The potential of mukene (*Rastrineobola argentea*) fishery in Lake Victoria with suggestions for its management

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Abstract

Following the decline in catches of endemic fish species in Lake Victoria, Mukene, *Rastrineobola argentea* has become an important commercial fish species. The fishery spread first through Kenyan, and Tanzanian waters and is now well established in the Ugandan portion of the lake. *Rastrineobola,* together with the Nile perch and the Nile tilapia are the three most important commercially exploited fish species in Lake Victoria now. High mortality due to human exploitation and predation pressure by the Nile perch have contributed to changes in biological characteristics of mukene populations. Monthly samples of mukene covering at least a calendar year were obtained from the artisanal fishermen operating in Lake Victoria. These were analyzed for size structure, growth, gonad maturity state and breeding periodicity. Type and quantities of by-catch species and parasite infestation were also determined. Size structure of mukene populations has reduced from a mean of more than 60 mm SL in the early 1970's to 44 mm SL in 1997. A five or three mm-mesh net, which captures may immature fishes, has replaced a 1 mm mesh net. Catches from closed bays and near shore areas contain a high proportion of juvenile mukene, tilapia and Nile perch as by-catch. In the "islands" belt of Lake Victoria, where the bulk of mukene fishing occurs, high proportions of immature mukene is caught during the months of November/December. This is the time when young mukene are recruited into the fishery and should be closed to fishing. Considering the above changes to mukene populations in the lake, a 10-mm mesh net previously recommended for harvesting the species, may no longer be suitable. *R. argentea* should therefore be exploited away from the shore line and closed bays using nets with minimum mess size of 5 mm.

Key words: Rastrineobola, Lake Victoria, life parameters, exploitation

Introduction

Until about two decades ago, the fishery of mukene *Rastrineobola argentea* on the Ugandan side of Lake Victoria was not very important. The fishery was then based on the endemic tilapiines, *Oreochromis (Oreochromis) esculentus* g. and *Oreochromis (Nyasatilapia) variabilis* (B).; the catfishes, *Bagrus docmak (F.)* and *Clarias (Clarias) gariepinus* (B). and the lungfish *Protopterus aethiopicus (H).* With the introduction and the subsequent establishment of foreign fish species, the Nile perch, *Lates niloticus* (L.) and the Nile tilapia, *Oreochromis (Oreochromis) niloticus* (L.), the indigenous species have almost disappeared from the catches. *R. argentea* is the only endemic species landed in significant quantities. It is second to the Nile perch in the Ugandan waters of Lake Victoria and coming up fast on Lake Kyoga. It is however not yet being fished on Lake Nabugabo. The species is exploited for both human consumption and animal feeds manufacture.

Increased pressure on Mukene has over time resulted in changes in the life history of the species. Such changes, therefore, require appropriate management measures for rational exploitation by the fishery. It has for example been recommended that *R. argentea* be fished with a 10 mm mesh size net. This was proposed at the beginning of the mukene exploitation on the Ugandan side of Lake Victoria before the species' biological parameters had stabilized. This paper outlines changes in biological parameters that have occurred to populations of *R. argentea* in the Ugandan sector of Lake Victoria following increased exploitation. In the light of these changes,

appropriate management measures are suggested for further exploitation of the species.

Materials and methods

Monthly samples of *Rastrineobola argentea* were obtained from artisanal fishermen operating in Napoleon Gulf at Kikondo, representing a sheltered bay; Buvuma Channel at Lingira for the "islands" zone and the open water at Bugaia Island (Figure1), between January 1997 and April 1998. During each sampling, about 0.5 kg of mukene were randomly scooped from a freshly hauled catch and immediately fixed in 5% formaldehyde solution.

