

Riverine Fishes of Kenya: The Current Status on the Diversity and Distribution in the Ragati-Sagana-Tana Rivers Drainage System

D.O. Okeyo

Faculty of Science and Technology, University of Fort Hare, Private Bag X1314, Alice 5700, Eastern Cape, South Africa

Abstract

Studies of the riverine fishes of the Ragati-Sagana-Tana Rivers drainage system in Kenya has lagged behind since the last comprehensive surveys of the 1950's and early 1960's, thus the purpose for the present study. A total of 30 riverine fish families, which consist of 46 genera and 60 species occur in the drainage system. Thirty-seven (37) of these species are strictly of freshwater origin, while 23 species are of marine origin. Four (4) of the freshwater fish species were introduced. The three most speciated riverine fishes in the system belong to the families Cyprinidae, consisting of eight (8) species, Mochokidae, consisting of five (5) species and, Gobiidae, consisting of four (4) species. The occurrence in the entire drainage system of one snoutfish species, *Mormyrops anguilloides* (Linnaeus, 1758), is uncertain. The use of the information from the present findings is highly recommended in carrying out further studies about fishes from the Ragati-Sagana-Tana Rivers drainage system. The knowledge is beneficial to fisheries managers, students of fish taxonomy, museum curators and researchers of African fishes.

Key words: East Africa, Kenya, Ragati, Sagana, Tana, riverine fishes, biodiversity

Résumé

Des études sur la faune ichtyologique fluviale du réseau hydrologique des rivières Ragati-Sagana-Tana au Kenya, ont stagné puisque les données exhaustives les plus récentes sur cette faune datent des années 1950 et début des années 1960. La présente étude vise l'actualisation des connaissances sur la population, et la diversité et la répartition de poissons dans ce complexe hydrologique. Les résultats montrent que 30 familles de poissons fluviaux totalisant 46 genres et 60 espèces se reproduisent dans ce réseau hydrologique. Trente sept (37) de ces espèces sont exclusivement des espèces d'eau douce, alors que 23 d'entre elles sont d'origine marine. Parmi les espèces de poissons d'eau douce, quatre d'entre elles ont été introduites. Trois espèces de poissons fluviaux les plus rencontrées dans le réseau appartiennent respectivement aux familles des Cyprinidés avec huit (8) espèces, des Mochokidés avec cinq (5) espèces et des Gobiidés avec quatre (4) espèces. La présence de *Mormyrops anguilloides* (Linné, 1758), une espèce Ostéoglossiformes, Anguillidé, dans ce réseau hydrologique reste douteuse. Les résultats émanant de cette études sont extrêmement nécessaires pour des recherches ichtyologiques ultérieures lors de la mise en valeur du réseau hydrologique Ragati-Sagana-Tana. Les responsables de la pêche, les étudiants qui font la taxonomie de poissons, les conservateurs de musée et les chercheurs ichtyologistes africains peuvent avantageusement se servir aussi des acquis tirés de cette étude.

Mots-clés: Afrique de l'Est, Kenya, Ragati, Sagana, Tana, pêche fluviale, biodiversité

Introduction

Studies on riverine fish species of eastern, as compared to western, central and southern regions of Africa, are lagging behind (Skelton, 1994). The problem of very old and poor documentation of the riverine fishes of the Ragati-Sagana-Tana Rivers drainage system (Copley, 1958; Whitehead, 1960) is, thus, not surprising. The Ragati-Sagana-Tana is the largest eastward flowing river system in Kenya (Fig. 1). It drains the southern and eastern slopes of Mount Kenya. The river system first flows northwards to the equator in its upper course, instead of flowing directly to the Indian Ocean. The river system turns southwards in a large bend, just before reaching the equator, to enter the Ocean at Kipini, southeast of Lamu, coastal Kenya.

Considering the global prediction that there will be about 3 to 4 times human population increase in Africa by the year 2030, there is an urgent need of studying all water sheds in the continent, for diversity and conservation reasons. It is evident that the human population is and will mainly concentrate in coastal regions and lake and river basins, of Kenya. Such concentrations may bring about water shed destructions, along with organisms therein yet to be described (Craig, 1992).

The current study of riverine fishes of the Ragati-Sagana-Tana Rivers drainage system updates old detailed classification from sporadic but comprehensive surveys, which were carried out in the 50's (Copley, 1958; Whitehead, 1959; 1960). It is one of the first attempts in more than three decades to

taxonomic information on respective fish species are included.

Results

A total of 30 riverine fish families with 46 genera and 60 species occur in the Ragati-Sagana-Tana Rivers drainage system (Table 1). Sixteen (16) of the riverine fish families consist of 37 species which are entirely freshwater. Two (2) of the freshwater fish species (i.e.) the grass carp, *Ctenopharingodon idella* (Valenciennes in Cuvier & Valenciennes, 1844) and the common carp, *Cyprinus carpio* Linnaeus, 1758) were introduced for purposes of culture; two (2) fish species (i.e.) the rainbow trout, *Oncorhynchus mykiss* (Walbaum, 1792) and the brown trout, *Salmo trutta* Linnaeus, 1758), were introduced for purposes of angling (Copley 1947, 1958); two (2) fish species (i.e. the mosquito fish, *Gambusia affinis holbrooki* (Girard, 1959) and the guppy, *Poecilia reticulata* Peters, 1859) were introduced for purposes of biological (i.e. mosquito) control (Whitehead, 1959; Mann, 1966) (Table 1). Fourteen (14) of the riverine fish families consist of 23 species, which move up into freshwater from marine, lagoon and estuary areas. The most abundant fish species occurring in the drainage system belong to the family Cyprinidae (14), followed by the families Mochokidae (5) and Gobiidae (4) (Table 1).

