A SECOND LOOK AT THE INDUSTRIAL FISHERIES DATA, BURUNDI, LAKE TANGANYIKA (1973-1992)

by Frits Roest

ABSTRACT

Catches of the industrial fishery in Burundi have been monitored statistically since the 1950s. In the early 1970s fisheries research, initiated under Belgian colonial rule, was restarted with support from FAO, involving in addition to improved data recording at the fish market in Bujumbura, sampling of the catch composition by species, in numbers and weight. The resulting data sets have been analysed and are presented. They consist of two separate series, one for the period 1973-1980 and 1981-1992. In the former period, with little change in the fishery and little outside disturbance, a neat predator-prey relationship is evident. In the second this is no longer the case and catch rates have shrunk considerably. This period was characterised by adaptations to new tax measures, strong competition from a new type of artisanal fishing craft, water quality issues with unknown effects and irregularities in the sampling frequency and methods.

RESUME

Réexamen des données de la pêche industrielle du Burundi, Lac Tanganyika (1973-1992). Les statistiques de la pêche industrielle furent collectées depuis les années 1950. Au début des années 1970, des recherches halieutiques initiées durant l'époque coloniale belge furent reprises par la FAO avec une meilleure couverture statistique et un échantillonnage pour la composition spécifique des captures. Les résultats consistent en deux séries, l'une pour 1973-1980 et l'autre pour 1981-1992. Dans la première période avec peu de changements dans la pêche et sans perturbations externes, une relation nette est visible entre prédateur et proie. Dans la seconde période, ceci n'est plus le cas et les taux de captures ont diminué considérablement. Cette période fut caractérisée par les réactions des pêcheurs à une nouvelle taxation, une forte compétition par la pêche artisanale, des problèmes de qualité d'eau ayant des effets inconnus et par un échantillonnage moins fréquent et modifié.

SAMENVATTING

Industriële visserijgegevens voor Burundi, Tanganyikameer opnieuw onderzocht (1973-1992). Vangststatistieken zijn bijgehouden sinds de jaren 1950. Begin jaren 1970 werd met behulp van FAO het door de Belgische koloniale autoriteiten gestarte visserijonderzoek nieuw leven ingeblazen. Naast verbeteringen in het verzamelen van statistieken op de centrale vismarkt in Bujumbura werd de soortsamenstelling van de vangsten bemonsterd in aantallen en gewicht en de resultaten onderzocht. Deze vallen uiteen in twee perioden, 1973-1980 en 1981-1992. In eerstgenoemde periode, waarin weinig veranderd is in de visserij en er weinig externe invloeden aanwezig waren, is een duidelijke predator-prooi relatie zichtbaar. Niet aldus in de tweede periode, waarin de vangstniveaus sterk zijn gedaald. Deze periode werd gekarakteriseerd door het ontwijken van een nieuwe belasting, een sterke competitie van de artisanale visserij, waterkwaliteitsproblemen met onbekende effecten en onregelmatige en deels gewijzigde bemonstering.

