Flow of food materials among fish communities in Lake Victoria

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Abstract

Trophic relationships for different fish communities interacting in Tanzania waters of Lake Victoria were investigated in order to understand the flow of materials among those communities. Food chains, which usually start with photosynthetic green plants (algae, water hyacinth, Azolla, macrophytes, phytoplankton) and protists, obtain chemical energy from non-organic sources. Herbivores acquire materials from the plants and in turn carnivores obtain their food materials from juvenile fishes, zooplankton, Molluscs, insects and insect larvae. Bacteria (organisms of decay) obtain materials from dead plants and animals. The study has revealed that Speke gulf had the highest densities of secondary producers compared to other zones of the lake implying that there is more food available in the Speke gulf than in Mara, Mwanza or Emin Pasha gulfs. The abundance of *Lates niloticus* was the highest in the Speke gulf (190.4 kg/h). This suggests that there is plenty of food in the area. There seems to be a recovery of threatened fish species in the Speke gulf which has been used partially to explain why those food items predominate in stomach contents of *Lates niloticus*.

Key words: Fish communities; Food chain; Material flow; Pyramid of numbers.

Introduction

Organisms do not live alone but form part of a community in which the existence of each species and individual is affected by others. There is, not only interdependence of living organisms but also interaction with many other things outside and around them. In discussing communities in which numerous and diverse organisms live together, aspects of the environment that are inseparably related to all others are looked at more closely.

Native fish species, the haplochromines in particular, used to occupy all trophic levels and that they really played a major role in the flow of energy in the ecosystem. These species and others declined in the 1980's. However, overfishing, competition, predation and environmental degradation were identified as being the cause of the decline (Ligtvoet and Witte, 1991; Mugidde, 1993). But very recently, some of the native species even those that were thought to be extinct in the lake, have started to re-appear in the catches. This situation calls for the assessment of the trophic dynamics of the lake.

There is always flow of materials in a community which is cyclic. Materials are transferred from one species of organism to another, and that is the basic feature of a community as an organized association of different, interacting species. The sequence of flow through which materials pass is the food chain and it necessarily starts with photosynthetic plants or protists since they are the organisms that acquire energy from non-organic sources.

The aim of this work was to examine very closely on how the food items taken by different fish species relate to the quantity of food available within the environment.

Material and methods

Study area

Lake Victoria was divided into several zones. Within zones, study sites were established. In zone 1, the sampling sites were Shirati bay, Mori bay, Mara bay and Baumann's gulf. Within zone 2, sampling sites were Bunda hills, Bulamba, Ramadi and Magu bay. In zone 3, the sampling site was Kirumo/Entrance. Zone 4 included sites such as Luchiri, Chato bay and Nyamirembe. At each sampling site, samples of fish, zooplankton and phytoplankton were collected.

Samples of fish were collected using a stern trawler RV TAFIRI II with 150 Hp operating a trawl net 30mm cod–end mesh size in inshore waters in depths ranging between 3 and 20 metres. Each trawl operation took 30 minutes and on retrieval of the net, a sub-sample was taken. Fish of different species in the sample were counted. The total number of fish in the total catch was obtained by multiplying the number of fish in the sample by the number at which the catch was divided to obtain the sample. The density of fish in the area was obtained by dividing the number of fish in the total catch by the swept area and expressed as fish per m^2.

Macro-invertebrates were collected using an Eckman grab. Data collected was analysed to obtain average number of organisms per m^2.

A plankton net of 100 µm mesh size with an opening of 25cm in diameter, 1 metre long was used to obtain vertical haul zooplankton samples. In the laboratory, a sub-sample of 5mls was counted. The densities of individuals (individuals per unit area) of major taxa were recorded.

Phytoplankton samples were obtained by using a plankton net of 10 µm mesh. The samples were sub-sampled by means of a calibrated syringe, agitated, diluted and introduced into a 2 ml Sedgewick sedimentation chamber. Samples were examined under an inverted microscope at 400x magnification.

Results

Figs. 1, 2, 3 and 4 show pyraqmid of numbers at different trophic levels in zone 1, 2, 3b and 4, respectively. The Speke gulf is the most productive area followed by Mara, Emin Pasha gulf and Mwanza gulf in decreasing order in productivity. In this study, phytoplankton densities for different zones were not quantified due to technical problems. However, the group appears at the bottom of the pyramids as primary producers. Primary producers represented by phytoplankton, were collected but could not be quantified.Primary consumers were represented by zooplankton and some invertebates. Secondary consumers were represented by zooplanktivorous and *Rastrineobola argentea*.Tertiary consumers included all carnivorous fish, which are *Lates niloticus,* *Schilbe intermedius, Brycinus jacksonii, Brycinus sadleri, Synodontis victoriae* and *Clarias gariepinus*.