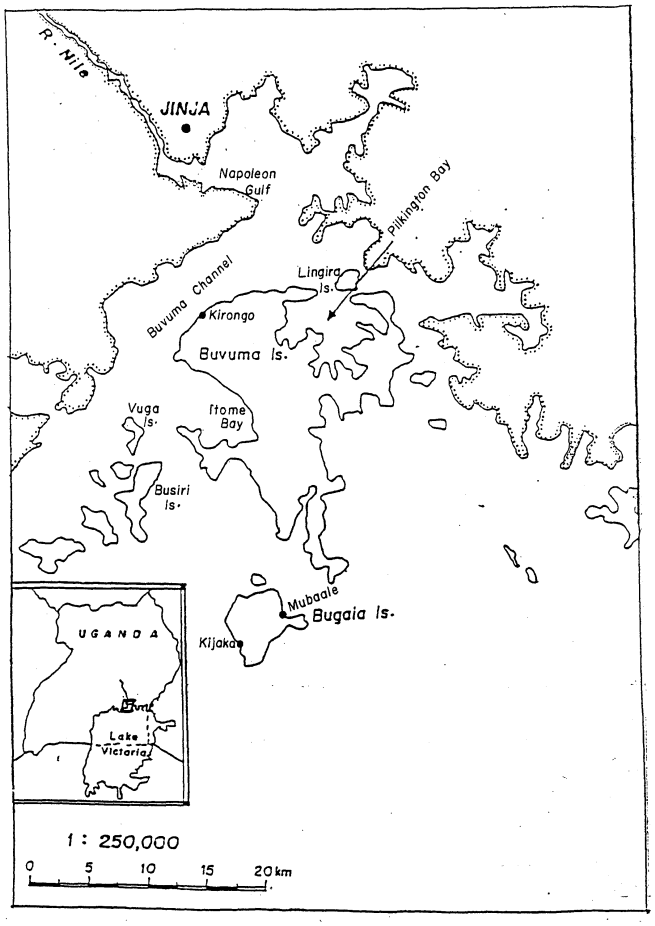

Figure 1. Map of Lake Victoria showing study area

In the laboratory, different fish species in the sample were identified, sorted counted and weighed to determine composition of by-catch. Standard lengths (in mm) of mukene were taken to determine length frequency distribution of the sample. Gonad maturity state of the fishes was determined as in Nikolsky (1963). Growth parameters were determined by subjecting length frequency data to computer analysis using ELEFAN software of Gayanilo *et al*. (1988). To compare population structures before and after the Nile perch upsurge in Lake Victoria, length measurements were also taken from a sample of mukene caught in August 1970 and stored in FIRRI museum.

Results

Length frequency distribution of populations of the species from Buvuma Channel showed an annual mean length of 44 mm SL as compared to 48 mm in 1988 and more than 60 mm SL in the 1970's (Figure 2).