Introduction

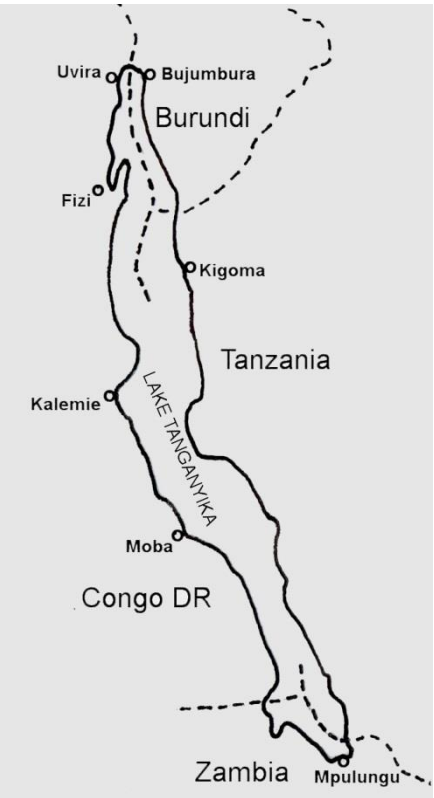

Fig.1: Lake Tanganyika

Lake Tanganyika occupies about 32,900 km^2 of the Western branch of the East African Rift Valley. It is the second deepest lake in the world (max. 1470 m), its length is 673 km, its maximum width 48 km and its catchment area 249,000 km^2 (VandenBossche & Bernacsek 1990). It is shared by the four countries Burundi (8%), D.R. Congo (45%), Tanzania (41%) and Zambia (6%). The great distance from the capitals of the latter three countries, the rugged mountainous nature of its shores and the general lack of roads make the lake difficult to access. Of the approximate 700 fish landing sites all around the lake, enumerated in 2011 (LTA 2012), only 30% can be reached by road. Transport across the lake therefore is important. For most of its length, steep mountains surround the lake. These fall off sharply under water, making the shallow inshore areas few and far between.

Historically, except in Burundi, human habitation around the lake has been sparse. This began to change in the 1960s when droughts and decades of conflict started to attract many newcomers to the resources of Lake Tanganyika (fish, employment, drinking water).

Lake Tanganyika's prolonged geographical isolation from the rest of Africa's inland waters, believed to have been of the order of 9-12 million years (Cohen et al. 1993), led to the development of a unique aquatic fauna. To the casual observer wandering around the lake, this is most visible in the fish species sold in markets and streets, most of which are endemic to the lake. Initially, only the swampy areas and narrow coastal strips were exploited by subsistence fishermen using traps, gill nets and hook-and-lines targeting bottom dwelling fish. Some fishermen practised light fishing at night using burning reeds kept in a basket in front of the canoe to attract the two species of small pelagic freshwater sardines (*Limnothrissa miodon* and *Stolothrissa tanganicae*) which were scooped up with large handheld nets.

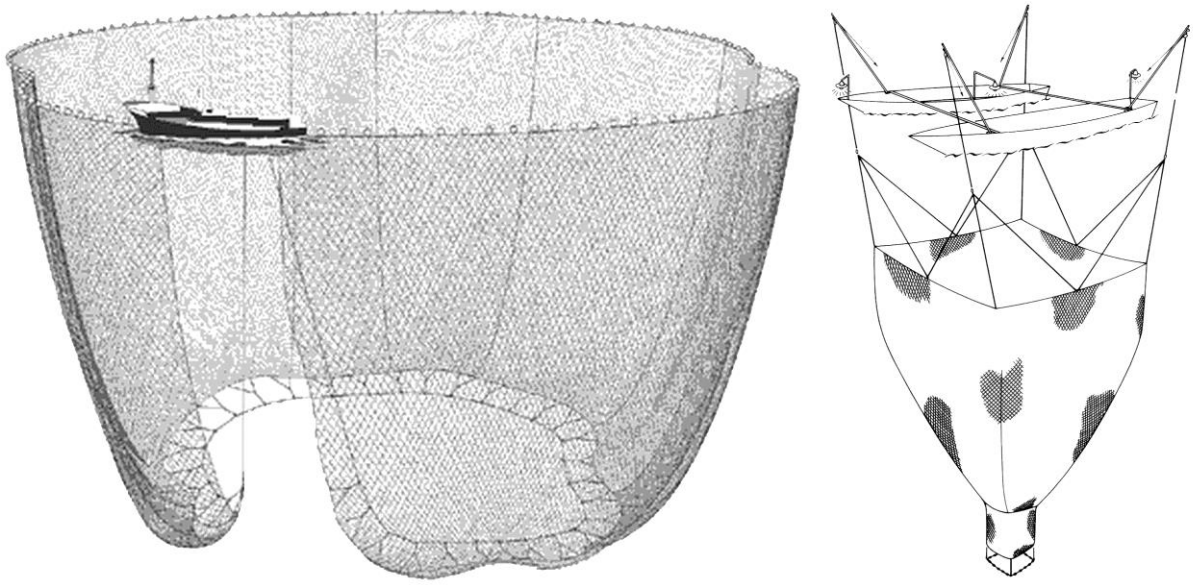

Fig. 2: Main fishing methods: industrial ring net or purse-seine (left) and artisanal lift net

