Diversity and Abundance of Ornamental Cichlids at Katonga in Lake Tanganyika

Kinyage, J.P.H. and Lamtane, H.A.

Department of Animal, Aquaculture and Range Sciences,
Sokoine University of Agriculture,
P.O. Box 3004, Morogoro,
Correspondence e-mail address: *hlamtan@sua.ac.tz*

Abstract

Diversity and abundance of ornamental cichlids of Lake Tanganyika was assessed in six habitats namely rocky, sandy, muddy, benthic, pelagic and surge water at Katonga fishing ground in Kigoma. Ornamental cichlids were collected using fishing net with a dimension of 10 m long x 1 m width and mesh size of 8 mm. eighteen species that are potential for export were observed and recorded. The highest diversity was recorded from sandy and rocky habitat (2.0) and the lowest in muddy habitat (0.0) respectively. Abundance of ornamental cichlids varied among habitats and species. Sandy habitat had the highest number (11) of ornamental cichlids predominated by ***Xenotilapia ochrogeny*** *(30%) followed by* ***Cyathofarynx fursifer*** *(17.17%) and* ***Benthochromis tricot*** *(12.86%). Rocky habitat, had 10 species predominated by* ***Tropheus kirschfleck*** *(24.24%) followed by* ***Goby cichlids*** *(19.70%) and* ***Tropheus brichardi*** *(17.42%). On the other hand, muddy habitat was found to be monospecific in terms of ornamental fish species dominated by only one species,* ***Cyathofarynx fursifer****. It can be concluded that the highest diversity and abundance of ornamental cichlids was recorded from rocky and sandy habitats. It is recommended that further study should be conducted to determine factors which may influence abundance and distribution of ornamental fish in the lake.*

Key words: Cichlids, Ornamental fish, Lake Tanganyika, Diversity

Introduction

Cichlids of African Rift valley have gained great popularity with aquarists around the world due to their fantastic colours, fascinating behaviour, hardiness and relative ease with which most can be bred (CARE SHEET, 2006). There are over 1500 varieties of cichlids estimated to be found in Lake Nyasa and Lake Tanganyika, where as a remarkable number being endemic to the "Great Lakes of Africa" (CARE SHEET, 2006). Lake Tanganyika is sometimes called a "paradise of cichlids" due to the presence of more than 300 cichlids species, whereas about 98% being endemic in this lake (Brichard, 1989). Konings (1998) mentioned about six species of cichlids from lake Tanganyika that sounds much as aquarium cichlids preferred by many aquarists in the world namely; *Cyphotilapia*, *Xenotilapia*, *Tropheus*, *Petrochromis*, *Lamprologini* spp, and goby cichlids.

Exploitation of cichlids and other non-cichlid aquarium fishes for exports is among the outlined means of eradicating poverty to local people around water bodies (Brummett, 2008; Reynolds, 1999 in West, 2001). Kiwale (2003) reported that income from aquarium fish's exportation in Tanzania increased from US$ 9.5 million in 1993 to US$ 94.2 million in 2003. Internationally, annual export values of ornamental fishes were estimated to reach US$ 25O million (FAO, 2006). In estimating the economic potential of ornamental fish trade, internationally a total value close to US$ 1 billion as wholesale trade was obtained while retail trade was about US$ 6 billion (Bhattacharjee, 2011). Exportation of ornamental fishes particularly cichlids from Lake Tanganyika has great potential implication to aquaculture and fisheries sustainability. It also has implication to the livelihood of people as well as raising the economy of the country through taxes on exportation. In some Asian countries for example Indonesia and India

ornamental fishes have been traded and act as an important livelihood activity (Ferse *et al.,* 2012) and agribusiness opportunity (Mandel *et al.,* 2007; Rani *et al.,* 2013). Information on the abundance, diversity and distribution of ornamental cichlid in Lake Tanganyika are lacking. Therefore this study aimed at assessing relative abundance and diversity of ornamental fishes in different habitats of Lake Tanganyika.

Materials and methods

Study area

The study was carried out in the Eastern part of Lake Tanganyika, around Kigoma municipality specifically at Katonga fishing ground located at Latitude: 03°20"-08º48"South and Longitude: 29º03"-31º12"East. Lake Tanganyika has average depth of 572 meters, with maximum depth of 1,310 meters in the northern basin and 1,470 meters in the southern which makes it the world's second deepest lake (West, 2001). In examining diversity and distribution of cichlids species in various habitats a number of methods were employed including sampled-based survey, net fishing (shallow habitat), snorkelling and scuba diving (rocky and bottom habitats) as recommended by Gulland (1983); Spare and Venema (1992) and Hoggarth (2006).

