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RESEARCH ARTICLE

Diet of Silver Cyprinid, *Rastrineobola argentea* in Lake Victoria, Kenya.

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ABSTRACT

Studies on the diet of *Rastrineobola argentea* were conducted between August 2014 and March 2015 in the Kenyan waters of Lake Victoria. Stomach contents of 1154 specimens collected from commercial fishers and experimental seining were analyzed. Juveniles of *R. argentea* under 30 mm SL fed almost exclusively on zooplanktons, while adult fish larger than 40 mm SL preferred insects. Changes in diet require morphological and physiological changes which are not yet well developed in young fish, thus, they can easily digest zooplankton that also satisfy their demand for protein.Diel feeding regime suggested that *R. argentea* is a visual feeder. There was spatial variation in diet composition within the studiedstations. Strauss Linear Index of food selection showed that *R. argentea* preferred cyclopoida, *Daphnia* sp and *Brachionus* sp(positive values). However, calanoida, *Bosmina* sp and *Keratella* sp were avoided in most stations (negative values). The change in diet among the stations could be attributed to the environmental changes occurring in Lake Victoria associated with changes in composition and abundance of zooplankton community. The information on the ecology of *R. argentea* are of considerable ecological importance.

INTRODUCTION:-

The Silver Cyprinid, *Rastrineobola argentea* (Pellegrin, 1904), is a species of ray-finned fish in the family Cyprinidae of order Cypriniformesfrom Lakes Victoria and Kyoga in East Africa.Its diet predominantly consists of zooplanktons, mainly copepods,cladocerans and rotifers(Wandera, 1992;Wanink, 1998). The diel behaviour of *R. argentea* is associated with feeding on insects near the surface at night and aggregating in the lower water column around the oxycline during the day and feeding on zooplankton (Getabu *et al*., 2003). According to Mkumbo (2002), *R. argentea*is one of the main prey items of the introduced Nile perch (*Lates niloticus*), that provides income, foreign exchange and employment to the fisher communities and the countries sharing the lake. The fish therefore, has a crucial role in the ecosystem of Lake Victoria as a link between the zooplankton and the top predators (Manyala and Ojuok, 2007). The composition and abundance of zooplankton community in Lake Victoria has changed significantly following the deteriorating water quality caused by increased disturbances in its catchments (Ngupula *et al*., 2010). This is thought to have an impact on the feeding ecology of *R. argentea*in the lake since zooplankton forms its major food item.In regard tothis effect, the study aimed to determine the diet composition, ontogenic shift, spatial variation in diet composition, diel feeding and food selection of*R. Argentea*in the Kenyan waters of Lake Victoria.

MATERIALS AND METHODS:-

Study area:-

This study was conducted in the Kenyan waters of Lake Victoria (Fig.1), with sampling stations at Dunga (0˚08'40.7"S, 34˚44'12.4"E); Ngegu (0˚29'25.0"S, 34˚30'03.8"E), and Wichlum (0˚14'21.4"S, 34˚12'34.3"E). The fishery at Dunga is shallow (3-4 m) covering the inner Nyanza gulf waters. Ngegu is deep (8-14 m) and covers the mid Nyanza gulf waters. Wichlum is shallow (5-7 m) covering the open waters.

Sampling procedures:-

Studies on the diet of *R. argentea* were conducted between August 2014 and March 2015. Stomach contents of 1154 specimens collected from commercial fishers and experimental seining were analyzed. For diel feeding regime, a 24-h sampling was conducted in every station using small seine net of mesh-size 8mm, length 100 m and width 8 m. Fishing was done at 3-h interval and fish samples were preserved in 5% formalin. Parallel to fishing, composite vertical samples of zooplankton were collected from the water column using 50µm plankton net of 30 cm diameter and preserved in 500 ml vials with 5% formalin. In the laboratory, the samples were washed with water to remove the formalin, and then diluted to 100mls of which 10mls were sub-sampled for counting using an inverted microscope at x 100 magnification. The zooplankton was identified using keys by Jung (2004). The stomach contents (SC) of the preserved fish were weighed (0.1 mg) using an electronic balance (Mettler Toledo, AG204). The contents were then put into a petri dish and the zooplanktons sorted and identified under a microscope. Strauss Linear index (Strauss, 1979) was used to calculate food selection according to the equation; $L_i = r_i - p_i$, where r_i is the proportion of prey taxon i in the guts of predators and p_i is the proportion of the same taxon in the environment. The means of r_i and p_i weighed by the number of prey in each sample was used to calculate L_i

