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Fish Feeding Guild in the Polluted River, Pengkalan Chepa River, Kelantan, Malaysia.

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Abstract. A study on water quality and fish guild was conducted in the year 2008 at four selected tributaries of Pengkalan Chepa River (PCR), Kelantan, Malaysia namely Sungai Pengkalan Chepa 1, Sungai Pengkalan Chepa 2, Sungai Alor B, Sungai Alor Lintah, and Sungai Keladi. Fish were collected using three-layered fish net from July to November, consecutively. Water quality of PCR was found highly contaminated with water quality index (WQI) ranging from 39-81 at each sampling. There were 170 fish collected from PCR during this study, which representing 18 families and 20 species. The most common fishes based on total fish captured were spotted catfishes (*Tachysurus maculatus)* and climbing perch (*Anabas testudineus*). This study showed that PCR were dominated by omnivorous while carnivorous fishes contributed about almost as higher percentage as omnivorous. Fishes were also categorized in four ecological guilds which are catadromous, amphidromous, marine, and potamonic guilds. The findings of this study concluded that PCR shows signs of deterioration in water quality that only support fewer species with highly skewed trophic structure (increasing frequency of omnivores and carnivores). PCR is only dominated by tolerant and generalist fish species.

Keywords: fish, distribution, feeding guilds, river, polluted

1. Introduction

Kelantan State, Malaysia is comprised of more than 25 rivers having seven major river basins that are Galas, Kelantan, Golok, Semerak, Pengkalan Chepa, Pengkalan Datu and Kemasin river basins. Pengkalan Chepa River Basin (PCRB) is located in the urban area of Kota Bharu District, Kelantan State, Malaysia. Pengkalan Chepa River is formed by the junction of Kelantan River and Pengkalan Chepa River, 10 km from the river mouth.

Situated in the urban area, Pengkalan Chepa River (PCR) is subjected to urban development and accommodates crowded and heavy population. Increasing infrastructure development contributed to high sediment run-off due to improper managed construction sites and eroding stream banks. PCR receives point pollution loads from sewage treatment as well as major industries including textiles and food manufacturing factories which are located near the river bank. Garages and workshops also contributed to river pollution. The non-point pollution in the study area is also contributed by domestic drainage and land run-off. In some places, the streams in the PCR are used for rubbish dumping sites. We also noticed that excessive nutrients from livestock, pet wastes and faulty septic systems in some locations along the river. Thus, this paper is aiming to describe fish feeding guild in the polluted rivers.

2. Materials and Methods

2.1. Sampling site

Sampling was conducted at four selected tributaries of Pengkalan Chepa River namely Sungai Pengkalan Chepa 2 (SPC 2), Sungai Alor B (SAB), Sungai Alor Lintah (SAL), Sungai Keladi (SK) and Sungai Pengkalan Chepa 1 (SPC 1) (Figure 1).

2.2. Fish Sampling

Sampling activities were carried out from July to November 2008. Fish were collected using three-layered fish net, N = 5 months X 4 stations x 5 replicates = 100 samples/stream. Nets were soaked for 12 hours for each sampling periods. All captured fish were placed immediately into a bucket containing water and identified to species, enumerated (collectively by species) and released back into the stream location from which they had been captured. Guild assessment were per Mohsin and Ambak 1983 [6] and Kottelat et al. [7]. Voucher specimens were retained for lab verification. These voucher specimens were preserved in 10% buffered formalin, labeled, and stored in Environmental Laboratory, School of Health Sciences, Health Campus, Universiti Sains Malaysia (USM), Malaysia.

2.3. Analyses

Relative abundances of fishes within fish guild were compared among sampling sites using repeated-measured ANOVA. Logarithmic transformations were performed when necessary to address requirements of normal distributions for parametric statistics. Significant differences were further investigated using a non-parametric least significant difference (LSD) multiple range test. An alpha level of 0.05 was used for accepting or rejecting hypotheses.

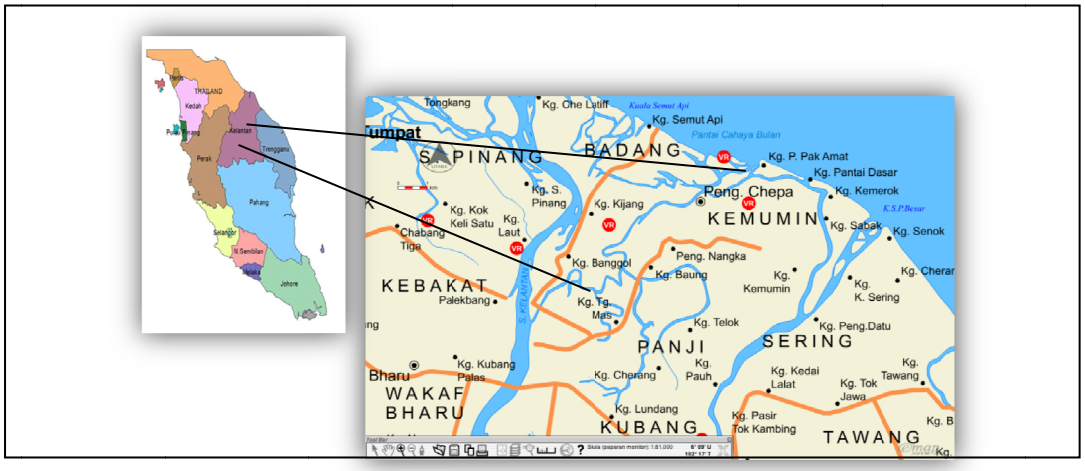

Fig. 1: Map of sampling locations, Pengkalan Chepa River (PCR) in Kelantan State, Malaysia

