

The Improvement of Water Quality Index and Distribution of Freshwater Fishes in Manjung River

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ABSTRACT

This project mainly studies the water quality of Manjung River in Perak, Malaysia. Five sampling sites were used to collect water quality and fish samples. The aim of this study is to verify water quality parameters based on the diversity of freshwater fish distribution. The second is to evaluate the influence of water quality on the distribution of freshwater fish. Finally, data on the diversity and distribution of fish in the study area will be analyzed. The method used in the data collection and analysis of this study is the collection of water samples in the designated study area using designated equipment. Nets and rods are used as a method to collect fish samples. Analysis of fish diversity (H'), richness (R'), and evenness (E') was performed using PAST software. Fish from 11 different species and 7 different families totaling 162 individual fish in total. Fish belonging to the Latidae family make up the majority of fish species in the region (15 species), followed by those belonging to the Cyprinidae family (18 species). Additionally, samples of three fish species were collected, including *Oreochromis mossambicus*, Pacific ladyfish, *Lutjanus fulviflamma*, *Megalops cyprinoides* and *Prophagorus nieuhofi*. In this river, pH is the most significant water quality factor for fish occurrence, followed by temperature, conductivity, dissolved oxygen, salinity, and turbidity. Data analysis showed that fish presence was influenced by several water quality factors, but not by the month of sampling. These findings provide fresh information from research on fish assemblages and habitat quality that may be important for future river fisheries and fish conservation.

Keywords: pH, Water Quality, Fish Diversity, Fish Distribution, Latidae, Cynrinidae

1.0 INTRODUCTION

One of the major rivers in Perak is Sungai Manjung. Its name comes from the Manjung district, which was once known as Dinding. As a result, the river is also known as Sungai Dinding or the Dinding River. Sungai Manjung is much smaller than Sungai Perak. The main river and significant tributaries of the Manjung River Basin constitute the focus of the research area, though. The main tributaries include Sg. Air Tawar, Sg. Setiawan, and Sg. Raja Hitam. These three rivers each have a unique system of tributaries and are all rather large in their own right. Bandar Seri Manjung, a central city between Sitiawan and Lumut, has a commercial centre, which contributes to river pollution. Whether we want it or not, human activities including restaurants, vehicle and motor services, wet markets, and clinics may produce a lot of pollutants. Many organic materials are introduced into the water bodies by markets and restaurants. Manjung area is known for its manufacturing of wood, brick, steel, and other building materials, as well as palm oil processing, flour and fertiliser factories, and food production. These operations will generate a large amount of organic waste that is not biodegradable, as well as chemical and hazardous waste that will be released into the water column. On cultural farms, it is especially important to consider how the environment and the effluent of the farm interact. The majority of wastewater outputs come from diluted farm effluents, while concentrated farm sediments from land-based farming activities are also possible.

They mostly come from feed and nutrient input produced on the farm, either directly in the form of uneaten or leached feeds or indirectly through animal digestion and excretory wastes. The organic molecules in fish farms are also broken down by certain bacteria, releasing dissolved inorganic nutrients into the water [4]. For fish management and conservation, an understanding of fishhabitat connections is essential [5]. Fish species are used to measure the impact of disturbance on the environment since they are highly dependent on the properties of water and its dynamics due to the specific habitat needs [16]. It has been established that fish can be utilised in environmental planning as a reliable indication of habitat conditions [20]. Aquatic ecosystems or habitat's fish assemblages have been shown in prior research to be significantly influenced by water quality.

The aim of this research is to study the level of customer satisfaction towards Kuala Perlis ferry terminal. The research objective is to determine the current status of customer satisfaction with ferry operation at Kuala Perlis and to examine the influence of terminal facilities towards customer satisfaction at Kuala Perlis.

The objective of the project is to determine the water quality in the chosen area. When a research endeavour is effective, the findings are the modifications or outcomes that were expected. Results from earlier research that can be compared for different purposes might have changed slightly. Because of this study, it fully depends on the precision of the tools employed to gather reliable data. Researchers also anticipate that their study of the distribution of freshwater fish in the Manjung River will be beneficial to the local fisherman in Manjung. However, this research will help other students and the university as a whole to carry out more research.

