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Full Length Research Paper

Exploring the Habitat and Behavior of Mbasa (*Opsaridium microlepis*) in Lake Nyasa, Tanzania

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The ecology of *Opsaridium microlepis* was studied in Lake Nyasa around the Ruhuhu River. The species is endemic to the lake and is economically very important. The catches of *O. microlepis* have declined tremendously and it is now regarded as a threatened species. The main objective of the study was to determine the probable reasons for the decline in the species populations in the Ruhuhu River. The species was found to make spawning runs in the river during the dry season when the water turbidity was low. Juveniles of *O. microlepis* descended into the lake when they were about six months old with a standard length of about 5.1 cm and became pelagic at about one year old. Adult *O. microlepis* making the runs were found to have a mean fork length of 60 cm and mean fecundity of 54,500 eggs. The study showed that turbidity of the Ruhuhu River may be the main determinant which governs when the species spawns.

Key words: *Opsaridium microlepis*, Lake Nyasa, Ruhuhu River, spawning runs.

INTRODUCTION

Opsaridium microlepis (locally known as Mbasa) is endemic to Lake Nyasa (Jackson et al., 1963; Tweddle, 1987) and the species is mostly caught while on spawning runs in large rivers (Lowe, 1975; Tweddle, 1981). The species is reported to grow to a maximum length of about 47 cm (Leveque and Daget, 1984) and is listed as a threatened species (Tweddle, 2001). *O. microlepis* is commercially important (Tweddle, 1987) and in Tanzania; it is heavily exploited around the mouth of the Ruhuhu River and in the upper reaches of the river itself.

The Ruhuhu River is the largest inflow to Lake Nyasa (Welcomme, 1977) contributing approximately 20% of the annual inflow to the lake (Kidd, 1983). There is only one rainy season in the drainage basin between November and May (Jackson et al., 1963). Though the ecology of *O. microlepis* has been studied in most rivers in Malawi, no information on the species is available on the eastern (Tanzania) side of the lake (Tweddle, 1983). It has been reported that juveniles of the species feed on plankton, insects and other small organic matter (Tweddle, 1983), while adult fishes are piscivorous, feeding on small pelagic fishes (Jackson et al., 1963). In Malawi, Msiska (1990) showed that *O. microlepis* was a fractional spawner with a fecundity ranging between 34, 510 and 65, 657 eggs.

In recent years, *O. microlepis* catches in Lake Nyasa and the Ruhuhu River have declined (Anon, 2008). Though the reasons for the decline are not known, it was felt that, it would be better to study the ecology of the species in and around the Ruhuhu River before possible extinction. The decline in catches could be either as a result of over-fishing or turbidity, resulting from land use dynamics and socio- economic processes in the surrounding catchment (Nindi, 2007; Boosma and Jorgensen, unpublished). In order to understand the behavior of *O. microlepis* in Lake Nyasa and its major inflow, the Ruhuhu River, a study was conducted to investigate the ecology of the species. The study is expected to give basic information on the current

knowledge of mbasa on the eastern side of the lake. From the study, it will be possible to recommend remedial measures to be taken, including closure of the river to fishing during the spawning season and also proper management of the catchment to reduce deforestation.

MATERIALS AND METHODS

Site description

The study area is situated at 10° 30' S, 34° 36' E. During the dry season, the Ruhuhu River is about 200 m wide at its mouth, with a depth of about 3 m. The bottom of the river had fine black silt and the water was brownish in colour even during the peak of the dry season in October. The Secchi disc transparency of the river during the dry season was only 42 cm. Within the lake, the course of the river was clearly seen for a distance of about 1.5 km during the dry season. During the rainy season, the river had a width more than 2 km and its velocity was very high. The transparency was less than 10 cm.

In the lake, the studies were concentrated within a distance of about 3 km south of the river mouth and about 2 km into the lake. North of the river, there were two large swamps grown with *Cyperus* spp. and *Typha* spp. The study area had sandy beaches with gently shelving slopes. In the river, the studies were conducted for a distance of about 15 km from the mouth of the river. Within this region, the river was gentle and meandering and its width varied from about 50 to 200 m.

Juvenile *O. microlepis*

Juvenile *O. microlepis* were collected in the lake using a beach seine 25 m long, 1 m deep with a stretched mesh size of 10 mm. In the Ruhuhu River, a mosquito net was used to sample the juvenile fishes. Immediately after collection, the juvenile fishes were preserved in 10% neutral buffered formalin for later analysis in the laboratory. In the laboratory, standard lengths were taken to the nearest 0.10 cm and weights to the nearest 0.10 g (Lagler, 1956). For each food type, scores were given depending on the number of individuals found in the stomach. For the purpose of this study, juvenile *O. microlepis* are small fish which have a maximum length of about 11 cm (Tweddle, 1987).