Identification and diversity of ornamental cichlids

Ornamental cichlids species were identified using the following fish identification guide books: Konings (1998), Eccles (1992) and Brichards (1988) in collaboration with the dealer in Exporters of Aquarium Ornamental Cichlids. Diversity of ornamental cichlids in each habitat was obtained from the proportional of each species using Shannon Weiner diversity index.

Abundance and distribution of ornamental cichlids

Ornamental fish sampling was conducted in the following six habitats types such as surge, rocky, muddy, sandy, pelagic and benthic, habitats as characterized by Konings (1998). In this study sample-based survey (Stamatopolous, 2002) was adopted. Fish sampling was done using five fishing nets in each habitat, each having a length of 10 m and 1m width, with small mesh size of about 2-8mm. After fish nets were anchored, a regular checking of the entrapped fish was done by divers for 24 hours in each habitat. The dip nets were used for chasing the school of fishes directing them to location where the nets were anchored. During chasing the school of fishes scuba diving was involved (Van Steenberge *et al.,* 2011).

Data Analysis

The diversity of the ornamental cichlids in their natural habitats were computed using Shannon weaver diversity index (H_o)

$$H_0 = -\sum \mathrm{Pr}\ In\ \mathrm{Pr}$$

Where H_o is the diversity index of the species, Pr is the proportional abundance of all species per habitat and ln is the natural logarithm,

And evenness (E) = H_o/ ln S.

Where H_o is the diversity index of species per habitat, E is the species evenness and S is the total number of species observed.

Results

Identification and diversity of ornamental cichlids

In this study, 18 species of ornamental cichlid species were recorded. The results showed the largest composition were contributed by *Xenotilapia ochrogeny* (19.08%) and *Benthochromis tricoti* (11.48%) while *Petrochromis yellowmoshi* (1.29%) and *Petrochromis famula* (1.57%) were the least in composition for all habitats (Table 1).

Diversity and evenness of ornamental cichlids

Some photographs of identified ornamental species are given in Figure 1. Species diversity was found to be high in rocky and sandy habitats as computed using Shannon weaver diversity index where, H values were 2.05 and 2.09 respectively. The muddy bottomed habitat showed the least species diversity (H_o=0).

Abundance and distribution of ornamental cichlids in habitats

In the rocky habitat, only 10 species were collected among which *Tropheus kirschfleck* showed high percentage abundance (24.24%) followed by Goby cichlids (19.70%), and

Table 1: Species composition of ornamental cichlids at Katonga fishing ground

S/N	Species name	(%)
1	*Cyphotilapia frontosa*	4.88
2	*Cyathofarynx fursifer*	7.89
3	*Tropheus kaiza*	6.03
4	*Benthochromis tricot*	11.48
5	*Tropheus kirschfleck*	7.89
6	*Xenotilapia ochrogeny*	19.08
7	*Cyathofaryxn foai*	3.73
8	*Tropheus brichardi*	5.6
9	*Cyprichromis microlepidotus*	2.01
10	*Petrochromis kazumbe*	2.44
11	*Petrochromis yellowmoshi*	1.29
12	*Tropheus duboisi*	5.02
13	*Goby cichlids*	7.89
14	*Eretmodus cyanostictus*	2.15
15	*Julidochromis regain*	3.01
16	*Cyprichromis leptosoma*	3.16
17	*Petrochromis famula*	1.57
18	*Tanganicodus irsacae*	4.88

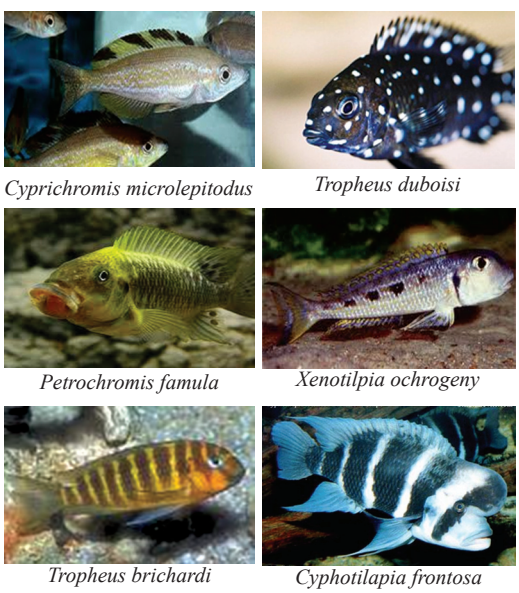

Fig. 1: Photos of some of the ornamental cichlids at Katonga in Lake Tanganyika
(***Photo by:*** Kibwanaqua, March, 2012)

