Rastrineobola argentea (Pellegrin, 1904)

Lake Victoria, Kenya. © D.O. Okeyo/Kenya Marine Fisheries Research Institute.

Synonyms
Neobola argentea Pellegrin, 1904

FAO names
Silver cyprinid

Local names
English: Silver cyprinid (official FAO name), Mukene (official AFS name), Lake Victoria sardine (Kenya)
Luo: Omena (Kenya)
Language not specified: Mukene (Uganda)
Swahili: Dagaa (Kenya, Tanzania, Uganda)

Geographical distribution
Lake Victoria drainage, including Lake Kyoga, Lake Nabugabo and the Victoria Nile (Greenwood 1966). Introduced in Lake Bulera (Rwanda) in 1991 from where it colonized Lake Ruhondo (Isumbisho et al 2011).

Key features
Body strongly compressed (Van Oijen 1995), its height 4.25-4.75 times in body length, caudal peduncle twice as high as long (Poll 1945). Lower jaw slightly prominent (Pellegrin 1905). Mouth large, terminal and rather oblique, without lips or circumoral barbels (Van Oijen 1995), extending to below anterior border of eye (Boulenger 1906, 1907, 1911). Cheek largely covered by thin suborbital bones (Boulenger 1907, 1911; Van Oijen 1995). Pharyngeal teeth conical (Pellegrin 1905). Gill rakers moderately long (Boulenger 1907, 1911), 16 on lower part of first branchial arch (Boulenger 1907, 1911; Greenwood 1966). Scales moderately large, 42-56 on lateral line (Van Oijen 1995). Lateral line descending from about upper part of gill opening to just before ventral-fin origin (Pellegrin 1905; Fowler 1936), more or less following the ventral body profile from ventral fin to caudal peduncle (Pellegrin 1905; Van Oijen 1995). Dorsal fin situated almost entirely above anal fin (Van Oijen 1995). Anal-fin base about twice as long as dorsal-fin base (Eccles 1992). 12-17 branched anal-fin rays (Greenwood 1966; Van Oijen 1995). Pectoral fin not reaching pelvic fin (Pellegrin 1905; Boulenger 1907, 1911; Eccles 1992). Body silver with an overall nacreous sheen (Greenwood 1966; Van Oijen 1995), yellowish brown above (Boulenger 1907). Caudal fin yellow (Boulenger 1907, 1911; Greenwood 1966; Van Oijen 1995), other fins colourless (Greenwood 1966; Van Oijen 1995), white or greyish (Boulenger 1907, 1911). Dead specimens with a distinct mid-lateral stripe (Greenwood 1966; Van Oijen 1995), stripe silver in life (Eccles 1992).

Habitat and Biology
Highly adapted to pelagic life (Corbet 1961). Known from the surface of inshore and coastal waters; some records from surface waters over great depth (Greenwood 1966; Witte & de Winter 1995). Adults stay near the bottom during the day and near the surface at night (Witte & de Winter 1995). Juvenile fish migrate away from the shore after spending their larval stage in shallow areas (Wanink

1999). In Lake Kyoga occurring in open water away from water-lily swamps; in the Victoria Nile caught in turbulent areas (Greenwood 1966). Feeds on zooplankton and surface insects (Corbet 1961; Greenwood 1966; Witte & de Winter 1995) and is eaten by birds and various fish species, mainly catfish including *Schilbe mystus*, *Clarias gariepinus*, *Bagrus docmak* (Graham 1929; Corbet 1961) and *Synodontis victoriae* (Sharpe et al 2015). Mature individuals spawn in the lake and produce floating eggs (Graham 1929). Sensitive to low oxygen conditions (Sharpe et al 2015). IUCN red list status least concern (FishBase team RMCA & Geelhand 2016).

Interest to fisheries

Since 1980, the commercial fishery of Lake Victoria shifted to Nile perch (*Lates niloticus*), Nile tilapia (*Oreochromis niloticus*) and the native cyprinid (*R. argentea*) (Natugonza et al 2020), which together make up 80%-90% of the catch, which is a major shift from previous observations of 80% haplochromine catches (Njiru et al 2018).

Because of its lower economic value, *R. argentea* comprises the bulk of the animal protein in the lake for communities surrounding the lake (Odongkara et al 2005).

