Reproductive biology of *Rastrineobola argentea* (Pellegrin) in the northern waters of Lake Victoria

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Abstract: Size at first maturity, breeding periods and condition factor were determined for the small pelagic cyprinid *Rastrineobola argentea* (Pellegrin) in the Jinja waters of Lake Victoria in 1996-1997. Females showed a reduced size at maturity compared to ten years earlier when exploitation of the species was minimal. The males, however, have changed little. Although the species breeds throughout the year, two breeding peaks were observed during the drier months of August and December-January. Minimal breeding was observed in the rainy months of April-May and October-November. Fish from the open water station at Bugaia showed a higher proportion of breeding individuals than those from inshore areas. The mean monthly condition factor of fish from Napoleon Gulf confirmed breeding peaks obtained from examination of gonad development.

Introduction

Establishment of the introduced fish species Nile perch, Lates niloticus (L.), and Nile tilapia, Oreochromis niloticus (L.), has changed the composition of commercial fish species being landed from Lake Victoria. Many indigenous species have almost disappeared from the catches. Now a small pelagic cyprinid Rastrineobola argentea (Pellegrin), locally known as mukene in Uganda, dagaa in Tanzania and omena in Kenya, remains the only endemic species of the lake under serious commercial exploitation. Until the mid-1980s, mukene was not an important component of the fisheries. The then multi-species fishery of the lake was based on larger table fish such as the endemic tilapias, Oreochromis esculentus (Graham) and Oreochromis variabilis (Boulenger), the catfishes Bagrus docmak (Forsskål) and Clarias gariepinus (Burchell) and the lungfish Protopterus aethiopicus Heckel. With the decline in catches of the preferred table fish, supposedly due to overfishing (Acere 1986) and predation by the Nile perch (Ogutu-Ohwayo 1990) fishermen turned to exploiting R. argentea. The species is exploited for both human consumption and animal feed manufacture.

Lack of interest in R. argentea in the past has resulted in a paucity of information on the species. Now that the species contributes an important portion of the commercial catch, it is essential to understand its biology and ecology to manage its fishery. This paper outlines the breeding biology, i.e. breeding, maturity and the condition factor of the species. This information can be used to take management decisions, for proper exploitation of the fishery.

Materials and methods

Sampling area

Sampling was carried out in three areas in the Jinja waters of Lake Victoria (Fig. 1).

1. Napoleon Gulf - An inshore zone, off Jinja Town, where the lake is <15 m deep. There is a fishing village at Kikondo, where *Rastrineobola* is landed from the gulf waters. This area represents the inshore sheltered habitat of the lake.

2. Buvuma Channel - The Buvuma Channel area of the lake is between 15 and 20 m deep. The zone represents what can be referred to as the "islands" zone. Here, numerous islands fringe the lake on the northern shores. Artisanal fishing for mukene is prevalent in this zone because the islands protect the area. Fishing villages landing the species from this zone include, Lingira, Kirongo, Itome Bay, the islands of Vuga, Busiri and the southern portions of Buvuma Island.

3. Bugaia waters - The deep open waters beyond the 30-m depth contour, outside the islands zone. In these waters fishing for mukene is less intensive than the above zones due to the rough weather normally experienced. Mukene fishing villages include: Kasaali, Mubaale and Kijaka.

Sampling methods

Two methods, sampling of commercial catches and experimental fishing, were employed to collect fish. Artisanal fishermen catch fish by light attraction using kerosene pressure lamps (Okedi 1981; Witte & van Densen 1995). On hauling fish ashore or aboard the canoe, a random sample of approximately 0.5 kg was obtained. It was immediately preserved in 5% formalin, and appropriately labeled for laboratory analysis. Experimental fishing employed a mid-water, frame trawl net. Fish caught were first weighed to determine the total catch. Different fish species were then sorted and weighed. Random samples from each of the species were taken and preserved as above.

