

INTEGRATED MANAGEMENT OF ZAMBEZI / CHOBE RIVER SYSTEM - TRANSBOUNDARY FISHERIES RESOURCE NAMIBIA / ZAMBIA / BOTSWANA

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Management plan for the Caprivi floodplain fisheries with particular reference to the activities of the Zambezi/Chobe fisheries project during 2010 to 2012

December 2009



Project meeting with Impalila Conservancy committee



Recording fish catches from Lake Liambezi



Fish landing site, Lake Liambezi



Exploiting a valuable food resource during floods

by: Denis Tweddle & Clinton J. Hay

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**INTEGRATED MANAGEMENT OF
ZAMBEZI / CHOBE RIVER SYSTEM -
TRANSBOUNDARY FISHERY RESOURCE,
NAMIBIA / ZAMBIA / BOTSWANA**

**MANAGEMENT PLAN FOR THE
CAPRIVI FLOODPLAIN FISHERIES**

**WITH PARTICULAR REFERENCE TO THE ACTIVITIES OF
THE ZAMBEZI/CHOBE FISHERIES PROJECT DURING
2010 TO 2012**

**Denis Tweddle & Clinton Hay
December 2009**

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PREFACE

The Caprivi Floodplains comprise a complex environment subject to extreme fluctuations, with both an annual flood cycle and considerable changes in flood levels from year to year. Over the last few decades since river levels began to be recorded, there have been lengthy periods of consistently high floods, and also periods when much smaller floods were the norm. The floodplains have an enormous variety of habitats and a diverse fish fauna adapted to the fluctuating environments.

Most fish species in the floodplain environment are small, fast-growing and early-maturing. They make spawning migrations out on to the floodplains as the water level rises and occupy all available habitats, from small rivulets to shallow ponds and to large lagoons and lakes. They take rapid advantage of the high productivity generated by flooding of terrestrial vegetation and other organic matter.

In contrast, the larger cichlid ('bream') species take much longer to reach maturity and are dependent on deeper water such as main river channels, backwaters and lagoons to spawn. The young are found in the shallows close to vegetation in which they avoid predation, only moving out into open water when they are large enough to be safe from predation. They move with the flood waters to colonise new areas.

Predatory tigerfish are predominantly mainstream fishes, although they do move out into larger channels on the floodplain during periods of strong flow.

The different lifecycles of these species and the large natural fluctuations in recruitment generated by the complex flood regimes means that no simple fisheries management measures can be put in place that would lead to optimum sustainable yields for all species. Setting of catch quotas, effort quotas, uniform mesh size restrictions, etc. are impractical. The complexity of the fish resources means that a complexity of regulations is needed, and this cannot be achieved through a uniform set of legal restrictions to be imposed throughout the floodplain area.

It is for these reasons that an adaptive management plan is proposed for the Caprivi Floodplains, with decision-making and management devolved to the local communities, who are more aware than anyone else of the dynamics of the fisheries in their particular sectors of the system. The role of central government then becomes primarily advisory, and providing back-up when strong measures are needed to assist communities in curbing illegal and destructive fishing practices.

This management plan has been developed through the course of the first phase of the project to adapt to the complex nature of the fisheries, and also to attempt to adapt to the difficulties caused by the trans-boundary nature of the resources and consequent need for harmonisation in activities between the three countries sharing the resources.

The plan is in two parts:

Firstly, a general overview is presented of the situation and the options available for management. This includes a description of the different components of the fishery (subsistence, semi-commercial and tourist angling) and the state of the stocks; a brief

description of alternative management methods, including community-based management and steps to be taken to accomplish this; cross-border collaboration; and the research needs to monitor the success or otherwise of the management actions.

