people's traditional knowledge of coral reef fish. Genetic identification using cytochrome c oxidase subunit I (COI) mitochondrial DNA (mtDNA) gene was used as a complementary approach to the morphological species identification. The morphological and molecular classification proved that all 24 individuals obtained in this study belong to 18 species, 15 genera, 13 families, and 3 orders. The GenBank has accepted nine COI mtDNA gene sequences of coral reef fishes obtained from this study (accession no.: MW476138-MW476146, submission date: January 8, 2020), and this has greatly aided in the recent availability of the species' gene sequences for use in future studies. The local people's awareness of the many reef fish species that are available, as well as their familiarity with the byproducts of reef fish, were additionally recorded. The findings

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from this study are considered the first record of coral reef fishes from Sedili Kechil, Johor, Malaysia.

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## 1. Introduction

Sedili is not just a fishing village but rather a coastal region in east Johor. It comprises of Tanjung Sedili and the Sedili Besar ('Big' Sedili) fishing village flanking both sides of the Sedili Besar River as it empties into the South China Sea. The area of Sedili also includes Teluk Mahkota, known previously as Jason Bay, sandwiched between the Sedili Besar River to its north and the Sedili Kechil River to its south. Sedili Kechil ('Small' Sedili) village was located at the mouth of the Sedili Kechil River. Under the Johor Tenggara Development Authority (KEJORA), the Pengerang area shares its boundary with Iskandar Malaysia however is separated by the Johor River. It covers under 5 Mukims of a total area of 123,830 hectares [1].

Sedili Kechil village is located at the southern end of the bay where the river is known as Sungai Sedili Kechil and is known as a fishermen village by surrounding villages. It is a typical Malay fishing village since the local population's main economies are diverse from fishing, small-scale grocery, and working in nearby oil palm estates [1]. Even though the rivers and streams were sparsely inhabited, they were used for many purposes, including as a means of livelihood for most local villagers. Due to most villagers only knowing the traditional ways as their source of income, extensive fishing was carried out in the deeper estuarine areas of the channel, both coastal and freshwater [2]. To keep the marine ecosystem of Sedili Kechil protected and beneficial for the local villagers, it is crucial to identify the marine species especially coral reef fish that can be found in Sedili Kechil.

Despite that, no studies have been done in Sedili Kechil despite their unique characteristics. Therefore, the information about them is still incomplete. As for the traditional knowledge study regarding the fisheries in Malaysia, a study by Arai [3] shows that overfishing, blast fishing, poison fishing, and trawling are the major threats in eastern Malaysia, with more than 80% of the coral reefs in Southeast Asia under threat [3]. Because of the strict protection of fisheries, prohibition of blast and poison fishing, and improvements to the fishing equipment for coral reef fishing are required. For such reason, the traditional knowledge studies of fisheries in East Malaysia can be found more easily than in West Malaysia [4].

In response to the above problems, this study proposes to record the species of coral reef fish found in Sedili Kechil, Johor. This will also play a part in developing the Malaysian database of coral reef fish through species documentation along the selected region of Sedili Kechil, Johor using bait fishing and net methods. On top of that, this study will also document the local people's traditional knowledge of coral reef fish. Genetic identification using cytochrome c oxidase subunit I (COI) mitochondrial DNA (mtDNA) gene was also incorporated as a complementary approach to morphological species identification.

## 2. Materials and Methods

### 2.1 Specimen Collection

The fishing rod, hand-net, and fish trap were used to catch fish. The fishing rod and the hand net will represent the active gear [5]. In terms of passive gear, fish traps were used to catch fish that hide in between the reefs. The "Catch and Release" method was applied in this study, particularly for redundant fish caught during the sampling. Some specimens were also obtained from local fishermen while interviewing them.

### 2.2 Species Identification

All fish collected were sorted and classified based on the morphological characteristics by referring to previous studies and the online FishBase identification portal before followed by the molecular approach [6]. Before any further molecular work was performed, images of each new specimen were taken for inventory purposes. The species richness was obtained by the number of different species observed, captured in the field study or during molecular work [7].

### 2.3 Collection of Tissue for Genetic Analysis

25 mg of muscle tissue was cut from the coral reef fish specimen. The total genomic DNA extraction was done by following the protocols of the Tissue Genomic DNA Extraction Mini Kit by Favorgen. The quantity and quality of each total genomic DNA yield were determined by using a NanoDrop Spectrophotometer and agarose gel electrophoresis [8].