The study of this project is to verify the water quality parameters based on the diversity of freshwater fish distribution, to evaluate the influence of water quality on freshwater fish distribution and to analyse data on the fish diversity and distribution in the study area.

2.0 LITERATURE REVIEW

2.1 Water Quality

Monitoring the environment for pollution is seen to be extremely important for maintaining the sustainability of the planet. Sustainable development is defined as meeting current demands without jeopardising the capability of future generations to fulfil their own requirements [20]. Because of this, every person has the right to live in a sustainable environment. One of the biggest bodies of water, which includes the ocean, rivers, and lakes, is crucial to maintaining a green environment. Poor water quality will have an effect on the entire environment. This claim is supported [12], who explore how the sensitive topic of water quality can have an impact on both natural and anthropogenic processes. Surface water is degraded and rendered unusable for drinking, industrial, agricultural, and other uses due to increased consumption and natural processes such changes in precipitation inputs, erosion, and weathering of crustal minerals. Undoubtedly, contaminated water spreads diseases like cholera and typhoid. contamination of water by microbes such *Escherichia coli* (*E. coli*), pathogenic bacteria, and protozoa. Disposing of waste can lead to illness and other health issues for people [10]. According to research by the Indian Institute of Chemical Technology, residents of contaminated areas are exposed to significant levels of arsenic pollution, which is found in the sample population's blood, urine, hair, and nails in Patancheruvu, India.

2.2 Water Quality Standards in Malaysia

The Department of Environment (DOE) in Malaysia has chosen the NWQS to categorise the river for the utilisation of water resources. Since the data from the water quality monitoring is crucial for managing the water, it should be compared to the water criteria and standards (DNASB, 2011). According to the NWQS, rivers in Malaysia have been divided into 5 primary classes, namely Class I, IIA, IIB, III, IV, and V, as stated in Appendix A.

2.3 Water Quality Parameter

A healthy river and environment depend on having high-quality water. Aquatic life cannot survive in water unless a number of fundamental requirements are met. Populations of certain species are stressed when these conditions are not ideal. Organisms may perish in unfavourable environments. In order to establish the health of the river water and ensure that it is safe to use for any purpose, a variety of water quality criteria must be measured. There are a number of elements that need to be taken into account when creating a water quality or river index [18]. The quality indicators for this study are DO, TDS, conductivity, salinity, temperature, and pH. Even if there are more parameters that can be used to determine the water quality, the ones that were chosen are sufficient to determine the preliminary water quality. Both the physical and chemical factors can be classified into two categories.

2.4 Freshwater Fishes

Malaysia is renowned for having a large variety of plants and animals. This nation has a variety of ecosystems and habitats that are suited for different living things, including the fish fauna [3]. A total surface area of 45,459 km² is taken up by inland water bodies and wetlands, such as rivers, lakes, peat bogs, marshes, reservoirs, former mining pools, irrigation canals, and paddy fields [10]. Fish have a strong chance of colonising the vast water area and variety of aquatic habitats. In total, 178 families and 413 freshwater species have been recognised in this nation [3]. However, the majority of fish species that are threatened are found in freshwater settings. According to studies, this country is home to 32 species of fish that are highly threatened, with 50% of those species originating in freshwater environments [6].

3.0 METHODOLOGY

3.1 Flowchart of Project

The flowchart for gathering information on water samples and freshwater fishes is given as seen in Figure 1. The task of collecting water samples from the Manjung River will be carried out by the researcher, who will then analyse them some equipment that made to test for these parameters. The pH and temperature experiments were carried out with the same equipment, the TRANS Instrument. At the same time the researcher will catch fish using nets and fishing rod with the help of fishermen.