The Belgian scientific expedition to Lake Tanganyika (1946-1947) (Poll, 1953, 1956) generated interest of the Belgian colonial authorities in developing an industrialized fishery to exploit the abundant pelagic fish resources. To this end, collaboration was sought with Greek fishermen to examine the feasibility of introducing Mediterranean fishing techniques to the northern waters of lake Tanganyika (Collart 1958). Ring-nets were thus introduced and since exploited by the Greek resident trading community. Fish are concentrated in the water column by light attraction at night and subsequently caught. This fishery, with its vessels of 15 meters, an auxiliary barge for storing the 400x100 meter ring or purse seine net (see Fig. 2), and a small fleet of 4-5 light boats, gradually grew in importance. Initially it aimed for four endemic predatory fish of medium ("mukeke" or *L. stappersii*) to large ("sangala" *L. angustifrons*, *L. mariae*, *L. microlepis*) size, all belonging to the genus *Lates* (of which the only other freshwater relative occurring throughout Africa is the Nile perch, *Lates niloticus*). When it was realized that it only took some minor adaptations in the mesh sizes of the nets to make them suitable for catching the two endemic freshwater sardines (locally known as "ndagala", of which *Stolothrissa* is by far dominant in the offshore areas) at the same time, from 1964 onwards this 'industrial fishery' as it was christened could be operated year-round and could provide inexpensive fish to local African markets.

Almost simultaneously, from 1954, an improved version of the light fishing technique was introduced by the Belgian authorities for the local small-scale fishermen (see Fig. 2). The new method consisted of using pressurized paraffin lamps suspended above the water surface to attract fish which were subsequently caught in a large nylon lift net which was stored underneath two fishing canoes joined together to form a 'catamaran' (Collart 1958). This marked the beginning of the 'artisanal' fishery which would gradually grow in importance and spread across the whole lake.

In order to provide a scientific basis for the development of the fishery, a research laboratory was created in Uvira, Congo, in late 1948 to study the biology and life history of the freshwater sardines (IRSAC 1949). Statistical recording of fish landings was initiated by the colonial agricultural and fisheries services.

Total lakewide catches at present (2013) are thought to be of the order of 200,000 tonnes annually, of which about 10% is caught in Burundi.

Fisheries research and management in Burundi

By the early 1970s, a fleet of 14 industrial fishing vessels was operational in Burundi. Its total annual catch then was of the order of 5,000 tonnes, forming around 39% of the overall total for the country (Roest 1988). In order to protect the artisanal sector, the industrial fishery was not allowed to fish within a radius of 15 km from Bujumbura nor within 5 km of the shoreline. In addition, this fishery was legally bound to sell all fish caught at the central fish market in Bujumbura. Fish landed in the early morning on beaches along the Burundi shoreline were thus transported by truck to the central market in Bujumbura. The three commercial categories "ndagala" (sardines and juvenile *L. stappersii*), "mukeke" (adult *L. stappersii*, 20-45 cm), and "sangala" (large *Lates*) were boxed and marketed separately.

When it became apparent that fish catches fluctuated greatly from year to year, both in volume and in species composition, around 1970 the Government of Burundi addressed a request for assistance in fisheries planning and management to the United Nations Food and Agriculture Organization (FAO). This led to a number of subsequent fisheries research and development projects.

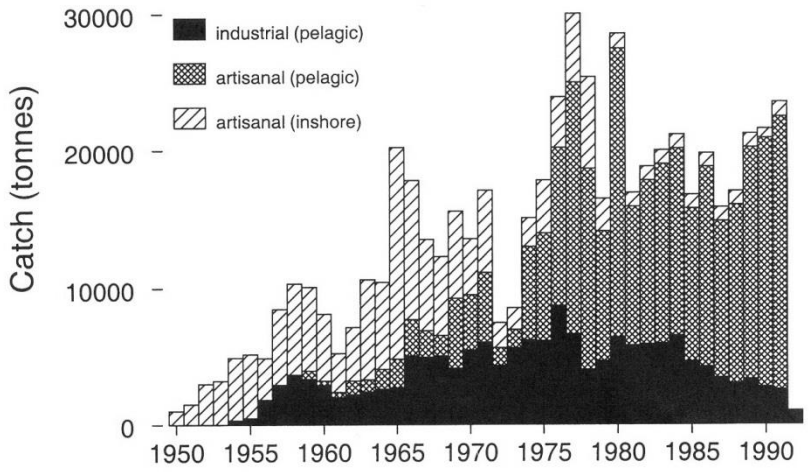

Fig. 3: Sampling in Bujumbura fish market (photo FAO 1977)