The general distribution shows more concentration of fish species (20 (23%)) in the lower reaches (south-southeast of Garissa town) than in the upper reaches (10 (17%)) of the Ragati-Sagana-Tana Rivers drainage system (Table 1). A few fish species (7 (12%)) have evolved to occupy the entire river drainage. There seems to be two (2 (3%)) fish species, whose clear descriptions are still underway - the Kenyan lungfish, *Protopterus* sp. and the squeaker, *Synodontis* sp. - in the lower reaches of the drainage system. The existence of the snoutfish, *M. anguilloides* (Copley, 1958) and the smoothhead catfish, *Clarias liocephalus* Boulenger, 1898 (Teugels, 1986) in the entire drainage system, is uncertain, thus the indication by question marks (Table 1). Special evolutionary adaptations such as living in ephemeral (seasonal) pools and warm saline lakes are demonstrated by two (2(3%)) freshwater fish species, the small-scaled nothobranch, *Nothobranchius microlepis* (Vinciguerra, 1897) and Sabaki tilapia, *Oreochromis spilurus spilurus* (Günther, 1894), respectively.

The updated scientific and the recommended English common names of the riverine fish species are accompanied by names of authorities who described them (Table 1).

Discussion

This study presents the most accurate and updated scientific and recommended English common names of 30 fish families consisting of 46 genera and 60 species, which occur in the Ragati-Sagana-Tana Rivers drainage system in Kenya. Uncertain information of similar kind is found in the literature: Copley, 1958; Whitehead, 1959; Daget *et al.*, 1984; 1986a; Campbell *et al.*, 1986; Jumbe, 1997; Okeyo, 1998. This study considers Protopteridae and Characidae as families of their own (Table 1). Nelson (1994) agrees to this classification. Claroteidae is recognized as separate from Bagridae. Mo (1991) attests to this classification. Mastacembelidae is recognized as a family under the order Synbranchiformes. Goltsline (1983) and Travers (1984a; b), however, contrasts by putting Mastacembelidae in the order Perciformes.

This study considers the genus *Brycinus* as distinct from the genus *Alestes* (Table 1). Myers (1929), Gery (1977) and Paugy (1986) accept this classification. Nelson (1994), however, contrasts the aforementioned idea. The genus *Pantanodon* is herein placed in the family Aplocheilichthyidae. Sethi (1960) and Meyer and Lydeard (1993) accept this classification. Eschmeyer (1990), however, disputes by placing the genus *Pantanodon* under the family Poeciliidae.

This study considers *Clarias gariepinus* (Burchell, 1822) as the most accurate and updated scientific name of the Sharptooth Catfish (Table 1). The name, however, is listed in the literature under its synonym, *Clarias mossambicus* Peters, 1852 (Teugels 1986). Boulenger (1901), Worthington & Ricardo (1936) and Hopson & Hopson (1982) also call the fish *Clarias lazera* Valenciennes, 1840. The lungfish is herein considered as *Protopterus annectens* (Owen, 1839). Trewavas (1954), has called the same fish *Protopterus amphibius* (Peters, 1844). Only *P. annectens* is presently recorded from the system. Bemis (1983), however, even formed the opinion that both of the fish species occurred in the drainage system, which contradicts results from the present finding. The taxonomic status of the Kenyan population of Protopteridae is unclear and is currently under study. Current records at the National Museums of Kenya, of *Protopterus aethiopicus* Heckel, 1851 from elsewhere in Kenya and from this drainage system, are based on misidentification. This study shows that a number of riverine fish species are called with different names by different authors (Table 1), suggesting a previous record of a large species number than is possible.

There are five unique behavioural categories surrounding the distributional patterns among riverine fish species, which occur throughout the

Table 1: Scientific, recommended English common names, authorities and distribution of riverine fish species of Ragati-Sagana-Tana River drainage system, Kenya. (?)=Fish species which occurrence is uncertain. (*)=Fish species which move into fresh water from marine, lagoon and estuary systems.

