A Checklist of the Fishes of the Kwando River, Selinda (Magwegqana) Spillway, Lake Liambezi and Chobe River Systems with Notes on their Biology and Distribution

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Introduction

The diversity and distribution of the fish species of the Kwando, Selinda Spillway, Lake Liambezi and Chobe River systems of northern Botswana (Figure 1) are poorly known. Although several fish collections have been made from the Okavango Delta (Merron & Bruton 1988), no systematic checklist of fish from the former wetland system is available for Botswana.

Van der Waal & Skelton (1984) reviewed the early history of fish collections, mainly based on collections from Caprivi. Important collections from the Chobe River near Kasane were made by the Vernay-Lang Kalahari Expedition in 1930 (Fowler 1935). The second Barnard Carp Expedition in 1952 made collections on the Kwando River (Jubb 1958). Collections of fish from Lake Liambezi and the Chobe River near Kazangula were made for the Queen Victoria Museum, Zimbabwe, in November and December 1961 (Guy 1962). Fox & Watt (1976) made a brief visit to the Linyanti River at Shaile in order to observe the effects of a dense growth of the exotic aquatic plant *Salvinia molesta* on the composition of the fish community in infested and non-infested lagoons. Van der Waal & Skelton (1984) provide the only comprehensive checklist of fishes of the Caprivii.

During the course of conducting a fisheries survey of the Okavango Delta between 1983 and 1987, four expeditions to the Kwando, Selinda (Magwegqana) Spillway and Chobe River systems in northern Botswana were made between September 1985 and December 1986. The Chobe River and Lake Liambezi support important commercial and subsistence fishing activities. Yields in excess of 1000 tonnes/annum have been marketed from Lake Liambezi to Zimbabwe and Zambia (Botswana Agricultural Report 1985). Commercial fishermen are also encouraged to produce dried salted fish for sale to the Department of Food Resources for distribution to villages and clinics throughout Botswana. Commercial and subsistence fishermen from Caprivi are also heavily dependent on these waters which annually yield more than 1000 tonnes of fish (van der Waal 1980).

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Due to the extreme drought which Botswana and other southern African countries experienced between 1981 and 1986, Lake Liambezi dried up and the Chobe River west of Ngoma Bridge was reduced to a series of turbid, disjunct isolated pools. This resulted in the loss of jobs and revenue to rural villages and a decreased food availability.

The drying up of Lake Liambezi offered an opportunity to study the response of fishes to desiccating conditions. The drought of the early to mid-1980's also resulted in the drying up of Lake Ngami at the southwestern corner of the Okavango Delta (Merron & Bruton 1988). In 1980 the fish community consisted of 26 species, including benthic, pelagic and littoral forms (Bruton 1980). By December 1982 only two catfish species, *Clarias gariepinus* and *C.ngamensis* were found (Skelton et al. 1983). In late 1984 Lake Ngami once again received water from the Kunyere River and subsequently 12 fish species recolonised the lake (Merron et al. 1985). The lake has, however, been dry since 1985.

These four surveys of northern Botswana also offered an ideal opportunity to compare the species composition and community structure of the fauna with that of the Okavango Delta (Merron & Bruton 1988). These two water bodies are joined via the Selinda Spillway during years of high floods which originate in Angola. Wellington (1955) indicates that river capture by the Zambezi of the Chobe-Linyanti has occurred, and in future a capture by the Linyanti of the Okavango River via the Selinda Spillway is the natural course of evolution of these drainage systems. Although there are conflicting reports with regard to the succession of river capture in relation to the geology of this seismographically active region (see Tilney 1966), the reports all demonstrate a degree of hydrological connection between these two water bodies. More recently, van der Waal (1980) noted that, during his study period, the shallow temporary connection between the Okavango Delta and the Kwando/Linyanti always brought water from the former to the latter area during exceptionally high flood years. It is therefore possible for the Kwando-Linyanti-Chobe-Zambezi-Okavango Rivers to be in periodic confluence.

In addition to the intrinsic scientific value of these expeditions, another objective was to monitor the fishing activities of the Chobe Fishing Competition held at Kasane in November 1985 (Merron & Sehemo 1987). This fishing competition was the first of its type to be held in Botswana and the results provide a foundation against which to compare catches in future competitions.

The present paper provides the first checklist of fishes of the Kwando River, Selinda Spillway, Lake Liambezi and Chobe River in Botswana and contributes to the understanding of the species diversity, distribution and ecology of this important wetland system.

Collecting Sites and Equipment

The terrain in northern Botswana is remarkably level. The annual floodwaters, therefore, have a large influence on the surface area of floodplain inundated each year. The Kwando, Linyanti and Chobe Rivers also form the international boundary with Namibia.