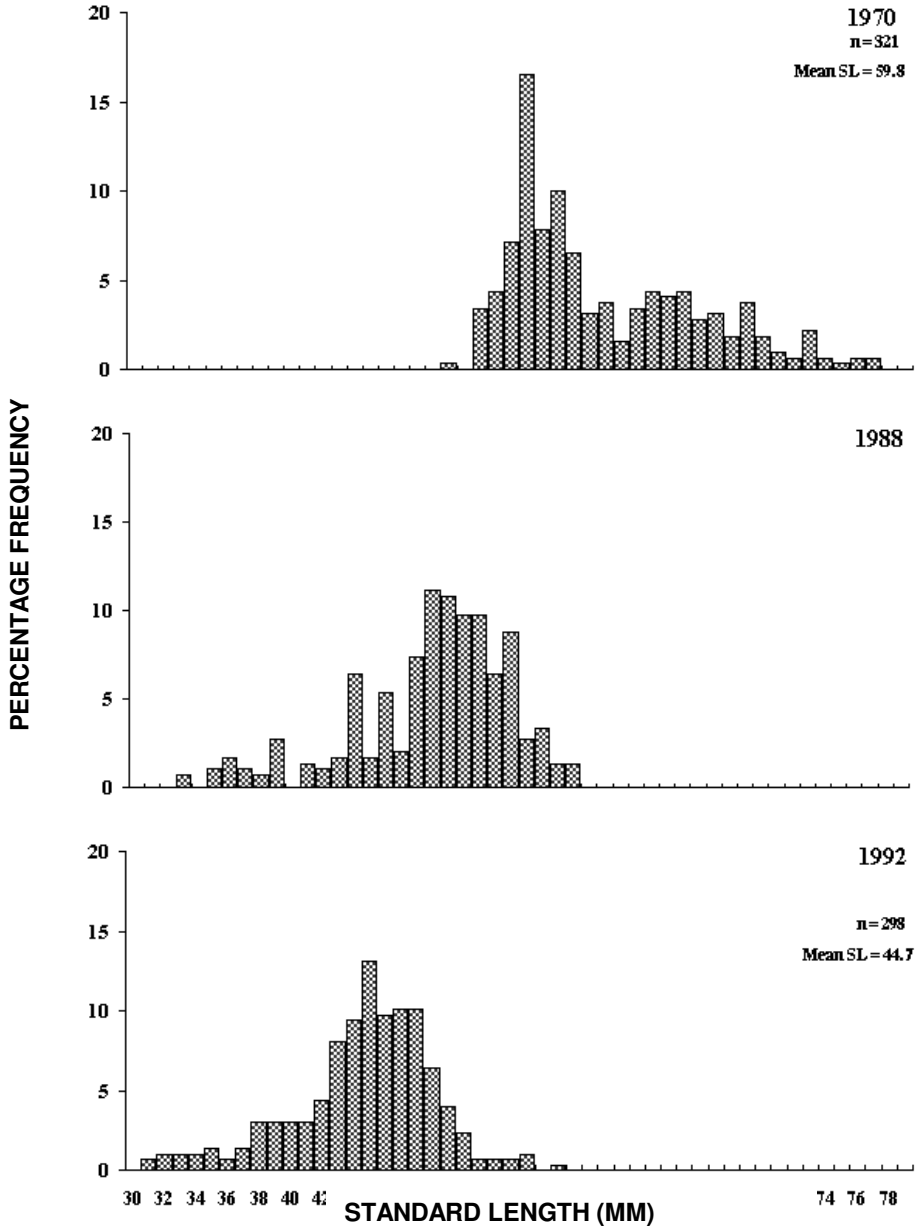

Figure 2. Length frequency distribution of *R. argentea* from Lake Victoria in 1970, 1988 and 1992

Size at first maturity in both Napoleon Gulf and Buvuma Channel was calculated at 41 mm SL for males and 42 mm for females (Figure 3). The Bugaia population however matured at a much smaller size of 36 mm SL (Figure 4). The three populations showed that 92.7% of the catch at Bugaia consisted of mature fishes while 68.8% and only 41.4% of mukene respectively in Buvuma channel and

napoleon gulf were mature (Figure 5). While mukene was observed to breed throughout, peak breeding occurred twice a year, in August and in December / January (Figure 6). With the exception of the months July, August and January, the bulk (>50%) of the catch in Napoleon Gulf consisted of immature mukene. At Lingira only the months of November and December had more than 50% immature while at Bugaia very few immature mukene were recovered throughout the year (Figure 7).