Adult *O. microlepis*

Adult *O. microlepis* were collected using fishermen's gillnets of between 106 and 127 mm mesh sizes. In the lake, the gillnets were set overnight at about 20 m depth, while in the river they were used as drift nets. Gillnet caught fishes were measured for fork and standard lengths (to the nearest 0.10 cm), weights (to the nearest 250 g), sex and stages of sexual maturities (Lagler, 1978). Thirty ovaries with ripe eggs were preserved in Gilman's fluid for fecundity studies. Samples for food analysis were collected by angling and the stomach contents were preserved in 10% neutral buffered formalin. In the laboratory, fecundity was determined using the gravimetric sub-sampling technique (Bagenal and Braum, 1978).

Water quality characteristics

Water samples were collected from both in the lake and river with a 2 l capacity van Dorn water sampler. In the Ruhuhu River water samples were collected at Ngingama village which is about 15 km from the river mouth and in the lake off shore samples were collected. Temperature was measured with a mercury bulb thermometer (0.5°C divisions) and a 20 cm diameter Secchi disc was used to determine water transparency. Total alkalinity was determined by titrating known volumes of water with standard sulphuric acid (APHA, 2000). Total hardness was measured by titrating aliquots of water sample with EDTA solution.

RESULTS

Juvenile *O. microlepis*

All juvenile fishes were caught in the lake in shallow water over sandy bottom. The *O. microlepis* juveniles caught in the littoral zone of the lake may have been of two age groups with a mean standard length of 8.6 cm (standard deviation 1.4 cm), with a modal length lying between 7.1 and 9.0 cm (Figure 1). Fish of standard lengths of up to about 13 cm were probably of one age group, while those whose standard lengths were greater than about 13 cm were of another age group. Male *O. microlepis* of more than about 12 cm standard length had nuptule turbacles. Tweddle (1987) reported *O. microlepis* to grow linearly at the rate of about 1 cm per month. Insects formed the principal food item for the juveniles of approximately 10 cm or less, standard lengths. Fish of standard length of about 10 cm or more had either empty stomachs or their guts contained fish remains.

Since it was only the large sized fish, which had empty stomachs, it was assumed that their diet consisted of fish which were readily digested. 30% of the juveniles had coleopteran in their guts, followed by diptera (26%), trichoptera and hemiptera constituted 20% of the food items. Odonata and ephemeroptera constituted 12 and 6% of the food taken, respectively. It was further found that each size range of juvenile *O. microlepis* fed on different types of food. For example, fish with mean standard length of more than 10 cm preyed on other fish, while those feeding mostly on dipterans had a mean standard length of 8.3 cm. Trichopterans were taken by juveniles of mean standard length of 7.5 cm.

Adult *O. microlepis*

In the lake, adult *O. microlepis* were mostly caught in bottom set gillnets, while in the river they were caught in gillnets which were used as drift nets. Adult *O. microlepis* caught in the lake around the river mouth and in the river had a mean fork length of 60 cm with a range between 48.5 and 63.2 cm. There were no significant size differences between the sexes. Male *O. microlepis* had a mean fork length of 57.5 cm (standard deviation 5.03 cm), while the mean fork length of the females was 56.5 cm (standard deviation 3.56 cm). The males had a mean wet weight of 2686 g (standard deviation 558 g) with the females having a mean weight of 2493 g (standard deviation 523 g). All the fish caught at the mouth of the river and in the river itself were sexually mature. In the

Table 1. Water characteristics of Lake Nyasa and Ruhuhu River.

Parameter	Lake Nyasa	Ruhuhu River
Water temperature (°C)	25.5	18.5
pH	8.6	8.55
Conductivity (µS/cm)	220	60
Total alkalinity (mg/L)	153	67
Total hardness (mg/L)	136	75
Transparency (m)	17	0.42

Secchi disc readings taken during the rainy season in March showed the river to have a transparency of 0.13 m.

Ruhuhu River, adult *O. microlepis* were caught only during the dry season between July and October while on their spawning runs in the river.