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The Kwando River originates in southeastern Angola. The annual flood reaches a peak in the Kwando River in June/July although the timing, magnitude and duration of flooding is unpredictable. The flow of water in this system is restricted as a result of the meandering course of the main river, the cushioning effect of the dense *Phragmites-Cyperus* margins and the extensive floating mats of *S. molesta.*

There is no clearly defined border between the Kwando River and Linyanti River but there is a change in habitat type. The sharp, almost 90^0 bend in the river (Figure 1) where the Selinda Spillway enters the system terminates the Kwando River and continues as the Linyanti River (P. Smith pers. comm.). The annual flood waters reach Sarugxa and Zibadianja lagoons (Figure I) in August. However, the interconnection betwen the Selinda Spillway and Kwando/Linyanti Rivers is, at present, a narrow, hippopotamus channel barely visible from the air and difficult to navigate in a boat (P. Smith pers. comm.). A high degree of suspended particle settling takes place in these lagoons due to decreased water velocity and dense submerged macrophyte beds. *S. molesta* is absent from Sarugxa and Zibadianja lagoons.

During years of high floods, the water level reaches a peak at Lake Liambezi, at the end of the Linyanti River, in August (Fisheries Unit pers. comm.). This system connects with the Zambezi via the Chobe River which has its origin in Lake Liambezi. During the time of these surveys all tributaries leading into Lake Liambezi were dry and the lake was reduced to approximately 5% of its potential surface area.

Flow in the Chobe River can change depending on the prevailing hydrological cycle. During years of high floods, flow in the Chobe can change direction three times a year: August-January eastwards towards the Zambezi (Kwando flood and rain-water drainage), February-March westwards towards Lake Liambezi, and April-June eastwards - during the drainage of the floodplains (van der Waal 1980). The margins of the Chobe River are characterised by reeds and bullrushes with papyrus only occuring in patches. Mats of *S. molesta* were observed floating on the river surface although they did not appear to have a major influence on flow patterns.

The collections of fish recorded during these four surveys were made between September 21-25 and November 9-14, 1985, along the Chobe River at Kasane and at Lake Liambezi; May 8-10, 1986, on the northeastern corner of the Selinda Spillway at Sarugxa and between December 7-11, 1986,,at James Camp situated on the Kwando River and Zibadianja Lagoon (Figure 1).

The following methods were used to collect fish at the different sampling sites:

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1. A gillnet fleet consisting of 15 m panels of 24, 40, 50, 60, 75, 96, 112, and 143 mm stretch mesh-size was set for two consecutive nights at each sampling station. These nets were frequently damaged by crocodiles.

2. A 10 m seine net with a mesh size of 12 mm was used along sandy beaches on the Chobe River at Kasane, and in drying up pools around Lake Liambezi near Satau.

3. Rotenone ichthyocide was used to sample fish populations in vegetated pools and reed beds along the Kwando River and Zibadianja Lagoon in December 1986.

4. Detailed examination of sport-fishing catches taken at the Chobe Fishing Competition (see Merron & Sehemo 1987).

5. Examination of catches of local commercial and subsistence fishermen were recorded in September and November 1985 at Kasane and Satau.

Selected fish species of commercial and ecological importance were measured (Standard length to 1 mm), weighed (to 1 g) and sexed and the maturation of the gonads assessed on a 1 to 6 scale (Nikolsky 1963). Stomachs were examined in the field, and stomachs with contents were removed and preserved in a 10% formalin solution. Stomach contents were sorted in the laboratory and a qualitative volumetric assessment of the dietary categories, weighted by a stomach fullness index, was assigned to each stomach. This method most closely resembles the Hynes (1950) method whereby values (e.g. 10%, 20%) are ascribed volumetrically to individual food items. Stomach fullness was visually assessed on a 0 to 4 scale, 0 being empty and 4 being full. The value ascribed to a particular food item was multiplied by the degree of stomach fullness. The importance of each dietary category was then calculated by expressing the product of values, for each food item for all stomachs, as a percentage of the total value.

The bulk of the gillnetted fish was given to local people. Fishes collected using seine nets and rotenone were identified and counted. These fish have been deposited in the fish collection of the J.L.B. Smith Institute of Ichthyology.

Results

1) Species Diversity and Distribution

Table 1 gives a summary of fish species collected during the four expeditions. A total of 53 species was recorded, with the greatest number of species collected in the Selinda Spillway. This area has a high diversity of fishes because habitat diversity is high even during extreme drought conditions when permanent refuge areas such as Saruxga and Zibadianja harbour important fish populations.