## 2.4 Polymerase Chain Reaction (PCR) Amplification

The Fish primer set selected from the primer cocktails that were being used which were Fish F1 (5' -TCA ACC AAC CAC AAA GAC ATT GGC AC-3' ) and Fish R1 (5' -TAG ACT TCT GGG TGG CCA AAG AAT CA-3' ) [9]. The reaction protocol was followed by the PCR kit (exTEN 2x PCR Master Mix), where each PCR mix will contain an overall volume of 25 µl, at which 9µl of ultrapure water, 12.5µl of 10× PCR buffer, 0.50µl of each primer, and 2.5µl of DNA template [9]. Each PCR reaction volume contains a total volume of 25 µl, including 16.25 µl ultrapure water, 2.25 µl 10× PCR buffer, 1.25 mM magnesium chloride (MgCl<sub>2</sub>), each dNTP at 0.2 mM, each primer at 2mM, 1.25 U Taq DNA polymerase and 1 µl DNA template [9].

There are three steps in thermal cycle conditions that consist of an initial step of 4 min at 95°C followed by 35 cycles of denaturing at 95°C for 30 sec, annealing at 56°C for 30 sec, and final denaturation steps at 72°C for 45 sec, with a final extension at 72°C for 10 min then later the samples will be held at 4°C. According to Lukman [9], the average annealing temperature for fish DNA is between 52°C to 62°C [10]. To be able to find the optimal annealing temperature, a process called PCR optimization has been done [11]. The PCR samples were screened on an electrophoresis of 1% agarose gel for the existence of PCR products [8].

## 2.5 DNA Sequencing and BLAST Analysis

In the suspension form for further purification, amplified COI fragments were sent to a sequencing service provider (Apical Scientific Sdn. Bhd.), and the bidirectional (forward and reverse) sequences were performed for all the samples using sequencing primers FishF1 and FishR1, respectively [9]. For finding corresponding sequences, the Basic Local Alignment Search Tool (BLAST) was used. Multiple forward reaction sequences were aligned using MEGA X version 10.0.5 (BETA). Confirmation regarding species identifications was achieved with the aid of BLAST quest which was accessible on the NCBI online portal [9].

## 2.6 GenBank Submission

The processed DNA sequences were submitted to GenBank for registration purposes by using online BankIt software. The GenBank access numbers were used in the publication.

## 2.7 Interview Session

The interview session conducted involved 10 respondents, mostly fishermen. The data was obtained by a combination of personal interviews and observation approaches for non-participants [12]. They were interviewed based on a guided questionnaire to measure their level of knowledge about coral reefs and coral reef fish.

## 3. Results and Discussion

### 3.1 Checklist of Species Identified from Sedili Kechil

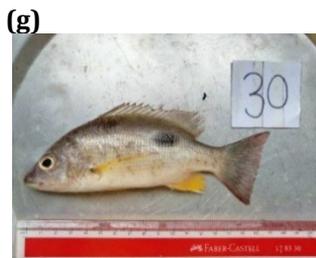
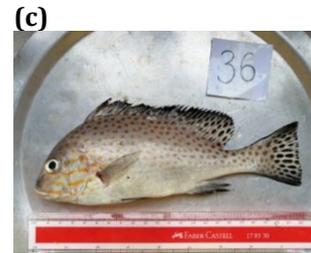
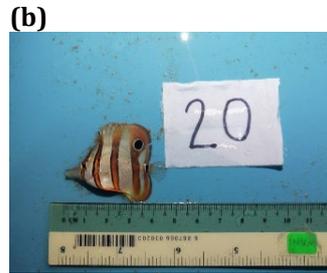
The morphological and molecular classification shows that the total 24 individuals of coral reef fishes recorded throughout the study period in Sedili Kechil, Johor represented the native fishes of the South China Sea that belong to 18 species, 15 genera, 13 families, and 3 orders. Table 1 shows the summary of the species checklist that was recorded along with families, scientific names, common names, and also local names. Photographs of some of the fish documented are in Figure 1. Eleven families and 13 genera belong to the order Perciformes which was the highest taxonomic order recorded in this study followed by 1 family and 1 genus for each Beryciformes order and Tetraodontiformes order. Family Pomacentridae (Damsel fish and Clownfish) had the highest individuals recorded with 2 species (8.33%) from genus *Abudefduf* and 3 species (12.5%) from genus *Pomacentrus*, followed by the second largest families recorded are Serranidae (Groupers) with 1 species (4.17%) from genus *Cephalopholis* and 2 species (8.33%) from genus *Epinephelus*.