O. *microlepis* females were found to be fractional spawners, with ripe and unripe eggs in their ovaries. Examination of thirty females gave a mean fecundity of 54,500 eggs (standard deviation 12,800 eggs), with a range between 34,100 and 80,400 eggs. The number of eggs per female generally depended on the size of the fish, with larger fish containing more eggs. Stomach contents of adult fish caught in the lake by angling showed the main food item to be *Haplochromis* spp., followed by *Engraulicypris sardella*.

Water quality characteristics

Table 1 shows the water characteristics for the lake and the Ruhuhu River in September. The results show that the lake is slightly saline, while the Ruhuhu River has very soft water.

DISCUSSION

Juvenile *O. microlepis*

All juvenile *O*. *microlepis* were caught in shallow sandy areas in the littoral zone around the river mouth. Similar observations have been reported by Tweddle (1983) on the Malawi side of the lake. All juvenile fish caught in the littoral zone had standard lengths of more than 5 cm (Figure 1). Fish of less than 5 cm standard length were probably still in the river. Similarly, it has been reported that in Malawi, the juvenile fishes remained in the rivers until they are about 6 cm total length (Tweddle, 1983). Tweddle (1983) speculated that, the juvenile fish migrated down river and entered the lake with the onset of the first rains when they were about six months old. Since *O*. *microlepis* is a fractional spawner, it is likely that the juveniles enter the lake, not only with the onset of the first rains, but throughout the rainy season when the Ruhuhu River is in flood. In the current study, the smallest fish were about 5 cm in standard length with an age of about five months. The few fish found in the littoral zone with standard length of more than 12 cm may have been of another age group. Tweddle (1987) reported that the growth in length of *O. microlepis* was nearly linear, about 11 cm per year, until about five years of age. Sizes of less than about 5 cm must have remained in the river. From Figure 1, it can be assumed that the species became pelagic in the second year, when it attained a standard length of about 12 cm.

Coleopterans occurred more frequently in the guts of the juvenile fishes, followed by dipterans. Trichopterans and hemipterans were found to be third in importance as food items for the juvenile fish. Odonata and ephemeroptans were of minor importance, constituting 12 and 6%, respectively. If it is assumed that fish with empty stomachs had fish for their food, relationships were found between fish size and food type. For example, the mean standard length of fish which preyed on other fish was 10.0 cm; while those feeding mostly on dipterans had a mean standard length of 8.3 cm. Trichopterans were taken mainly by *O*. *microlepis* of mean standard length of 7.5 cm. From the results, it was concluded that the species became piscivorous at about 10 cm standard length. Since most of the insects eaten by the juvenile fishes were of running waters (Hynes, 1970; Lock and Williams, 1981), it was not surprising that the juveniles were found near the river mouth.

Adult *O. microlepis*

In the Ruhuhu River, *O*. *microlepis* adults were caught only during the dry season. In Malawi, the species spawns during the rainy season (Jackson et al., 1963; Tweddle, 1983) . It is not known what could be the factors which drive the fish to spawn during the rainy season on the western side and during the dry season on the eastern side of the lake. Since *O* . *microlepis* are pelagic during their adult stages (Ricardo et al., 1942; Jackson et al., 1963), and because the lake has an average width of only about 50 km (Jackson et al., 1963). It is likely that the eastern and western stocks meet. The differences in

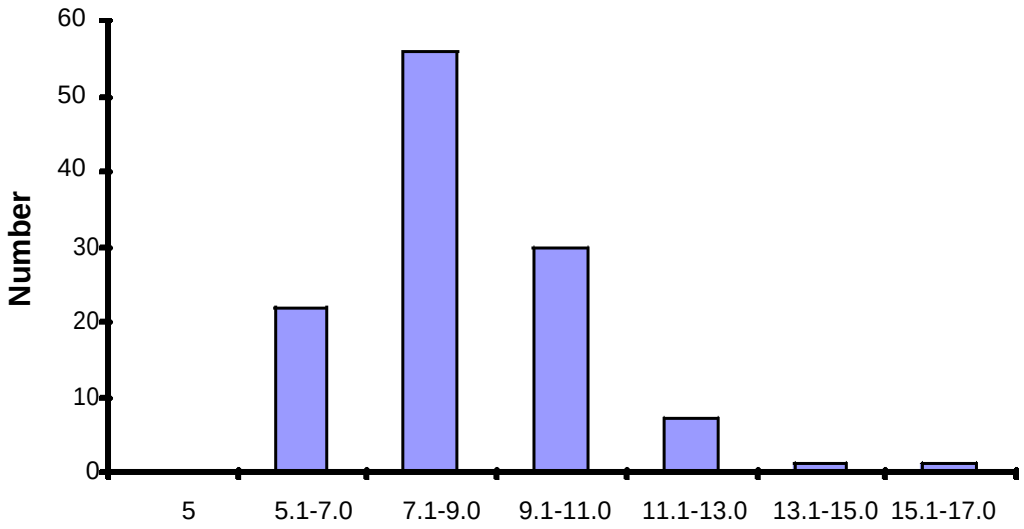

Figure 1. Length frequencies of Juvenile *O. microlepis* (cm).