The observations in this fishery are indicative of highly variable seasonal patterns of the catches. The estimated total catch has been decreasing from 2006 to 2015, and contributed 43.7% to 71.24% of the total fish catches from the lake. The lake-wide dagaa catch estimates are heavily influenced by the situation in Tanzania where total landings are clearly higher than in Kenya and Uganda. In Tanzania, the dagaa fishery contributes significantly more to the total fresh fish catches (71.24%) then in the Kenyan (57.1%) and Ugandan (43.7%) part of the lake. Lake-wide, dagaa contributes 64.6% (Lake Victoria Fisheries Organisation 2016).

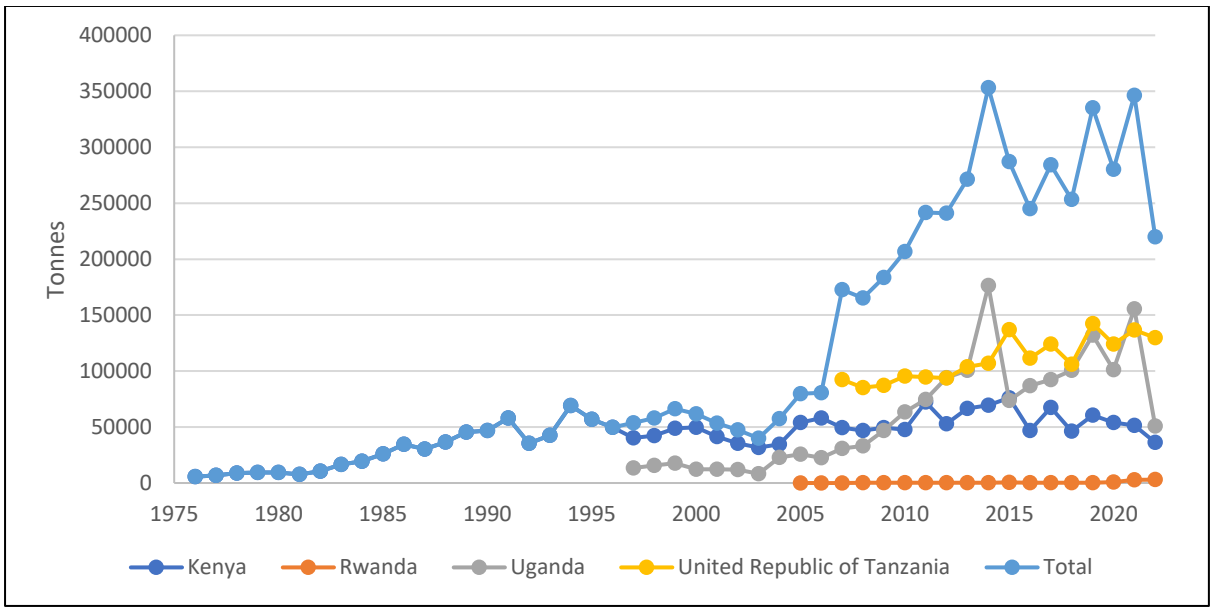

Figure 1: Catches (in tonnes) of Rastrineobola argentea *as available from FAO (April 2024).*

FAO (2024) holds official catch data from all riparian countries of Lake Victoria, but for Uganda and Tanzania only from 1997 and 2007 respectively. The data from Rwanda refer to the fishery that developed after the introduction of *R. argentea* in Lake Bulera and Lake Ruhondo. Especially in the latter a fishery is developing (Isumbisho et al 2011). FAO (2024) statistics indicate an increase in catches from Rwanda from 35 tonnes in 2005 to 2930 tonnes in 2021.

We found the available data from various sources (e.g. Mkumbo 1999; Natugonza et al 2020, 2022; Njiru et al 2018) not to agree with FAO (2024) data. From the graph with FAO data, one gets the impression that catches have gradually build up from almost zero, but this is not the case. There was a four-fold increase in lake-wide catches, from a recorded 20000 tonnes in 1980 to 84000 tonnes in

1990 (Pitcher et al 1996). Up to 2006, FAO holds no data from Tanzania, although Mkumbo (1999) reported Tanzanian catches of several thousands to even several ten thousand tonnes in the period from 1986 to 1995, with a peak around 40000 tonnes in 1992 (Figure 2). Unfortunately, the Tanzanian reporting system broke down in 1996 because of a lack of resources and poor infrastructure.