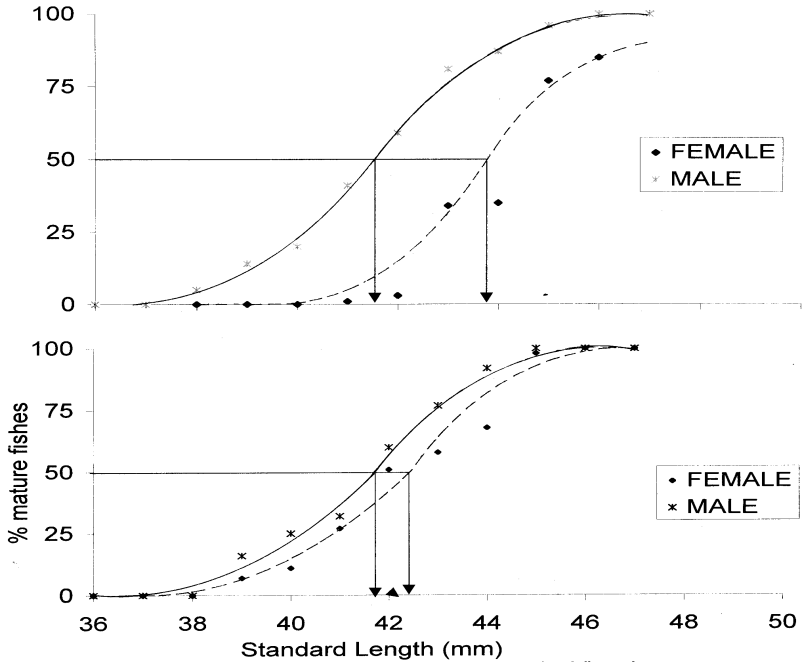

Figure 3. Size at first maturity of R. *argentae* from Lake Victoria, Jinja

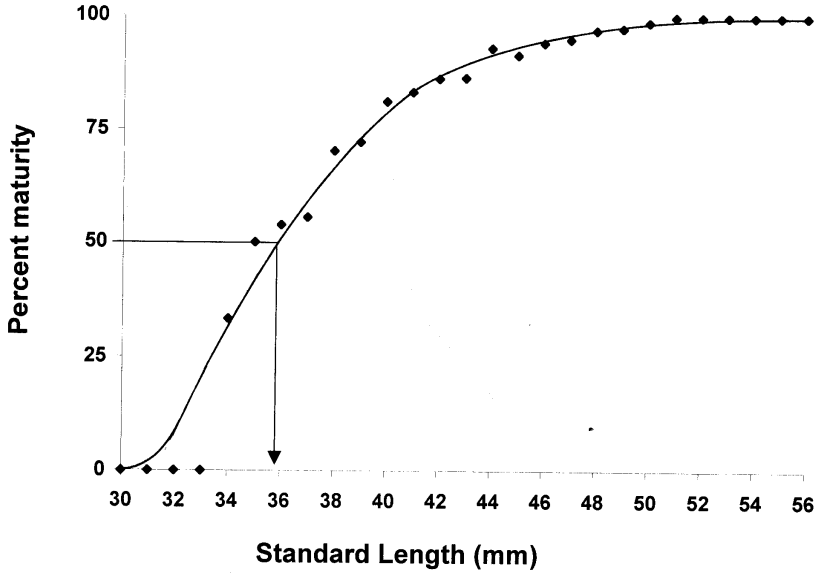

Figure 4. Size at first maturity of