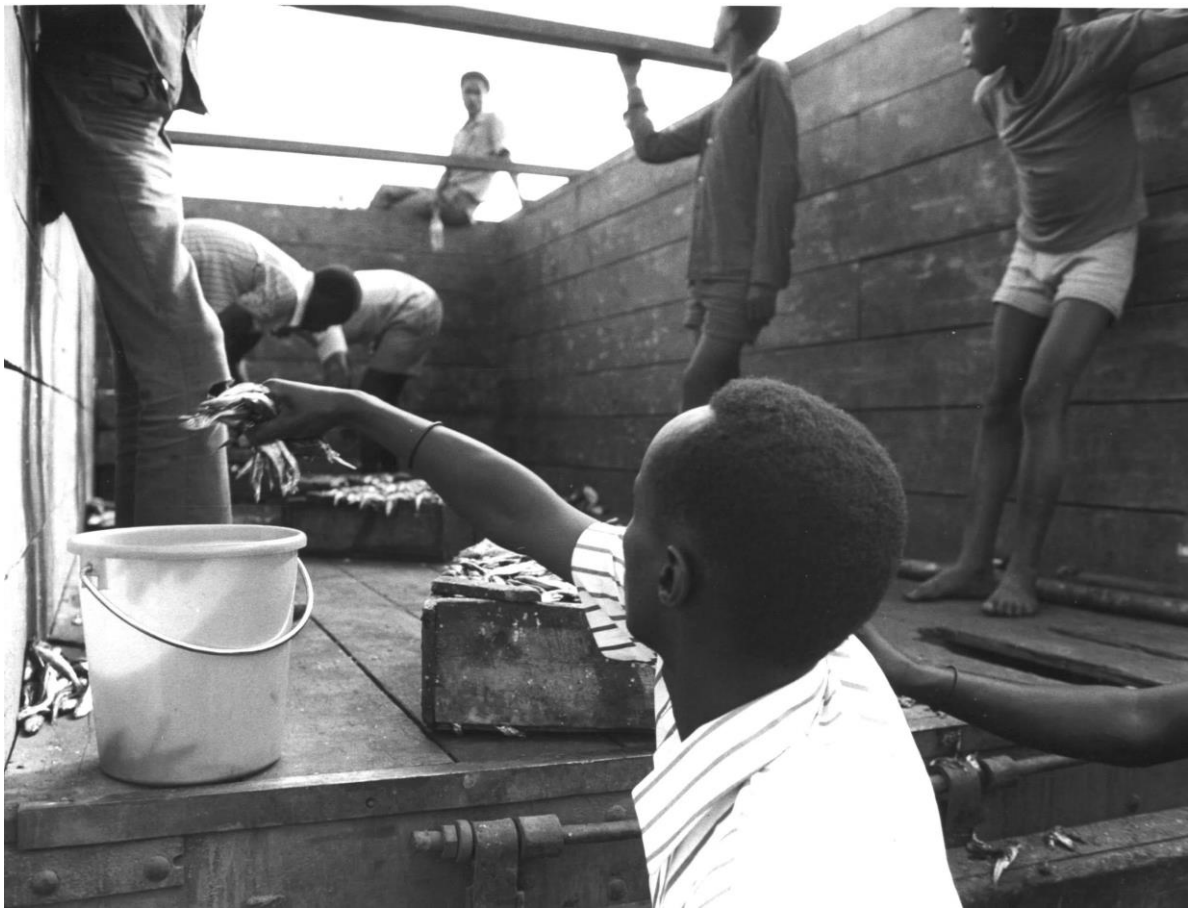

Fig. 4: Processing of samples in the laboratory (photo FAO 1977)