their spawning behavior may suggest that they are different variants of the same species. Tweddle (1981) reported that each river had its own stock of *O. microlepis*. Studies on the *Haplochromis* sp. of Lake Victoria had shown geographical variation of species which otherwise looked similar (Hoogerhoud et al., 1983; Hoogerhoud and Witte, 1981; Oijen et al., 1981).

Similarly, genetic studies had shown species variations in some fishes which otherwise had similar morphological characteristics (Avis et al., 1975; Kirkpatrick and Selander, 1971; Kornfield et al., 1982). The *O. microlepis* of the Ruhuhu River may probably be different from those of the western side of the lake. For example, the smallest ripe female in Malawi had a total length of 19 cm with a fecundity of 1,381 eggs (Tweddle, 1983) while in the Ruhuhu River the smallest ripe female had a standard length of 44.8 cm with a fecundity of 41,820 eggs. In Malawi, Msiska (1990) reported the fecundity of *O. microlepis* to range between 34,510 and 65,657 eggs for females with total lengths ranging between 54 and 57.7 cm. In the Ruhuhu River, a fish of 55.5 cm fork length had a fecundity of 67,790 eggs. In the lake *O. microlepis* fed mainly on *Haplochromis* spp. The ability of *O. microlepis* to prey on *Haplochromis* spp. enables the species to co-exist with the small sized *Opsaridium macrocephalum* which feeds mostly on *Engraulicypris sardella*. Since the water characteristics of the Ruhuhu River were different from those of the lake (Table 1), it is likely that the fish remained at the mouth of the river for a period to acclimatize to the river conditions. The congregation of anadromous fish at river mouths prior to ascending rivers to spawn had also been reported by Beadle (1981) and Nikolsky (1978). All the *O. microlepis* caught in the river had empty stomachs. Similar observations had been reported by Tweddle (1983).

Water quality characteristics

The Ruhuhu River water characteristics differed markedly from those of the lake (Table 1) . Similar results had been reported by Talling and Talling (1965) for both the river and lake. The river was found to be turbid throughout the year with Secchi disc readings ranging between less than 10 and 42 cm during the rainy and dry seasons, respectively. Tweddle (1983) showed that in Malawi, *O. microlepis* spawned in shallow water on clean gravel substratum. In the Ruhuhu River, the species was found to ascend the river for spawning during the dry season between late June and October. No *O. microlepis* was caught in the river with the onset of the first rains in November when the water was very turbid.

It is likely that turbidity in the Ruhuhu River may be the main determinant which forces the species to spawn during the dry season. In recent years, the catch for *O. microlepis* in the Ruhuhu River has declined greatly (Anon, 2008). The declined fish lands could be a combination of over fishing and habitat degradation in the catchment basin. Currently, deforestation is heavy in the catchment due to both agricultural and mining activities which increase the turbidity of the river (Nindi, 2007).

Conclusion

O . microlepis is a pelagic economically important cyprinid in Lake Nyasa which makes spawning runs in rivers. In the Ruhuhu River the species makes these runs during

the dry season, a fact which is different from Malawi Rivers where spawning runs take place during the rainy season. It is not known what factor(s) make the Ruhuhu River fish ascend the river during the dry season, while the same species spawns in Malawi Rivers during the rainy season. The very high turbidity in the Ruhuhu River during the rainy season is likely to be the main determinant which makes the species to make spawning runs during the dry season. However, more studies, including the hydrology of the whole of the Ruhuhu River basin, should be conducted to ascertain the main factors which may lead to the disappearance of *O. microlepis* in the Ruhuhu River system.

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REFERENCES

Anon (2008). Annual Report. Division of Fisheries, Ministry of Livestock Development and Fisheries, Dar es Salaam, Tanzania.

APHA (2000). Standard Methods for the Examination of Water and Wastewater, 18th edition. American Public Health Assoc., Washington, D.C.

Avis JC, Smith JJ, Ayala FJ (1975). Adaptive differentiation with little genetic change between two native Californian minnows. Evolution, 29: 411 - 426.