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Fish species collected during these surveys which were not collected by van der Waal & Skelton (1984) in the Kwando, Lake Liambezi or Chobe Rivers include *Hippopotamyrus discorhynchus* and *Labeo cylindricus*. Species not recorded in these surveys but recorded by these authors include *Barbus paludinosus*, *B. afrovernayi*, *B. barotseensis*, *L.lunatus*, *Nothobranchius* sp., *Zaireichthys* sp., *Clarias submarginatus*, *Serranochromis (Sargochromis) carlottae* and *Tilapia ruweti*. Many of these species are extremely rare habitat specialists which require a considerable amount of effort to catch. Two species, *Afromastacembelus frenatus* and *Auchenoglanis ngamensis* were collected in Lake Liambezi but were not previously recorded by van der Waal & Skelton (1984) from this lake.

The most ubiquitous species collected in all sampling sites were *Marcusenius macrolepidotus*, *Hepsetus odoe*, *Schilbe mystus*, *Clarias gariepinus*, *Oreochromis andersonii*, *Pharyngochromis darlingi*, *Pseudocrenilabrus philander* and *Tilapia rendalli*. These species are also found throughout the Okavango Delta system (Merron & Bruton 1988). The capture of *Micralestes acutidens* and *Opsaridium zambezense* only from the Kwando River is in agreement with the distribution of these species recorded by van der Waal & Skelton (1984).

2) Species Composition of Sampling Sites

Figure 2 shows the mass compostion of the fishes collected in the Kwando River. The fauna is dominated by *Hydrocynus forskahlii*, which contributes 69% of the total mass. Other prominent species include *Clarias gariepinus* (16%), *O. andersonii* (9%) and *Tilapia rendalli* (2%). The remaining 13 species contribute 4% to the total. Numerically the smaller rheophilic fish, such as *M. acutidens* and *O. zambezense*, are the most commonly encountered species (Table 1).

The low diversity of fish in the Kwando River (i.e. 17 species) may be related to the limited habitat diversity of this sampling site. The width of the river, at the time of this survey, averaged 10 m with a narrow littoral fringe. Dense, floating mats of *S. molesta* were often observed clogging the entire width of the river channel. The presense of this exotic plant has been shown to effect the species composition of fish in the Linyanti River (Fox & Watt 1976). Of the 11 species recorded from gillnet catches in the non-*Salvinia* infested water, only 2 species were recorded in *Salvinia*-infested water (Fox & Watt 1976). In addition, less than 15% of the total weight of fish caught in the non-*Salvinia* infested waters was recorded in *Salvinia* infested waters. The establishment of *Salvinia* mats leads to the exclusion of light, thus reducing primary productivity and nutrient exchange. This results in a reduction in oxygen concentrations to levels which are unsuitable for most fish species.

The species mass composition of the Selinda Spillway at Sarugxa and Zibadianja lagoons (Figure 2) indicates a fish population dominated by *O. andersonii* (19%), *Serranochromis (Serranochromis) angusticeps* (12%), *S. (S.) robustus* (5%), *S. (Sargochromis) giardi* (11%), *Clarias gariepinus* (23%) and *C. ngamensis* (12%). A more uniform distribution in species

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mass composition, when compared to the Kwando River, is apparent with important contributions from *Schilbe mystus* (5%), *Mormyrus lacerda* (3%) and *Hepsetuus odoe* (2%).

The fish communities of the Selinda Spillway most closely resemble those found in the lower seasonal swamp of the Okavango Delta (Fox 1976; Merron & Bruton 1988). The relatively high diversity of fishes recorded from this sampling site may be attributed to a greater habitat diversity and absence of S. molesta.

The species composition of Lake Liambezi (Figure 2) was dominated by a few larger fish species such as *C. gariepinus* (35%), *Oreochromis macrochir* (21%), O. andersonii (17%), *Serranochromis (S.) angusticeps* (11%) and *T. rendalli* (7%). Other relatively common species included *H. odoe* (2%) and *Synodontis nigromaculatus* (1.8%). Of particular interest was the relative increase in mass contribution of *Oreochromis macrochir* when compared to *O. andersonii.*

The species composition of Lake Liambezi as recorded here under desiccating conditions is similar to that recorded for Lake Ngami during late 1982 when this lake was also drying up (Skelton et al. 1984). The dominance of the genus *Clarias* and *Oreochromis* during extreme environmental conditions has also been reported by Jackson (1989) and this trend can be attributed to the wide range of physiological tolerances and phenotypic plasticity exhibited by these fish.

Although van der Waal & Skelton (1984) record 43 species from Lake Liambezi at a time when it was full, many of these species have now disappeared due to increased competition and predation in the remaining water bodies. In drying up pools in the Kunyere River leading in to Lake Ngami, large numbers of a variety of species (25-30) were found in pools without the predator *C. gariepinus* while low numbers of 1-2 species were found in pools with this predator (Skelton et al. 1983).