The trend in total catches of *R. argentea* in Lake Victoria is similar between the FAO (2024) data and those of Natugonza et al (2020, 2022; Figure 3) and Njiru et al (2018), with a sharp increase between 2005 and 2015. Catch numbers, however, differ greatly between the datasets, with the data from Natugonza et al (2020, 2022) and Njiru et al (2018) similar to the data reported by the Lake Victoria Fisheries Organisation (2016). Depending on the period, these catch data are one and a half to four times larger than those reported by FAO (2024), meaning that a substantial part of the catches is potentially absent from the data officially sent to FAO.

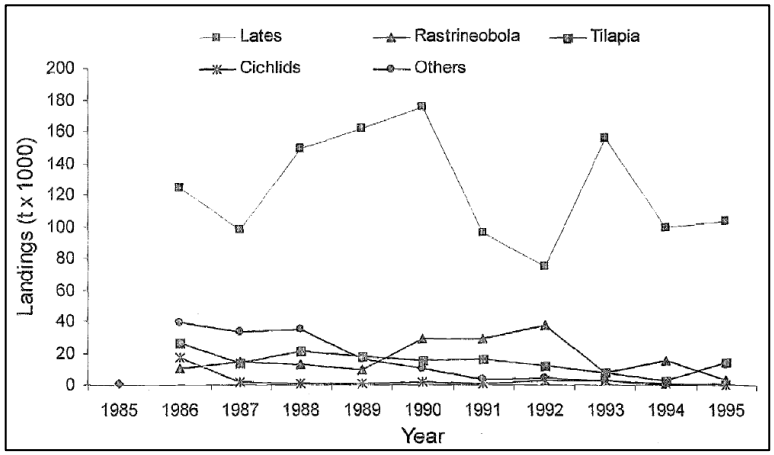

Figure 2: Landings by species from Tanzanian waters of Lake Victoria (image from Mkumbo 1999).

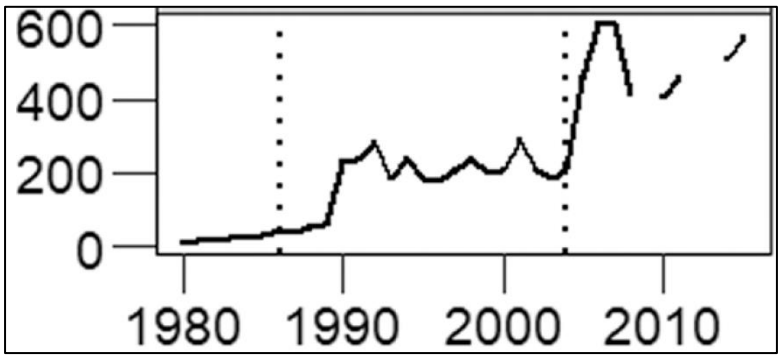

Figure 3: Total annual catches (thousand tonnes) of Rastrineobola argentea *in Lake Victoria over time. Image from Natugonza et al 2022 (due to the lack of trawl data, as this is a pelagic species, data was estimated using the Atlantis model; see Nyamweya et al 2016).*

In Kenya, a comprehensive beach recording system is conducted by KMFRI and duplicated, in part and not on the same scale, by the Fisheries Department (Figure 4). The results are in conflict, resulting in little confidence in the results (Cowx et al 2003). The lower catch data from the Fisheries Department corresponds to the data in FAO (2024) for Kenya.

The drop in the Nile perch fishery in the Tanzanian waters of Lake Victoria in the early 1990s was accompanied with an increase in catches of *Rastrineobola*. However, the latter has subsequently declined. This possibly reflects a conversion from the longline and gillnet fishery to lift netting, but without details of gear usage this could not be confirmed (Mkumbo 1999).

FAO (1992) reported a shift from 10 mm to 5 mm meshes in the dagaa fishery, which lead to increasing captures of immature individuals. Wanink (1999) noted that the dagaa stocks may be

damaged by small-meshed seine nets fishing in the inshore breeding grounds. A ban on mosquito seines and a stimulation of offshore fishing would increase both the yield and the sustainability of this fishery (Wanink 1999).