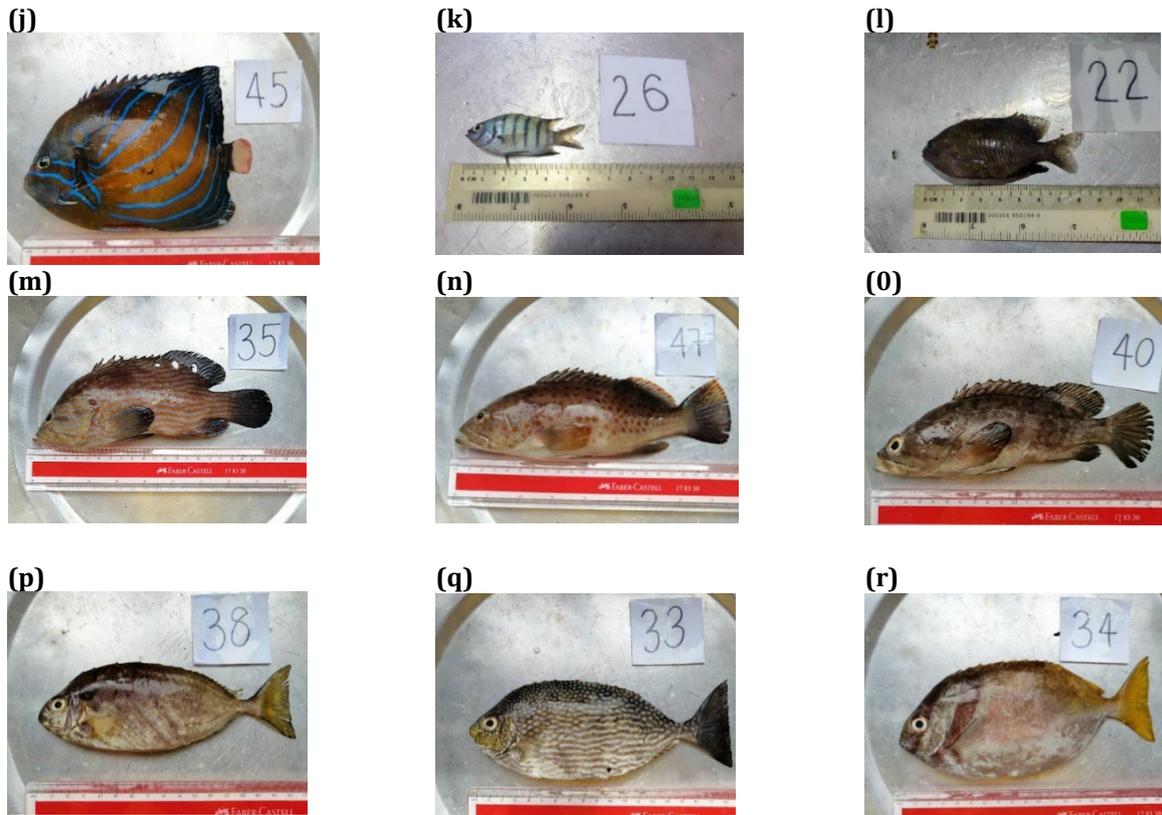
**Table 1** Taxonomic classification of reef fish species

Order	Family	Genus	Scientific name
Perciformes	Centrogenyidae	Centrogenys	<i>Centrogenys vaigiensis</i>
	Chaetodontidae	Chelmon	<i>Chelmon rostratus</i>
	Haemulidae	Diagramma	<i>Diagramma pictum</i>
	Labridae	Choerodon	<i>Choerodon oligacanthus</i>
	Lethrinidae	Lethrinus	<i>Lethrinus lentjan</i>
	Lutjanidae	Lutjanus	<i>Lutjanus russellii</i>