Tropheus brichardi (17.42%) (Figure 2). Sandy habitat with 11 ornamental cichlid species, expressed high abundance of *Xenotilapia ochrogeny* (30.04%) followed by *Cyathofarynx fursifer* (17.17%) and *Benthochromis tricoti* (12.86%) (Figure 3). Species observed in the pelagic habitat showed high variation in terms of their abundances where *B. tricoti* and *T. kirsfleck* had highest abundances of 39.68% and 18.25% respectively, while *Tropheus (kaiza and kirsfleck)* and goby cichlids had around 12%, *C. leptosoma* and *P. famula* shared the lowest 1.59% abundance (Figure 4).

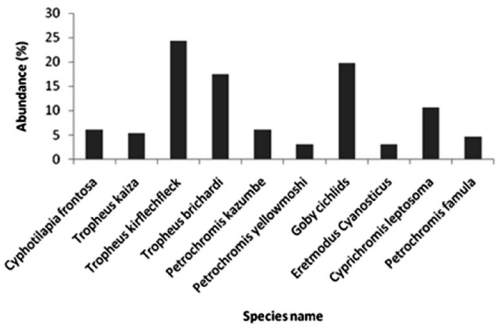

Fig. 2: Species abundance in the rocky habitat

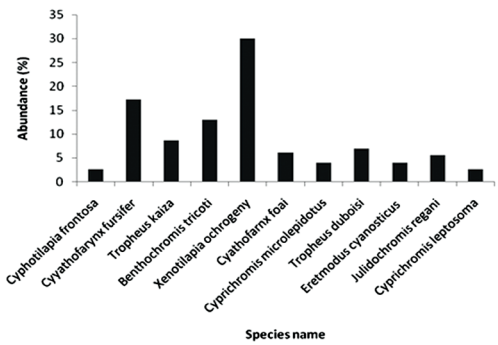

Fig. 3: Species abundance in the sandy habitat

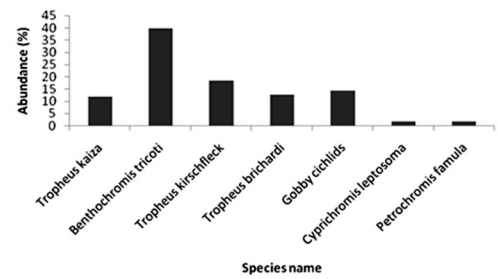

Fig. 4: Species abundance in the pelagic habitat

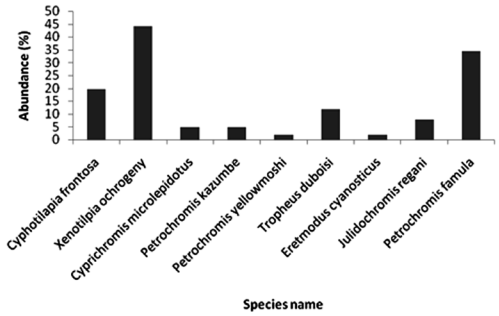

Fig. 5: Species abundance in the benthic habitat

Benthic habitat making the lake's constituted of rocky and sandy substrates had nine species, where *X. ochrogeny* and *P. famula* were more abundant than other species making 44.12% and 34.34%, while *C. frontosa* were 19.61% and *T. duboisi* -11.76% in abundance, *P. yellowmoshi* and *E. eretmodus* showed the lowest abundance of 1.96% each (Figure 5). On the other hand, muddy habitat in this study was found to be monospecific in terms of ornamental fish species with highest abundance of *Cyathofarynx fursifer* (100%).

The intermediate water of the lake, the surge habitat, was dominated by *Tanganicodus irsacae* (34.34%). Other seven species were even distributed with abundance between 10-18% while *P. Kaiza* and *P. yellow* moshi were lowest in abundance with 4.04% and 3.03% respectively (Figure 6).