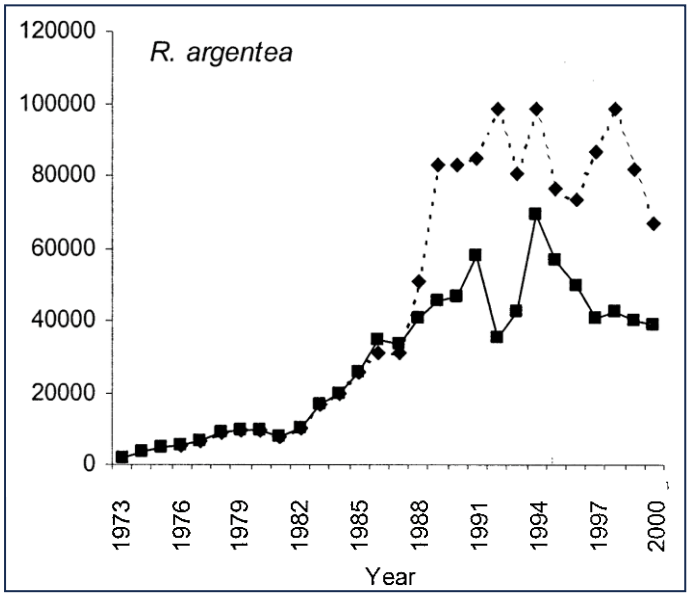

Figure 4: Comparison of Kenyan catch statistics from the Fisheries Department (square) and KMFRI (diamond) (image from Cowx et al 2003).

Studies by Marshall (2001) indicated that *R. argentea* is infected by a cestode (*Ligula intestinalis*) that destroys its gonads, reducing its reproductive potential by almost 10%, and affecting its annual recruitment (Marshall 2001). Cestode infestation, high exploitation and the use of *R. argentea* for fishmeal production jeopardize the availability of protein for lake communities (Njiru et al 2008).

Bibliography

Boulenger, G.A. (1906). Fourth contribution to the ichthyology of Lake Tanganyika. Report on the collection of fishes made by Dr. W.A. Cunnington during the Third Tanganyika Expedition, 1904-1905. Transactions of the zoological society London 17(6): 537-600.

Boulenger, G.A. (1907). Zoology of Egypt: the fishes of the Nile. Hugh Rees, Limited, London. 578p.

Boulenger, G.A. (1911). Catalogue of the fresh-water fishes of Africa, Volume 2. British Museum (Natural History), London. 530 p.

Corbet, P.S. (1961). The food of non-cichlid fishes in the Lake Victoria basin, with remarks on their evolution and adaptation to lacustrine conditions. Proceedings of the Zoological Society London 136: 1-101.

Cowx, I.G., M. van der Knaap, L.I. Muhoozi and A. Othina (2003). Improving fishery catch statistics for Lake Victoria. Aquatic Ecosystem Health and Management 6(3): 299-310.

Eccles, D.H. (1992). FAO species identification sheets for fishery purposes. Field guide to the freshwater fishes of Tanzania. Prepared and published with the support of the United Nations Development Programme (project URT/87/016). FAO, Rome. 145 p.

FAO (1992). Committee for Inland Fisheries of Africa. Report of the sixth session of the Sub-Committee for the development and management of the Fisheries of Lake Victoria. Jinja, Uganda, 10-13 February 1992. FAO Fisheries Report 475. 48p.

FAO (2024). FishStat: Global capture production 1950-2022. [Accessed on 29 March 2024]. In: FishStatJ. Available at www.fao.org/fishery/en/statistics/software/fishstatj. Licence: CC-BY-4.0.

FishBase team RMCA and D. Geelhand (2016). *Rastrineobola argentea*. The IUCN Red List of Threatened Species 2016: e.T61257A47242399. https://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T61257A47242399.en. Accessed on 13 August 2024.

Fowler, H.W. (1936). Zoological results of the George Vanderbilt African Expedition of 1934. Part III. The fresh water fishes. Proceedings of the academie of natural sciences of Philadelphia 83: 243-335.

Graham, M. (1929). The Victoria Nyanza and its fisheries. A report on the fishing survey of Lake Victoria 1927-1928, and appendices. The Crown Agents for the Colonies, London. 255 p.

Greenwood, P.H. (1966). The Fishes of Uganda. The Uganda Society, Kampala. 131p.

Isumbisho, M., P. Petit, J.B. Gashagaza and J. Moreau (2011). The feeding habit of the Cyprinidae *Rastrineobola argentea* in its new habitat, lakes Bulera and Ruhondo, two Rwandan lakes (Eastern Africa). Knowledge and Management of Aquatic Ecosystems 403: 04.