	Nemipteridae	Scolopsis	<i>Scolopsis vosmeri</i>
	Pomacanthidae	Pomacanthus	<i>Pomacanthus annularis</i>
	Pomacentridae	Abudefduf	<i>Abudefduf bengalensis</i>
		Pomacentrus	<i>Pomacentrus tripunctatus</i>
	Serranidae	Cephalopholis	<i>Cephalopholis formosa</i>
		Epinephelus	<i>Epinephelus bleekeri</i>
			<i>Epinephelus erythrurus</i>
	Siganidae	Siganus	<i>Siganus fuscescens</i>
			<i>Siganus javus</i>
			<i>Siganus virgatus</i>
Beryciformes	Holocentridae	Sargocentron	<i>Sargocentron rubrum</i>
Tetraodontiformes	Monacanthidae	Monacanthus	<i>Monacanthus chinensis</i>

More than 50% of order Perciformes was dominated by eight families including Pomacentridae and Serranidae [2]. The third largest family recorded was Siganidae (Rabbitfish) with 3 species (12.5%) from the genus *Siganus* followed by the family Holocentridae (Squirrelfish) with 3 species (12.5%) from the genus *Sargocentron*. The next family recorded is Lutjanidae (Snappers) with 2 species (8.33%) from genus *Lutjanus*. The other families are Centrogenyidae (False scorpionfish), Chaetodontidae (Butterflyfish), Haemulidae (Grunt fish), Labridae (Wrasses), Lethrinidae (Emperors), Monacanthidae (Leatherjackets) and Nemipteridae (Threadfin Breams and Monocle Bream) all recorded with only one species for each family.





**Fig. 1** Coral reef fishes recorded in Sedili Kechil: (a) *Centrogenys vaigiensis* (False Scorpionfish); (b) *Chelmon rostratus* (Copperband butterflyfish); (c) *Diagramma pictum* (Painted Sweetlips); (d) *Sargocentron rubrum* (Redcoat); (e) *Choerodon oligacanthus* (White-patch tuskfish); (f) *Lethrinus lentjan* (Pink ear emperor); (g) *Lutjanus russellii* (Russell's Snapper); (h) *Monacanthus chinensis* (Fan-bellied leatherjacket); (i) *Scolopsis vosmeri* (Whitecheek Monocle Bream); (j) *Pomacanthus annularis* (Bluering angelfish); (k) *Abudefduf bengalensis* (Bengal Sergeant); (l) *Pomacentrus tripunctatus* (Threespot damsel); (m) *Cephalopholis formosa* (Bluelined Grouper); (n) *Epinephelus bleekeri* (Duskytail Grouper); (o) *Epinephelus erythrurus* (Cloudy Grouper); (p) *Siganus fuscescens* (Mottled Spinefoot); (q) *Siganus javus* (Streaked Spinefoot); (r) *Siganus virgatus* (Barhead spinefoot)

### 3.2 DNA Barcoding and GenBank Submission

Nine species of coral reef fishes from this study were identified through DNA barcoding using the cytochrome c oxidase I (COI) mitochondrial DNA (mtDNA) gene. In total, 37 partial sequences of COI mtDNA gene were aligned consisting of nine sequences of coral reef fish from Sedili Kechil, Johor; 27 sequences of coral reef fish species selected from the GenBank based on the BLAST results, and one sequence of *Oncorhynchus mykiss*, a rainbow trout fish as the outgroup [14].

A total of 9 COI mtDNA gene sequences of coral reef fishes obtained from this study have been registered with the GenBank (accession no.: MW476138-MW476146, submission date: 8 January 2020) thus significantly contributing to the recent availability of the gene sequences of the species for future research. Table 2 shows the GenBank accession numbers of the coral reef fishes from Sedili Kechil, Johor.

**Table 2** The GenBank accession numbers of the coral reef fishes from Sedili Kechil, Johor

No.	Sequence ID	Species	Accession Number
1	LRSK30	<i>Lutjanus russellii</i>	MW476138
2	SJSK33	<i>Siganus javus</i>	MW476139
3	PASK45	<i>Pomacanthus annularis</i>	MW476140
4	ABSK26	<i>Abudefduf bengalensis</i>	MW476141
5	SVSK32N	<i>Scolopsis vosmeri</i>	MW476142
6	DPSK36	<i>Diagramma pictum</i>	MW476143
7	LLSK37	<i>Lethrinus lentjan</i>	MW476144
8	EESK40	<i>Epinephelus erythrurus</i>	MW476145

### 3.3 Local People's Knowledge of Availability of Different Reef Fish Species

The fishermen identify various types of reef fishes based on their external characteristics particularly color, marking pattern, body, mouth, fin, and tail shape. These characteristics help them to differentiate the fish species easily for example Cloudy Grouper (*Epinephelus erythrurus*) also known as 'kerapu panau' by local people because of the coloration and body pattern (dark grey color with irregular pale spots and blotches randomly joined around the body). It shows that local people always gave names to fish usually based on their appearance as it is easy to remember (Table 3). According to the informants especially the fishermen, there is no specific habitat for them to find specific reef fish species. As long as the area has coral reefs, they would mark that area to go fishing again. However, in both temperate and tropical environments, the structural complexity of coral reefs is also positively correlated with fish abundance and diversity because the more complex reefs provide a broader structure for reef fish [14].