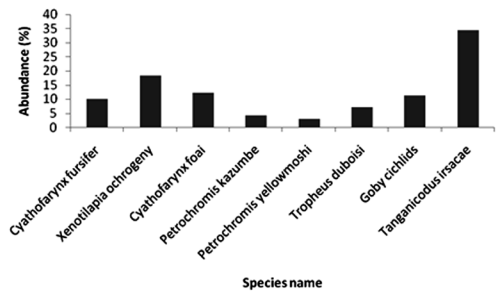

Fig. 6: Species abundance in the surge habitat

Discussion

This study aimed at assessing diversity and relative abundance of ornamental fishes in Lake Tanganyika in five different habitats. Sandy and rocky habitats were found to be more diverse as compared to the pelagic, benthic and surge habitats. Results from the present study is similar to the observation made by Van Steenberge (2011) and Koning (1998) that marked high diversity of cichlids in the rocky and sandy habitats. Only 18 species of ornamental cichlids are reported in this study despite of numerous cichlids species diversity reported by Konings (1998) and Brichard (1989). These authors reported more than 250 species of cichlids in Lake Tanganyika. The differences might be due to short time spent for sampling and numbers of sites sampled; only Katonga was considered as sampling site in this study. However, the number of ornamental cichlids did not much from Bangertar (2007) who reported 16 ornamental cichlids from the lake potential for agribusiness purposes.

Rocky and sandy habitats have more diversity of ornamental fishes of high demands in markets including *Cyphotilapia frontasa* and *Petrochromis species*. These habitats have been considered as the major fishing ground of ornamental cichlids. According to Sturmbauer (1997) such habitats contribute colour of the fish that is due to environmental-gene integration. For example species like *Cyphotilapia frontosa* which is found in black habitat has black strips. Although Petrochromis, Tropheus and Xenotilapia are predominated rocky and sandy habitats they are also found at small percentages in other habitats of the lake (Konings, 1998). Only small percentages of colourful ornamental cichlids are found in muddy and are considered for business purposes in aquaria. Generally, variations in abundance of ornamental cichlids are determined by species preference and selection of habitats with the desirable cichlids species. According to Konings (1998) rocky habitat is preferred by cichlid because of the availability of natural food items including algae and animal materials.

According to Konnings (1998) sandy and rocky habitats have high water transparency that increased visibility to the ornamental cichlids contrary to the muddy habitat. Allin *et al.* (1999) reported relationship of fish diversity and density with the landscape and water clarity.

These authors showed that species diversity and density in Lake Tanganyika decrease with depth and an increase in turbidity. The presence of caves and rocky structures made conducive hiding environment for the cichlids hence contribution of higher relative abundance compared to other habitats (Rossiter, 1995). Similar observation on preference of ornamental fish in respect to the habitat types was reported by Konings (1998). It can be concluded that diversity and abundance of ornamental cichlids is high in sandy and rocky habitats followed by the surge, benthic, and pelagic habitats while muddy habitat is the poorest in terms of diversity and abundance. It is recommended that further research on the seasonal variation of commercially important ornamental cichlids from Lake Tanganyika should be conducted.

Acknowledgements

Authors acknowledge the management and staff of TAFIRI-Kigoma as well as Nunu M Mwamba fishing company and Kibwanaqua-cichlids exporters for the assistance that was received during data collection.

References

Ahilan, B., Felix, N. and Santhanam, R. (2008). Text book for Aquariculture. Daya Publishing House, Delhi India, 85pp.

Allin, S.R., Cohen, A.S., Bills, R., Gashagaza, M.M., Michel, E., Tiercelin, J.J., Martens, K., Covelier, P., Mboko, S.K., West, K., Soreghan, M., Kimbadi, D. and Ntakimazi, G. (1999). Effects of landscape disturbance on animal communities in Lake Tanganyika, *East Africa. Conservation Biology,* 13: 1017 – 1033.

Bangerter, D.L. (2007). Freshwater Tropical Aquarium cichlids: Species description and environment stats, Report, 79pp.

Bhattacharjee, M.J. (2011). DNA barcoding of ornamental fishes of North-East India, Assan University, Silcher India, 105pp.

Brichard, P. (1989). Pierre Brichards book of Cichlids and all the other fishes of Lake Tanganyika. T.F.H Publishing Inc, USA 544pp.