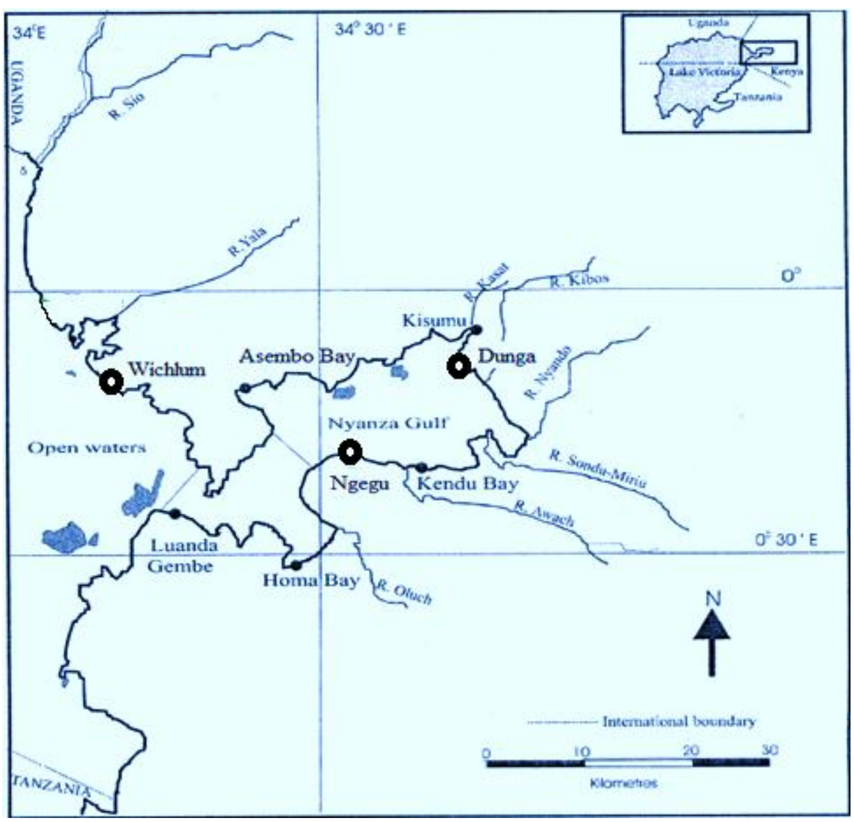

Fig. 1: Map of Lake Victoria, Kenya showing the sampling stations

RESULTS:-

Diet composition:-

During the period of August 2014 to March 2015 the gut contents of 1154 specimens of *R. argentea* consisted mostly of copepods, cladocerans, rotifers and insects (Fig. 2). Copepods contributed the highest (34.6%) while insects contributed the least (18.7%).