**Table 3** Traditional knowledge on the availability of different coral reef fishes

Scientific name	Local name
<i>Centrogenys vaigiensis</i>	Depu
<i>Chelmon rostratus</i>	Keper sumpit
<i>Diagramma pictum</i>	Ikan Kaci
<i>Sargocentron rubrum</i>	Lolong bara
<i>Choerodon oligacanthus</i>	Ketarap tanda
<i>Lethrinus lentjan</i>	Landok calit merah
<i>Lutjanus russellii</i>	Tanda cina
<i>Monacanthus chinensis</i>	Ikan barat-barat kipas
<i>Scolopsis vosmeri</i>	Pasir-pasir pipi putih
<i>Pomacanthus annularis</i>	Taring-pelanduk cincin biru
<i>Abudefduf bengalensis</i>	Gombing Benggala
<i>Pomacentrus tripunctatus</i>	Gombing-tanda pangkal ekor
<i>Cephalopholis formosa</i>	Kerapu garis biru
<i>Epinephelus bleekeri</i>	Kerapu ekor gelap
<i>Epinephelus erythrurus</i>	Kerapu panau/tompok awan
<i>Siganus fuscescens</i>	Dengkis turus
<i>Siganus javus</i>	Dengkis Jawa
<i>Siganus virgatus</i>	Dengkis kepala jalur

### 3.4 Local People's Knowledge of Byproducts from Reef Fishes

Based on this study, subsistence fisheries are crucial to preserving the local population's standard of living. Furthermore, according to the research by Baran [15], subsistence fisheries are crucial since they can create jobs and revenue for the community. Following the interview, locals mostly use fresh reef fish as a food supply and a way for fishermen to make an income [16]. However, they would dry the fish and manufacture salted fish when it got bad and could not be sold to the market. Later on, the fish would either be sold to the market or used as a food source for personal consumption. Therefore, if this issue is resolved, subsistence fishing can assist them in improving their standard of living and provide a suitable source of income for their family.

## 4. Conclusion

This study recorded 18 species of coral reef fish found in Sedili Kechil, Johor, Malaysia: contributing to the first record of coral reef fishes from Sedili Kechil, Johor, Malaysia. Morphological identification and genetic identification using the COI mitochondrial DNA gene revealed 24 individuals belonging to 18 species, 15 genera, 13 families, and 3 orders. GenBank accepted nine COI mtDNA gene sequences, enhancing future studies. Additionally documented were the locals' knowledge of the various species of reef fish that are accessible and their familiarity with the byproducts of reef fish.

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## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

## Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Noor Syazwani Shahrul Zaman; Kamarul Rahim Kamarudin; **data collection:** Noor Syazwani Shahrul Zaman; Kamarul Rahim Kamarudin Muhammad Asyaff Azahar; Ummi Nurain Akma Baharin; Siti Nursyuhada Mohd Fadzil; Nurin Husnina Mohd Faid; Hanis Azman; Farhanah Shahdan; Siti Najihah Solehin; Nursyamfarhani Akashah; Nur Sabrina Badrulhisham; Muhammad Idham Legiman; **analysis and interpretation of results:** Noor Syazwani Shahrul Zaman; Kamarul Rahim Kamarudin; Aisyah Mohamed Rehan; **draft manuscript preparation:** Noor Syazwani Shahrul Zaman; Kamarul Rahim Kamarudin. All authors reviewed the results and approved the final version of the manuscript.

