Betta persephone: The Challenges in Only Existed Natural Habitat; Ayer Hitam Peat Swamp Forest Reserve (AHPSFR)
Muar Johor

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Abstract. Betta persephone is a native species and has been categorized as endangered in Ayer Hitam Peat Swamp Forest Reserve (AHPSFR), Muar Johor. This area is the only wild stronghold of this species. This species is facing greatest threats nowadays. As the study aimed to analyze the challenges of this species by using qualitative method. Interviews session has been conducted by the involvement of four respondents which all of them are ichthyologists and have expertises in this matter. Also, observations have been conducted inside AHPSFR. The data that have been gathered in interviews being analyzed by using NVivo software. For, observation sessions, a checklist was being obtained from the findings of the interview sessions. In the findings, all the respondents and observations have the consensus that challenges have been found out were overexploitation, land encroachment for oil palm plantation, illegal logging, water contamination, fires and illegal mining. The challenges that have been stated need to be bridle for the survivor and sustainability of the species for the reference of future generations.

1. Introduction
Malaysia is blessed with variety of natural resources and wildlife. One of the prominent body in wildlife and diversity has stated that Malaysia is one of the mega-diversity countries in the world which have high density of species with estimated 1500 species of terrestrial vertebrae [1] With the high densities of number of species, 640 species have been reported and classified as fishes [2]. In a present day, the number of fish species that have been identified and classified have been increased due to the comprehensive exploration by the researchers [3]. The World of Conservation Union (IUCN), a body in charge on assessing the conservation have stated that 14% of freshwater fish species have been listed as endangered species with the addition of 83 species have listed as critically endangered [4].

Based on the statistics that have been proposed, the number of endangered and critically endangered can increased if there are no efforts being done to overcome it. The population of human has escalated in recent years causing encumbrance on the natural resources. These natural resources are being encroached for industrialization, plantation, and other human activities that lead to habitat destructions, degradation and fragmentation. These activities pose threats to the aquatic environment and the potential resources. These threats actually happen in the Ayer Hitam Peat Swamp Forest Reserve (AHPSFR). Vast area surroundings
of this forest reserve were being filled with development caused by human. This will cause threats to the all living things inside the area include B. persephone.

B. persephone is a native species that can only be found wildly Ayer Hitam Peat Swamp Forest Reserve, Muar, Johor. This species is being classified in the family of Osphronemidae in the order of perciformes. According to Linke, 2013[5], the family of Osphronemidae are being listed as one of the labyrinth fishes, where these fishes are equipped with a unique accessory respiratory organ called labyrinth. The members of this family can be found in variety of ecological niches and environments such as stagnant water ditches to flowing hill streams which includes a water with high acidic pH such as in peat swamp forests [6]. B. persephone sizes are relatively small with the average size is about 3.5 cm [7]. The name of Persephone is come from the sobriquet of Greek Goddess, the Queen of Underworld. The name of underworld is being referred to this species due to the existence of this species which often to be found in the secretive under dead leaves. The coloration of this species is quite different with other Betta as they come with dark-grey to black coloration with no markings and have dark green iridescence color on dorsal, caudal and anal fins [7]. This fishes are commonly consumed on small aquatic and terrestrial invertebrates. The distinguish features between male and female B. persephone, the male have striking light border at the upper part with white tips at ventral fin and the female are quite rounded and shorter fins [5]. Moreover, this species commonly lived in peat swamp forest and streams under dense canopy and branches above with minimal lights can penetrates on the surface of its natural environments. The habitat fish is commonly water with very acidic condition with the pH around 3.0 or 4.0. The water coloration commonly dark due to humic acid and other chemicals from decaying organic material underneath the water. One of the famous researchers who have studied the species comprehensively has stated the habitats of this species exist have been majorly being encroached and modified into oil palm plantations [8]. As for now, the last habitat of this species in Malaysia are in Ayer Hitam Peat Swamp Forest Reserve in Muar Johor and as being assessed currently in 2018 by IUCN Red List Conservation status, this species is listed in endangered [9].

2. The Trends, Issues and Challenges

B. persephone is one of endemic fish species that can be found in Malaysia. One of the well-known researcher in the research of freshwater species field in Malaysia, Zakaria Ismail in 1992 [10] have stated that the number of freshwater fish species in Malaysia is approximately 300 species. As being updated by Fishbase in 2020 [11], the number of species of freshwater fishes in Malaysia have been increased to over 600 species. Even Malaysia have a vast number of freshwater fish species, many of this species are exposed to threats. This chapter will discuss on the trends, issues and challenges of freshwater fishes in Malaysia.