The second part of this document describes the set of activities to be undertaken to achieve the aims of the Zambezi/Chobe project and ensure sustainable management into the future. It includes:

1. defining the roles of Central Government, Traditional Authority, Regional Council, Conservancies and village/area committees;
2. devolving decision-making to local communities;
3. establishing and bringing into law a basic set of regulations to universally ban the most destructive fishing gears;
4. setting out steps for developing agreed localised regulations;
5. setting up Fish Protection Areas with the aim of protecting breeding stocks of commercially-valuable fish species to improve recruitment to other fishing areas nearby, while simultaneously generating revenue from angling tourism lodges;
6. establishing collaboration with neighbouring countries;
7. harmonising management actions between the countries using the resource.

If these activities are achieved during the three years of the next phase of the project, an effective management system for the different components of the Caprivi fishery should be assured for the future, ensuring both sustainable food supplies for the people of the area and an angling tourist industry bringing valuable employment to floodplain communities.

PART 1. OVERVIEW OF FLOODPLAIN FISHERIES AND MANAGEMENT

1.1 Introduction

Fishery management systems entail a wide array of activities to ensure sustainable and responsible use of fish resources. These include controlling and management procedures (policies, legislation, development of infrastructures, devolution of rights, surveillance), research studies (developing databases for the identification of trends, stock assessment, etc.) and monitoring aspects (quantitative assessment tools).

In the fisheries of the main river channels and the floodplains of the Zambezi-Chobe system, fish species diversity and distribution, fish abundance, flood magnitude, transboundary issues, multi-disciplinary activities on the floodplains, and the diverse aspirations of the different stakeholders must all be taken into consideration when developing a comprehensive management plan.

Is it possible to manage a dynamic and fluctuating system such as the Zambezi Floodplains in such a way that it impacts on the fish and fishing communities in a way that benefits all stakeholders? Different approaches to manage the resource are possible:

1. Comprehensive rational planning where the resource is considered to be fully understood as a result of research. This could have unintended consequences if it turns out that the system is not as fully understood as previously thought.
2. The precautionary principle, i.e. “rather safe than sorry”. This may lead to the under-exploitation of a resource to the detriment of poor rural communities.
3. The third is the adaptive approach, which responds to circumstances and new information and is structured as a process of “learning by doing”.

The latter is recommended for dynamic systems such as the Zambezi and Chobe Rivers.

The Government of Namibia is bound by its Constitution (Article 95), i.e.

“The state shall actively promote and maintain the welfare of the people by adopting --- policies aimed at --- maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future.”

As the Upper Zambezi River flows through several countries, this further complicates the management aspect of the resource. To develop legislation in any particular country is already a very difficult task, but to expand this to include several countries asks for patience, skill and trust.

One aspect, which must be taken into consideration in stock assessment, is the inter- and intra- annual environmental variability of a pulsed system. The annual flood cycle of the Zambezi River is the main driving force of nutrient input into the system, stimulating biological productivity. Variability of fish stocks in pulsed river systems such as the Zambezi River occurs naturally whether the system is exploited or not. Several aspects of the flood play an important role in the biological production and can be listed as follows:

- The timing of the flood.
- The magnitude of the flood.
- The duration of the flood.
- The number of flood peaks.
- The rate at which the floodplains inundate and the rate at which the flood recedes.

Fish species and communities in highly pulsed systems respond to the unpredictability of the flood regime. Many of the species compensate for the variability by having short trophic pathways, seasonal spawning with a high fecundity with no parental care, and lateral and longitudinal migratory behaviour. Many are pioneering species with short life cycles. They are *r*-selected and growth to maturity is fast, within 1-2 years. The natural mortality is variable, the biomass is low, but the productivity is high. Furthermore, the species are very resilient, with a high potential yield.

Some of the larger species do, however, exhibit some *K*-selected traits such as large size, slow growth, late maturity, long-lived, and with breeding and feeding specialisations. This group of fishes, particularly the large mouth-brooding cichlids, is thus more susceptible to fishing pressure than the first group. It is these species that are the most valuable in the fishery, both for food and for sport.