Laboratory examination

In the laboratory samples were soaked in water to remove excess formaldehyde. Length frequency data were generated by measuring all the fish (standard length, SL, nearest mm below). From each one-mm length class 10 specimens were randomly selected for biological investigations. For each specimen, length and weight (W, to the nearest mg) were taken. The fish was opened and sexed, and the status of maturity recorded (Bagenal & Braum 1978).

Foulton's condition factor (K) was calculated using $K = (W \times 100) / SL^3$.

Results

Size at first maturity

Fish showing gonad maturity stages I and II were considered immature while those at stages III and above were mature. Male *R. argentea* matured (Lm_{50}) at 41 mm SL while females matured at 42 mm SL. All fish larger than 45 mm SL were mature (Fig. 2). The smallest mature female measured 37 mm in the Napoleon Gulf, 39 mm in the Buvuma Channel and 38 mm SL in the open water at Bugaia. Males from the three stations first matured at 39, 38 and 35 mm SL respectively.

Breeding cycle and condition

Fish at gonad maturity stages V and VI were regarded as breeding, while III and IV and VII were considered resting and spent respectively. Breeding occurred throughout the year in all sampled zones. There were peaks in breeding activity in August and December/January (Fig. 3). Little evidence of breeding was found in April to June and October to November.

Only female fishes measuring 45 to 50mm SL were used to determine condition. Males were omitted because testes are too small to influence the overall weight of the fish. *Rastrineobola* >50 mm SL tended to be infected by a parasitic cestode *Ligula intestinalis* (Wanink 1992). The presence of the parasite could bias the condition factor of infected fish thus larger fish were also omitted. Populations of *R. argentea* from Kikondo showed peak condition in August and again in January (Fig. 4).

Discussion

Over the last decade, commercial exploitation of *R. argentea* in the Jinja waters of the lake has more than doubled. In 1987, *R. argentea* was only fished at Lingira (Wandera 1992; Ogutu-Ohwayo, Wandera & Kamanyi 1998). Fishing effort was then very low. About 10 canoes were operating 2 beach seine nets of 10-mm stretched mesh, as opposed to the current number of over 30 canoes using an equal number of boat seine nets of even smaller mesh (3-5mm). The size at first maturity then was 41 and 44 mm SL respectively for males and females and 100% maturity was attained at 47 mm SL. Changes in size at maturity is apparently a reaction to the increased fishing pressure being exerted to the fishery. The mean adult size of the population has also been reducing with increased fishing and predation pressure. Prior to the establishment of the Nile perch, which preys on the species, *R. argentea* grew to a larger adult size than was observed during the post perch era. A sample of *R. argentea* from Lake Victoria caught in August 1970 and stored in the FIRI museum shows a mean length of 60 mm SL. This size reduced to 48 mm in August 1989 (Wandera 1992) and has further shrunk to the present 44 mm for the same month of August. The combined effect of both predation by the Nile perch and fishing could be responsible for this gradual reduction in mean length of *Rastrineobola* populations in this lake.

Breeding peaks occurred during the dry months of the year. The timing of breeding was probably synchronised with the period of abundant food for both the brooding stock and the young. Zooplankton abundance in the Jinja waters of Lake Victoria peaks around the months of July and August (Ndawula-Mwebaza 1998).

Around this time, length frequency analysis showed recruitment of juvenile *R. argentea* into the inshore artisanal fishery (Ogutu- Ohwayo *et al.* 1998). Breeding peaks compare very well with peaks in condition factor observed above. The open water station at Bugaia showed more individuals in breeding condition at all times than the inshore stations.