Family/Species	Distribution	Supporting Source
Carcharhinidae - Requiem Sharks <i>Carcharhinus leucas</i> (Valenciennes, 1839) - bull shark*	Lower reaches, Tana	-
Pristidae - Sawfishes <i>Pristis microdon</i> Latham, 1794 -smalltooth sawfish*	Lower reaches, Tana	-
Protopteridae - African lungfishes <i>Protopterus annectens</i> (Owen, 1839) - lungfish	Lower reaches, Tana, coastal drainage (Bemis, 1983). The taxonomic status of the Kenyan population is unclear and is currently under study	Bemis, 1983
<i>Protopterus</i> sp. (No authority) - Kenyan lungfish	There seems to be an occurrence of another undescribed <i>Protopterus</i> sp., other than the <i>annectens</i> described by Trewavas (1954) and by Bemis (1983), in the lower reaches of Tana River. The taxonomic status of Kenyan populations is currently under study. Current records at the National Museums of Kenya, of <i>P. aethiopicus</i> from elsewhere in Kenya and this drainage basin are based on misidentification	Trewavas, 1954; Bemis, 1983
Mormyridae - snoutfishes <i>Marcucenius macrolepidotus</i> (Peters, 1852)- bulldog	Lower reaches, Tana	Whitehead, 1959; Whitehead and Greenwood, 1959 Bigorne, 1987
? <i>Mormyrops anguilloides</i> (Linnaeus, 1758) - cornish Jack (roof-bottelneus)	Identification of <i>Mormyrops</i> sp. in the drainage system is uncertain	
<i>Petrocephalus catostoma</i> <i>tanensis</i> Whitehead & Greenwood, 1959 - Tana- churchil	Tana River	-
Megalopidae - Tarpons <i>Megalops cyprinoides</i> oxeye tarpon*	Lower reaches	Fowler, 1973; Bruton (Broussonet, 1782) - and Kok 1980
Anguillidae - Eels <i>Anguilla bicolor bicolor</i> McLelland, 1845 - shortfin eel*	Tana River	Copley, 1958
<i>A. mossambica</i> Peters, 1852 - African longfin eel*	Upper reaches, Ragati River	Copley, 1958
<i>A. bengalensis labiata</i> Peters, 1852 - African mottled eel*	Ragati, Gura, Tana Rivers	Copley, 1958
Clupeidae - Herrings <i>Pellona ditchela</i> Valenciennes in Cuvier & Valenciennes, 1847 - Indian pellona*	Lower reaches	-
Cyprinidae - Barbs, Minnows and Labeos		

<i>Barbus kerstenii kerstenii</i> Peters, 1868 - Kersten's barb	Ragati, Sagana and Tana Rivers	Greenwood, 1962
<i>B. marie</i> Holly, 1929 - Rhino-fish	Tana River	Copley, 1958; Fowler, 1976; Kenya Gov., 1990a
<i>B. oxyrhynchus</i> Pfeffer, 1889 - Pangani barb	Thika/Mathioya	Günther, 1894;
<i>B. paludinosus</i> Peters, 1852 - straightfin barb	Upper reaches, Thika River	Boulenger, 1902; 1911 Boulenger, 1904
<i>Ctenopharyngodon idella</i> (Valenciennes in Cuvier and Valenciennes, 1844) - grass carp	Introduced for culture	-
<i>Cyprinus carpio</i> Linnaeus, 1758 - common carp	Introduced for culture	-
<i>Labeo gregorii</i> Gunther, 1894 - Tana labeo	Tana River	Matthes, 1963
<i>Neobola fluviatilis</i> (Whitehead, 1962) - Athi sardine	Tana River	Whitehead, 1962; Howes, 1980; 1984
Characidae - Characins		
<i>Brycinus affinis</i> (Gunther, 1894) - redfin robber	Tana River	Bailey, 1969
Claroteidae - Clarotid Catfishes		
<i>Clarotes laticeps</i> (Ruppell, 1829) - wideheaded catfish	Lower reaches, Garsen, Tana River	Whitehead, 1959; Blache <i>et al.</i> , 1964; Kenya Gov., 1970
Schilbeidae - Butter Catfishes		
<i>Parailia (Physailia) somalensis</i> (Vinciguerra, 1897) - Somalia buttercatfish	Tana River	Whitehead, 1959; 1962; De Vos, 1984
<i>Schilbe intermedius</i> Ruppell, 1832	Whole of the Ragati-Sagana-Tana River drainage	Whitehead, 1959; De Vos, 1984; De Vos and Skeleton, 1990
Amphiliidae - Mountain Catfishes		
<i>Amphilius uranoscopus</i> (Pfeffer, 1889) - stargazer (mountain catfish)	Upper reaches, Chania River of Tsetse, Tana	Boulenger, 1905
Clariidae - Catfishes		
<i>Clarias gariepinus</i> (Burchell, 1822) - Sharptooth Catfish, Common Catfish	Ragati-Sagana-Tana Rivers drainage system	Whitehead, 1959; Teugels, 1986
? <i>C. liocephalus</i> Boulenger, 1898 - smoothhead catfish	The occurrence of the fish in the Ragati-Sagana -Tana Rivers drainage system (Teugels, 1986) is not well substantiated	Teugels, 1986
Ariidae - Sea Catfishes		
<i>Arius africanus</i> Playfair and Gunther, 1866 - African sea catfish*	Lower reaches, Tana	Jayaram, 1984; Kenya Gov., 1991
<i>A. dussumieri</i> Valenciennes in Cuvier and Valenciennes, 1840 - Shupanga sea catfish*	Lower reaches	Bianchi 1985
Mochokidae - Squeakers and Suckermouths		
<i>Chiloglanis brevibarbis</i> Boulenger, 1902 - short barbeled suckermouth	Tana River	Hubbs, 1918; Whitehead, 1958

