Research Application Summary

Influence of water quality parameters on *Opsaridium microlepis* catches in the Linthipe River in central Malawi

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Abstract

The dwindling catches of the fish *Opsaridium microlepis* (locally called mpasa) from the Linthipe river in Malawi is of great concern. This is especially so given that the species has disappeared from some other river systems in Malawi. One of the reasons for this could be the deteriorating water quality of the river as a result of farming activities in the river catchment. This study aimed at assessing the effect of water quality on *O. microlepis* catches along the Linthipe river. Fish monthly catches were very variable and ranged between 0.006-0.611ghr^{-1}, with the highest catches made in February. Month of the year influenced water quality, which in turn influenced fish catches. There were more catches as total suspended solid, increased. This implies that as the catchment is degraded through farming activities, the river receives more eroded soil, increased suspended solids which increase water turbidity and reduce the visibility of fish for the fishing gear. From this study, it is recommended that fishing areas and periods on the Linthipe river be restricted. And that faming activities in the river catchment be done in such a way to minimise soil erosion.

Key words: River catchment, soil erosion, suspended solids, turbidity

Résumé

La diminution de prise des poissons *Opsaridium microlepis* (appelés localement mpasa) dans la rivière Linthipe au Malawi sont très préoccupantes. Cela est particulièrement vrai du fait que l'espèce a disparu de certains systèmes fluviaux au Malawi. L'une des raisons pourrait être la détérioration de la qualité des eaux de la rivière à la suite des activités agricoles dans le bassin versant de la rivière. Cette étude visait à évaluer l'effet de la qualité de l'eau sur les captures des *O. microlepis* le long de la rivière Linthipe. Les captures des poissons par mois ont été très variables et se sont situées entre 0.006 et 0.611ghr^{-1}, avec les captures les plus élevées effectuées en février. Le mois de l'année a influencé la qualité de l'eau, ce qui a aussi influencé les prises de poissons. Il y avait plus de captures quand les

solides totaux suspendus augmentaient. Cela implique que, comme le bassin versant est dégradé par les activités agricoles, la rivière reçoit plus de sol érodé, plus de matières en suspension qui augmentent la turbidité de l'eau et réduisent la visibilité des poissons pour les engins de pêche. De cette étude, il est recommandé que les zones et les périodes de pêche sur la rivière Linthipe soient limitées et que les activités agricoles dans le bassin versant de la rivière soient faites de manière à réduire l'érosion des sols.

Mots clés: Bassin versant de la rivière, érosion des sols, les matières en suspension, turbidité

Background

Opsaridium microlepis, locally known as the *mpasa* is listed among the endangered fish species likely to become extinct (Tweddle, 2001). Its vulnerability is attributed to decline in catches (Tweedle, 2001) and the degradation of the spawning grounds i.e., the affluent rivers (Tweddle, 1994).

Riverine water quality and sediment loads affect fish migration and spawning success of some freshwater fishes (Jamu *et. al*., 2003). Since *O. microlepis* goes upstream into the freshwater river to breed, it is easy to conceive that changes in water quality and gravel deposition as a result of anthropogenic activities would affect its catches and reproduction. It is on these premises, that a study on age and growth of *O. microlepis* and the influence of water quality parameters on the catches of *O. microlepis* was conceived.

Literature Summary

Opsaridium is a small genus containing 13 species belonging to the family Cyprinidae, order Cypriniformes, class Osteichthyes and sub class Actinopterygii (ray-finned fishes) The endemic fish species in this family in L. Malawi are *O. microlepis* and *Opsaridium microcephalum*. *O. microlepis* seems to have disappeared from a number of rivers. For example, Lowe-McConnell (1952) reported the species in River Lisangadzi which is now a flash flood stream and in Bwanje River (Tweddle, 1981). The species is no longer found in these two river systems.

Linthipe River is one of the major rivers, in which *O. microlepis* migrates for spawning during the rainy season. It is the largest river of the southern part of Lake Malawi and its catchment is one of the most densely populated around the lake (Mkanda and Barber, 1999). The catchment of Linthipe River is

characterized by heavy agricultural activities with maize being the most farmed crop (Mkanda, 2002).

Study Description

The study was conducted in the Linthipe River, from the confluence of Linthipe and Lilongwe River going down stream to Kamuzu Bridge on M5 road and at the river mouth in Traditional Authority (TA) Maganga. Linthipe River catchment lies in the Central Region of Malawi between latitudes 13°21'E and 34°35'E. The river basin is fan shaped and drains an area of 8 641 km^2 into Lake Malawi. Most parts of the Linthipe River basin lie between 500 m and 1500 m above mean sea level (GOM, 1994).

Specimens of *O. microlepis* were collected once per month over a period of three days using gillnets set across the river from the two selected sites, i.e., at a fishing village near the river mouth in Maganga (Mkama site) and near the confluence of Linthipe and Lilongwe Rivers going down stream up to Kamuzu Bridge on M5 road, (thereafter, Kamuzu Bridge site).

Total fish catch from the two sites was computed. Catch per unit effort (CPUE) was calculated as the total weight of fish in grams per duration of the net cast in hours. CPUE is used in fisheries stock assessments and it is assumed to be proportional to abundance and therefore included in the stock assessment as a relative index of abundance (Sparre *et al*., 1998).

