Freshwater Fish Checklist in Pergau Reservoir and its Catchment Area, Kelantan

Mohd Shafiq Zakeyuddin1*, Shahril Mod Husin1, Aisah Md Shukor1, Ayuni Samsul Bahri1, Sharudin Shahadan1, Mohd Syafiq Mohd Saharudin1 and Ahmad Lutfi Ahmad Ghazilan1

1Regulatory and Environmental Science Unit, TNB Research Sdn Bhd, No.1 Lorong Ayer Itam, Kawasan Institusi Penyelidikan, 43000 Kajang, Selangor, Malaysia

E-mail: shafiq.zakeyuddin@tnb.com.my

Abstract. An ichthyological survey was carried out at Pergau Reservoir and its catchment area during the scientific expedition of Pergau Reservoir that was held on 28th October to 2nd November 2019. The objective of this study is to determine fish checklist present at the reservoir and its catchment area. Various sampling gears were used to maximize fish collections such as eletrofishing, cast nets, gill-nets, rod fishing and scoop nets. A total of 20 fish species from 10 families were recorded during the study. Two fish species listed as ‘Data Deficient’ category, Tor tambra (Malayan Mahseer) and Betta kuehnei (Betta) were also recorded, indicating proper management plan should be carried out to preserve important species from being overexploited. The present study also added new recorded fish checklist, Macrognathus maculatus to the total fish checklist. So, the total of combined fish checklist from past to present studies were 49 fish species including four non-native species. This information is helpful for the development of management plan of Sultan Ismail Petra Ecosystem Protection Park that is currently in the process of the gazettment.

1. Introduction
Reservoirs can be defined as water bodies of different shapes and size that have been constructed by damming of river [1]. In Malaysia, more than 51 reservoirs were reported including Pergau Reservoir with several purposes such as for water supply for domestic uses, flood mitigation control, irrigation, food sources for local community and hydroelectric power [2]. Pergau Reservoir, which is located in the Jeli District, Kelantan, occupies about 4.63 km² of total water surface and having 224 km² of the catchment area [3]. Freshwater fishes in Malaysia are extremely diverse and estimated about 470 species were recorded [4]. However, there are limited studies related to fish biodiversity that had been carried out in Pergau Reservoir and its catchment area. The first study was carried out prior to the construction of Pergau Hydroelectric Project [5] before being compiled by [3] and [6]. Meanwhile, species diversity of fishes in small streams around the Pergau Reservoir had also been carried out [7].

Thus, the objective of this study is to update on fish species checklist present at the Pergau Reservoir and its catchment areas based on the scientific expedition of Pergau Reservoir that was conducted on 28th October to 2nd November 2019.
2. Materials and methods

2.1 Study area
Pergau Reservoir and its catchment area can be divided into two zones; lotic (reservoir) and lentic (river intakes) zones. Eight river intakes and one reservoir were selected during the study as shown in Fig. 1 and Table 1.

![Location of sampling stations](image_url)

**Figure 1.** Location of sampling stations.

**Table 1.** Coordinate of sampling stations.

| Sampling station | Name of location         | Latitude  | Longitude        |
|------------------|--------------------------|-----------|------------------|
| F1               | Renyok 1 Intake          | 5° 33'00.29 | 101° 46'03.32   |
| F2               | Renyok 2 Intake          | 5° 31'36.37 | 101° 46'12.42   |
| F3               | Renyok 3 Intake          | 5° 31'11.27 | 101° 46'59.42   |
| F4               | Suda Intake              | 5° 28'37.98 | 101° 47'56.49   |
| F5               | Terang Pumping House     | 5° 26'36.46 | 101° 48'01.42   |
| F6               | Long 1 Intake            | 5° 35'58.58 | 101° 43'47.52   |
| F7               | Long 2 Intake            | 5° 35'11.30 | 101° 44'21.03   |
| F8               | Pergau River             | 5° 37'45.20 | 101° 41'69.90   |
| F9               | Pergau Reservoir         | 05° 37'13.40 | 101° 42'30.60   |
2.2 Freshwater fish sampling

Fish sampling was carried out at nine sampling locations using various sampling gears such as multiple panel gill nets (1” – 3”), a backpack electrofishing gear (Smith-Root POW Electroshocker Model 12-B), cast net, scoop net and fishing rod. The length (cm) and weight (g) of all fish samples were measured and the fish were identified to species taxa by using standard taxonomic keys provided before being released upon identification [8,9,10]. All the species spellings, authorship and dates of publication were properly validated [11]. The fish data from the present study was compared to and combined with previous studies [3,5,6,7]. All the fish checklist were checked their conservation status via IUCN Red List of Threatened Species [12].