<p><i>Synodontis manni</i> De Vos, 2001 – Mann's squeaker <i>S. schall</i> (Bloch & Schneider, 1801) - Nile squeaker <i>S. serpens</i> Whitehead, 1962 - Tana squeaker <i>S. zanzibaricus</i> Peters, 1868 - eastcoast squeaker <i>Synodontis</i> sp. - no recommended English common name Salmonidae - Trouts <i>Oncorhynchus mykiss</i> (Walbaum, 1792) - rainbow trout <i>Salmo trutta</i> Linnaeus, 1758 - brown trout Aplocheilichthyidae - Topminnows or Lampeyes <i>Pantanodon stuhlmanni</i> (Ahl, 1924) - eastcoast lampeye Poeciliidae - Livebearers <i>Gambusia affinis holbrooki</i> (Girard, 1959) - mosquito fish <i>Poecilia reticulata</i> Peters, 1859 - guppy, million fish Aplocheilidae - Nothobranchius <i>Nothobranchius jubbi</i> Wildekamp & Berkenkamp, 1979 - blue nothobranch <i>N. microlepis</i> (Vinciguerra, 1897) - small scaled nothobranch <i>N. patrizii</i> (Vinciguerra, 1927) - Somalia nothobranch Syngnathidae - Pipefishes <i>Hippichthys (Hippichthys) cyanospilus</i> (Bleeker, 1854) - blue spotted pipefish* <i>Microphis (Belonichthys) fluviatilis</i> (Peters, 1852) - freshwater pipefish* Mastacembelidae - Spinyeels <i>Caecomastacembelus frenatus</i> (Boulenger, 1911) - longtail spinyeel Ambassidae - Glassies <i>Ambassies gymnocephalus</i> (Lacepede, 1802) - bald glassy* Kuhliidae - Flagtails <i>Kuhlia rupestris</i> (Lacepede, 1801) - rock flagtail* Centrarchidae - Sunfishes <i>Lepomis macrochirus</i> Rafinesque, 1819 - bluegill</p>	<p>Lower Tana River Tana River Tana River Lower reaches, Tana There is an undescribed <i>Synodontis</i> sp. in the Lower Tana River Introduced into rivers of the upper reaches of the Ragati, Sagana and Tana River drainage Introduced into the upper reaches of the Ragati -Sagana and Tana River drainage Lower reaches Introduced in the drainage system Introduced into the drainage system Lower reaches of Tana Lower reaches, seasonal pools, Tana Lower reaches, seasonal pools, Tana Lower reaches, coastal streams, estuaries and lagoons Lower reaches, coastal streams, estuaries and lagoons Ragati-Sagana-Tana River drainage Lower reaches Lower reaches, coastal streams, estuaries and lagoons Introduced into the upper reaches, Ragati-Sagana-Tana</p>	<p>De Vos, 2001 Mann, 1968 Whitehead, 1962; Mann, 1966 - - - - Seegers, 1996 Mann, 1966 Whitehead, 1959 Wildekamp and Berkenkamp, 1979; Seegers, 1981; Haas, 1981 Seegers, 1985a; b Seegers, 1985b; c - - - - Mann, 1968</p>
---	---	--

Monodactylidae - Moonies <i>Monodactylus argenteus</i> (Linnaeus, 1758) - silver moony*	Lower reaches, coastal streams, estuaries and lagoons	-
Scatophagidae - Scats <i>Scatophagus tetracanthus</i> (Lacepede, 1802) - African scat*	Lower reaches, coastal streams, estuaries and lagoons.	-
Cichlidae - Cichlids <i>Oreochromis spilurus</i> <i>spilurus</i> (Gunther, 1894) - Sabaki tilapia	Lower reaches, floodplains, saline lakes, Tana	-
Mugilidae - Mulletts <i>Liza macrolepis</i> (Smith, 1849) - large-scale mullet*	Lower reaches	-
<i>Mugil cephalus</i> Linnaeus, 1758 - flathead mullet*	Lower reaches.	-
Eliotridae - Sleepers <i>Butis butis</i> (Hamilton- Buchanan, 1822) - pointed head gudgeon*	Lower reaches.	-
<i>Eleotris fusca</i> (Schneider in Bloch and Schneider, 1801) - dusky sleeper*	Lower reaches	Whitfield 1980; Blaber and Cyrus, 1981
Gobiidae - Gobies <i>Acentrogobius simplex</i> Sauvage, 1880 - Bagamoyo goby*	Lower reaches	-
<i>Awaous aeneofuscus</i> (Peters, 1852) - freshwater goby*	Lower reaches	-
<i>Glossogobius giuris</i> (Hamilton-Buchanan, 1822) - tank goby*	Lower reaches, Tana	Whitehead, 1959
<i>Stenogobius kenya</i> Smith, 1959 - East African rivergoby*	Lower reaches	Smith, 1959

entire river drainage. The first category is demonstrated in the eel family (Anguillidae). For example, the three species of eel, the shortfin eel, *Anguilla bicolor bicolor* McClelland, 1845, recorded from Tana River, the African longfin eel, *Anguilla mossambica* Peters, 1852, recorded from the upper reaches of the drainage system in Ragati River, and the African mottled eel, *Anguilla bengalensis labiata* Peters, 1952, recorded from Ragati, Gura and Tana Rivers, all breed in the Indian Ocean and return to live and mature in the drainage system (Copley, 1958). The life cycle require rivers and oceans. Young fish migrate upstream against fast moving waters. Adults also need moving water to migrate back to the ocean, especially after heavy rains. Damming of Ragati-Sagana-Tana Rivers bars eels from reaching original destinations (eels may only enter into, feed and grow, in rivers where they were born, before their vast voyages into the ocean for spawning purposes). The

eels are, therefore, robust fish species, able to withstand a wide variety of ecological conditions.