The species composition of the Chobe River (Figure 2) was dominated by *C. gariepinus* (30%), *O. andersonii* (27%) and *H. forskahlii* (19%). Other important contributions were made by *Schilbe mystus* (9%), *Synodontis spp.* (6%), *Serranochromis (Serranochromis) augusticeps* (3%), and *S. nigromaculatus* (2%). The presence of *H. forskahlii* and *Labeo cylindricus* (Table 1) indicate a more riverine environment and in this respect the fauna of the Chobe River shares some similarities with the Kwando River.

The results on species composition for the Chobe River, particularly for the larger fish species (e.g. *C. gariepinus O. andersonii* and *H. forskahlii*) are similar to those recorded during the Chobe Fishing Competition (Merron & Sehemo 1987). This provides further evidence of the dominance of these three species at this sampling site.

A further mention of the distributional pattern of *H. forskahlii* is warranted. At present *H. forskahlii* in the Chobe River most likely immigrate into this river system from the Zambezi River while *H. forskahlii* in the Kwando River originate from a different stock.

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This is because the Chobe River, during periods of drought, is maintained by backflow from the Zambezi River with limited, if any, flow from Lake Liambezi. The population of *H. forskahlii* becomes separated as the waters of the Linyanti Swamp become shallow and inhibit the movement of this species. During periods of high floods when a strong flow comes down the Kwando River, Linyanti Swamp and Lake Liambezi, large scale movements of *H. forskahlii* from the Kwando and Chobe rivers into Lake Liambezi probably occur, resulting in an overlap of stocks.

3) Catch Per Unit Effort (CPUE)

To determine the distribution of biomass at different sampling sites, catches were made using a standard fleet of gillnets set during each survey period (Table 2). There were marked differences in the CPUE between the four sampling sites. The highest catches were recorded at Sarugxa and Zibadianja lagoons with an average CPUE of 30 kg of fish per experimental gillnet fleet. An explanation for the large catch of fish in these lagoons may lie in the fact that they are nutrients sinks for organic and inorganic material transported down the Kwando River. The presence of a large number of resident hippopotamuses also enriches the waters through defecation. The dung forms an important component of the detrital food web which is the principle food source for many fish species.

The CPUE for Lake Liambezi was similar to that recorded for Sarugxa and Zibadianja with 25.5 kg of fish caught per experimental gillnet fllet. The relatively large catch in Lake Liambezi probably reflects the concentrating effect of fish during reduced water levels in the lake.

The CPUE for the Chobe River system was 10kg per experimental gillnet fleet. This apparent decrease in catch may reflect the lower biological productivity of this river system when compared to sampling sites in the Selinda Spillway. In addition, commercial, recreational and subsistence fishing activities by both Batswana and Caprivi fishermen may also be responsible for the reduced catch. Fishermen from Caprivi harvest considerable numbers of fish using large mesh gillnets (e.g. 75, 96 & 110 mm stretch-mesh) from the Chobe system.

The Kwando River had the lowest recorded CPUE of 5.5 kg for the experimental gillnet fleet. The relatively low catch in the Kwando River is most likely due to the limited habitat diversity in the river as a result of the drought and presence of *S. molesta* discussed above.

4) Reproduction and Spawning Observations

The gonad maturation index for selected species caught in the four different surveys is presented in Table 3. In September 1985 none of the fish were in ripe-running condition (Table 3). During this time many of the tilapia and catfish species did have ripe gonads, indicating that these fishes were preparing to spawn (Table 3).

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During the November 1985 survey, *C. gariepinus*, *O. andersonii*, *T. rendalli*, *Serranochromis (Serranochromis) augusticeps*, *S. (S.) macrocephalus* and *Schilbe mystus* were in ripe-running condition (Table 3). This is in sharp contrast to fish collections made in May 1986 in which most fishes had spent or undeveloped gonads.

Widespread spawning in most species was recorded during the December 1986 survey (Table 3). Juveniles of many species were caught with seine nets and rotenone indicating that a large amount of spawning activity occurred during early summer. In permanent water bodies, such as Sarugxa and Zibadianja lagoons, it is believed that many multiple spawning fish species, such as the tilapia, have an extended spawning season as recorded by van der Waal (1980) for Lake Liambezi. Fishes spawn throughout the summer period taking advantage of relatively stable hydrological conditions and increasing water temperatures.

It is generally accepted that the standing stock of fish in African wetlands is reasonably well-correlated with the flood history of the two previous years (Welcomme 1979). Periods of high water level result in greater percentage of the fish population successfully spawning with subsequent strong year classes becoming apparent in the fishery.