In addition to an improved system for statistical data collection of all fisheries subsectors, a fisheries research phase was started which involved a routine sampling of the industrial catches in the central market of Bujumbura (see Fig. 3). The samples were analysed in the laboratory for species composition, and individual fish were measured and weighed (Fig. 4). Detailed information on the volume, species composition and the length-frequency distribution of the industrial fish catches as initiated and collected by FAO for the period 1973-1980 was analysed by Roest (1988). As the fishing area, fishing techniques (without technological change or other innovation) and practices remained constant over this period, the observed variation in catch rates may be considered to reflect actual changes to the fish stocks in the northern lake waters. Fig. 5 summarizes the total catch data from the beginning of the fishery to 1992 (Van Zwieten et al. 2002). Numbers of active industrial vessels grew to a maximum of 23 in 1980-1981.

Fig. 5: Estimated annual total fish catch per sector, Burundi (modified after Van Zwieten et al. 2002)

Expressed in terms of fish abundance (kg per fishing boat per night) (Fig. 6), the main sardine species *Stolothrissa* showed a regularly decreasing cyclical abundance pattern alternating with that of its main predator *Lates stappersii*, which increased to a maximum at month 57 (July 1977) and then decreased. The observed overall negative correlation between the abundances of the predator and its short-lived prey (sardine generations only last one year) had been suggested earlier by acoustic surveys in the lake. Time on the horizontal axis is expressed in 'lunar months' as light fishing stops for a few days before and after the full moon.

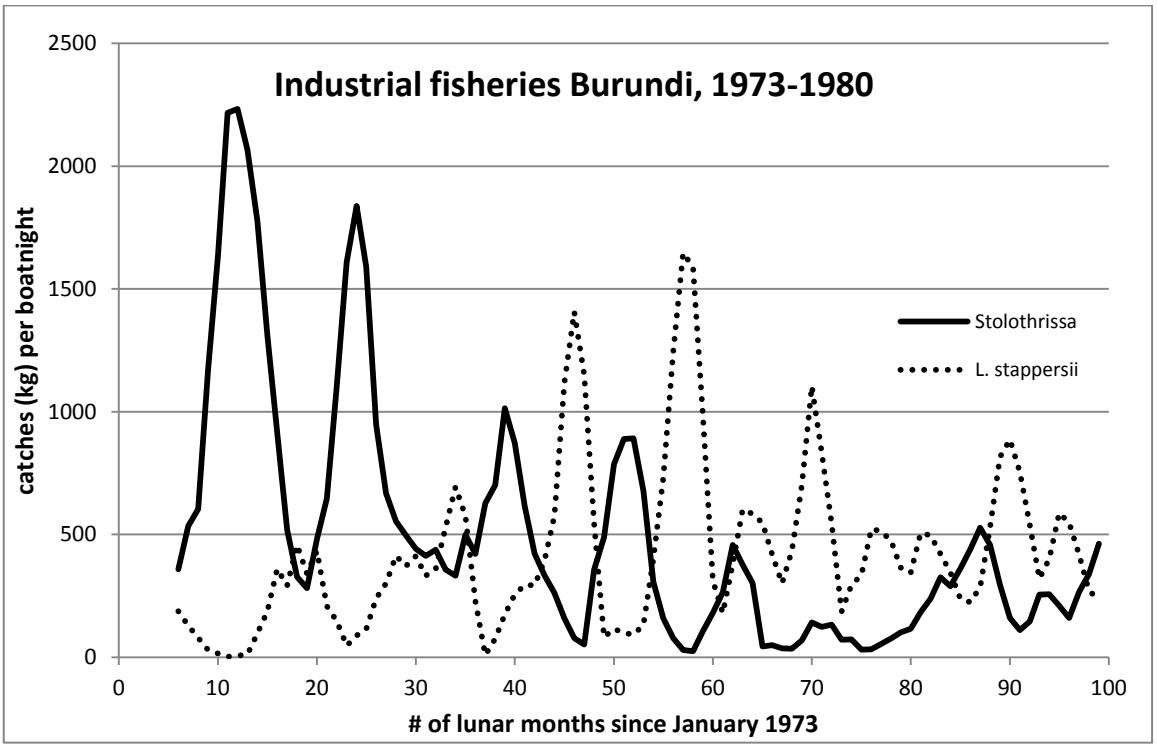

Fig. 6: Catches per boatnight (kg) by lunar month, 1973-1980. 3 months running averages. Solid lines: *Stolothrissa*, dotted *L. stappersii*. Horizontal axis: time expressed in lunar (fishing) months