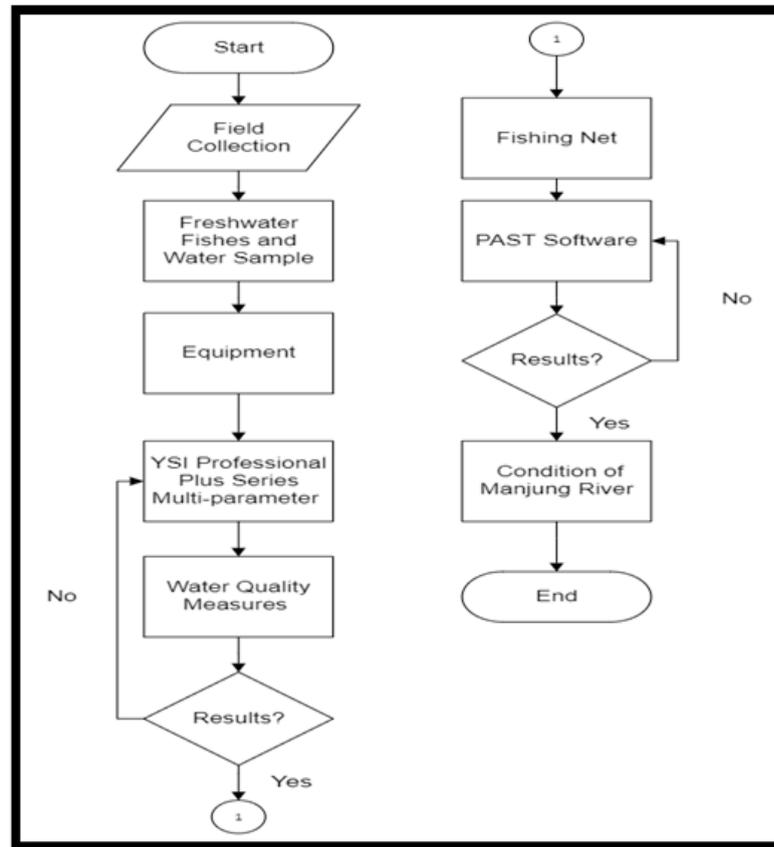


Figure 1. Research Flowchart

3.2 Experimental Technique and Method Used

In-situ measurements will be used to assess all water samples. Table 1 provides the water quality criteria and methods used to determine the water quality of the Manjung River and its tributaries. Next, fishermen will assist the researcher in catching fish using nets and fishing rod. Fish identification was carried out utilising the conserved samples and images. This investigation was carried out to categorise various fish types into genus, species, and families. Information about a fish's fin, colour, mouth, eye, lateral line, gill cover, and pelvic fin are all necessary for identification. This is the taxonomical method used by science to identify, describe, and categorise creatures. The fish was photographed as soon as possible using a digital camera because formalin causes fish to lose their colour (Vijaylaxmi, 2010). The identification and classification processes involved the use of some reference materials, including books and websites. For the purpose of identification, "The IUCN Red List of Threatened Species" website, "Freshwater Fish in Western Indonesia and Sulawesi" book, and "Fishes in Malaysia" book were utilised. The fish's width, weight, and length were all measured.

Table 1: Water Quality Parameters and Method Use

Parameters	Unit	Method Use
pH	-	In- situ
DO	mg/l	In- situ
Temperature	°C	In- situ
Salinity	%	In- situ
Conductivity	μS/cm	In- situ
TDS	ppm	In- situ

3.2.1 Water Sampling

Water samples will be tested based on five parameters: pH, Dissolved Oxygen (DO), Salinity, Temperature, and Total Dissolved Solid (TDS). Each of these factors has a unique Standard Operating Procedure (SOP) that specifies how it should be tested using specific tools.

In this study, water samples were tested utilising tester equipment in accordance with each parameter that was selected. The same instrument, a TRANS Instrument, was used to do experiments on pH and temperature. Salinity, dissolved oxygen, and total dissolved solids were examined using equipment designed to measure these parameters as the other parameter.

3.2.2 Fish Sampling

Fish were obtained from each sampling location by carefully sampling all the microhabitats that were present within the reach as we moved upstream [16]. Simple fishing equipment called a cast net and fishing rod was once employed. Fish samples were preserved by being kept in plastic containers filled with stream water. At each sampling site, a stream section of 30 m was sampled. Consequently, the physical properties of the Manjung River were studied and discussed. Then, sample preservation is among the crucial techniques where a caught fish which can be identified in-situ was maintained to sustain the collection of specimens. For preservation, diluted formalin with 5–10% formaldehyde was utilised in this procedure. Additionally, other species that local fisherman caught at the sampling sites were also taken into account in this study.