5) Feeding

An analysis of the stomach contents taken in selected fish species is presented in Table 4. It is apparent that a wide variety of food items are consumed, though not necessarily simultaneously. The dietary items consumed by fish in the narrow, fast flowing stretches of the Kwando River indicate an epiphytic and predatory food chain. The majority of food items (i.e. invertebrates) inhabit the papyrus mats, reed beds and associated periphyton. These plants support a large epiphytic population for the fish to feed on. This epiphytic food chain exists with a predatory trophic link (e.g. *M. acutidens* and *O. zambezense* to *H. forskahlii*) as the dominant (in terms of biomass) trophic group.

The stomach contents of fish from Sarugxa and Zibadianja lagoons indicate a detrital and epiphytic food chain with a strong predator link (e.g. *O. andersonii*, *O. nacrochir* to *H. odoe*)

Unfortunately, the stomach contents of fish from Lake Liambezi were largely decomposed at the time of collecting. It was difficult to sample Lake Liambezi as the lake was drying up and took over two hours to reach by foot, often through thick mud. Based on the species composition of the gillnet catch, it is, however, apparent that a detrital/predator food chain exists. The stomach contents which were not decomposed did not contain any epiphytes which is probably the result of the limited littoral fringe as the lake dries up.

The stomach contents of fishes from the Chobe River indicate that a wide variety of dietary items are consumed and in this respect their diets are similar to the diets recorded for fish from the Selinda Spillway. An epiphytic and detritivorous food web is found, with fish feeding on plant and animal material with *H. forskahlii* as the top predator.

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Discussion

Fifty-three fish species have been collected during these brief but intensive surveys in northern Botswana. Some typical fish species are illustrated in Figure 3. The fish communities vary between river systems, although it is postulated that a greater degree of community overlap occurs during prolonged high water levels, when conditions allow a greater access of species throughout the system. The fish fauna of this area is similar to that of the Okavango Delta and the upper Zambezi River, as a result of the periodic inter-linking of these river basins.

The fish species of the Kwando, Selinda Spillway, Lake Liambezi and Chobe river systems may be divided into two groups according to their habitat preferences. In the Kwando and Chobe Rivers species such as *H. forskahlii, O. zambezensis, M. acutidens, L. cylindricus* and *A. frenatus* are highly mobile, rheophilic species which prefer fast-flowing conditions. In the Selinda Spillway and Lake Liambezi, the fauna was characterised by relatively sedentary species such *O. andersonii, O. macrochir, S. (S.) augusticeps, C. ngamensis, H. odoe*, and many of the smaller species such as *Hemigrammocharax machodoi, Barbus spp.* and *Ctenopoma intermedium* which prefer well-vegetated, slower flowing waters in more swampy conditions.

In Lake Liambezi, the community was dominated by a few larger residual species. Once this lake refills and the fishery at Satau and those in other small rural villages resume operations, every effort should be made to crop the abundant stock of *Schilbe mystus*. This is presently being carried out in the Okavango (Merron & Bruton 1988). This species of fish represents an important resource which could be drawn on to increase the yields of fish to local fishermen. This resource could be exploited and provide a more balanced fishery using smaller mesh gillnets of 50-60 mm stretched mesh. Merron & Bruton (1988) have shown that relatively few immatures of the larger growing fish species will be caught in these nets, which reflects different behaviour patterns in immature fish preferring shallow well-vegetated areas.

The CPUE was highest in Sarugxa and Zibadianja lagoons where a yield of 30 kg per experimental gillnet fleet was recorded. This high catch may reflect the underexploited nature of the waters. In addition, these waters appear to be more eutrophic, although limnological information is wanting. It is possible, however, that these lagoons serve as nutrient sinks for organic material moving down the Kwando River. Theoretically, a higher productivity would be expected. The Kwando River had the lowest CPUE of 6 kg per experimental gillnet fleet. The reasons for the apparent depauperate catch are difficult to explain with the limited information and may be attributable to a number of factors. The most obvious reason is that this area has experienced a severe drought and irregular flood cycle since the early 1980's. It is postulated that due to the absence of sufficient lateral flooding onto the floodplains, the smaller prey species have been severely limited by a

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reduction in spawning habitat. This may have had an impact on the larger species such as *H. forskahlii* by reducing their food resource.

It is also possible that the waters of the Kwando River are oligotrophic (i.e. nutrient-poor) as recorded for the Okavango (Thompson 1976). The presence of *S. molesta* may also be a contributing factor to the lower catch by reducing sunlight penetration and limiting primary productivity

Pack-hunting by catfish has been recorded for Lake Liambezi by van der Waal (1980). He observed that *C. gariepinus* pursue fish to the water surface when the lake and surrounding floodplains recede. The main prey species recorded from van der Waal's (1980) study were the small cyprinids *Barbus paludinosus* and *B. haasianus*, the distichodontid *Hemigrammocharax spp.* and small cichlids. In the Okavango, Merron (1987) found *C. gariepinus* feeding almost entirely on mormyrids. In the Savuti Channel pack-hunting catfish have been observed, although not in the Chobe River (M. Slogrove pers. comm.).

