European River Restoration Conference
Featuring the IRF Riverprize

Celebrating Successes and Addressing Challenges
5th edition | 11-13 September 2013 | Vienna

SESSION 10 — River Restoration: A Shared Challenge

APPLICATION OF CASiMiR MODEL FOR ASSESSMENT OF TINFOIL BARB HABITAT SUITABILITY IN LANGAT

Thamer Ahmad Mohammad (Professor, Universiti Putra Malaysia, Malayia, thamer@eng.upm.edu.my)
Abdul Halim Ghazali (Assoc. Prof. Universiti Putra Malaysia, Malasyia), Tannaz T. (Postgradute Student, Universiti Putra Malaysia, Malaysia)

Problem Statement

1. River ecological system is not only affected by the degree of pollution but it is also affected by river hydraulics and it geometry . This is because these characteristics have direct impact on habitat suitability in rivers. Nowadays, the problems related to healthy aquatic life in rivers became important environmental issues which consequently affect lives of human being. Therefore, there is an increasing need to sustain healthy river ecology.

2. Fish is highly effected by the deterioration of river ecological life. So, it is usually used as an indicator for river habitat suitability.

3. Simulation models can be used to assess the habitat suitability in rivers . This will help to assess the suitability of the river ecological system. CASiMiR model is a powerful simulation model that cab used to assess fish habitat availability and suitability under different physical conditions.

Methodology

1. CASiMIR model which is working with fuzzy rules, fuzzy sets and expert knowledge has been used to assess the fish habitat suitability in Lanagt River, Malaysia where the habitat quality is defined as either high (H), medium (M) or low (L). The model is applied for the first time in Malaysia. The main objective of using CASiMiR is to study the impact of hydraulic and morphologic characteristics of Langat River on habitat suitability of Tinfoil Barb fish species in its four stages , Adult, Juvenile, Fry and Spawners .

Fig. 1. Tinfol Barb fish

2. Two reaches from the Lanagt River were selected to assess the habitat suitability in the river. Every reach has a length of 200 m and first reach is located at up stream (urban area) while the other reach is located at down stream(urban area). The data used to run the CASiMiR model was acquired from the Department of Irrigation and Drainage, Malaysia. The data include discharge, water level, velocity, river cross sections and characteristics of the bed and banks materials.

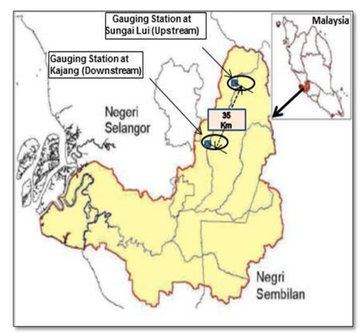

Fig. 2. Lanagt River Basin, Malaysia

3. Basically, four files are required in running the CASiMiR model and theses files are, input file for river geometry and structure file (*.SRstr) or (*.SRgrd), input file for water surface profile (*.SRswp), input file for habitat suitability (*.Srfzy) and input file for discharge (*.Srgan). Data for these files were prepared for Lanagt River.

4. The fuzzy rules define the relation between input variables and habitat suitability for certain species/life stage. For Tinfoil Barb in its adult life stage, if flow velocity is high, water depth is high, and substratum size is high then suitability index (SI) is low. A total of 27 rules per life stage were generated. A fish expert has been asked to define the most likely consequence of habitat suitability for different combinations of input variables (i.e substrate diameter, velocity, and water depth). This involves indicating L. M. H category for 27 combinations.

5. The weighted usable area (WUA) and hydraulic habitat suitability (HHS) were computed using the following formulae

$$WUA=\sum_{i=1}^{n} (HIS)_i\,(A)_i \quad , \quad HIS=WUA/Wetted\ Area$$

Summary of Main Results

1. At upstream and for adult Tinfoil Barb life stage, when the flow rate of Langat River increase, the habitat suitability increase too as shown in Figure 3. The highest suitability indexed (0.6 to 0.7) was found at a flow rate of 10.65 m^3/s.

2. At upstream and for juvenile Tinfoil Barb life stage, when the low rate of Langat River increase, the habitat suitability decrease. So, higher habitat suitability was found with flow rate of 1.3 m^3/s.