3. Results

A total of 20 fish species from 10 families were recorded during the survey (Table 2). The most dominant family was Cyprinidae with eight species belonging to this family while other eight families were represented by only one to two fish species. Based on the percentage of fish composition, *Neolissochilus soroides* (Tengas) had the most abundant by contributing 50.1% from the total composition, followed by *Poropuntius normani*, Tengas daun (23.7%), *Hampala macrolepidota*, Sebarau (11.2%), *Oreochromis niloticus*, Tilapia (6.0%), *Hemibagrus capitulum*, Baung (4.0%), *Channa limbata*, Haruan kedak (3.8%) and *Osteochilus vittatus*, Terbul (2.2%). All other species contributed 6.5% of the total composition (Fig. 2).

Based on combination from previous to present studies, overall fish checklist recorded in Pergau Reservoir and its catchment area was 49 fish species from 19 families, including four non-native species; *Oreochromis mossambicus*, *Oreochromis niloticus*, *Barbonymus gonionotus* and *Cyprinus carpio*. Forty one fish species were listed as Least Concern (LC) while two fish species were listed for respective categories of Not Evaluated (NE), Vulnerable (VU), Data Deficient (DD) and unknown. However, species that listed under vulnerable category, *O.mossambicus* and *C. carpio* were threatened from their native countries but not in Malaysia. They are actually invasive species and potentially impact aquatic resources in Malaysia. Hence, their conservation status are not considered important in this country. In contrast, two important species that need attention are *Tor tambra* (Malayan Mahseer) and *Betta kuehnei* (Betta). The population of both species were reportedly declining and listed as DD. Meanwhile, *Macrognathus maculatus* was added to the checklist.

![Figure 2. Percentage of fish species composition in Pergau Reservoir and its catchment area.](image_url)

4. Discussion

Cyprinid fishes are the most dominant family in this area and common in Malaysian freshwater ecosystems [4]. The dominance of *N. soroides* in major river intakes is expected since this species
commonly found in clean, flowing water and heterogeneous habitat, alongside *T. tambra* and *P. normani*. Two native species that listed as DD, *T. tambra* and *B. kuehnei* were found in Suda, Terang, Long 1 and Long 2 intakes. *B. kuehnei* is a fighting fishes of the genus *Betta*, which are labyrinth fishes widely distributed in Southeast Asia [13]. To date, this species can only be found in Kelantan and Kelantan-Terengganu border [12]. However, current population trend of this species is less documented. Based on physico-chemical characteristics, this species lives in clear-water (pH7, temperature ~25°C) forested streams, where it has been captured from amongst aquatic plants (*Cryptocoryne cordata*) and submerged leaf litter [13]. *T. tambra* is known as one of the most expensive fishes in Malaysia due to its dark reddish colour. This species is an indicator for perfect environment because the habitats of kelah that range from mountainous to fast flowing rivers in the plains, preferring clear waters with stony, pebbly or rocky bottoms[14]. Currently, Kelah status is under Data Deficient (threat of extinction due to over-harvesting, environmental degradation, inconsistent of gametes produced and slow growth in captivity).

5. Conclusion
There are no known conservation actions in place for this area. Research into its population, life history, and threats is needed alongside monitoring of habitat trends and the development of an area-based management plan. Based on the results, there is a potential to develop fishery management plan at several intakes to ensure the sustainability of fishery resources at the Pergau Reservoir and its catchment area.