The second category is demonstrated in the barb, minnow and labeo family (Cyprinidae), the characin family (Characidae) and the catfish family (Clariidae). For example, the Kersten's barb, *Barbus kerstenii kerstenii* Peters, 1868 (Hubbs, 1918; Greenwood, 1962; Trewavas, 1983), recorded from Ragati, Sagana and Tana Rivers, the redfin robber, *Brycinus affinis* (Gunther, 1894) (Whitehead, 1959; Trewavas, 1983), recorded from Tana River, and the Sharptooth Catfish, *C. gariepinus* (Whitehead, 1959; Kenya Gov., 1989), recorded throughout the entire drainage system, breed in April-June after migrating upstream following the onset of high river levels during the rainy season. The Sharptooth Catfish is collectable from all habitable habitats of the drainage system.

The third category is also demonstrated in the barb, minnow and labeo family (Cyprinidae) as well

as the cichlid family (Cichlidae). The Athi sardine, *Neobola fluviatilis* (Whitehead, 1962) (Whitehead, 1962; Howe, 1984), recorded from Tana River, and Sabaki tilapia, *O. spilurus spilurus* (Whitehead 1960, Daget *et al.*, 1986b) occur in the flood pools, dams and lakes of the Ragati-Sagana-Tana Rivers drainage floodplain, as well as in the main river channel. Young of the Athi sardine mainly occupy shallow areas over sandy beaches of the flooded pools (some of which are seasonal) and at river edges.

The fourth category is demonstrated in the African lungfish family (Protopteridae) and the nothobranchius family (Aplocheilidae). For example, the lungfish, *P. annectens* (Bemis, 1983; Kenya Gov., 1983, 1990a; b), recorded from the lower reaches of the drainage system, Tana River and coastal drainage, and the small scaled nothobranch, *N. microlepis* (Seegers, 1985a; b), recorded from lower reaches of the drainage system, seasonal pools and Tana River, have special adaptations to living in ephemeral and shallow pools, swamps and ditches (rain pans) that remain fallow during dry seasons, usually without connection to river courses. The lungfish hibernates in the dried-up mud, while the eggs of the small scaled nothobranch withstand months of desiccation in the dried-up mud, awaiting the next rains, after adults die out.

The fifth and last category is demonstrated in the tarpon family (Megalopidae), sea catfish family (Ariidae), the pipefish family (Syngnathidae), the sleepers family (Eliotridae) and the gobi family (Gobiidae). For example, the oxeye tarpon, *Megalops cyprinoides* (Broussonet, 1782), recorded from the lower reaches of the drainage system, the African sea catfish, *Arius africanus* Playfair & Günther, 1866, recorded from lower reaches of the drainage system and Tana River, the freshwater pipefish, *Microphis (Belonichthys) fluviatilis* (Peters, 1852), recorded from lower reaches, coastal streams, estuaries and lagoons, the dusk sleeper, *Eleotris fusca* (Schneider in Bloch & Schneider, 1801) (Whitehead, 1959), recorded from the lower reaches of the drainage system, all can withstand the raised salinities of the estuaries (and marine waters) as well as the fresh water situations (coastal rivers and streams) above the estuaries. The freshwater pipefish are found in quiet water, among vegetation, which they resemble, where they literally stand on their heads to conceal themselves among the fronds, as well as in the vicinity of logs at river edges. Despite the weak swimming characteristics, the freshwater pipefish manages to successfully move upstream for kilometres from the estuaries. Collectors may have overlooked the fish in the past or it may be slowly moving upstream by population dispersal of the young. The success of upstream movement perhaps can possibly be aided by human activities in

the drainage system, such as increase in salinities of rivers due to additional detergents and fertilizers of industries and agricultural schemes, respectively. The dusky sleeper is commonly epibenthic in fresh, brackish and inshore (littoral) waters, under logs and rootstocks in muddy reaches of estuaries and mangrove swamps and fresh water streams leading into lagoons.

Acknowledgements

The initial idea of the study of updating information on the riverine fish species of Kenya was highly encouraged during thorough discussions with officials from the Ministry of Regional Development (MRD), Kenya (Messrs. N. Odero, S. Oburu and Ms. J. Kinya), the South African Institute of Aquatic Biodiversity (SAIAB; formerly, JLB Smith Institute of Ichthyology), Grahamstown (Prof. P.H. Skelton), the Natural History Museum, London (Drs. H.P. Greenwood, R. Lowe-McConnell, D.J. Siebert), the Museum of Central African Fisheries, Tervuren (Dir. D.F.E. Thys van den Audenaerde, Drs. G.G. Teugels, and J. Snoeks) and the American Museum of Natural History, New York (Dr. M.L.J. Stiassny) to whom I owe special thanks. Dr Lothar Seegers made comments on some results during the study. Part of the study was carried out at the Natural History Museum (NHM), London, as well as in the field in Kenya: I am grateful to the entire staff of the fish section and the library (NHM), to the personnel of the MRD (i.e. at the Department of Fisheries, Kenya Marine & Fisheries Research Institute, Development Authorities) and to my academic colleagues and students, for their kind assistance given during this study. The Association of Commonwealth Universities, KE FO34, through Kenyatta University, Nairobi, Kenya, and the British Council, KE/0003/29, to which I am thankful, sponsored parts of this study