Bagenal TB, Braum E (1978). Eggs and Early life history. In: Begenal, T. (ed.); Methods for assessment of fish production in freshwater, 3rd edition. Blackwell Scientific Publ., London. pp. 165–201.

Beadle LC (1981). The Inland Waters of Tropical Africa, 2nd edition. Longman, London. p. 475.

Hoogerhoud RJC, Witte F (1981). Revision of species from the “Haplochromis” empodisma group. Neth. J. Zool., 31: 232-272.

Hoogerhoud RJC, Witte F, Barel CDN (1983). Ecological differentiation of two closely resembling Haplochromis species from Lake Victoria (H. iris and H. hiatus, Pisces: Cichlidae). Neth. J. Zool., 33: 283-305.

Hynes HBN (1970). The Ecology of running waters. Liverpool Univ. Press, Liverpool.

Jackson PBN, Iles TD, Harding D, Fryer G (1963). Report on the Survey of Northern Lake Nyasa, 1954–1955. Govt. Printer, Zomba, Malawi.

Kidd CHR (1983). A water resources evaluation of Lake Malawi and the Shire River. UNDP Project MLW/77/012, World Meteorological Organization.

Kirkpatrick M, Selander RK (1979). Genetics of speciation in Lake Whitefish in Allegash Basin. Evolution, 33: 478-485.

Kornfield I, Smith DC, Ganon PS, Taylor JN (1982). The cichlid fish of Cuatro Cienegas, Mexico: Direct evidence of conspecificity among distinct trophic morphs. Evolution, 36: 658-664.

Lagler KF (1956). Freshwater Fishery Biology. W.M.C. Brown Co. Publ., Dubuque, Iowa. p. 427.

Lagler KF (1978). Capture, sampling and examination of fishes. In: Bagenal, T. (ed.): Methods for assessment of fish production in freshwaters, 3rd edition. Blackwell Scientific Publ., London.pp.7- 47.

Leveque C, Daget J (1984). Cyprinidae. In: C. Leveque, P. Gosse, D.F.E. Thys van den Audenaerd (eds.); Check list of the Freshwater Fishes of Africa. MRAC, Tervuren and ORSTOM, Paris. pp. 217-342.

Lock MA, Williams DD (1981). Perspectives in running water ecology. Plenum Press, New York.

Lowe MRH (1975). Fish communities in tropical freshwaters. Longman, London. p. 337.

Msiska OV (1990). Reproductive strategy of two cyprinid fishes in Lake Malawi and their relevance for aquaculturedevelopment. Aquacult. Res., 21: 67-75.

Nikolsky GV (1978). The ecology of fishes. T.F.H. Publications, Inc. Ltd. p. 352.

Nindi SJ (2007). Changing livelihoods and the environment along Lake Nyasa, Tanzania. Afr. Stud. Monogr., 36: 71-93.

Oijen MJP, Witte F, Witte-Mass ELM (1981). An introduction to ecological and taxonomic investigations on haplochromine cichlids from Mwanza Gulf of Lake Victoria. Neth. J. Zool., 31: 149-174.

Ricardo CK, Borley HJH, Trawavas E (1942). Report on the fish and fisheries of Lake Nyasa. Crown Agents, London. p. 181.

Talling JF, Talling I (1965). The chemical composition of African lake waters. Int. Revue ges Hydrobiol., 50: 421-463.

Tweddle D (1981). The importance of long-term data collection on river fisheries, with particular reference to the cyprinid Opsaridium microlepis (Gunther 1864) fisheries of the affluent rivers of Lake Malawi. In: Seminar on river basin management and development. CIFA/T, 8: 145-163.

Tweddle D (1982). Fish breeding migrations in the North Rukuru area of Lake Malawi with a note on gillnet colour selectivity. Luso: J. Sci. Tech., 3: 67-74.

Tweddle D (1983). Breeding behavior of the mpasa, Opsaridium microlepis (Gunther) (Pisces: Cyprinidae), in Lake Malawi. J. Limnol. Soc. S. Afr., 9: 23-28.

Tweddle D (1987). An assessment of the growth rates of mpasa, Opsaridium microlepis (Gunther, 1864) (Pisces: Cyprinidae) by length frequency analysis. J. Limnol. Soc. S. Afr., 13: 52-57.

Tweddle D (2001). Threatened fishes of the world: Opsaridium microlepis (Gunther, 1864) (Cyprinidae). Env. Biol. Fish, 61: 72.

Welcome RL (1971). Preliminary list of the inland waters of Africa and their characteristics. FIRI/C 134, FAO, Rome.