R. *argentae* from Lake Victoria, Bugaia

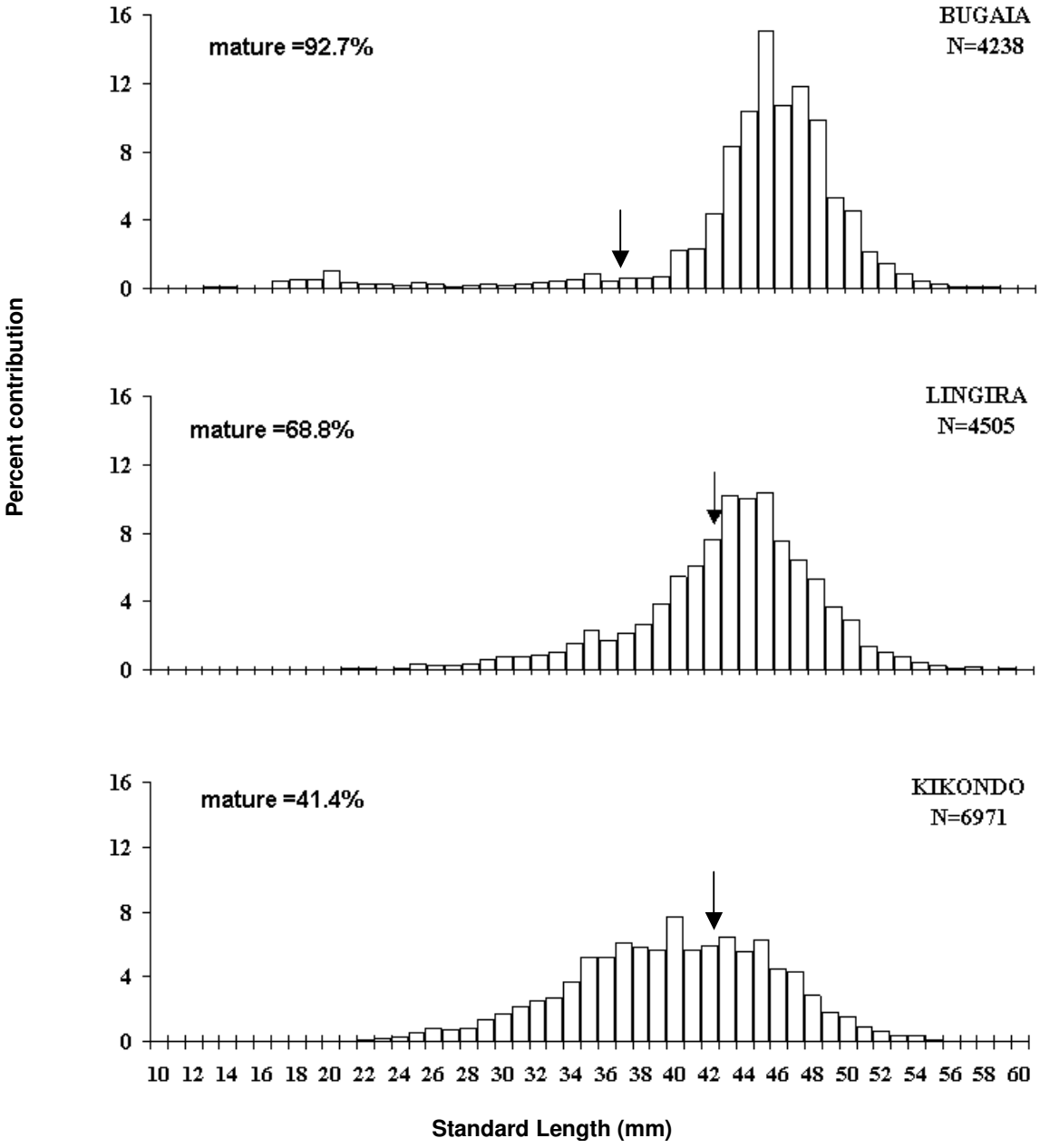

Figure 5. Length frequency distribution of *Rastrineobola argentea* caught in 5 mm mesh net from Lake Victoria