3.2.3 Water Quality Assessments

Based on in-situ testing, quantities of water quality measures were used in this investigation. Each sampling site along the Manjung River was used in this study to examine the water quality between low tide and high tide. Each parameter's output is an average sample frequency value. The categorization was then decided upon using Malaysia's NWQS and EQA standards.

3.2.4 Shannon-Weiner Index, Margalef Index and Evenness Index

i. Shannon-Wiener Index

Shannon-Wiener Index was used to determine the fish species abundance based on the number of species and the number of individuals in each species. [22]

$$H' = -\sum p_i \ln(p_i) \quad \text{Eq. 1}$$

Where;

H' = Shannon-Wiener Index, $p_i = n_i/N$
 p_i = Proportional abundance of species i
 n_i = Total number of individuals of species i
 N = Total number of individuals of all species

ii. Margalef Index

The Margalef diversity index appears to be a good indicator of diversity and a valuable parameter for evaluating the time series of data [15]. The Margalef diversity index (d) was calculated using the following formula:

$$d = \frac{S - 1}{\ln N} \quad \text{Eq. 2}$$

Where;

S = number of species
 N = total number of individuals in the sample

iii. Evenness Index

Evenness index was used to compare the numbers of individuals in the same study site for each species [16].

$$J = \frac{H/H_{\max}}{H/\log_e S} \quad \text{Eq. 3}$$

Where;

J = evenness index
 S = total number of species present in the sample
 H' = Shannon-Wiener index

3.2.5 PAST software (PAleontological STatistics)

In this work, PAST software is used to examine fish diversity (H'), richness (R'), and equality (E'), as shown in figure 2. PAST is free software that may be used to manipulate data, plot data, perform univariate and multivariate statistical analyses, perform ecological analysis, time series analysis, spatial analysis, morphometric analysis, and stratigraphic analysis.