This vast wetland system in northern Botswana contains an important fisheries resource and every effort should be made to study the resource in greater detail in order to provide a more thorough understanding of the factors which limit the distribution and abundance of the fish species. This information is vital for the longterm conservation of this unique wetland resource.

ACKOWLEDGEMENTS

I am most grateful to the Office of the President and the Ministry of Agriculture, Fisheries Unit, for permission to perform research in Botswana. Numerous persons have assisted in the fieldwork and/or provided logistical support during these surveys. I am especially grateful to John Paton, Pete Smith, the Chobe Safari Lodge, Tom Sehemo, James Molefane and Monnaesheko. Vuyisile Yose is thanked for his untiring laboratory efforts.

Financial support for these surveys was provided by the Southern Africa Nature Foundation, Nampak and the J.L.B. Smith Institute of Ichthyology. I would also like to extend a special thank you to Prof. M.N. Bruton and Dr. P.H. Skelton for reviewing this manuscript and to Sheila Coutouvidis for preparing the figures.

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TABLE 1. Checklist and relative abundance of fish species collected in the Kwando River (December 1986), Selinda Spillway (May & December 1986), Lake Liambezi (September & November 1985) and Chobe River (September & November 1985). Data for Linyati from Fox and Watt (1986).

Species	Common Name	Kwando	Selinda Spillway	Linyati	Lake Liambezi	Chobe
Mormiridae						
Hippopotamyrus discorhynchus	Zambezi parrotfish	3				
Marcusenius macrolepidotus	Bulldog	3	33	58	2	3
Mormyrus lacerda	Western bottlenose		11	6		
Petrocephalus catostoma	Churchill				2	95
Pollimyrus castelnaui	Dwarf stonebasher		5			1
Characidae						
Brincynus lateralis	Striped robber		46		7	72
Hydrocynus forskahlii	Tigerfish	28				24
Micralestes acutidens	Silver robber	64				
Rhabdalestes maunensis	Slender robber	12	1			147
Hepsetidae						
Hepsetus odoe	African pike	1	11	7	12	4
Distichodintidae						
Hemigrammocharax machodoi	Dwarf citharine		14			8
H. multifasciatus	Multibar citharine		2			
Cyprinidae						
Barbus barnardi	Blackback barb		1		18	
B. bifrenatus	Hyphen barb		3			9
B. fasciolatus	Red barb		3			
B. haasianus	Sicklefin barb		6			

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Species	Common Name	Kwando	Selinda Spillway	Linyati	Lake Liambezi	Chobe
B. multilineatus	Copperstripe barb		1			13
B. poechii	Dashtail barb		4		3	21
B. radiatus	Beira barb		5		2	
B. thamalakenensis	Thamalakane barb		14			
B. unitaeniatus	Longbeard barb		7		5	3
Labeo cylindric	Redeye labeo					11
Coptostomabarbus wittei	Upjaw barb		14			
Opsaridium zambezense	Barred minnow	38				
Schilbeidae						
Schilbe mystus	Butter catfish	1	103	74	17	70
Clariidae						
Clarias gariepinus	Sharptooth catfish	1	32	4	31	16
C. ngamensis	Blunttooth catfish		18	5		1
C. theodorae	Snake catfish	2	3			
Mochokidae						
Synodontis leopardinus	Leopard squeaker		13	6	34	35
S. macrostigma	Large-spot squeaker		1			
S. nigromaculatus	Spotted squeaker	1	8		18	23
Poeciliidae						
Aplocheilicthys hutereaui	Mesh-scaled topminnow		13			
A. johnstonii	Johnston's topminnow		14			
A. katangae	Striped topminnow	2	1			
Bagridae						
Auchenoglanis ngamensis	Zambezi grunter				1	

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Species	Common Name	Kwando	Selinda Spillway	Linyati	Lake Liambezi	Chobe
Cichlidae						
Hepichromis elongatus	Barred jewelfish					1
Oreochromis andersonii	Threespot tilapia	3	51	9	28	20
O. macrochir	Greenhead tilapia		15		56	1
Pharyngochromis darlingi	Zambezi happy	2	18		63	18
Pseudocrenilabrus philander	Southern mouthbrooder	1	35		40	8
Serranochromis (Serrnochromis) angusticeps	Thinface largemouth		20	1	19	2
S. (S.) longimanus	Longfin largemouth				1	
S. (S.) macrocephalus	Purpleface largemouth		1		5	1
S. (S.) robustus jallae	Nembwe		9			1
S. (S.) thumbergi	Brown spot largemouth		1			
S. (Sargochromis) codringtoni	Green happy		2	1	6	
S. (S.) giardi	Pink happy		33	3		
S. (S.) greenwoodi	Greenwood's happy		1			
Tilapia rendalli rendalli	Redbreast tilapia	1	7	1	33	14
T. sparrmanii	Banded tilapia	1	10			22
Anabantidae						
Ctenopomo intermedium	Blackspot climbing perch		5			
Mastacembelidae						
Aethiomastacembelus frenatus	Manyspined climbing eel	1				2
No. of species		17	42	12	23	30
No. of specimens		162	595	175	404	652
Total mass (g)		13846	128848	40100	105742	42800