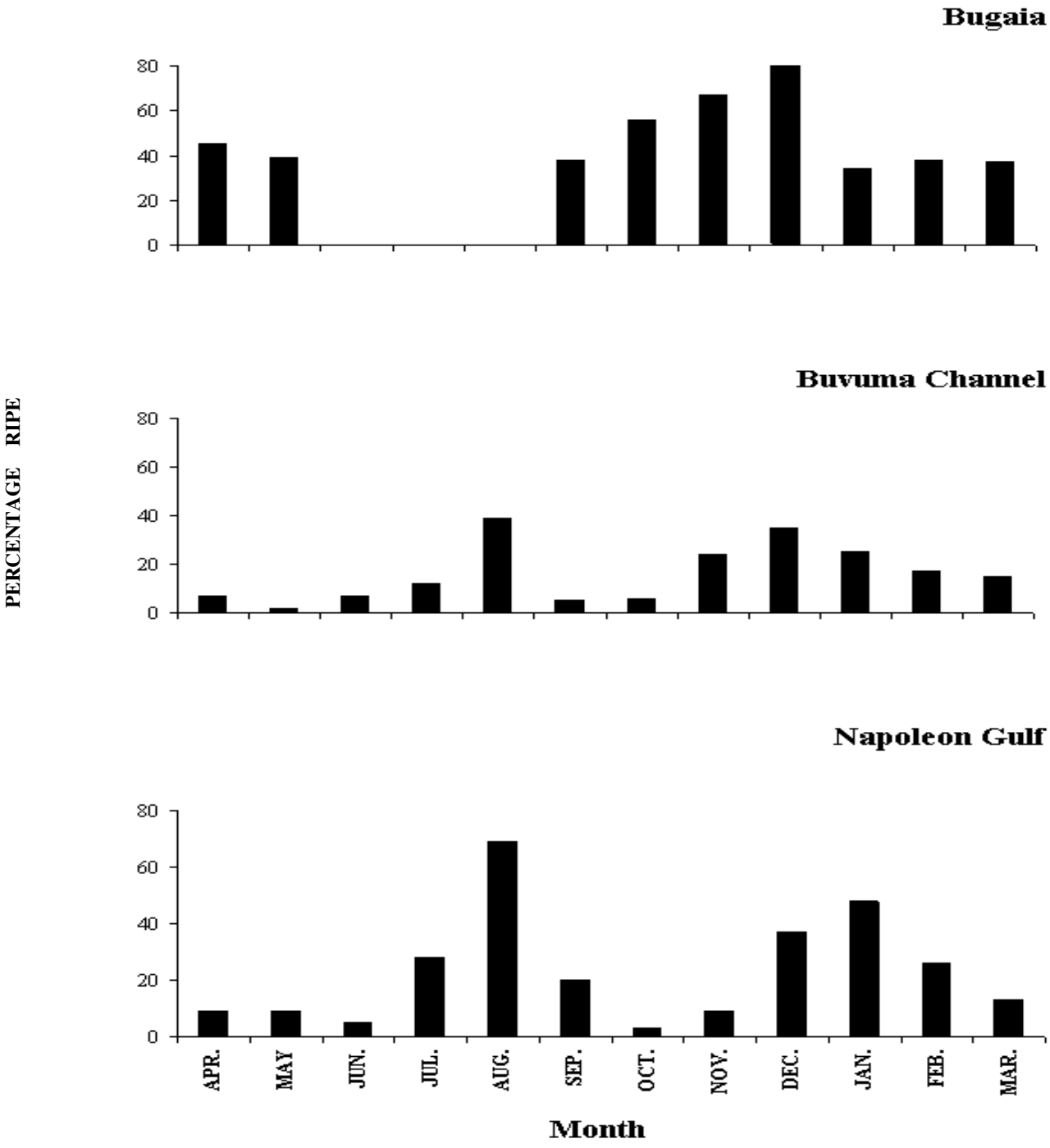

Figure 6. Percentage of ripe gonads in *R. argentea* – all sites

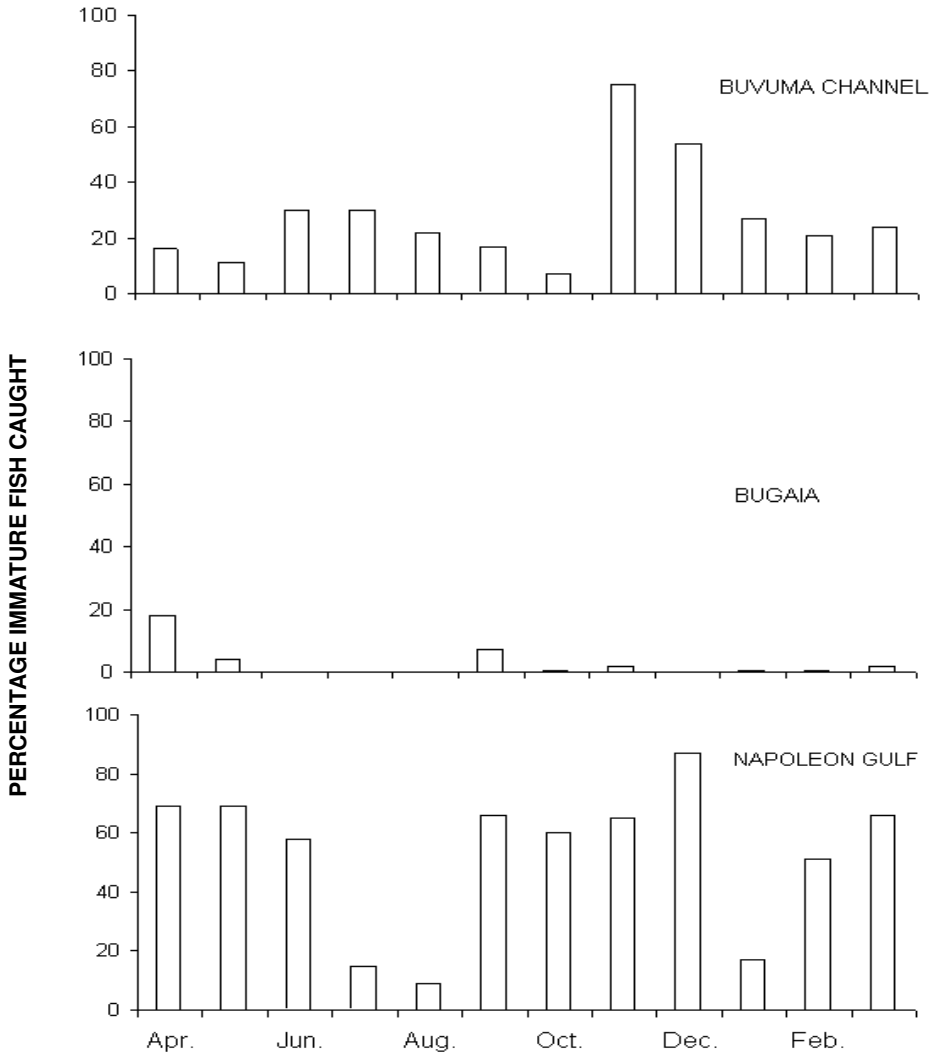

Figure 7. Monthly percentage of immature *R. argentea* caught by artisanal fishermen in Napoleon Gulf, Buvuma channel and Bugaia