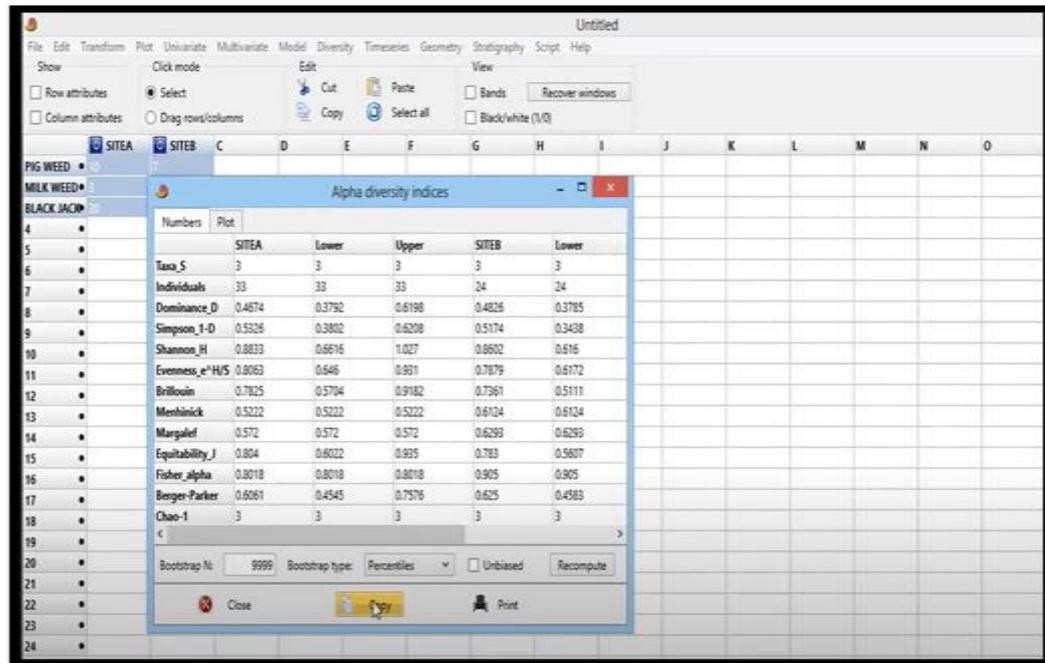


Figure 2. PAST software

4.0 FINDING OF THE RESEARCH

In this chapter, all the data that were gathered using a few of the techniques that were covered are revealed and analysed. Three strategies have been employed: observation, sampling procedures, and equipment for measuring parameters. Additionally, this chapter goes into greater depth on the analysis of the water sample for each chosen parameter. Every time there is a collection activity in the research area that could have an impact on the water quality, observations are made about the weather and other maritime activities. For the purpose of interpreting the scientific formula from the Water Quality Assessments, each parameter was further characterised in terms of the average, maximum, minimum, and standard deviation. Using the results, a standard indicator based on national water quality criteria was utilised to assess the Manjung River's water quality status.

4.1 Water Quality data of Manjung River

The water quality parameter data from each sampling site and the overall readings (Site 1 to Site 5) are presented in Table 2. For the overall water quality readings, the sampling sites in this area showed alkaline water where the average pH reading was at 7.64 ± 0.04 and ranged between 7.60 to 7.68. The range of water temperature (29.76 to 31.28°C) and DO (5.26 to 5.94 mg/L) was relatively high considering the measurements from the rainy and dry seasons throughout the year with mean at $30.52 \pm 0.76^\circ\text{C}$ and 5.6 ± 0.34 mg. /L, respectively. The average conductivity of water is about 66.74 ± 3.39 $\mu\text{S}/\text{cm}$, where the range is 63.35 to 7013 $\mu\text{S}/\text{cm}$. For TDS, the range was 56.42 to 61.38 mg/L, with a mean of 58.9 ± 2.48 mg/L.

Table 2. Water Quality data of Manjung River

Variables	Site 1		Site 2		Site 3		Site 4		Site 5		Overall reading	Site 1 - 5
	Mean										Mean ± SD	Range
pH	7.61	7.73	7.65	7.65	7.69	7.54	7.64	7.63	7.6	7.59	7.64 ± 0.04	7.60 - 7.68
Temperature	30.48	29.28	30.65	28.97	30.98	30.62	31.71	30.42	31.52	31.28	30.52 ± 0.76	29.76 - 31.28
DO	5.89	5.7	5.54	5.14	6.45	5.67	5.92	5.39	5.75	5.21	5.6 ± 0.34	5.26 - 5.94
Conductivity	60.76	63.47	66.54	61.5	70.78	69.25	69.71	65.45	69.46	63.99	66.74 ± 3.39	63.35 - 70.13
TDS	56	53	60	57	61	58	60	59	60	55	58.9 ± 2.48	56.42 - 61.38

4.2 Average of Parameters Value at 5 Stations

The average parameter values at each station are displayed in the figure 3. It is evident that the outcomes of the parameter tests conducted at each location fall within the same broad value range. This is as a result of the parameter value readings having few, if any, substantial differences amongst each other. This is because the water samples were taken at the same location and using the same methodology, such as at shrimp farm outlets, close to shrimp farms in Sg Pasir, near floating fish cage areas, next to Jalan David Sung close to fertiliser factories, and at shipping and port areas close to Lumut Maritime Terminal.