Lake Victoria Fisheries Organisation (2016). Regional catch assessment survey synthesis report. June 2005 to November/December 2015. 19p.

Marshall J. R. (2001). Some aspects of the ecology and reproduction of the small pelagic cyprinid, Rastrineobola argentea in Lake Victoria. Lake Victoria Fisheries Research Project/TECH/01/12, Lake Victoria Fisheries Organization, Jinja, Uganda.

Mkumbo, O.C. (1999). Catch trends from Lake Victoria - Tanzanian waters. p. 99-107. In: I. Cowx and D. Tweddle (eds.) Lake Victoria Fisheries Research Project Phase II. Report on fourth FIDA WOG workshop held at Kisumu, 16-20 August 1999. UNECIA Ltd. 209p.

Natugonza V., C. Ainsworth, E. Sturludóttir, L. Musinguzi, R. Ogutu-Ohwayo, T. Tomasson, C. Nyamweya and G. Stefansson (2020). Ecosystem modelling of data-limited fisheries: How reliable are Ecopath with Ecosim models without historical time series fitting? Journal of Great Lakes Research 46(2): 414-428.

Natugonza, V., C. Nyamweya, E. Sturludóttir, L. Musinguzi, R. Ogutu-Ohwayo, S. Bassae, E. Mlaponi, T. Tomasson & G. Stefansson (2022). Spatiotemporal variation in fishing patterns and fishing pressure in Lake Victoria (East Africa) in relation to balanced harvest. Fisheries Research 252: 106355.

Njiru, M., J. Kazungu, C.C. Ngugi, J. Gichuki and L. Muhoozi (2008). An overview of the current status of Lake Victoria fishery: Opportunities, challenges and management strategies. Lakes and Reservoirs: Research and Management 2008 13: 1-12.

Njiru, J., M. van der Knaap, R. Kundu and C. Nyamweya (2018). Lake Victoria fisheries: Outlook and management. Lakes and Reservoirs 23: 152-162.

Nyamweya, C., E. Sturludottir, T. Tomasson, E.A. Fulton, A. Taabu-munyaho, M. Njiru, and G. Stefansson (2016). Exploring Lake Victoria ecosystem functioning using the Atlantis modeling framework. Environmental modelling and software 86: 158-167.

Odongkara K., Abila R. O. & Onyango P. O. (2005). Distribution of economic benefits from the fisheries. In: The State of the Fisheries Resources of Lake Victoria and Their Management. Proceedings of the Regional Stakeholders' Conference, pp. 124–31. Lake Victoria Fisheries Organization Secretariat, Jinja, Uganda.

Pellegrin, J. (1905). Mission scientifique de Ch. Allaud en Afrique orientale (Juin 1903 - Mai 1904). Poissons. II. Systématique. Mémoires de la société zoologique de France 17(3-4): 174-185.

Pitcher, T.J., A. Bundy and W.E. Neill (1996). The fishery for Rastrineobola argentea in Lake Victoria: estimation of potential yields using a new approximate model based on primary production. Fisheries Research 28: 133-149.

Poll, M. (1945). Descriptions de cinq espèces nouvelles de Cyprinidae du Congo belge appartenant aux genres *Barbus* et *Engraulicypris*. Revue de zoologie et de botanique africaines 38(3-4): 298-311.

Sharpe, D.M.T., R.B. Langerhans, E. Low-Décarie and L.J. Chapman (2015). Little evidence for morphological change in a resilient endemic species following the introduction of a novel predator. Journal of evolutionary biology 28: 2054-2067.

van Oijen, M.J.P. (1995). Appendix I. Key to Lake Victoria fishes other than haplochromine cichlids. p. 209-300. In: F. Witte and W.L.T. van Densen (eds.) Fish stocks and fisheries of Lake Victoria. A handbook for field observations. Samara Publishing Limited, Dyfed, Great Britain. 404p.

Wanink, J.H. (1999). Prospects for the fishery on the small pelagic *Rastrineobola argentea* in Lake Victoria. Hydrobiologia 407: 183-189**.**

Witte, F. and W. de Winter (1995). Appendix II. Biology of the major fish species of Lake Victoria. p. 301-320. In: F. Witte and W.L.T. Van Densen (eds.) Fish stocks and fisheries of Lake Victoria. A handbook for field observations. Samara Publishing Limited, Dyfed, Great Britain. 404p.