FAO's involvement in fisheries data collecting in Burundi ended in early 1981, but catch recording and market sampling continued, albeit unsupervised. Roest (1992) described the status of the pelagic

fishery until 1989 and mentioned that yields of the industrial fishery in the northern part of Lake Tanganyika (both in Burundi and Zaïre) had dropped to uneconomically low levels because of the excessive development of the artisanal fishery. The number of industrial fishing boats gradually declined from 22 in 1982 to 14 in 1992.

Van Zwieten et al. (2002) examined the complete 37 years' data set (1956-1992) for trends and observed annual long-term downward trends of 1.6% in the total catch, 1.4% in the sardines and 2.7% in the larger *Lates* species, while *Lates stappersii* showed no trend. Basic uncertainty - variance not explained by trend or seasonality - represented of 75% the variance in total catch rates, 83% of that in the sardines and 89% in *Lates stappersii*. Their conclusion was that with such large uncertainties and the compounding effects of the various types of variance around long-term trends, Burundi management authorities have few possibilities to evaluate the effectiveness of controlling fishing effort as a direct and basic management measure. Although there can be no doubt as to the soundness of their analysis, based on the regularity in the abundance pattern observed for the period 1973-1980 (Fig. 6), this seemed surprising.

Fig. 7 shows the further development of the catch rates in the industrial sector (1981-1992), based on the records collected by the Burundi fisheries authorities. The pronounced predator-prey effect which was so characteristic in the earlier data set is no longer visible. Apart from the unexplained extremely high catches of L. stappersii in the lunar month December 1983/January 1984, catches per boatnight had shrunk to well below 500 kg. During this period, conditions in the fishery changed considerably, making a comparison with the earlier data set less meaningful: a combination of tax evasion strategies by boat owners, severe competition from the artisanal fisheries sector, a rapid degradation of the water quality in the northern lake basin and financial and logistical problems to keep the sampling programme going.