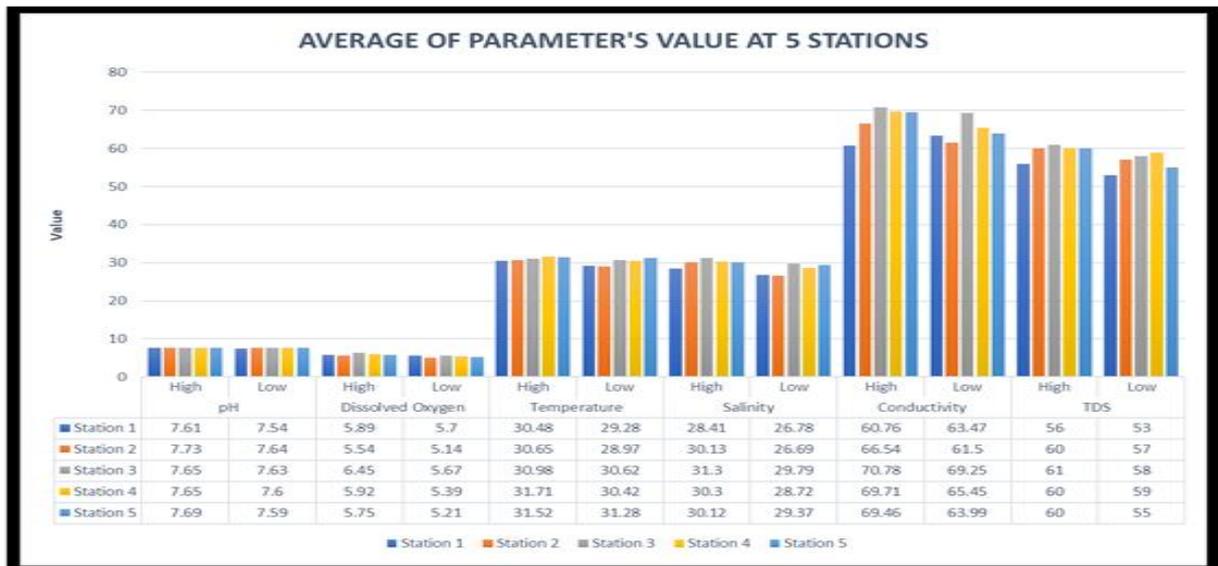


Figure 3. Average of Parameters Value at 5 Stations

4.3 Freshwater Fishes

Table 3 shows the data of diversity and distribution of fish caught in Sungai Manjung. Fish from 7 families totaling 162 individuals were caught in total. *Mystacoleucus marginatus*, a member of the Cyprinidae family, had the highest population density of these ten species, with 50 individuals (34%) followed by *Osteochilus haseltii* with 22 individuals (15%), *Hemibagrus nemurus* with 21 individuals (14%), *Cyclocheilichthys apogon* with 16 individuals (10.9%), *Oreochromis mossambicus* with 20 individuals (13.6%), Latidae with 15 individuals (9.88%) and Ham Notopterus notopterus, *Barbonymus schwanenfeldii*, *Homaloptera tweediei*, and *Oxyeleotris marmorata* are the least numerous species, each having only two individuals (1.4%).

Table 3. The diversity and abundance of fish at Sungai Manjung, Perak

Family	Common Name	Scientific Name	Individual
Cyprinidae	Sia	<i>Mystacoleucus marginatus</i>	50
	Terbul	<i>Osteochilus haseltii</i>	22
	Cemperas	<i>Cyclocheilichthys apogon</i>	16
	Lampam Barbonymus	<i>Barbonymus schwanenfeldii</i>	1
	Sebarau	<i>Hampala microlepidota</i>	13
Cichlidae	Tilapia Hitam	<i>Oreochromis mossambicus</i>	20
Bagridae	Baung	<i>Hemibagrus nemurus</i>	21
Notopteridae	Belida	<i>Notopterus notopterus</i>	2
Balitoridae	Ikan Pasir	<i>Homaloptera tweediei</i>	1
Eleotridae	Ikan Ubi	<i>Oxyeleotris marmorata</i>	1
Latidae	Siakap	<i>Barramundi</i>	15
7	11	11	162

4.4 Analysis of fish diversity by Shannon-Weiner Index, Simpson Index and Evenness Index

The data on table 4 was analysed using PAST software. Shannon-Weiner Index, Margalef Index and Evenness Index show that Manjung River consists of a high number of fish diversity. The results of the analysis of diversity were recorded for Station 1 as follows: diversity (H') = 1.839, richness (R') = 2.427, and evenness (E') = 0.6988. While at Station 2, the following values were discovered: diversity (H') = 1.7, richness (R') = 1.898, and evenness (E') = 0.6843. The diversity (H') is 1.777, the richness (R') is 1.939, and the evenness (E') is 0.7387 at station 3. The diversity (H') values for stations 4 and 5 are respectively 1.809, 1.801, and 0.8722 for richness and evenness. For station 4, the diversity (H') values are 1.74, 1.764, and 0.8136 for evenness.