3. Results and Discussion

Water quality of PCR was found highly contaminated with water quality index (WQI) ranging from 39-81 each sampling from the year 2008. WQI fluctuated from polluted (0-59) to slightly polluted (60-80) and *vice versa* during sampling periods due to variation of water discharge especially during monsoon season where precipitation was higher (WQI > 78). During dry season, WQI are found to be very low (WQI < 50) because water movement is rather minimal with very low velocity. Average WQI for the year 2008 is indicated in Table 1.

There were 170 fish collected from PCR during this study, which representing 17 families and 19 species (Table 2). The most common fishes based on total fish captured were spotted catfishes (*Tachysurus maculatus)* and climbing perch (*Anabas testudineus)*. The number of fish species was low in sampling stations SAB and SAL which contributed to low abundant of fish. Based on observation, SAB did not offer variety of microhabitat preferences and foraging strategies for fish. It appears that SAB has less distinctive habitat types (e.g., riffles, runs, pools, overhangs) that can be fully utilized by different kind of fish species. Intolerant species were confined to less impaired part of the stream and absent in moderately and highly impaired section of the streams. SPC 1, SPC2 and SK showed an improved ichtheio-fauna ranging from

three to 13 species. More number of species recorded in SPC 1, SPC 2 and SK was due to improvement of water quality through dilution process. Catfishes, snakeheads and perches are known for their high tolerance of poor water quality and mostly were caught at SAB and SAL. Spotted catfish (*Tachysurus maculatus*) and any other marine fishes (i.e., *Stolephorus* sp. *Epinephelus coioides,* and *Achiroides leucorhynchos*) only occur in SPC 1 probably due to the wide ranging of water pH (6.5 – 8.29). This is because SPC 1 is under influences of tides. During high tides, the salt water is able to move up more than 50 km upstream. During this time, the river flows in the different direction bringing up most of marine/brackish fishes upstream.

Table 1: Water quality classification based on water quality index and its water classes and uses for Pengkalan Chepa River, Kelantan, Malaysia for the year 2008.

Sampling sites	WQI (average for year 2008 to 2009)	Degree of pollution and it classes
SPC 2	77.3	Slightly Polluted, CLASS IIB*
SAB	63.5	Very Polluted, CLASS III**
SAL	57	Very Polluted, CLASS III**
SK	78.7	Slightly Polluted, CLASS IIB*
SPC 1	75	Slightly Polluted, CLASS IIB*

*Class IIB – The water can be used as recreational purpose with body contact

**Class III - The water only can be used for irrigation and if use for water supply, the water needs an extensive treatment and it is not advised for recreational purposes

Table 2: Fish species checklist from Pengkalan Chepa River, Kelantan Malaysia.

Fish Species	**Common name**
Anabas testudineus	Climbing perch
Trichogaster trichopterus	Three spotted gouramy
Carangoides sp.	-
Clarias batrachus	Walking catfish
Channa striatus	Snakehead
Oxyleotris marmoratus	Marble goby
Stolephorus sp.	-
Gerres filamentosus	Filamentous mojarra
Leiognathus equulus	Ponyfish
Lutjanus sp.	Snappers
Megalops cyprinoides	Yavula
Liza subviridis	Greenback mullet
Toxotes jaculatrix	Archerfish
Pseudorhombus arsius	Smalltooth flounders
Epinephelus coioides	Orange spotted grouper
Scatophagus argus	Butterfish
Tachysurus maculatus	Spotted catfish
Arius sagor	Sagor catfish
Notopterus notopterus	Bronze featherback

The richness and variety of unpolluted riverine habitats provide a wide range of possible food organisms and substrates [1]. These originate either from within the aquatic system itself (autochthonous food sources) or from outside the system (allochthonous food sources), although they are all ultimately dependent on materials of external origin in the form of alluvial silt, dissolved nutrients, material washed into the system with surface flow or decomposition products on inundated ground [2]. In most unpolluted tropical streams and rivers, fish feeding guilds may include algivores, insectivores, planktivores, piscivores, herbivores and omnivores [3]. Perrow et. al. 1997 indicated that an ideal community in unpolluted lake should consist of a high proportion of piscivores fish with a corresponding low density of zooplanktivores and low biomass of benthivores fish [4]. Rohasliney and Jackson 2009 on the other hands showed that unpolluted stream should comprise of high proportion of insectivore, followed by detritivores and piscivores with low density of herbivores, planktivores and omnivores [5]. Some fish can be placed in a trophic guild easily because of its obvious feeding habits. But some, feeding habits are most like to change over an individual's life cycles.