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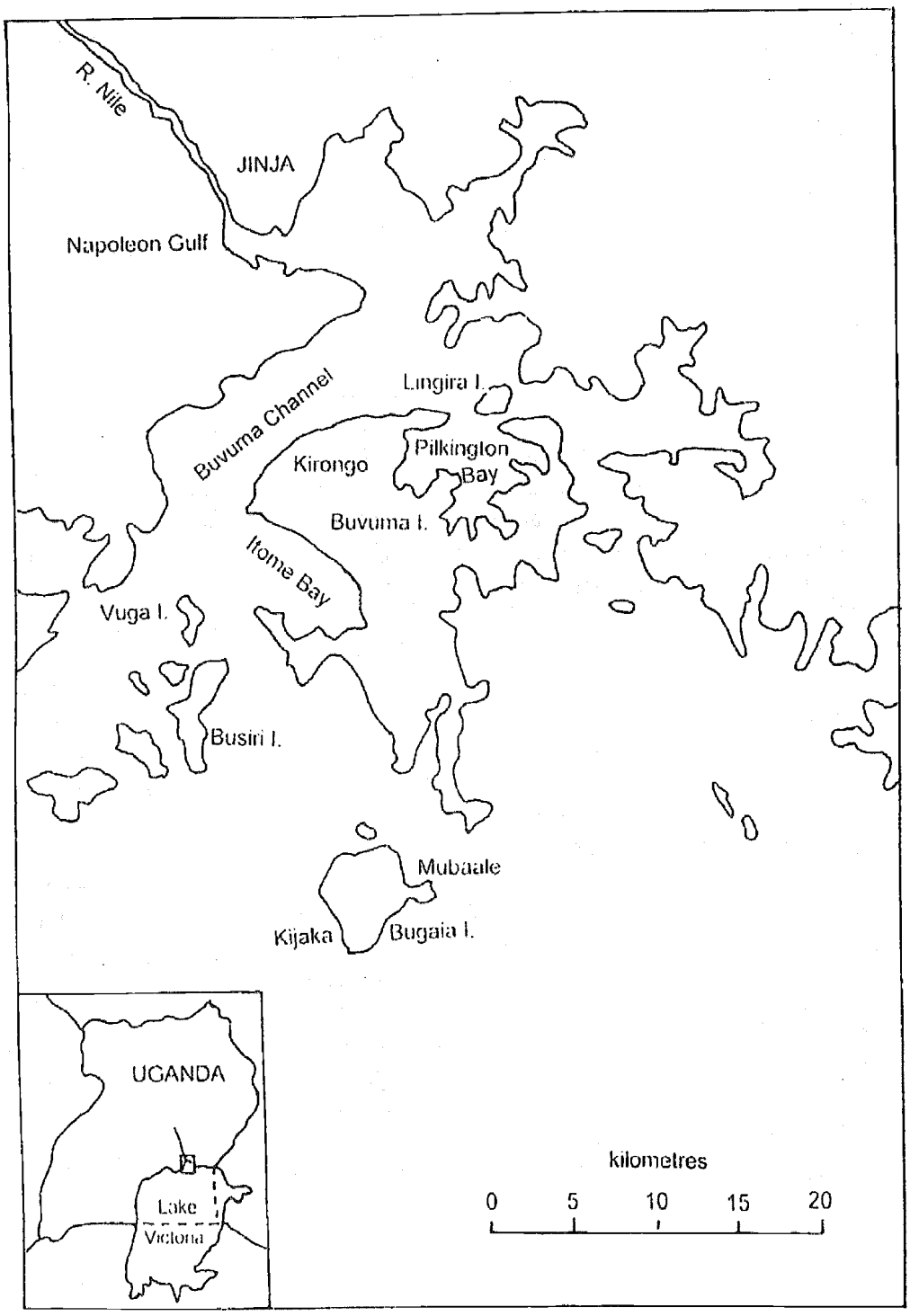

Figure 1. Map of the study area, showing sites mentioned in the text.