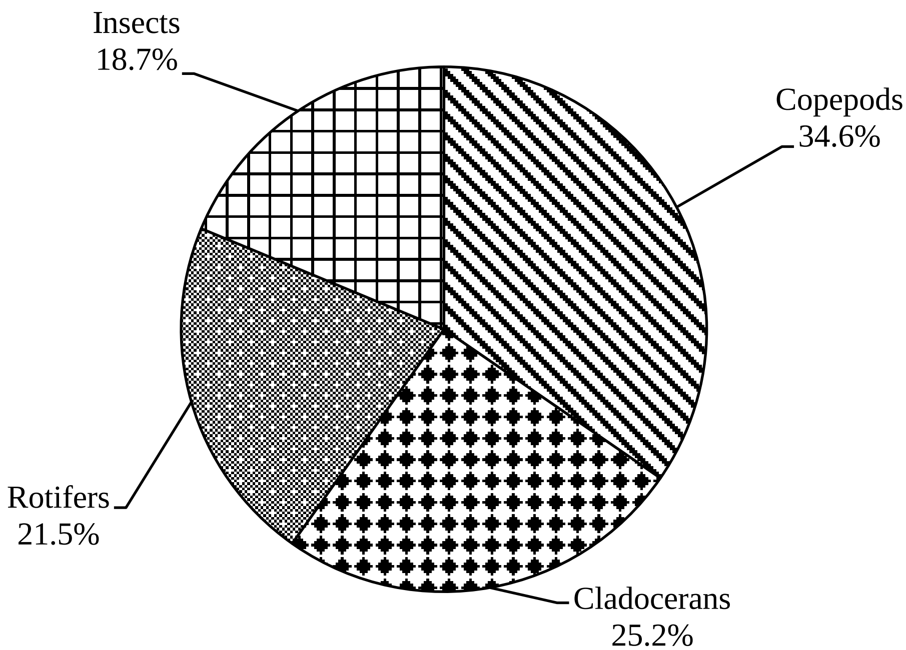

Fig. 2: Contribution of different food items in the diet of R. *argentea* in Lake Victoria.

Spatial variation in diet composition:-

There was spatial variation in the composition of the food items consumed by *R. argentea* from the three sampled stations in Lake Victoria (Table 1). The dominant food items in the diet were rotifers (36.8%), copepods (54.2%) and insects (32.0%) at Dunga, Ngegu and Wichlum. The other important food item in the lake was cladoceran. Chi-square test revealed significant difference between the ingested copepods (χ^2=16.96, $p<0.05$), rotifers (χ^2=17.51, $p<0.05$) and insect (χ^2=21.63, $p<0.05$) in the three stations. No significant spatial variation was detected with cladocerans (χ^2=5.72, $p>0.05$).

Table 1: Numbers and percentages (%)of various food items in the guts of *R. argentea* from various stations in Lake Victoria, Kenya.

Food items	Dunga	Ngegu	Wichlum
Copepods	38(27.1)	70(54.2)	36(22.5)
Cladocerans	22(15.6)	41(31.7)	45(28.3)
Rotifers	52(36.8)	14(10.4)	28(17.2)
Insects	29(20.5)	5(3.7)	51(32.0)

Food in relation to fish size

The fish examined ranged from 27 to 59 mm SL. A change in the diet with increasing size was apparent, with all size classes consuming all the important food items (Fig. 3). copepods were the major food of *R. argentea* under 30 mm SL, and was of little importance to fish larger than 40 mm SL. Insects were also of little importance in the diet of small *R. argentea* (<30 mm), but were major food items of larger fish. Cladocerans and rotifers were consistently important to all size groups.