However, Mohsin and Ambak 1983, Kottelat et al. 1993 and Ambak et. al. 2010 gave a very clear boundary of trophic guild for freshwater fish in Malaysia [6] [7] [8].

Some study showed that different feeding groups of fishes have particular impacts on the stability of stream/river's trophic level and interaction [9]. Perrow et al. indicated that a grazing pressure on phytoplankton by zooplankton can be reduced by through selective predation by zooplanktivores fish [10]. Meanwhile, through foraging amongst bottom sediments, benthivores fish may uproot submerged plants [11] which may suspend fine material in the water column. In that way, significant water turbidity increases and enhances the release of nutrients into the water column. Whilst, piscivorous fish may control prey density and biomass in a natural ecosystem in order to produce stability in fish population [12].

This study showed that PCR were dominated by omnivorous (Figure 2). High abundant of omnivorous fishes are primarily due to their ability to vary their diets. This is important for fishes where food forage is limited or preferred food is unavailable [12]. Carnivorous fishes contributed about almost as higher percentage as omnivorous (Figure 2). Hence, this study found that no clear distribution pattern of omnivores and carnivores were observed as they were found all throughout sampling sites. Catfishes caught in this study also can be classified as scavenger that scavenges on dead and dying animals. Herbivorous is relatively among marine and brackish water fishes (*Liza subviridis* and *Siganus* sp.). Herbivorous fishes caught in this study may consume a significant fraction of the aquatic vegetation emerged at the riverbank of SPC 1. This result indicated that herbivorous species had preferences for the less impaired sites. Furthermore, wider stream width at SPC 1 had obviously contributing to more establishment of phytoplankton which forms the food of herbivorous fishes. This is because wider stream width provides a low flow rate which allows suspended sediment to settle down, resulting in clear water for phytoplankton to build up.

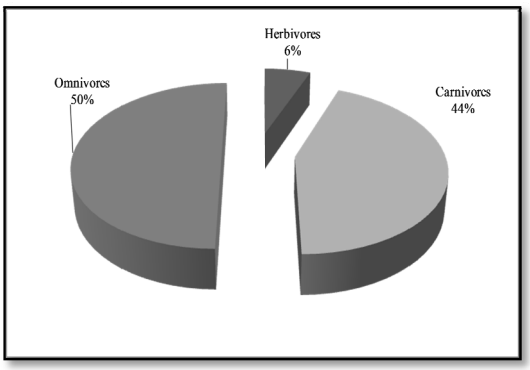

Fig. 2: Percentage of feeding guild from all sites for the year 2008. No significant different of relative abundance of fishes among sampling sites and among fish feeding guilds

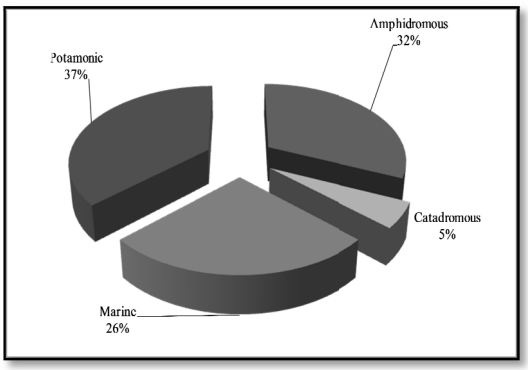

Fig. 3: Percentage of ecological guild from all sites 2008. There are significant different of relative abundance of fishes among sampling sites. SPC 1 and SPC 2 have the highest marine guilds compared to other sampling sites. Characterization of ecological guilds was adapted from Welcomme et al. 2006 [13] and fishbase.org [14].

In term of ecological guild, categorization of fish species caught in PCR is showed in Figure 3. Marine guild (26%) was mostly found in SPC 1 and SPC 2. This fish are an opportunistic marine fish that enters brackish water opportunistically during high tides. Fishes in catadromous guild (e.g., *Liza subviridis*) usually feed in the freshwater environment. Potamonic fish guild such as climbing perch (*Anabas testudineus*), three spotted gouramy (*Trichogaster trichopterus*) and walking catfish (*Clarias batrachus*) are completely tolerant to anoxia. These species can tolerate extremely unfavorable water conditions and is associated mainly with turbid and stagnant waters. Welcomme et al. 2006 separated these species in a paleopotamonic guild while snakehead (*Channa striatus*) can be grouped in plesiopotamonic guild because it can tolerant of low dissolved oxygen tension only [13].

4. Conclusion

The findings of this study concluded that PCR shows signs of deterioration in water quality that only support fewer species with highly skewed trophic structure (increasing frequency of omnivores and carnivores). PCR is only dominated by tolerant and generalist fish species.

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