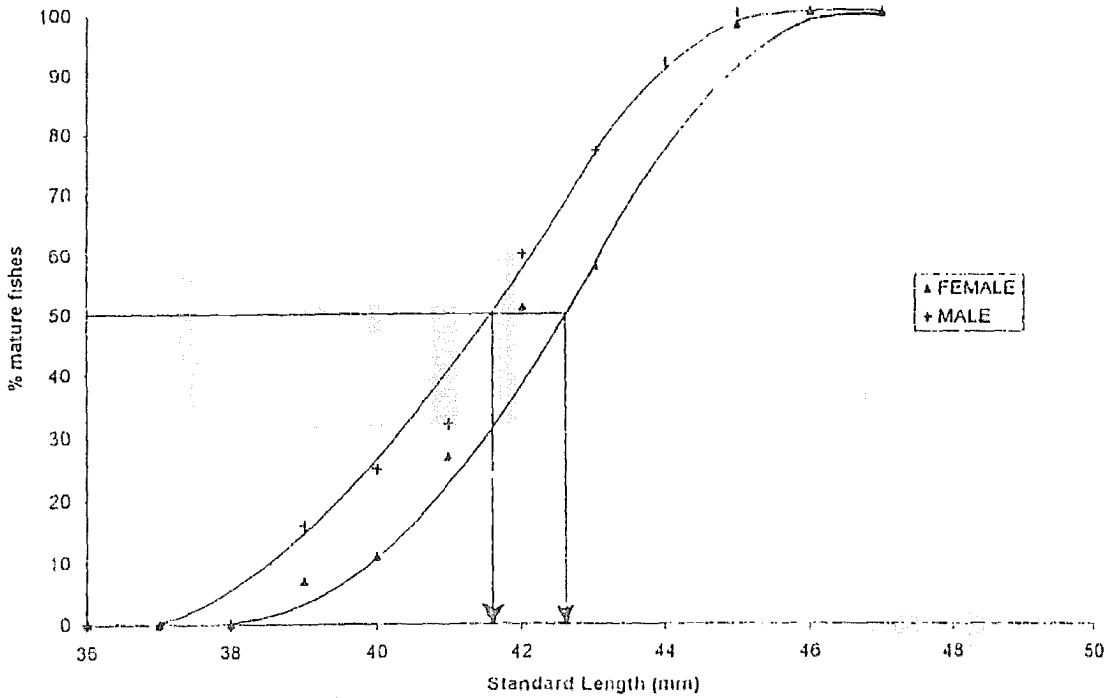

Figure 2. The size of first maturity of *R. argentea* from the Jinja area of Lake Victoria.