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TABLE 2. Catch per unit effort (kg/120 m experimental gillnet/14 hours) at different sampling sites between September 1985 and December 1986.

Locality	Habitat type	CPUE
Kwando River	narrow, riverine	5.5
Sarugxa & Zibadianja	open water, lacustrine	30.0
Lake Liambezi	shallow, endorheic	25.5
Chobe River	wide, slow flowing	10.0

Figure 1. The Kwando River, Selinda Spillway, Linyati River, Lake Liambezi and Chobe River systems in northern Botswana showing the location of the sampling sites.

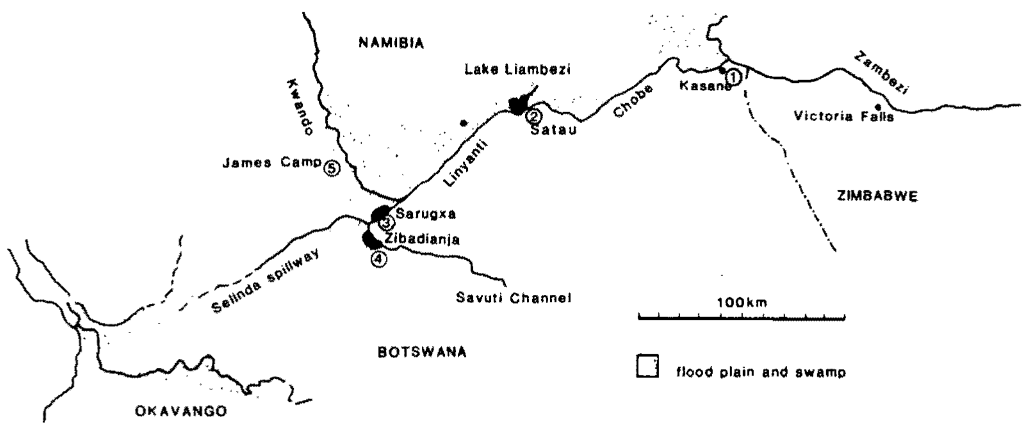

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Figure 2. The percentage mass composition of species gillnetted in the Kwando River, Selinda Spillway, Lake Liambezi and Chobe River systems between September 1985 and December 1986