Discussion

During the pre-perch period, *Rastrineobola argentea* grew to a large adult size with a mean length of 60 mm SL. This size was reduced to 48 mm SL in 1989 (Wandera and Wanink, 1995) and by 1998 had shrunk to 44 mm. Over the same period growth parameters of the species have also changed. In 1988 the asymptotic length was calculated as 64.5 with a growth constant (K) of 0.92 yr^{-1} (Wandera and Wanink *Op. cit.*). This had by 1992 changed to 54.0 with a K of 1.76 yr^{-1} (Wandera, 1999). The combined effect of predation by the Nile perch and human exploitation could be responsible for the changes in growth parameters above and size at first maturity (Fig. 3). *Rastrineobola argentea* is exploited by light attraction (Okedi, 1981; Witte and van Densen, 1995). Fishing gears used in the capture of mukene in Ugandan waters are scoop nets, beach seines and lampara (boat seine) nets. Initially, the beach seine nets in use were of a stretched mesh size of 10 mm. With the introduction of the

lampara boat seine net, the mesh size was reduced to 5 mm. Size structure of mukene caught by fishermen from the study area (Figure 5) indicate that the lampara (boat seine) nets operated away from closed bays and off the shore does not harm the fishery by capturing many immature fishes.

Management strategies suggested for the mukene fishery of Lake Victoria

Rational exploitation of *Rastrineobola argentea* in Lake Victoria can be maintained if strict management measures are put in place. The most vital intervention points have been identified as:

(a) Establishment of closed fishing grounds
Many fish species, especially their juveniles occur in sheltered bays and very close to the shore. Because of the high numbers of immature mukene caught in Napoleon Gulf and other similarly sheltered bays (Figures 5 and 7), such grounds should be closed to mukene fishing. Mukene catches from fishing grounds further out in the open lake contain fewer immature individuals. Open waters as those in Bugaia are the best grounds for mukene fishing.

(b) Establishment of closed fishing seasons
Recruitment periods, when high numbers of juvenile mukene occur should be closed to fishing. While sheltered bays have high numbers of juveniles the whole year round and are recommended closed grounds, "Island" zones such as Lingira experience high recruitment only from November to December (Fig 7). The two months could be declared closed to mukene fishing. Closed seasons are however not necessary in the open waters.

(c) Control of fishing methods and gears
Beach seines capture many bye-catch fish species. Juveniles of non-target species occur very close to the shore and tend to be dragged along during beach seining. Beach seines should therefore be discouraged. The lampara (boat seine) is a better gear since it can be operated away from these shore dwelling fishes.

(d) Control of mesh size
Based on data collected in 1988, a 10 mm mesh net had been recommended as ideal for mukene exploitation (Ogutu-Ohwayo, Wandera & Kamanyi, 1998). With changes in the population structure of *R. argentea*, this mesh size is no longer appropriate. The present mean size of the mukene at 44 mm SL is small compared to 48 mm SL in 1988. Most fish would now not be retained in the 10 mm mesh net making it unprofitable for the fishermen. With the reduction in the size at first maturity, the mean percentage of mature mukene retained by a 5mm mesh net is now increased. Catches by this mesh size from recommended fishing grounds i.e. open water - Bugaia, and "islands" zone – Lingira contained low percentages of immature mukene (Figure 5). As long as nursery grounds for mukene are avoided the 5 mm mesh net is recommended for exploitation of the species. Meshes smaller than 5 mm should however be discouraged as they are likely to increase toll on immature mukene to unacceptable levels.

Conclusion

The study showed a gradual decline in the size of mukene caught from Lake Victoria between the pre-perch days and the present. Other biological parameters have also changed over this period. The recommended mesh size of 10 mm for the capture of mukene is no longer appropriate and 5 mm is suggested instead. Fishing very close to the shores and in sheltered bays captures high percentages of juvenile mukene and other species and is therefore discouraged. Fishing should, therefore, be restricted to the more exposed waters away in the "islands" zone and beyond.

Acknowledgements

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