References

- Banister, K. E. 1973. A revision of large Barbus (Pisces, Cyprinidae) of East and Central Africa. Studies in African Cyprinidae, part II. *Bulletin of the British Museum of Natural History (Zoology)* 26: 1-148.
- Bailey, R. G. 1969. The non-cichlid fishes of the eastward flowing rivers of Tanzania, East Africa. *Rev. Zool. Bot. Afr.* 80(1-2): 170-199.
- Bemis, W. E. 1983. *Studies on the evolutionary morphology of lepidocerinid lungfish (Pisces: Dipnoi)*. Dissertation, University of California, Berkeley I-XII: 1-331.
- Berrebi, P., Kottelat, M., Skelton, P. and Rab, P. 1996. Systematics of *Barbus*: state of the art and heuristic

- comments. *Folia Zoologica*. 45 (1): 5-12.
- Bianchi, G. 1985. *Field guide to the commercial marine and brackish-water species of Tanzania*. FAO Species Identification Sheets for Fishery Purposes. FAO, Rome, 199 p.
- Bigorne, R. 1987. Le genre *Mormyrops* (Pisces, Mormyridae) en Afrique de l'Ouest. *Rev. Hydrobiol. Trop.* 20 (2): 145-164.
- Blabber, S. J. M. and Cyrus, D. P. 1981. A revised checklist and further notes on the fishes of the Kasi System. *The Lammergeyc.* 31: 5-15.
- Blache, J., Milton, F., Stauch, A., Itlis, A. and Loubens, G. 1964. *Les poissons du bas in du Tchad et du bas in adjacent du Mayo-Kebbi. Etude systematique et biologique*. Mem. ORSTOM. 4 (2): 485.
- Boulenger, G. A. 1901. On a small collection of fishes of Lake Victoria made by order of Sir H. H. Johnson K.B.C. *Proc. Zool. Soc. Lond.* 1901: 158-162.
- Boulenger, G. A. 1902. On the fishes collected by Mr. S. L. Hinde in the Kenya district East Africa, with descriptions of four new species. *Proc. Zool. Soc. London.* 1902 (II): 221-224.
- Boulenger, G. A. 1904. Diagnoses of three new species of *Barbus* from Lake Victoria. *Ann. Mag. Nat. Hist.*, (7) 13 (78): 449-450.
- Boulenger, G. A. 1905. On a second collection of fishes made by Mr. S. L. Hinde in the Kenya district, East Africa. *Proc. Zool. Soc. Lond.* 1905 (I): 62-64.
- Boulenger, G. A. 1911. *Catalogue of fresh-water fishes of Africa in the British Museum (Natural History)*. British Museum (Natural History), London. 529 p.
- Boulenger, G. A. 1916. Description of three new cyprinid fishes from East Africa. *Annals and Magazine of Natural History*, (8) 17 (99): 244-245.
- Bruton, M. N. and Kok, H. M. 1980. The freshwater fishes of Maputoland. In *Studies on the ecology of Maputoland*. Edited by M. N. Bruton and K. H. Cooper, Rhodes University, Grahamstown, another Natal Branch of the Wildlife Society of Southern Africa, Durban, pp. 210-244.
- Campbell, K., Coe, C. and Saunders, M. 1986. A survey of fishes of the Tana River at Kora and a checklist of fishes of the Tana River. In *An ecological inventory of the Kora National Reserve, Kenya*. Edited by M. Coe and N. M. Collins. Royal Geographical Society, London, pp. 175-188.
- Copley, H. 1947. *Review of Kenya fisheries 1939 to end of 1945*. Colony and Protectorate of Kenya. Gov. Printer, Nairobi.
- Copley, H. 1958. *Common freshwater fishes of East Africa*. H. F. and G. London, Whitherby, 172 p.
- Craig, J. F. 1992. Human-induced changes in the composition of fish communities of African Great Lakes. *Rev. in Fish Biol. and Fish.* 2: 93-124.
- Daget, J., Gosse, J. P. and D. F. E. Thys van den Audenaerde (Eds) 1984. *Check-list of the freshwater fishes of Africa (CLOFFA)*. Vol. I. ISBN, Brussels, MRA, Tervuren, and ORSTOM, Paris, 410 p.
- Daget J., Gosse, J. P. and D. F. E. Thys van den Audenaerde (Eds) 1986a. *Check-list of the freshwater fishes of Africa (CLOFFA)*. Vol. II. ISBN, Brussels, MRA, Tervuren, and ORSTOM, Paris, 520 p.
- Daget J., Gosse, J. P. and D. F. E. Thys van den Audenaerde (Eds) 1986b. *Check-list of the freshwater fishes of Africa (CLOFFA)*. Vol. III. ISBN, Brussels, MRA, Tervuren, and ORSTOM, Paris, 273 p.
- De Vos, L. 1984. Preliminary data of a systematic revision of the African species of the family Schilbeidae (Pisces, Siluriformes). *Rev. Zool. afr.* 98 (2): 424-433.
- De Vos, L. 2001. *Synodontis manni* (Teleostei: Siluroidea: Mochokidae), a new catfish from the Lower Tana River, Kenya. *Ichthyological Exploration of Freshwaters*.
- De Vos, L. and Skelton P. 1990. Name changes for two common African catfishes. Rehabilitation of *Schilbe intermedius* Ruppell, 1832 (Siluriformes, Schilbeidae). *Cybiium*. 14 (4): 323-326.
- Eschmeyer, W. N. 1990. *Catalogue of the genera of recent fishes*. California Academy of Sciences, San Francisco, 697 p.
- FishBase. 1998. FishBase89. CD-Rom. ICLARM, Manila.
- FishBase. 1999. FishBase99. CD-Rom. ICLARM, Manila.
- FishBase. 2000. FishBase2000. CD-Rom. ICLARM, Manila.
- Fowler, H. W. 1973. A catalogue of world fishes (18). *Q.T. Taiwan Mus.* 26 (1-2): 1-111.
- Fowler, H. W. 1976. A catalogue of world fishes (24 & 25). *Q.T. Taiwan Mus.* 29 (1-4): 1-110, 227-396.
- Gery, J. 1977. *Characoids of the world*. T. F. H. Publications, Neptune City, U.S.A., 672 p.
- Gosline, W. A. 1983. The relationships of the mastacembelid cyprinid fishes. *Japan J. Ichthyol.* 29: 323-328.
- Greenwood, P. H. 1962. A revision of certain *Barbus* species (Pisces, Cyprinidae) from East, Central and South Africa. *Bull. Br. Mus. nat. Hist. (Zool.)* 8 (4): 151-208.
- Günther, A. 1894. Report of the collections of reptiles and fishes made by Dr. J.W. Gregory during his expedition to Mount-Kenia. *Proc. Zool. Soc. Lond.* 1894: 84-91.
- Haas, R. 1981. Notes on three Somalian *Nothobranchius*, new to aquarists. *J. Amer. Killifish Ass.* 14 (4): 91-95.
- Hopson, A. J. and Hopson J. 1982. The fishes of Lake Turkana with a description of three new species: *Alestes ferox* sp. nov., *Alestes minutus* sp. nov. (Pisces, Characidae) and *Barbus turkanae* sp. nov. (Pisces, Cyprinidae). In *Lake Turkana Vol. 1*. Edited by A. J. Hopson. Overseas Development Administration, London, pp. 283-347.
- Howes, G. J. 1980. The anatomy, phylogeny and classification of bariliine cyprinid fishes. *Bull. Bri. Mus. nat. Hist. (Zool.)* 37 (3): 129-198.
- Howes, G. J. 1984. A review of anatomy, taxonomy,