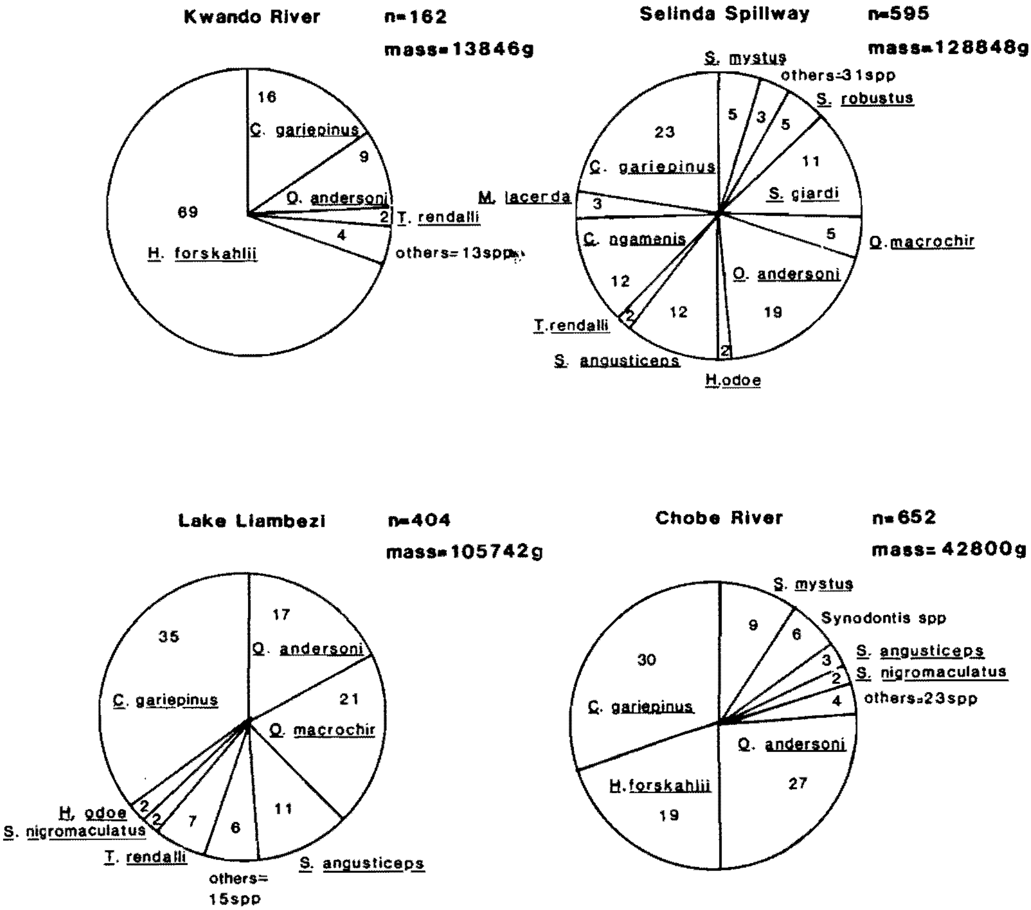

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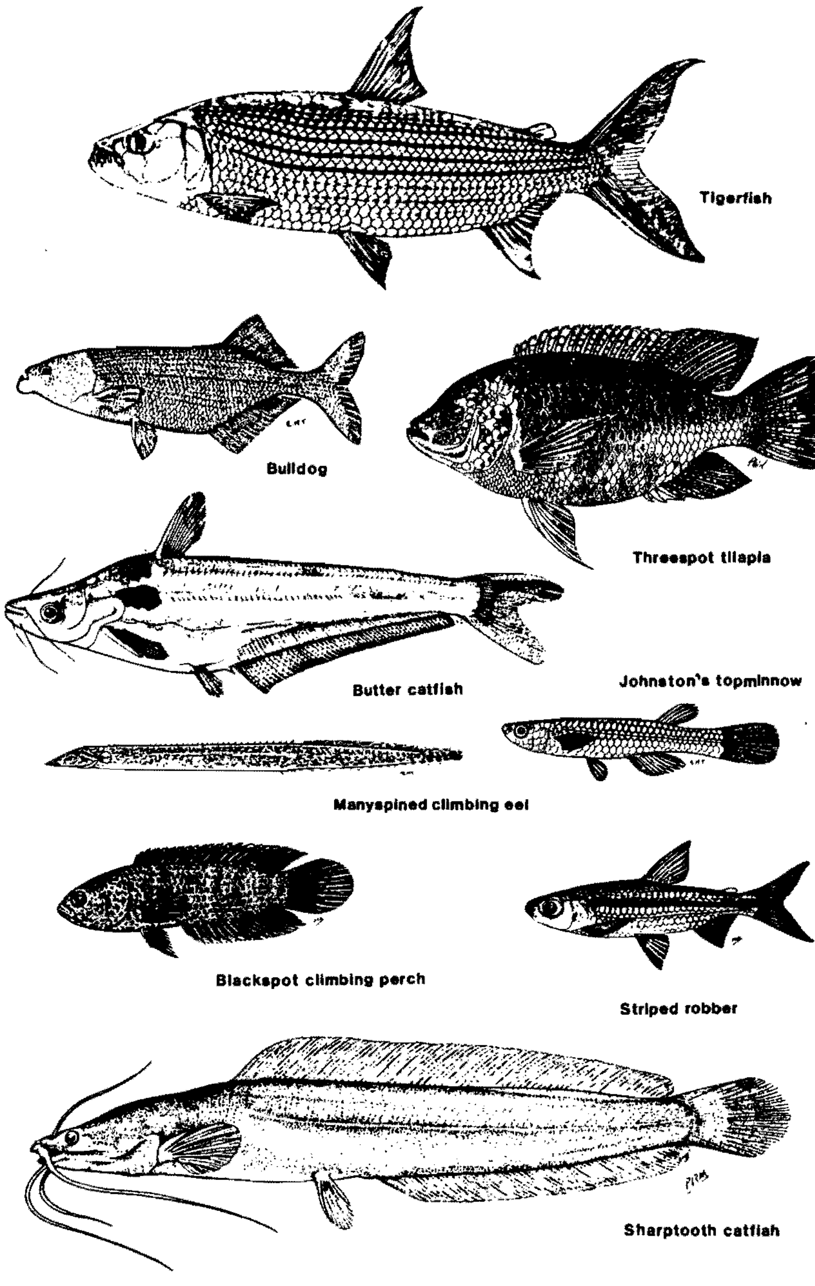
Figure 3. Representative fishes collected from various sampling sites in northern Botswana between September 1985 and December 1986



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