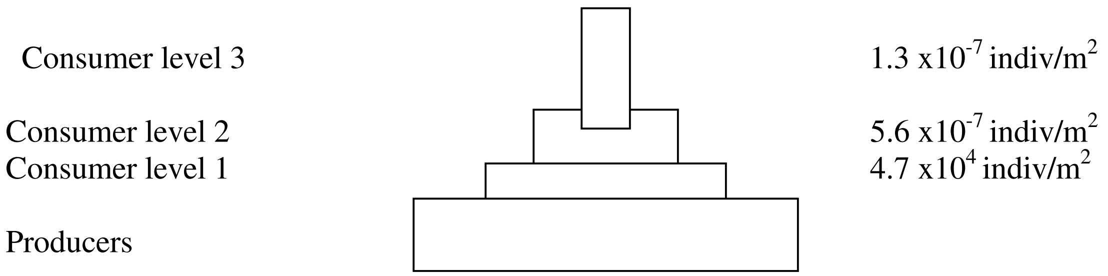

Fig. 1: Pyramid of numbers for Mara zone.

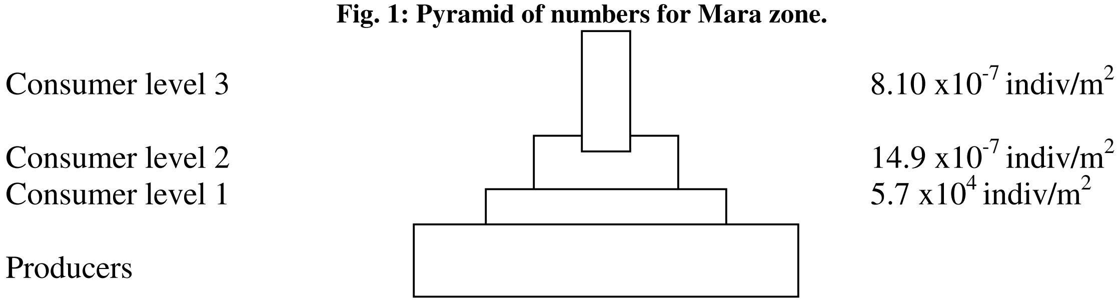

Fig. 2: Pyramid of numbers for Speke gulf

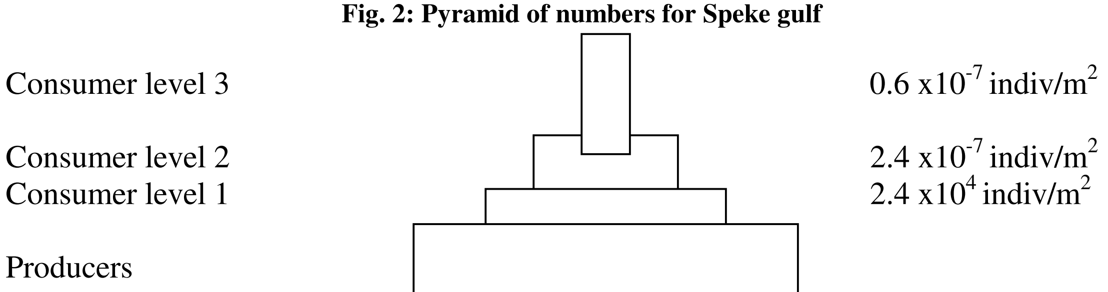

Fig. 3: Pyramid of numbers for Mwanza gulf .