## References

- [1] Rezayee, M., Huat, T. W., Shamsudin, N., Muthusamy, M., & Tasnim, S. (2019). Model of Sustainable Village for Kampung Sedili Kecil in Johor, Malaysia. *International Journal of Basic Sciences and Applied Computing*, 2(9), 14–21. <https://doi.org/10.35940/ijbsac.i0149.122919>
- [2] Moore, B., & Colas, B. (2016). *Identification guide to the common coastal food fishes of the Pacific Islands region*. Pacific Community
- [3] Arai, T. (2014). Diversity and conservation of coral reef fishes in the Malaysian South China Sea. *Reviews in Fish Biology and Fisheries*, 25(1), 85–101. <https://doi.org/10.1007/s11160-014-9371-9>
- [4] Matsunuma, M., Motomura, H., Matsuura, K., Shazili, N. A. M., Ambak, M. A. & Meguro, M. (2011). *Fishes of Terengganu - east coast of Malay Peninsula, Malaysia*. National Museum of Nature and Science, Universiti Malaysia Terengganu, and Kagoshima University Museum. <https://ci.nii.ac.jp/ncid/BB11248756>
- [5] Thornton, T. F., & Scheer, A. M. (2012) Collaborative Engagement of Local and Traditional Knowledge and Science in Marine Environments: A Review. *Ecology and Society*, 17(3), 8. <https://api.semanticscholar.org/CorpusID:2727361>
- [6] Froese, R., & Pauly, D. (2019). *Fish Identification: Find Species*. FishBase. Retrieved April 8, 2019, from <https://www.fishbase.in/identification/classlist.php>
- [7] Bingpeng, X., Heshan, L., Zhilan, Z., Chunguang, W., Yanguo, W., & Jianjun, W. (2018). DNA barcoding for identification of fish species in the Taiwan Strait. *PLoS ONE*, 13(6), e0198109. <https://doi.org/10.1371/journal.pone.0198109>
- [8] Kamarudin, K. R., Rehan, A. M., Hashim, R., Usup, G., Ahmad, H. F., Anua, M. H., & Idris, M. Y. (2011). Molecular phylogeny of *Holothuria (Mertensiothuria) leucospilota* (Brandt 1835) as inferred from cytochrome C oxidase I mitochondrial DNA gene sequences. *Sains Malaysiana*, 40(2), 125–133.
- [9] Bingpeng, X., Heshan, L., Zhilan, Z., Chunguang, W., Yanguo, W., & Jianjun, W. (2018). DNA barcoding for identification of fish species in the Taiwan Strait. *PLoS ONE*, 13(6), e0198109. <https://doi.org/10.1371/journal.pone.0198109>
- [10] Lukman, A. L., Nordin, N. F. H., & Kamarudin, K. R. (2014). Microbial population in the coelomic fluid of *Stichopus chloronotus* and *Holothuria (Mertensiothuria) leucospilota* collected from Malaysian waters. *Sains Malaysiana*, 43(7), 1013–1021.
- [11] Liu, Z., Kang, Y., Zhang, Z., & Shao, X. (2017). Effect of Batch Annealing Temperature on Microstructure and Resistance to Fish Scaling of Ultra-Low Carbon Enamel Steel. *Metals*, 7(2), 51. <https://doi.org/10.3390/met7020051>
- [12] Gangan, S. S., Metar, S. Y., Nirmale, V. H., Chogale, N. D., Balange, A. K., Bhalekar, M. S., & Pai, R. (2013). Indigenous knowledge in the management of Bivalve Fishery of South Konkan coast of Maharashtra, India. *Indian Journal of Traditional Knowledge*, 12(1), 72-79.
- [13] Graham, N. A. J., & Nash, K. L. (2012). The importance of structural complexity in coral reef ecosystems. *Coral Reefs*, 32(2), 315–326. <https://doi.org/10.1007/s00338-012-0984-y>

- [14] Ward, R. D., Zemplak, T. S., Innes, B. H., Last, P. R., & Hebert, P. D. (2005). DNA barcoding Australia's fish species. *Philosophical Transactions of the Royal Society B Biological Sciences*, 360(1462), 1847–1857. <https://doi.org/10.1098/rstb.2005.1716>
- [15] Baran, E. (2002). The importance of non-commercial fish. In *Fisheries and Aquaculture: towards sustainable aquatic living resources management* (pp. 2-11). UNESCO Encyclopedia of Life Support Systems. Oxford, UK: EOLSS Publishers.
- [16] Nather Khan, I., Firuza, B. M., & Abdul Aziz, A. S. (2013). Ecology and conservation values of Sedili Kecil wetland, Malaysia. *Ecology, Environment and Conservation*, 19(3), 19-27.