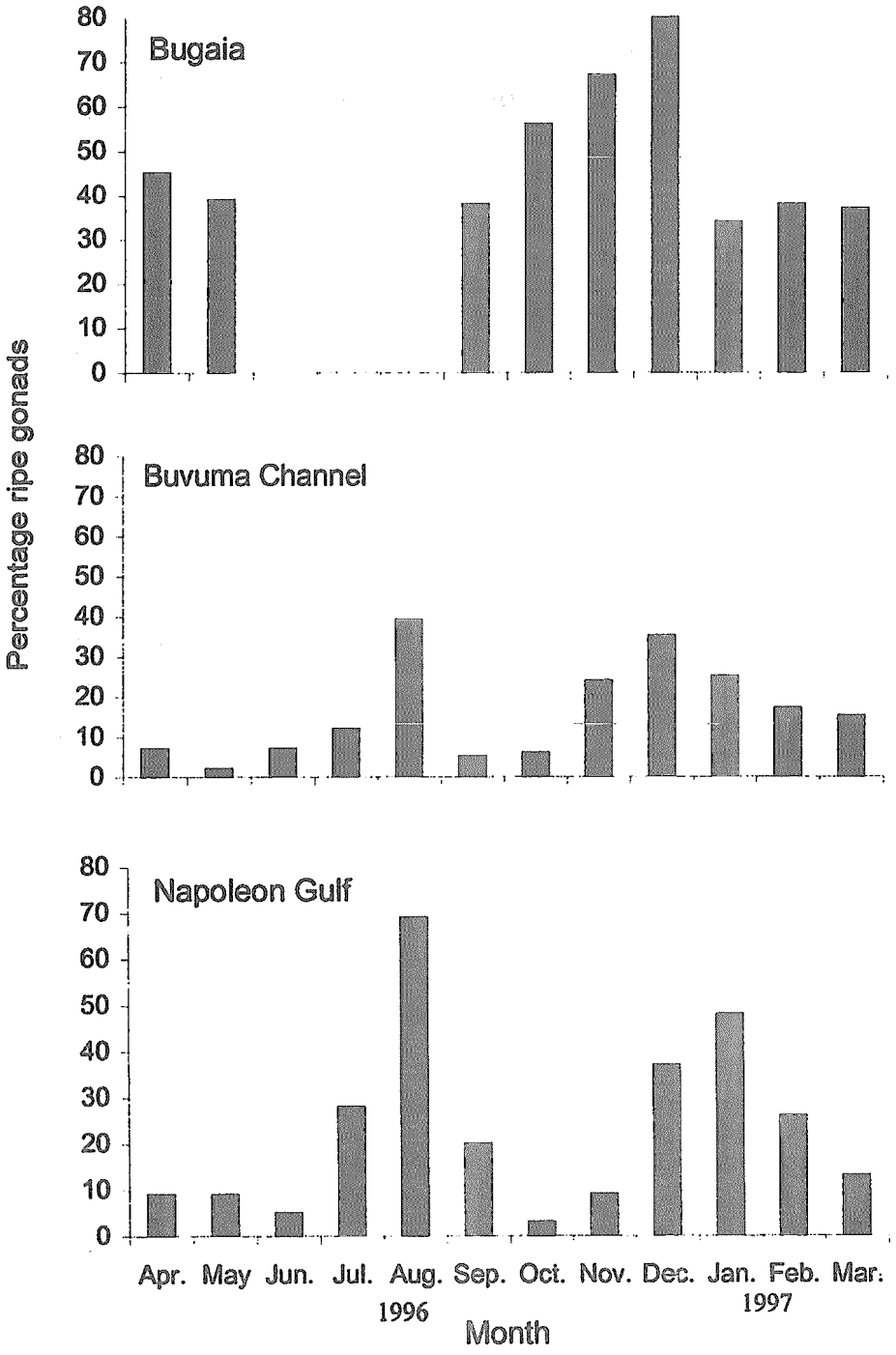

Figure 3. Monthly percentages of breeding *R. argentea* from the three sites in Lake Victoria

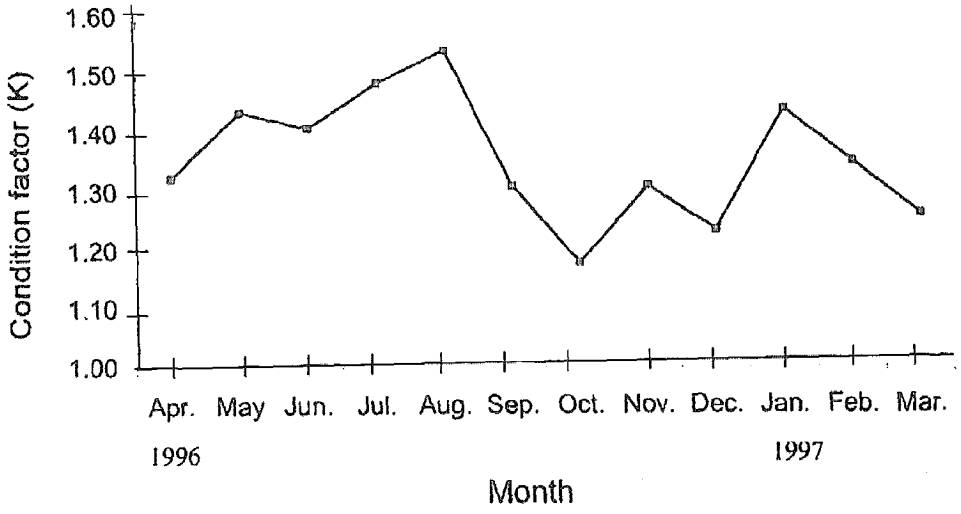

Figure 4. Mean condition factor of *Rastrineobola argentea* at Kikondo, Lake Victoria.