Table 4 The data analysis of fish at Manjung River

Sampling Site	Shannon-Weiner Index (H')	Margalef Index (R')	Evenness Index (E')
Station 1	1.839	2.427	0.6988
Station 2	1.7	1.898	0.6843
Station 3	1.777	1.939	0.7387
Station 4	1.809	1.801	0.8722
Station 5	1.74	1.764	0.8136

4.5 Data of length, weight and width of fish caught at Manjung River

As shown in Table 5, the length of samples successfully collected ranged from 4 cm to 46 cm while the weight ranged between 2 g to 13000 g. The width of samples ranged from 1.5 cm to 6.5 cm. There were five individuals of *Cyclocheilichthys apogon* caught during the period of study with maximum length, 15.5 cm and minimum length about 13.1 cm. The median length of this species was 13.4 cm. The highest weight for *Cyclocheilichthys apogon* was 105.98 g and the lowest weight was 57.83 g whereas the median weight was 59.2 g. The maximum width for this species was 6 cm and the minimum width was 5.6 cm. The median width of this species was 5.8 cm. Next, there were 13 individuals of *Osteochilus haseltii* successfully caught. The maximum length of sample was 19 cm and minimum length was 13 cm respectively whereas the median length of this species was 15 cm. The highest weight of *Osteochilus haseltii* caught was 157.13 g and the lowest weight was 64.01 g. The median weight of this species was 85.46 cm. The maximum width for this species was 6.5 cm. Both minimum width and median width of these species was 5 cm.

Table 5 The data of length, weight and width of fish samples caught at Manjung River

Scientific Name	Individual No	Length (cm)			Width (cm)			Weight (g)		
		Min	Med	Max	Min	Med	Max	Min	Med	Max
<i>Mystacoleucus marginatus</i>	50	4	8	12	1.5	3	4.5	2	11	44
<i>Osteochilus haseltii</i>	22	8.5	11.75	14	3	4.5	5.5	9	42.5	78
<i>Cyclocheilichthys apogon</i>	16	7	9	10.5	2.8	4	5	3	16	39
<i>Barbonymus schwanefeldii</i>	1	21.8			8.8			291		
<i>Hampala microlepidota</i>	13	7.5	9	9.6	2.5	3	4	7	12	28
<i>Oreochromis mossambicus</i>	20	14	18	21	5.5	7	13	39	166.5	770
<i>Hemibagrus nemurus</i>	21	10.5	12	15.8	2.5	3	6.5	6	26	112
<i>Notopterus notopterus</i>	2	17		19.5	5		5.5	47		65
<i>Homaloptera tweediei</i>	1	18.2			2.5			14		
<i>Oxyeleotris marmorata</i>	1	11.5			2.5			35		
Barramundi	15	7		46	2.7		6	60		13000

5.0 CONCLUSION AND RECOMMENDATION

In conclusion, the impact of water quality on the distribution of freshwater fish was shown to be significant and essential for the wellbeing and abundance of fish populations. The total fish caught in Sungai Manjung of Perak is 162 individuals from 7 families. 11 species were found during these sampling activities. It was considered as highly diversified and with abundant species. Sungai Manjung was dominated by Barramundi or Ikan Siakap from family Latidae, followed by *Osteochilus hesseltii* and *Cyclocheilichthys apogon*. The results showed that Sungai Manjung can be considered as not threatened by development pressure due to anthropogenic activities. For the long-term ecological integrity of freshwater ecosystems and the maintenance of healthy fish populations, effective management and conservation techniques that aim to enhance and safeguard water quality are essential.

Conservation programs need to be carried out to protect the Manjung River ecosystem. Although, the situation around Sungai Manjung already has development such as factories and ports, most of the species in Sungai Manjung are considered non-threatened and they are also not listed in The International Union for Conservation of Nature Red List of Threatened Species (IUCN Redlist), their existence however still needs to be monitored. Environmental management such as Environmental Impact Assessment (EIA) needs to be done in this area to preserve the stability of this ecosystem.

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