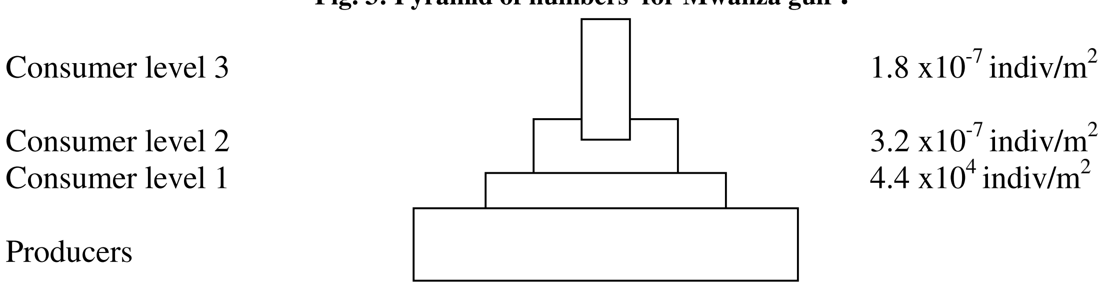

Fig. 4: Pyramid of numbers for Emin Pasha gulf.

Discussion

The Speke gulf had the highest densities of secondary producers compared to other zones of the lake implying that there is more food available in the Speke gulf than in Mara, Mwanza or Emin Pasha gulfs.

The abundance of *Lates niloticus* was the highest in the Speke gulf (190.4 kg/h). This suggests that there is plenty of food in the area.

Lates niloticus prefers to feed on haplochromines, *Rastrineobola argentea*, *Caridina nilotica* and on other fish species but changes its diet depending on the availability of the food item. These food items are shared with other carnivorous fish.

The recovery of the threatened fish species in the Speke gulf could have been a reason as to why those food items predominate in stomach contents of *Lates niloticus*. The predators normally tend to look for those food items that are abundant in order to conserve energy.

Organisms pass on to others less energy than they receive. When a herbivore eats a plant, it receives chemical energy, but the energy received is much less than the energy that the plant received from the sun. The organisms of decay end the sequence by passing on the materials of life in forms that are utilizable by other organisms but they practically complete the dissipation of energy in the community.

Smaller animals are generally found to be more numerous than larger ones and this has been revealed in the pyramid of numbers. Predaceous animals generally eat animals smaller than themselves. Most taxa of Macro-invertebrates are prey items of fish. Gastropoda snails are the food source of *Protopterus aethiopicus*, *Synodontis victoriae*, *Barbus altinalis*, *Lates niloticus* and the haplochromines which are normally smaller than the predator (Corbet, 1961; Hoogerhoud, 1986). The Chaoborid and Chironomid larvae are major food sources of insectivorous and zooplanktivorous haplochromines (Goldschmidt *et al*., 1990) and *Odonata* nymphs is the food source of *Lates niloticus* (Hughes, 1986; Ogutu-Ohwayo, 1990). The predators are usually larger and fewer than their prey and they require more food than a small one, and so have to monopolize more territory in order to survive as there is more food available for small than large animals in any given area.

Principles of cycles of materials, energy transfers and food chains have important implications for the abundance and activity of life of living organisms at any one place and time. All the energy and the greatest part of the materials in all living organisms must pass through green plants. The total activity of life, the flow of energy through all living organisms in the lake can proceed no faster than the fixing of that energy by photosynthesis. Photosynthesis can proceed no faster than the inflow of radiant energy from the sun.

Limitation of vital activity by the budget of available materials of nitrates, phosphates and silicates are strong and may be quite obvious in particular locations. Along the shores and river mouths, the areas are very productive compared to other areas farther out in the lake where nitrates and phosphates are rapidly utilized in upper levels of water where photosynthesis occurs. In deeper levels of water, dead organisms sinking to these waters are decomposed by bacteria and may be returned to sunlit surface waters by rise through currents.

The fluctuations of the abundance of diatoms is another limitation of material and energy budgets. Since diatoms regardless of their small size are the most important photosynthetic organisms of the lake and the whole rich life of the lake community changes with their fluctuation.

Conclusion

The study has revealed that Speke gulf had the highest densities of secondary producers compared to other zones of the lake implying that there is more food available in the Speke gulf than in Mara, Mwanza or Emin Pasha gulfs. The abundance of *Lates niloticus* was the highest in the Speke gulf (190.4 kg/h). This suggests that there is plenty of food in the area. There seems to be a recovery of threatened fish species in the Speke gulf which has been used partially to explain why those food items predominate in stomach contents of *Lates niloticus*.

Recommendations

Although the flow of food materials in fish communities of Lake Victoria is a continuous process, several other research areas need to be studied so that food materials and energy transfers can be correlated with fish stocks of the lake.

i. There is need to estimate the biomass of fish stocks, zooplankton and phytoplankton.
ii. Studies on physico-chemical characteristics of the lake should be conducted alongside biological studies.

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