- phylogeny, and biogeography of the African neoboline fishes. *Bull. Br. Mus. nat. Hist. (Zool.)* 47 (3): 151-185.
- Hubbs, C. L. 1918. Notes on fishes from the Athi River in British East Africa. *Field Mus. nat. Hist. Publ.* 12 (2): 9-16.
- Jayaram, C. K. 1984. *FAO Species Identification Sheets for Fishing Purposes*. Western Indian Ocean Fishing Area 51.1. Ariidae, 48 p.
- Jumbe, J. J. 1997. The Status of Tana River Dam Fisheries Twenty Years after Dam Construction. In *African Inland Fisheries, Aquaculture and the Environment*. Edited by K. Remane. FAO and United Nations. Fishing News Books, pp. 33-44.
- Kenya Gov. 1970. *Kenya Fisheries Report of the year 1967-68*. Republic of Kenya.
- Kenya Gov. 1983. *Kenya Aquatic Bulletin No. 1*. Edited by R. M. Nzioka. A Bulletin of Kenya Marine and Fisheries Research Institute.
- Kenya Gov. 1989. *Sagana Fish Culture Farm Annual Report*. Min. Reg. Devlp. Fish Dep. Republic of Kenya. Njuki Investment Ltd., Sagana.
- Kenya Gov. 1990a. *Kenya District River and Camp Report*. Kenya Fisheries Dep. DRL/2.
- Kenya Gov. 1990b. *Kindaruma Dam Commercial Fisheries Report*. Kenya Fisheries Department. DRL/2/2.
- Kenya Gov. 1991. *Shimoni Kwale Fisheries Report*. Kenya Fisheries Dep. Vol.IV. Mar/15/A.
- Mann, M. J. 1966. A preliminary report on a survey of the fisheries of the Tana River, Kenya. *E.A.F.F.R.O., Annual Report (1965)*: 36-43.
- Mann, M. J. 1968. A note on a second survey of the fisheries of the Tana River, Kenya. *E.A.F.F.R.O., Ann. Report (1967)*: 38-41.
- Matthews, H. 1963. A comparative study of the feeding mechanisms of some African Cyprinidae (Pisces, Cypriniformes). *Bidjr. Dierk.* 33: 1-35.
- Meyer, A. and Lydeard C. 1993. The evolution of copulatory organs, internal fertilization, placentas and viviparity in killifishes (Cyprinodontiformes) inferred from a DNA phylogen of the tyrosine kinase gene X-src. *Proc. Roy. Soc. Lond., Ser. B.* 254: 153-162.
- Mo, T. 1991. *Anatomy, relationships and systematics of the Bagridae (Teleostei: Siluroidei) with a hypothesis of siluroid phylogeny*. Theses Zoologicae 17, 216 p.
- Myers, G. S. 1929. Cranial differences in the African characin fishes of the genera *Alestes* and *Brycinus* with notes on the arrangement of related genera. *Amer. Mus. Novit.* 342: 1-7.
- Nelson, J. S. 1994. *Fishes of the world*. Third edition. Wiley-Interscience, New York. 523 p.
- Okeyo, D. O. 1998. Updating names, distribution and ecology of riverine fish of Kenya in the Athi-Galana-Sabaki River drainage system. Naga, the ICLARM Quarterly, 21 (1): 44-53.
- Paugy, D. 1986. *Revision systematique des Alestes et Brycinus Africains (Pisces, Characidae)*. ORSTOM, Paris, Etudes et Theses, 295 p.
- Seegers, L. 1981. *Nothobranchius cyaneus* spec. nov., ein neuer Prachtgrundkarpfling aus Kenia. *D.A.T.Z.* 34 (11): 365-368.
- Seegers, L. 1985a. Farbtupfer aus Ostafrika: Prachtgrundkarpflinge. 5. Die *Nothobranchius*-Arten Kenias, Somalias und des Sahelgürtels. *Aquarien Magazin.* 19 (2): 45-50.
- Seegers, L. 1985b. Prachtgrundkarpflinge. Die Gattung *Nothobranchius*: Systematik, Vorkommen, Pflege und Zucht. *DKG-Journal, Supplementheft Nr. 1*: 1-48.
- Seegers, L. 1985c. Natürliche Biotope. Die Heimat unserer Aquarienfische und -pflanzen. Beispiel: Mini-Teich im Maxi-See: Ein Biotop am Lake Victoria. *Aquarium Heute* 3(1): 30-32; also in: *Today's Aquarium.* 3 (2): 30-32 (eng. trans).
- Seegers, L. 1996. (in press). *The fishes of the Ruhwa Drainage*. Ann. r. Mus. Afr. Centr. (Zool.), pp. 1-394.
- Sethi, R. P. 1960. *Osteology and phylogeny of oviparous cyprinodontfishes (Order Cyprinodontiformes)*. Ph.D. Thesis, Univ. of Florida, Univ. Microfilms, Ann Arbor, 275 p.
- Skelton, P. H. 1994. Diversity and distribution of freshwater fishes in East and Southern Africa. Biological Diversity in African- and Brackish Water Fishes. Geographical Overviews - Symposium Paradi. In Teugels et al. (eds.). *Ann Mus. r. Afr. Centr., Zool.* 275: 95-135.
- Smith, J. L. B. 1959. Gobioid fishes of the families Gobiidae, Periophthalmidae, Trypauchenidae, Taenioididae and Kraemeriidae of the western Indian Ocean. *Ichthyol. Bull. Rhodes Univ.* 13: 185-225.
- Teugels, G. G. 1986. A systematic revision of the African species of the genus *Clarias* (Pisces; Clariidae). *Ann. Mus. r. Afr. Centr., Sci. Zool.* 247: 1-199.
- Travers, R. A. 1984a. A review of the Mastacembeloidei, a suborder of synbranchiform teleost fishes. Part I: Anatomical descriptions. *Bull. Br. Mus. nat. Hist. (Zool.)* 46 (1): 1-133.
- Travers, R. A. 1984b. A review of the Mastacembeloidei, a suborder of synbranchiform teleost fishes. Part II: Phylogenetic analysis. *Bull. Br. Mus. nat. Hist. (Zool.)* 47 (2): 83-150.
- Trewavas, E. 1954. The presence in Africa East of the Rift Valley of two species of *Protopterus*, *P. annectens* and *P. amphibius*. *Ann. Mus. r. Congo Belge,* (4) 1: 83-100.
- Trewavas, E. 1983. Tilapiine fishes of the genera *Sarotherodon*, *Oreochromis* and *Danakilia*. *British Museum (Natural History), London,* 583 p.
- Whitehead, P. J. P. 1958. A new species of *Chiloglanis* (Pisces, Mochocidae) in Kenya. *Ann. Mag. nat. Hist.* (13) 1: 197-208.
- Whitehead, P. J. P. 1959. Notes on a collection of fishes from