Acknowledgements
We would like to thank Stesen-Stesen Janaelektrik Perak (SSJP) of Tenaga Nasional Berhad (TNB) for funding this project. We wish to acknowledge the assistance of the expedition organizing committees (TNBR, Jeli District Council, Universiti Malaysia Kelantan, Department of Wildlife and National Parks – PERHILITAN and Kelantan Department of Forestry) for their help throughout the expedition.

References
[1] United Nation Environment Programme, UNEP 2000 Planning the management of lakes and reservoir: an integrated approach to eutrophicphication, environmental Publications from united Nation Environment Programmer (UNEP) and Key International organizations.67 pages. ISBN: 928071810x.
[2] Ho S.C. 1994 *Mitt. Internat. Verein. Limnol.* 24 129-145
[3] Shah ASR, Hashim ZH, Zakeyuddin MS, Mohamad, MS, Ahmad, MN, Razad AA and Ismail WR 2017 Fish checklist of Pergau Reservoir, Jeli, Kelantan pp 74-79 In: Ibrahim Z, Abdullah MRC, Raman RA, Abong ND, Nordin SM and Latif A (eds.) *Gunung Basor and Tasik Pergau Kelantan* Pustaka Aman Press Sdn Bhd 1–230
[4] Chong V.C., Lee P.K.Y. and Lau C.M. 2010 *Journal of Fish Biology* 76 2009–2066
[5] EIA-UKM 1987 *Environmental Impact Assessment of Pergau Hydroelectric Project* Bangi Universiti Kebangsaan Malaysia
[6] Alias M.I.M., Hambali K., Amir A., Fauzi N., Hassin H. and Yin SA 2019 *Tropical Life Sciences Research* 30(1) 161–167
[7] Ahmad A. and Rizal S.A. 2017 Species diversity of fishes in small streams around Tasik Pergau, Kelantan pp 67-73 In: Ibrahim Z., Abdullah M.R.C., Raman R.A., Abong N.D., Nordin S.M. and Latif A. (eds.) *Gunung Basor and Tasik Pergau Kelantan* Pustaka Aman Press Sdn Bhd 1–230
[8] Rainboth W.J. 1996 *Fishes of the Cambodia Mekong*. Food and Agriculture Organization of the United Nations
[9] Ambak M.A., Isa M.M., Zakaria M.Z. and Ghaffar M.A. 2010 *Fishes of Malaysia*. Terengganu:Penerbit Universiti Malaysia
[10] Kottelat M., Whitten A.J., Kartikasari S.N. and Wirjoatmodjo S. 1993 *Freshwater fishes of Western Indonesia and Sulawesi*. Singapore: Periplus Editions Limited

[11] Eschmeyer W.N. 2019 *Catalog of fishes, Genera, Species, References*. [online] Available at: http://research.calacademy.org [Assessed on 30th December 2019]

[12] IUCN 2019. The IUCN Red List of Threatened Species. Version 2019-3. http://www.iucnredlist.org. Downloaded on 10 December 2019

[13] Schindler I. and Schmidt J. 2008 *Bulletin of Fish Biology* 10 1–8.

[14] Shreshtha T.K. 1997 *The Mahseer in the Rivers of Nepal Disrupted by Dams and Ranching Strategies*. Mrs. Bimala Shrestha, Kathmandu, Nepal 259.
Table 2. Fish checklist of Pergau Reservoir and its catchment area based on presence (+) and absence (−) data by sampling station, and data from (a) EIA (1987), (b) Shah et al. (2017), (c) Ahmad and Rizal (2017) and (d) Alias et al. (2019). (*) = Fish species that are newly recorded in the reservoir. (**) = Type locality of BMR.