3. At upstream and for fry Tinfoil Barb life stage, there is slight difference in the value of the habitat suitability index for all Lanagt River flow rates.

4. At upstream and for spawning life stage, habitat suitability increases when there are flow rate in the Lanagat River.

5. At downstream and for adult Tinfoil Barb life stage, when the flow rate of Langat River increase, the habitat suitability increase. The highest suitability indexed (0.6 to 0.7) was found at a flow rate of 6 m^3/s.

6. At downstream and for juvenile Tinfoil Barb life stage, when the low rate of Langat River increase, the habitat suitability decrease. The best suitability index (0.24) was found in flow arte of 1.03 m^3/s.

7. At downstream and for fry Tinfoil Barb life stage, the best satiability index was found at flow rate of 4.13 and the best suitability index was 0.4 only.

8. At downstream and for spawning life stage, there is no much difference in the value of habitat suitability for the recorded values of the flow rates in Langat River. The highest habitat suitability was found to be 0.42 which corresponding to a value of flow arte equal to 4.13 m^3/s.

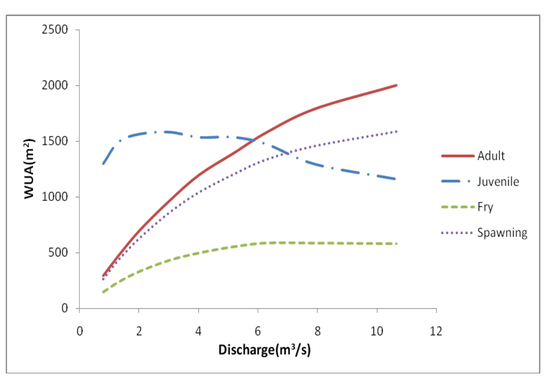

Fig. 3. Weighted Usable Area (WUA) for Tinfoil Barb at Upstream

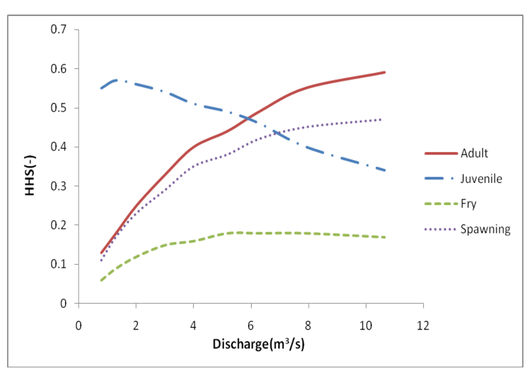

Fig. 4. Habitat Suitability Index for Tinfoil Barb at Barb at Upstream

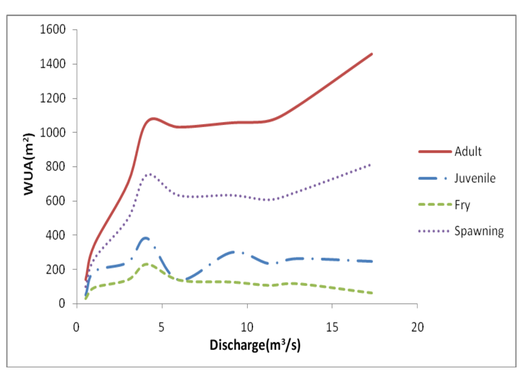

Fig. 5. Weighted Usable Area (WUA) for Tinfoil Barb at Downstream

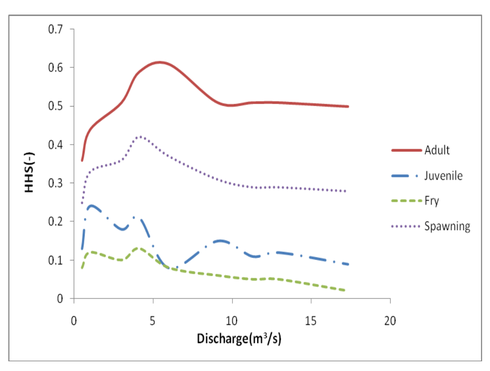

Fig. 6. Habitat Suitability Index for Tinfoil Barb at downstream