Many floodplain fisheries in Africa have a tendency to target the larger fish species. Such selective fishing results in small, short-lived, less valuable species replacing larger, longer-lived, more valuable species as the fishery intensifies. The short-lived species can better withstand higher fishing pressure (mortalities) due to their short turn-over rate. This is described as fishing down the food web. Fishermen adapt to changes in the catches, especially if it is for household consumption by changing to smaller mesh sizes or using traditional gear to target smaller floodplain species, especially during the receding phase of the flood or during migration periods.

Fishing for a market with a specific preference results in increased, capital-driven effort, where more efficient fishing gears are used. Catches have to justify the investment. The rural poor seldom form part of any capital-driven fishery that is undertaken by the wealthier section of the community, who do not depend on the fish resource for a daily protein source. This leads to a fishery where the rich get richer and the poor even poorer. The Namibian Government stipulates that poor rural communities should be protected and thus a commercial fishery on the floodplain and rivers is undesirable.

An example of a collapsed *Oreochromis* spp. fishery can be found in Lake Malombe in Malawi. The annual yield declined from 4000 tonnes to 50-200 tonnes per year. The 0+ and 1 year juveniles were overfished mainly by small mesh beach seine nets and nkacha nets, a simple form of open water seine. Destruction of the vegetation, in which the juveniles lived and fed, by dragging nets further aggravated the problem. This led to the collapse of the *Oreochromis* spp. fishery in Lake Malombe. It is important that Namibia and Zambia learn from this collapse and ensure the same does not happen to the *Oreochromis* and other large cichlids fishery in Caprivi.

In Namibia, the Ministry of Fisheries and Marine Resources (MFMR) developed an Inland Fisheries Policy and Legislation in 1993. All important fishery regions were visited by the MFMR to acquire input from the stakeholders to ensure that their fisheries experience and concerns regarding the resource are noted. A forum was created where all stakeholders could

participate and the MFMR developed a policy and legislation that could be modified over time. The White Paper “*Responsible Management of the Inland Fisheries of Namibia*” was published in 1995 and the Act was promulgated in 2003.

The Inland Fisheries Policy addresses the sustainable management of the inland fish resources and is based on the following principles:

- To allow sustainable utilisation of resources and to protect the biodiversity of the freshwater fish in the country.
- Different management approaches are devised to deal with each particular river system.
- The interests of the subsistence households are protected in terms of the availability of fish as a supplement to their diet and are given priority over the commercialisation of the fish resource.
- The control of fishing and the protection of the resources through gear restrictions are adopted. Preference is given to passive gear and traditional gear in preference to modern equipment.
- The control and law enforcement will be carried out by law officers already employed by other Ministries with assistance from the traditional authorities.
- The principle that local people in communal areas should share in the income generated by commercialisation or use of communal resources is followed.
- Future research policies on freshwater fish and the establishment of a multi-disciplinary research station to eventually serve the region is addressed.
- The need for regional co-operation on inland waters and related matters between states in the region that share these river systems is emphasised.

The present management of the fish resource in the Caprivi is twofold; management by central government and management by the traditional authority. The management by central government is formalised by the Inland Fisheries Resources Act of 2003 and based on the concept of restriction of fishing effort in the form of restricting fishing gear type allowed, minimum mesh size, maximum number of gillnets allowed per fisherman and the method used to catch fish. Further restrictions may include closed fishing seasons or the establishment of fish sanctuaries.

Management by the traditional authority is not yet formalised in any document or regulation. It takes effect by means of the restriction on the use of certain gear types and also access rights to certain fishing grounds as arranged by the Traditional Authority (Khuta), Silalo induna and village induna. No access restriction to fishing areas is enforced during the high water period. During low water periods, permission is needed for fishing in isolated pools (known as mulapo [pl. milapo] and lisa [pl. masa]) and backwaters. Usually the mainstream is seen as open access and permission is not needed to fish in these waters.

The communities are all supportive of management of the fish resources. The reasons listed by them are:

- Increasing number and magnitude of conflicts over the fisheries.
- A perceived decline in the fish stocks.
- Population driven increase in the fishing effort due to people migrating into the region due to the failure of crops because of droughts.