Bummett, E. (2008). Ornamental fishes a sustainable livelihood option for rainforest communities. Yaounde', FAO, Aquaculture newsletter. 7pp.

Bwathondi, P.O.J. (2003). The fishes and fisheries research in the Great Lakes of Africa, Tanzanian sector: Tanzania Fishes Research Institute, Dar es Salaam, Tanzania, 85pp.

CARE SHEET, (2006). African Rift Valley Cichlids, Aquarium Indus Industries, Project Report, 28pp.

Coche, A. (1994). Aquaculture development and research in Sub-Saharan Africa: National review. CIFA Technical paper, No. 23. suppl. Rome, FAO. 1994. 397p.

Eccles, D.H. (1992). Field guide to the freshwater fishes of Tanzania. Food and Agriculture Organization of the United Nation, Rome 154pp.

Ekaratne, S.U.K. (2000). A review of the status and trends of ornamental fishes resources and their habitats in Sri Lanka: Bay of Bengal Program. Chennai, Y.S. Yadava 68pp.

FAO (2006). Fisheries Management, 3, Managing fishing capacity: FAO Technical guidelines for Responsible fisheries No. 4. Suppl.3. Rome, FAO. 2008, 104P.

Ferse, S.C.A., Knittweis, L., Krause, G., Maddusila, A and Glaser, M. (2012). Livelihoods of ornamental coral fishermen in South Sulawesi/Indonesia: Implications for management. *Coastal Management,* 40: 525-555.

Hoggarth, D.D. (2006). Stock assessment for fishery management: A frame guide to fish stock assessment tools of the Fisheries Management Science Programme 99pp

Jorgensen S.E, G. Ntakimazi and S. Kayombo (2006). Lake Tanganyika. UNDP/GEF and UNOPS. 56pp

Kiwale, J. (2003). The Tanzania fish export sector: Board of external trade. Dar es Salaam. Report, 56pp.

Koning, A. (1998). Tanganyika Cichlids in their natural habitat, Cichlid Press, ISBN 0-9668255-0-0, 272pp.

Mandel, S., Mahapatra, B.K., Tripath, A.K., Verma, M.R., Datta, K.K., and Ngachah, S.V. (2007). Agribusiness opportunities of ornamental fisheries in North-eastern

Region of India. Agricultural Economics Research Review, Vol. 20 (Conference issue) pp. 471 – 488.

Munyandorero, J. (2002). The Lake Tanganyika clupeid and latid fishery system: Indicator and Problem inherent in assessment and management. African Study Monographs. 69pp.

Rani, P., Immanuel, S., Anarithan, P.S., Ojhas, N., Kumar, N.R. and Krishinan, M. (2013). Export performance of Indian ornamental fish – an analysis of growth, destination and diversity. Indian Journal of Fishery, 60: 81-86.

Rossiter, A. (1995). The Cichlid Fish Assemblages of Lake Tanganyika: Ecology, Behaviour and Evolution of its Species Flocks. *Advances in Ecological Research,* 26: 187-252.

Spare, P. and S.C. Venema (1992). Introduction to tropical fish stock assessment: Part 1: Manual, FAO 1992, Rome. 126pp.

Stamatopoulos, C. (2002). Sample-based fishery survey: A technical hand book, FAO, Fisheries Technical Paper, No. 425. Rome 132p.

Sturmbauer, C. (1997). Phylogeographic Patterns in Populations of Cichlid Fishes from Rocky Habitats in Lake Tanganyika In: Molecular Systematics of Fishes, ACADEMIC PRESS, USA, pp. 97-111,

Travares, I. (2009). Lake Tanganyika, Variant in Xenotilapia, Ochrogenys and other cichlids: AFI magazine.7pp.

UNDP/GEF (2000). Strategic Action Plan: Lake Tanganyika Biodiversity Projects. Nairobi, Global Environmental Fund Project, 36pp.

Van Steenberge (2011). A recently inventory of fishes of the northern-western and central western coast of Lake Tanganyika, "Democratic Republic of Congo" 26pp.

West, K. (2000). Pollution and other measures to protect biodiversity in Lake Tanganyika: Bioss final technical report, UNDP/GEF projects 25pp.

West, K. (2001). Lake Tanganyika Biodiversity Project. UNDP/GEF conservation 56pp.