| Family          | Species                      | (a) | (b) | (c) | (d) | Renyok 1 | Renyok 2 | Renyok 3 | Suda | Terang | Long 1 | Long 2 | Sg. Pergau | Reservoir | IUCN |
|-----------------|------------------------------|-----|-----|-----|-----|---------|---------|---------|------|--------|--------|--------|-------------|-----------|------|
| Ambassidae      | Parambassis stamensis       | −   | −   | +   | −   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Amblycipitidae  | Amblyceps foratanum         | −   | −   | +   | −   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Bagridae        | Hemibagrus capitulum        | −   | +   | +   | +   | −       | +       | −       | −    | −      | −      | −      | −           | LC        |      |
| Bagridae        | Leiocasis poeciopiera       | −   | +   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Bagridae        | Mystus castaneus            | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Balitoridae     | Pseudohomaloptera leonardi  | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Balitoridae     | Balitorops zollingeri       | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Balitoridae     | Homaloptera porcilella      | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Balitoridae     | Homalopteroides nebulosus   | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Belonidae       | Xenentodon cancilioides     | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Chanidae        | Channa mircopetres          | −   | +   | +   | +   | −       | −       | −       | −    | +      | +      | −      | +           | LC        |      |
| Chanidae        | Channa striata              | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Cichlidae       | Oreochromis mossambicus*    | −   | −   | +   | −   | −       | −       | −       | −    | −      | −      | −      | VU*         |           |      |
| Cichlidae       | Oreochromis niloticus*      | −   | +   | +   | +   | −       | −       | −       | −    | +      | −      | −      | +           | LC        |      |
| Claridae        | Clarias batrachus           | −   | +   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Claridae        | Clarias leiacanthus         | −   | +   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Cyprinidae      | Barbodes banksi             | −   | −   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Cyprinidae      | Barbodes binotatus          | −   | +   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Cyprinidae      | Barbunymus gonionotus*      | −   | −   | −   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Cyprinidae      | Barbunymus schwaneffeldii   | −   | +   | −   | −   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Cyprinidae      | Crossocheilus oblongus      | +   | −   | −   | −   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
| Cyprinidae      | Cyclocheilichthys apogon    | −   | +   | +   | +   | −       | −       | −       | −    | −      | −      | −      | +           | LC        |      |
### Present study

| Family       | Species                        | IUCN |
|--------------|--------------------------------|------|
| Cyprinidae   | Cyprinus carpio               | LC   |
|              | Garra cambodiensis            | LC   |
|              | Labeo bicolor                 | LC   |
|              | Mystacoleucus dayi           | LC   |
|              | Mystacoleucus macrolepidota   | LC   |
|              | Mystacoleucus novemnarienii   | LC   |
|              | Mystacoleucus platine        | LC   |
|              | Mystacoleucus spilurus        | LC   |
|              | Mystacoleucus obtusirostris   | LC   |
|              | Mystacoleucus subrufus        | LC   |
|              | Mystacoleucus trachyceps     | LC   |
|              | Neolissochilus chilopterus    | LC   |
|              | Neolissochilus soroides       | LC   |
|              | Osteochilus spilurus          | LC   |
|              | Osteochilus vittatus          | LC   |
|              | Poropuntius normani           | LC   |
|              | Tor tambra                    | DD   |
|              | Rasbora notura                | LC   |
|              | Rasbora paviana               | LC   |
|              | Leptobarbus hoevenii          | LC   |
|              | Oxyeleotris marmorata         | LC   |
|              | Macrognathus circumcinctus    | LC   |
|              | Macrognathus favus            | LC   |
|              | Macrognathus maculatus        | LC   |
|              | Nemacheilus sp.               | LC   |
|              | Notopterus notopterus         | LC   |
|              | Betta kuehnei                 | DD   |
|              | Pangasius sp.                 | LC   |
|              | Pristolepis fasciatus         | LC   |
|              | Sibbicichthys harskii         | LC   |
|              | Glyptothorax fasciatus        | LC   |

*Note: The table represents the presence (+) or absence (-) of species in different locations.*
| Family       | Species                  | (a) | (b) | (c) | (d) | Renyok 1 | Renyok 2 | Renyok 3 | Suda | Terang | Long 1 | Long 2 | Sg. Pergau | Reservoir | IUCN |
|--------------|--------------------------|-----|-----|-----|-----|----------|----------|----------|------|--------|--------|--------|------------|-----------|------|
| Sisoridae    | *Glyptothorax schmidti* | +   | -   | +   | -   | -        | +        | -        | -    | -      | -      | -      | -          | -         | LC   |
|              |                          | 11  | 17  | 29  | 14  | 2        | 2        | 3        | 5    | 4      | 2      | 4      | 8          |           | 8    |

* Non-native species