Water temperature, dissolved oxygen, salinity, pH, electrical conductivity, and turbidity were measured on each site using a Horiba U-10 Multiparameter Water Quality Meter. For alkalinity, total hardiness, total suspended solids and total dissolved solids; water samples were collected from each site and analysed in the laboratory at Bunda College. Flow rate was measured using a vernier flow meter.

Stepwise multiple regression analysis using SPSS version 15.0 computer package was used to identify the water quality parameters which were correlated with CPUE of *O. microlepis*. A model of the following expression was used:

$$Y = f\,(b_1X_1, b_2X_2, \ldots, b_{11}X_{11})$$

Where: Y = catch/effort; X_1 = water temperature; X_2 = dissolved oxygen; X_3 = salinity; X_4 = pH; X_5 = electrical conductivity; X_6 = turbidity; X_7 = alkalinity; X_8 = total hardness; X_9 = total

suspended solids; X_{10} = flow rate; X_{11} = total dissolved solids while b_1, b_2, b_3, b_4, b_5, b_6, b_7, b_8, b_9, b_{10} and b_{11} are the coefficient of the parameters $X_1 \ldots X_{11}$.

To determine the relationship between water quality parameters and CPUE, multi-collinearity was checked using the Variance Inflation Factor (VIF) of the predictor variables.

Research Application

Catches of *O. microlepis* ranged between 0.006 kg/hr in November to 0.611 kg/hr in February. The trend was similar for the two sites. The highest CPUE value was obtained in February (Fig. 1).

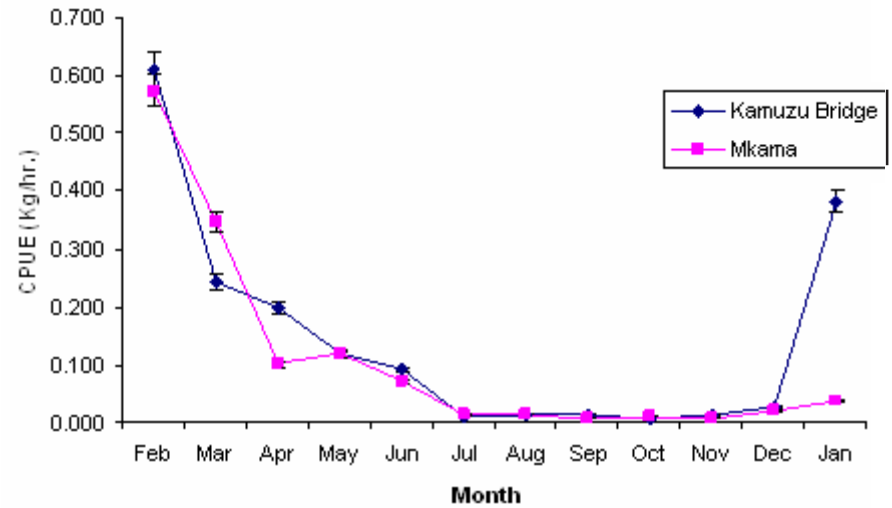

Figure 1. Mean monthly CPUE values (±SE) for *Opsaridium microlepis* sampled in the Linthipe River at two sites (Kamuzu Bridge and Mkama).

All the water quality parameters in the river were significantly different between the sampling months ($P < 0.05$), but not between the sampling sites ($P > 0.05$). Partial correlation showed that of all the parameters, dissolved oxygen, total suspended solids and electrical conductivity were significantly ($P < 0.05$) correlated to *O. microlepis* catches. Since multicollinearity was detected, electrical conductivity and dissolved oxygen were separated and two multiple linear regression models were developed. Dissolved oxygen, total suspended solids and electrical conductivity were significantly correlated ($P < 0.05$) to CPUE.

The study revealed high total suspended solids (TSS) in the river. TSS was slso significantly ($P < 0.05$) correlated with CPUE. This implies that there is an increased efficiency in

catching fish as TSS increases. Total suspended solids (TSS) cause turbidity, which limit light penetration (Bootsma and Hecky, 1999), and which may reduce visibility of fishing gears and thereby making fish more susceptible to capture. Degree of soil erosion which results in high TSS has been found to significantly correlate with the amount of cultivated farmland (Mkanda, 2002). Hence, total suspended solids (TSS) is bound to increase with time, implying that stock of *O. microlepis* may rapidly decrease due to increased CPUE.

There was a negative correlation between EC and CPUE. This could be a reflection of the rainfall pattern. In Malawi, the rainy season runs from December to April. Since evaporation of water from the surface of a water body concentrates the dissolved solids in the remaining water resulting in higher EC. It is explainable why the onset of the dry season resulted in an increase in EC and *vice versa* at the onset of rains in December.

Recommendation

- The impacts of the positive correlation of TSS with CPUE, entails that a lot fish are captured. Therefore, measures to reduce soil erosion due to bad land use practices should be enforced.
- Closed fishing season and area should be instituted in the Linthipe River. This should be done during the peak-breeding season i.e., January to April.
- Other studies must be taken in the Linthipe River catchment to evaluate the impacts of land use practices on the riverine fishes.
- Gear selectivity studies must be carried out in order to know the mesh size which can sustainably catch *O. microlepis.*

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