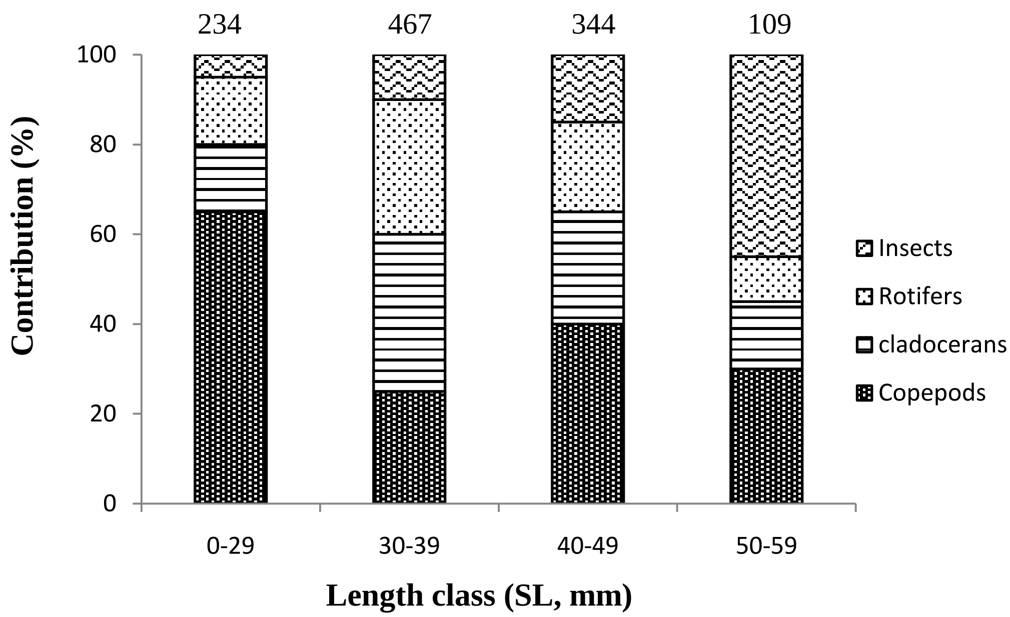

Fig. 3: Food of *R.argentea* of different length classes from Lake Victoria, Kenya. Numbers above columns indicate sample size (n).

Diel feeding rhythm:-

A 24-h feeding study showed that *R. argentea* fed mostly during the day, and ingests very little food at night. The feeding regime at Ngegu showed two peaks around 6pm and 6am, whereas at Wichlum the peaks were around 6pm and 9am (Fig 4). The stomach contents reduces reaching the lowest levels at midnight (Ngegu) and 3am (Wichlum). An increase in the stomach contents was recorded from around 3 am and 6 am at Ngegu and Wichlum respectively.

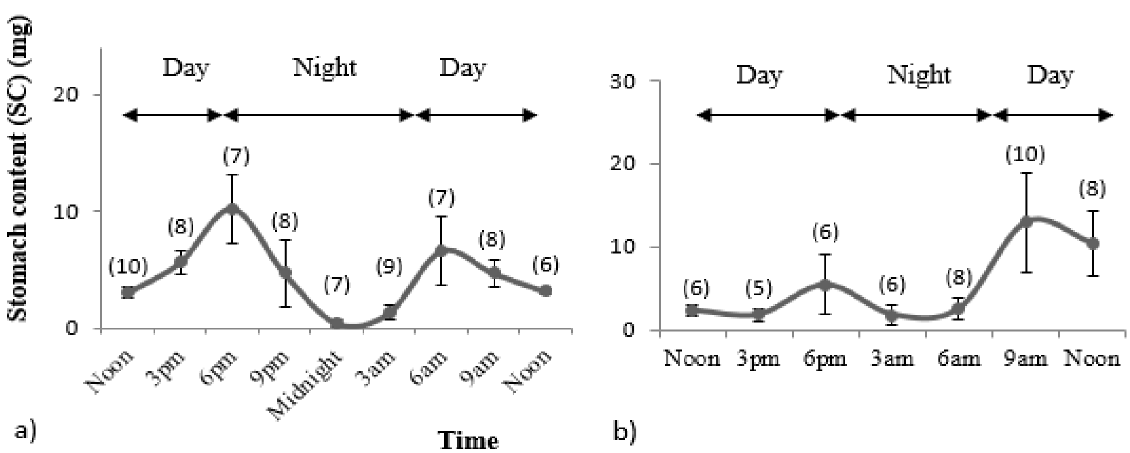

Fig. 4: Diel feeding regime of *R. argentea* in Lake Victoria, Kenya. a) Ngegu, b) Wichlum. Vertical lines indicate the mean ± SE. Parentheses indicate sample size (n).

Food selection:-

Strauss Linear Index of food selection showed that *R. argentea* preferred cyclopoida (Ngegu), *Daphnia* sp (Wichlum) and *Brachionus* sp (Dunga) (positive values). However, calanoida, *Bosmina* sp and *Keratella sp* were avoided in most stations (negative values) (Fig. 5).