- Price increase at fish markets.
- Fish are seen as a quick cash converter when needed.

1.2 Purpose and Objectives of the Fisheries Management Plan

This management plan is designed with the following purpose:

“All stakeholders in the Zambezi/Chobe River System are guided towards effectively co-managing the shared fish resource in a sustainable manner”.

To be able to achieve the purpose, the following objectives are outlined:

1. The fish life and fisheries of the Zambezi and Chobe Rivers are better understood and the knowledge shared amongst all stakeholders.
2. A framework that is conducive to the co-management of the fish resource is in place.
3. The capacity of local communities to sustainably manage their fish resource is enhanced.

The following strategies are outlined for each objective:

Objective 1: The fish life and fisheries of the Zambezi and Chobe Rivers are better understood and the knowledge shared amongst all stakeholders.

Strategies:

- Biological monitoring programme jointly with Zambia is in place.
- Fisheries monitoring programme jointly with Zambia is in place.
- Frame survey is conducted as stipulated.
- Regular reports on the state of the fish stock and fisheries are produced.

Objective 2: A framework that is conducive to the co-management of the fish resource is in place.

Strategies:

- Amendment of legislation to facilitate co-management (locally and internationally) and devolution of rights over natural resources to local level is implemented.
- Facilitate the formation of management structures at international, regional and local level.
- Build capacity within management structures through training programmes.

Objective 3: The capacity of local communities to sustainably manage their fish resource is enhanced.

Strategies:

- Launch public awareness programmes.
- Involve local communities in co-management.
- Develop strategies for decision making and regulations formulation at the local community level as outlined in Part 2 of this management plan.

1.3 Description of Caprivi and the different River Systems

The Caprivi Region has the highest rainfall in Namibia, although the mean value of 600+ mm is low in a global perspective. Higher rainfall occurs in the upper catchment of the Zambezi River and decreases towards the Namibian/ Zambian border. The rainfall in Caprivi has very little effect on the annual discharge of the Zambezi River, which is most influenced by rains in the extensive Angolan catchment area. The Caprivi Region experiences extensive annual flooding of the Zambezi River and the large floodplains on the Namibian side of the river are inundated during late summer and early autumn. These floods are the main stimulus for biological interactions in the system and the floods play a major role in the movement and seasonal activities of the riverine communities. During the wetter part of the flooding cycle, the Kwando–Linyanti and the Zambezi–Chobe River Systems are interlinked at Lake Liambezi for a number of months. Large sections (30%) of the Eastern Caprivi [area east of the Kwando] are then inundated.

1.3.1 The Zambezi River

The Zambezi River consists of a deep, wide mainstream, with bends and deep pools. Numerous small vegetated islands, sandbanks, bays, backwaters and narrow streams are present. Several large channels occur in the project area such as the Kalimbeza channel and the Kasaya, where the latter connects the Zambezi with the Chobe River at Impalila. Rapids are uncommon in this part of the river and are only found at Katima Mulilo and at Mambova/Impalila. Sandy substrates dominate the mainstream whereas the substrates of the backwaters are mainly muddy.

The water level of the Zambezi starts to rise usually in December and the flood reaches its peak between March and May. Large floodplains are inundated during the high water period that creates favourable habitats that act as breeding and nursery areas for fish. When the flood recedes, large numbers of fish move back to the main river and significant upstream migratory movements can be witnessed during certain years.

The aquatic vegetation consists of emergent aquatic grasses, reeds and submerged and floating vegetation in shallower and calmer areas. The alien plant species, *Salvinia molesta*, is found throughout the study area but is presently not seen as a menace to the ecosystem

1.3.2 The Chobe River

The Chobe River is a complex system with large floodplains, backwaters, side channels and mainstream habitats. The main channel is wider and deeper closer to the confluence with the Zambezi River and the flow direction is mainly towards the Zambezi River. The water flow of the Chobe River further southwest of the confluence changes direction seasonally depending on the water level in the Zambezi River. During the rising water period, water flows towards Lake Liambezi, but changes some time after the Zambezi River recedes. The water current is slow in the Chobe River due to the presence of large floodplain habitats but there are stronger currents near the confluence of the Zambezi River. A large section of the river is National Park on the Botswana side of the river with restricted impact by local communities. On the Namibian side of the Chobe, fishing plays an important role for these riverine communities.