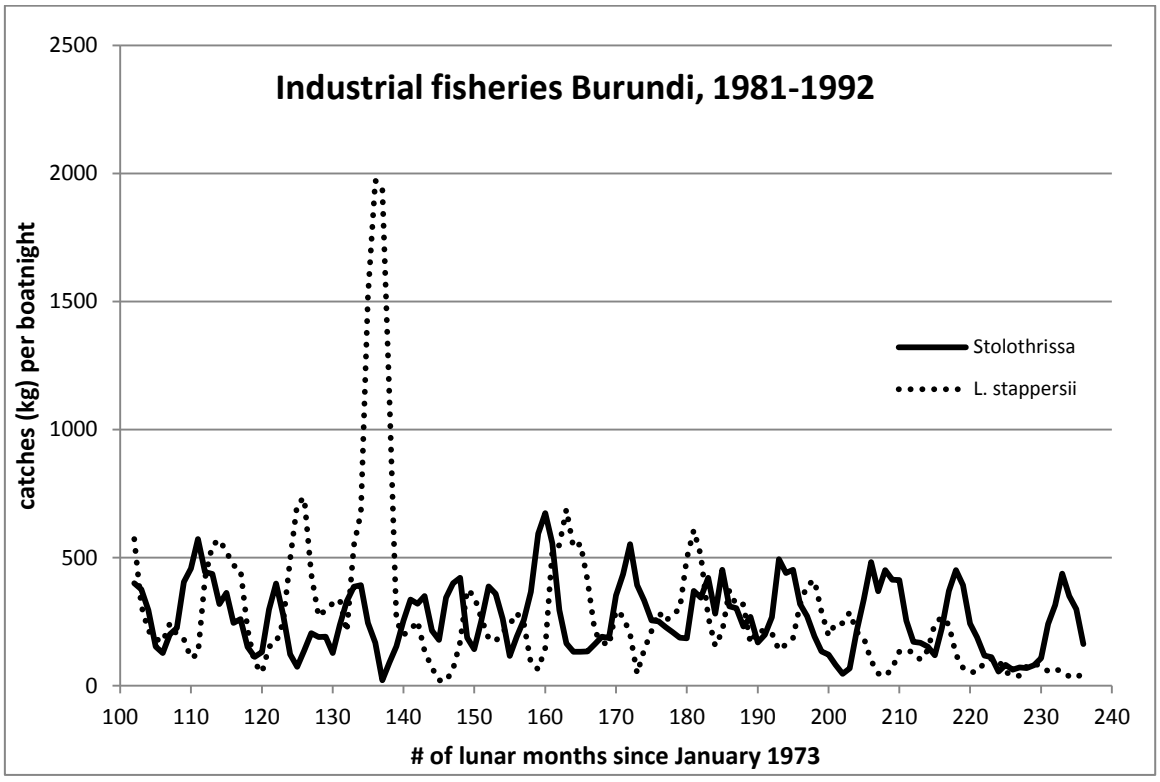

Fig. 7: Catches per boatnight (kg) by lunar month, 1981-1992. 3 months running averages. Solid lines: *Stolothrissa*, dotted *L. stappersii*. Horizontal axis: time expressed in lunar (fishing) months

First, the industrial fishery was subjected to additional taxation by the Burundi Government, based on the number of fish crates landed. This led to a response from the Greek fishermen who increased the size of their crates to more than the standard 40 kg used previously. In addition, an oversized artisanal fishing catamaran came into being and became popular, using a much larger net than before (the so-called "Apollo net" measured 80-100 m in circumference and was operated from eight pulleys instead of the traditional four as visible in Fig. 2). These new fishing units now left the reserved 5 km inshore area and started catching all species, competing not just for target species – predators included, which had not been accessible before - but also for fishing space with the industrial fishery. This resulted in a serious decline in catch rates of the industrial fishery, which became uneconomical as its operating costs were many times superior to those of the catamarans. Meanwhile, building new roads and whole new town quarters in Bujumbura resulted in large amounts of mud being washed into the lake causing widespread erosion and siltation of the northern lake waters. Finally, Government routine sampling of the catches partly changed in nature, focusing more on L. stappersii (which was the subject of a thesis of a Burundi scientist) and became more erratic as the transportation of recorders to and from the market was no longer guaranteed and funding was generally limited.

Although the system continued to provide data on the industrial fish landings, variations in the latter ceased to reflect actual changes in fish populations, despite attempts at correcting them (e.g. Bellemans 1992).

Conclusion

The importance of time series, particularly in pelagic fisheries, is paramount. Although much, even lake-wide, fisheries research has been carried out on Lake Tanganyika since the 1990s, the unique situation of a 'stable' fishery undisturbed by outside factors which could relatively easily be monitored never again materialized. This underlines the uniqueness of the situation and of the data set for the period 1973-1980.

Although it seems logical to assume that a similar strong predator-prey relationship continues after this period, there are no clues whatsoever as to what is happening in the lake at the moment. A basic question remains with regard to the timing of the abundance peak in the sardines which drives the predator-prey system. In small pelagic fish species there is usually no simple numerical relation between the size of the parent stock and that of the new generation and their annual recruitment success is probably linked to external environmental conditions. It had been suggested that the El Niño Southern Oscillation (ENSO) might play a role in determining the productivity of the African Great Lakes. This was examined in detail by Plisnier et al (2000) who concluded that although there certainly is an impact of ENSO on the climatic and ecological variability in East Africa this is much more complex than was previously assumed.

Absolute priorities in fisheries management on Lake Tanganyika further are the training of fisheries biologists in pelagic fish stock assessment and related sampling methods as well as the development of an institutional memory from which results of earlier research can be made available. Both these capacities are fully lacking at the moment. The Lake Tanganyika Authority based at Bujumbura should play a crucial role in their development.

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FOOTNOTE

[1] Present address: Haselweg 18, 6721 ME Bennekom, The Netherlands.