The threats toward local freshwater being risen nowadays. [12] have stated that 76% of fish species were threatened in the sense of habitat degradation, loss and modification. These threats have caused serious implications to some species such as Blackskin Catfish (C. meladerma), Pearl Gourami (T. leeri) and all endemic species from the Betta genus. These species have been listed as endangered and to make thing worse, some species have been considered extinct includes Bala shark (B. melanopterus), E. keloides and N. microlepis. As in Malaysia, approximately 141 species of freshwater fishes have been listed in threatened/extinct species and from this number 81 of the species were native species and 26 of it are making brackish water as their main habitat.

The local freshwater fish species are facing threats nowadays. According to [13] estimated that 76% species were threatened mainly by habitat degradation, loss and modification. Blackskin Catfish (C. meladerma), Pearl Gourami (T. leeri) and all endemic species from the Betta genus. Some species have been considered extinct includes Bala shark (B. melanopterus), E. keloides and N. microlepis which are typically found in pristine rivers and wetlands. It is estimated that there are 144 threatened/extinct species, 81 endemic species and 26 introduced species in Malaysian brackish and freshwater habitats.

The study of Ichthyo-fauna in this country have existed since 19th century. The research regarding on the taxonomy and the conservation of freshwater fishes are still low and in the exploratory stage [10, 12-14]. This happen due to lack of funds given by the government and also the numbers of researchers regarding
on this matter are not many as compared to other countries. Other than that, the lack of interests in doing
the research regarding on the conservations also one of the constraints that effecting the ichthological
studies. In Malaysia, the taxonomic problems of freshwater fishes are still unresolved as many of new
species being discovered day by day [13]. As example, the study regarding the taxonomy of Tor tambroides
in different kinds places are still not finished yet.

Then another challenges regarding on the conservation of Freshwater Fishes in Malaysia is the
overlapping of power and responsibilities among government bodies in Malaysia. In the conservation
process of fishes, these overlapping powers are occurs between Department of Wildlife and National Parks
and Department of Fisheries. These responsible bodies have different kinds of approach when dealing with
the conservation matters. In addition, most of conservation efforts in Malaysia that have been done are
mostly being conducted by individual initiatives without any kinds of help and assistance from government
and non-government bodies. These individual are using their own funds and it is all based on their interests
and motivational. Some of them are able to breed some species and then release back to the natural habitat.

Other than that, another challenge in of freshwater fishes in Malaysia is over fishing. Over fishing is the
arch enemy for fish conservation efforts in many parts of the world. The freshwater fishes especially the
tropical species are not being sold as source of food but commonly sold as ornamental fish due to rarities,
looks, demands and the high values of it. FAO have come up with the statistic which stated, between
year 1996 to 2005, the total value of ornamental fishes that have been imported worldwide approximately
278 million Dollar. This shows that, these fishes have brought ‘businesses’ and profits to these pet
entrepreneurs. Due to increase of demands and profits that it brings, these fishes are exposed to
overexploitation.

Another threats that faced by freshwater fishes in Malaysia is water pollution. These contamination of
water are coming from various resources such as industrialization and plantation. As in industrialization,
the waste has been thrown into rivers and water sources. For plantation, the usage of pesticide and non-
organic fertilizers flows into plantation irrigation and caused the water become polluted (Ng et al., 1994).
The water that have been polluted by these chemicals will poison the water and causes death to many species
of freshwater species that inhibits the area.

In addition, forest degradation is one of the challenges faced by freshwater fishes in Malaysia. The activities that happens inside the forest such as illegal logging and mining for natural resources are the
causes of forest degradation. The enforcement in Malaysia regarding on the forest degradation are still low
as nowadays many forest in Malaysia have been explored and degraded.

The challenges that have been discussed above needed to be overcome. Sustainable and effective actions
needed to be implemented by all stakeholders. The survivor of freshwater fishes are rely on how effective
the action that have been taken to overcome this problems and challenges.

2.1 Scope of study
Ayer Hitam Peat Swamp Forest Reserve (AHPSFR) is situated in Muar, Johor. The GPS area of the forest
is pinpointed at Latitude: 2.03555 Longitude: 102.8005. This area has been gazette by the Johor State
Governement and it is the bigges, last prevail peat swamp forest in Johor state. This peat forest covers 3797
hectares of land and being surrounded by oil palm plantations which belong to the locals. An assessment
which have been conducted by Wetlands International, this area has high biodiversity with many significant
of wildlife species. 91 species of birds, 21 species of fishes and 7 species of mammals were spotted. As
currently, this area is the only wild habitat of the endangered species of B. persephone as being stated by
IUCN Red List, 2018 [15].

3. Data collection methods
In this research, the qualitative methods have been implemented as the procedures to gain the data.
Therefore, the interviews with respondents and the observation inside the AHPSFR have been carried out
by the researcher. In interviews, face to face unstructured interviews with four respondents have been
conducted. All of the respondents have experiences and expertise in the conservation of B. persephone in AHPSFR. Another instrument used by the researcher is through on site observation where the observations sessions on the subject matter were not being interference and generalized.