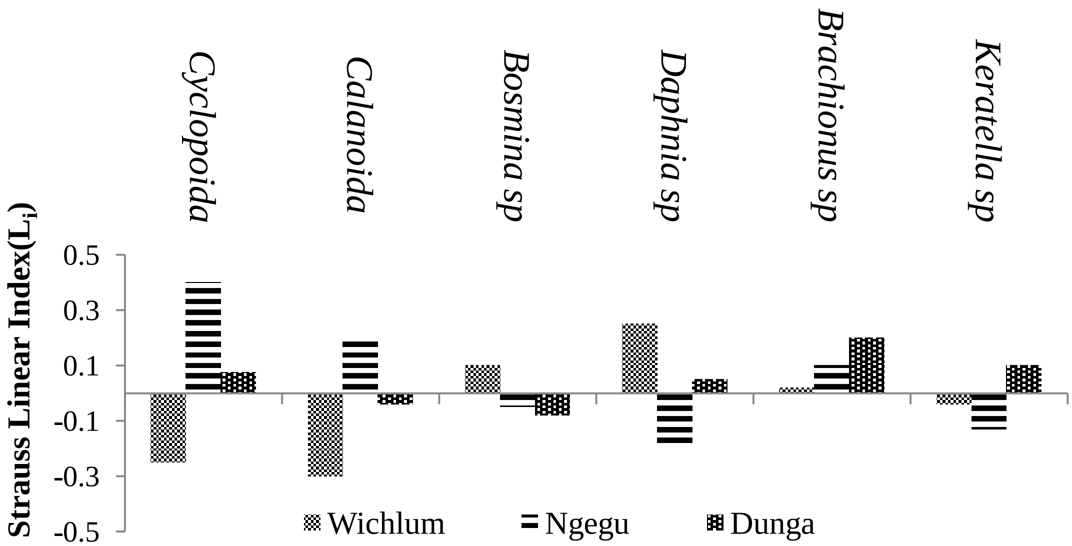

Fig. 5: Selectivity of zooplankton species by *R. argentea* in Lake Victoria, Kenya.

DISCUSSION:-

The study identified four food items of *R. argentea*, i.e. copepod, cladoceran, rotifers and insects, of which copepod contributed the highest proportion of the diet. This could be attributed to their high abundance in the lake. The law of optimal foraging could also explain that the fish preferred copepods because of the higher net energy gain (Krebs, 1979). These results concur with Wandera (1992) who found copepods forming the major diet of *R. argentea* in the Ugandan waters of Lake Victoria.However, Budeba and Cowx (2007) identified six food items of *R. argentea*, i.e. *C. nilotica*, cladoceran, copepod, chaoborus, insects and chironomids in the Tanzanian part of Lake Victoria. Results for the spatial diet composition differ from Owili (1999) who reported the dominance of cladoceran in the diet of *R. argentea* in the Nyanza gulf of Lake Victoria. The change in diet among stations could be attributed to the environmental effectscausing changes in zooplankton community (Ngupula *et al.*, 2010). According to Wanink *et al* (2002) the zooplanktivore fish (i.e. *R. argentea*, haplochromines, and juveniles of Nile perch) do not have any significant preferences towards big sized calanoids and cladocerans.Juveniles of *R. argentea* under 30 mm SL fed almost exclusively on zooplanktons. Njiru *et al* (2004) made similar observations in the lakereporting zooplankton as the major food of *Oreochromis niloticus* under 5 cm TL. The dominance of zooplankton in the diet of juvenile *R. argentea* was probably because of their smaller mouth gape (Wandera, 1992). Changes in diet require morphological and physiological changes which are not yet well developed in young fish, thus, they can easily digest zooplankton that lack cell wall (Govoni *et al*., 1986). Juvenile fish require more energy for active growth and in such they depend on zooplankton to satisfy their demand for protein (Benavides *et al*., 1994). Diel feeding regime suggested that *R. argentea* is a visual feeder.The visual responsiveness in fish is decreased at night because the photoreceptors (rod and cone) are actively depolarized in the dark and hyperpolarize in the light (Emran *et al*., 2010). The low stomach contents recorded at night was mainly due to the completion of digestion of the food consumed during the day, while the rise in stomach contents from dusk could be as a result of feeding by the fish to satisfy the demand after the digestion at night. These results concur with Wandera (1992) who reported the highest and least feeding peaks during day and night respectively, with digestion completed after midnight. Outa *et al*(2014) also reported almost similar diurnal feeding regimewith *O. niloticus* in Lake Naivasha, Kenya.

Conclusion:-

R. *argentea* fed mostly during the day, with preference to copepods among zooplankton groups. The change in diet among the stations could be attributed to the environmental changesoccurring in Lake Victoria associated withchanges in composition and abundance of zooplankton community. The information on the ecology of *R. argentea* are of considerable ecological importance.

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