- the Tana River below Garissa, Kenya. *J.E. Afr. nat. Hist. Soc.* 23: 167-171.
- Whitehead, P. J. P. 1960. The river fishes of Kenya. Part II. The lower (Sabaki) river. *East African Agr.* 25: 259-265.
- Whitehead, P. J. P. 1962. A new species of *Synodontis* (Pisces: Mochocidae) and notes on a mormyrid fish from the eastern rivers of Kenya. *Rev. Zool. Bot. Afr.* 65 (1-2): 97-120.
- Whitehead, P. J. P. and Greenwood, P. H. 1959. Mormyrid fishes of the genus *Petrocephalus* in eastern Africa, with a redescription of *Petrocephalus gliroides* (Vincig.). *Rev. Zool. Bot. Afr.* 60 (3-40): 283-295.
- Whitfield, A. K. 1980. A checklist of fish species of Maputoland estuarine systems. In: *Studies on the ecology of Maputoland*. Edited by Bruton Cooper. Rhodes University, pp. 204-209.
- Wildekamp, R. H. and Berkenkamp, H. O. 1979. Untersuchungen zur Identität von *Nothobranchius neumanni* (Hilgendorf, 1905) aus Tanzania, mit der Beschreibung einer neue Art und einer Unterart aus Küstengebiet Kenias. *Deutsche Killifisch Gem. J.* 11 (5): 65-75.
- Worthington, E. B. and Ricardo, C. K. 1936. Scientific results of the Cambridge expedition to the East African lakes, 1930-31. No. 15. The fish of Lake Rudolf and Lake Baringo. *J. Linn. Soc.* 39: 353-389.