3.1 Interviews

Unstructured interview has been conducted in this paper. The chosen respondents were interviewed in a session between 40 minutes and an hour. The demography of the respondents was asked at the beginning of interview as shown in table 1. After that, questions regarding on the challenges by B. persephone in AHPSFR. Open ended questions were asked to the respondents as they were given opportunities to share their views and experiences regarding on the matter. There were four respondents participating in this paper. Therefore, these respondents were being coded as R1, R2, R3 and R4 for confidential purposes. The total respondents participating in this research is four. All of them actually have a direct knowledge and also expertise in the research subject matter. These respondents are coded as R1, R2, R3 and R4 for confidential purposes. For demographic backgrounds, questions such as the age, occupation, origin and also years of experience in preserving and protecting B. Persephone were asked. The demographic backgrounds of each respondent are as follows:

**Table 1**: Demographic Background of Respondents

| Respondents | Demographic Descriptions |
|-------------|--------------------------|
| R1          | Age: 32 years old        |
|             | Gender: Male             |
|             | Occupation: Fishmonger / Ichthyologists/Freshwater fishes’ researcher |
|             | Experience in preserving and protecting B.persephone: 11 years |
|             | Origin: Muar, Johor      |
| R2          | Age: 25 years old        |
|             | Gender: Male             |
|             | Occupation: IT Programmer / Sales Advisor / Ichthyologists/Fish trader |
|             | Experience in preserving and protecting B.persephone: 3 years |
|             | Origin: Ampang, Selangor |
| R3          | Age: 56 years old        |
|             | Gender: Male             |
|             | Occupation: Retired from Department of Fisheries / Ichthyologists/Book writer related to Betta fishes |
|             | Experience in preserving and protecting B.persephone: 35 years |
|             | Origin: Duyung, Melaka   |
| R4          | Age: 62 years old        |
|             | Gender: Male             |
|             | Occupation: Labour/ Farmer / Ichthyologists/Fish trader |
|             | Experience in preserving and protecting B.persephone: 45 years |
|             | Origin: Muar, Johor      |

3.2 Observations

In this research, the researcher plays as a non-participant observation. This is because the researcher wanted to make limited interaction to the subjects. Also, the researcher was providing and using field notes based on the checklists in making observations. The researcher was doing the observations inside the Ayer Hitam
Peat Swamp Forest Reserve (AHPSFR) to look on the conditions of the area. The information of the checklist is based on the findings on interview sessions with the respondents.

4. Data Analysis

Analysis data were conducted after all the data gathered through the interview with the respondents and observations inside Ayer Hitam Peat Swamp Forest Reserve (AHPSFR).

4.1 Interview

In interview sessions the data collected were segmented based on the research objectives that have been proposed. The data gathered being coded in the open coding way. The data in the early coding being labelled as REC 1, REC 2, REC 3 and etc. The unwanted data were erased and the one who related to the research were chosen. Once it done, the axial coding on the data were conducted by the researcher. In the axial coding process, the data were put together in groups based on the research objectives and research model. The axial data were being labelled as DATA AXL 1, DATA AXL 2, DATA AXL 3 and etc.

The final step in analyzing the interview data was by using selective coding process. The data from the axial steps were analyzed and elaborated. The comparisons and similarities of data between respondents were analyzed in order to understand the full thoughts of respondents in the subject matter. The selective coding data were labelled as R1, R2, R3 and etc.

The researcher was used NVivo 12 as the medium to analyze the interview sessions data. The software is well-known in analyzing the interview data due to precision in managing data systematically. From the interview sessions, a checklist has been utilized from the findings of it and being used in the observation sessions later.

4.2 Observations

The observations were being conducted inside Ayer Hitam Peat Swamp Forest Reserve (AHPSFR). The observations were focused on the challenges inside the forest reserve itself. A checklist has been using based on the findings of the interview sessions. All findings were recorded and documented.

5. Results and Discussions

Based on the interviews with the respondents and observations that have been conducted inside Ayer Hitam Peat Swamp Forest Reserve (AHPSFR), these are all the challenges B. persephone faced inside the Ayer Hitam Peat Swamp Forest Reserve (AHPSFR).

5.1 Overexploitation

B. persephone are exposed to overfishing due to high price of this species in the ornamental fish market. There are some cases of overexploitation for this species happen inside AHPSFR. The overexploitation happens due the weak enforcement by the government. During early 80’s and early 90’s, the species were caught in their wild habitat and being exported to countries such as Singapore, Hong Kong and China. The overexploitation has caused the number of this species depleted drastically. Currently, there are some efforts by researchers and government in the conservation of this species inside AHPSFR.

5.2 Open Land for Oil Palm Plantations

Oil palm plantations is one of the economic resources for local around AHPSFR. Local tend to encroach the area and make it as the palm oil plantation. The opening of oil palm plantation will destroy the habitat of B. persephone as previously this species can be found outside the AHPSFR. Due to progressive development of oil palm plantation surrounding the AHPSFR, the species seems to be extinct outside the AHPSFR as many attempts to find the species outside AHPSFR failed. Luckily, the State Government of Johor managed to gazette the AHPSFR and any human activities are not allowed inside AHPSFR.
5.3 Illegal Logging Activities
Illegal logging is also one of the challenges faced by B. persephone inside AHPSFR. Illegal logging usually done by the locals as the value of logs inside AHPSFR are very high in the market. The enforcement done the government bodies are weak and exposed these illegal loggers to take the logs out from AHPSFR freely.

5.4 Water Pollution
As being mentioned before, the lands surrounded the AHPSFR are full with oil palm plantations. The irrigation canals have been build up by the farmers to irrigate the plantations. The water from these irrigation canals will flow inside the AHPSFR. These farmers tend to use non-organic fertilizers and pesticides for their crops and those chemicals will flow inside the canals. Once the chemicals flows into the canals, it will contaminate the water and caused destruction to habitat of B. persephone and other aquatic lives.

5.5 Fires
In 2014, AHPSFR were on fire due to hot weather that happen on that particular year. AHPSFR is vulnerable of fire as the AHPSFR soils are extremely flammable when dry. The peat soil consists of partially decomposed plant material so the risk of easily caught in fire are high. The fires destroy the habitats inside AHPSFR and unfortunately it consumes a lot of time to recover.

5.6 Illegal Mining
AHPSFR has been blessed with mineral bauxite and gold. The area has been encroached for illegal mining by the locals. The mines will destroy the area surroundings which include the habitat of B. persephone and other aquatic lives.

6. Conclusions
The status of B. persephone inside AHPSFR is uncertain due to these challenges. In order to overcome these challenges, a well and sustainable conservation steps needed to be carried out. Comprehensive and effective efforts in conservation inside AHPSFR needed to be carried out in the future. It is important to conserve this species as it is important for the survival of this species and for future references.

7. References
[1] World Wildlife Foundation 2016 Living Planet Report 2016 Retrieved on September 30, 2020 from https://www.worldwildlife.org/pages/living-planet-report-2016
[2] Froese R and Pauly D 2016 FishBase Retrieved on August 30 from http://www.fishbase.org, version (01/2016)
[3] Roberts T R 1989 The freshwater fishes of Western Borneo (Kalimantan Barat, Indonesia) Mem. Calif. Acad. Sci. 14
[4] International Union for Conservation of Nature (IUCN) 2016 Threatened Species in Each Country (Totals by Taxonomic Group) Retrieved on September 30, 2020 from https://www.iucnredlist.org/resources/summary-statistics
[5] Linke H 2013 Labyrinth Fish of the World (Fish Magazine Taiwan)
[6] Posa M R C, Wijedasa L S and Corlett R T 2011. Biodiversity and conservation of tropical peat swamp forests. BioScience 61 49-57
[7] Schaller D 1986 Laubschlupf. Eine Überlebensstrategie in einem besonderen Biotop und die Beschreibung einer neuen Kampffischart Aquar Terrar 39 297-300
[8] Kottelat M and Whitten, T 1996 Freshwater fishes of Western Indonesia and Sulawesi: additions and corrections (Hong Kong: Periplus editions)
[9] International Union for Conservation of Nature (IUCN) 2018 B. persephone: Conservation Status. IUCN Red List Threatened Species 2019. Retrieved on August 30, 2020. https://www.iucnredlist.org/species/2779/91308319
[10] Zakaria R, Mansor M and Ali A B 1999 Swamp riverine tropical fish population: A comparative study of two spatially isolated freshwater ecosystems in Peninsular Malaysia. Wetl Ecol Manag 6 261-268
[11] Froese R and Pauly D 2020 FishBase Retrieved on August 30 from http://www.fishbase.org, version (01/2020)
[12] Chong V C, Lee P K Y and Lau C M 2010 Diversity, extinction risk and conservation of Malaysian fishes J. Fish Biol. 76 2009-2066
[13] Ng C, Ooi P, Wong W L and Khoo G 2017 An overview of the status, trends and challenges of freshwater fish research and conservation in Malaysia. Surv. Fish. Sci. 3 7-21
[14] Fahmi M R, Kusrini E, Hayuningtiyas E P, Sinansari S and Gustiano R 2020 DNA Barcoding Using Coi Gene Sequences Of Wild Betta Fighting Fish From Indonesia: Phylogeny, Status And Diversity Indones. Fish. Res. J. 26 97-105
[15] IUCN 2018 The IUCN Red List of Threatened Species Retrieved on July 2, 2020 from https://www.iucnredlist.org/