1.3.3 The Kwando River

The catchment of the Kwando River lies both in Angola and in Zambia. Due to the large floodplains and marshy areas in Angola, the flood reaches the Namibian section only during June-July. The storage volume of the Silowana floodplains in the upper reaches of the river is more than the annual run-off of the Kwando River. These floodplains therefore have a huge impact on the hydrology of the Kwando River. During very high floods, the water will reach Lake Liambezi via the Linyanti. The difference between the high water and low water level in the Kwando is usually between one and two metres. It is a diverse system and consists of a main stream, side streams, floodplains, pools, oxbows, and backwaters. These backwaters often get isolated during low water periods. The river expands into large floodplains during the higher water periods resulting in a slow flow. Vegetation dominates the habitat types in the Kwando River. No rocky or gravel habitats are present in the Caprivi section. The section of the Kwando River surveyed falls within the Mudumu National Park and is considered an area where the fish population is not harvested.



Figure 1. The six stations used for fish surveys (in red) in the Zambezi River (Katima Mulilo, Lake Lisikili and Kalimbeza), Impalila at the confluence of the Zambezi and Chobe Rivers, Kabula in the Chobe River and the station in the Kwando River. Lake Liambezi is also indicated on the map.

1.4 Hydrology

The water level of the Zambezi River usually starts to rise in December, with a dramatic increase during January and February. The river reaches its peak between the end of March and beginning of May after which the level recedes until the end of September. The duration and the peak of the annual flood vary considerably. The flood during 2007 had a much earlier increase compared to the previous ten years of data, but also an earlier receding phase. The highest peak during the last ten years was also reached in 2007 with a level higher than 7 m¹.

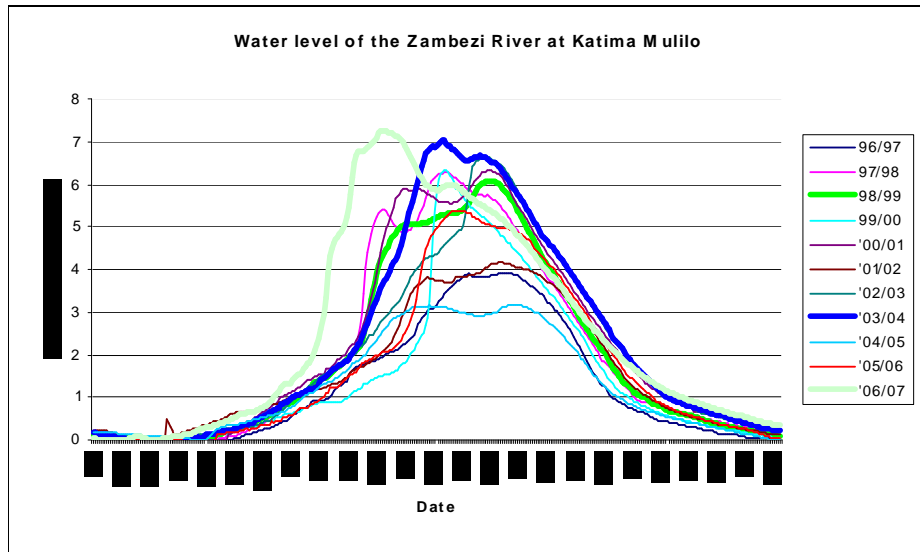


Figure 2. Water level (m) of the Zambezi River at Katima Mulilo for periods 1st October to end September for the years 1996 to 2007. (Data received from Namwater).

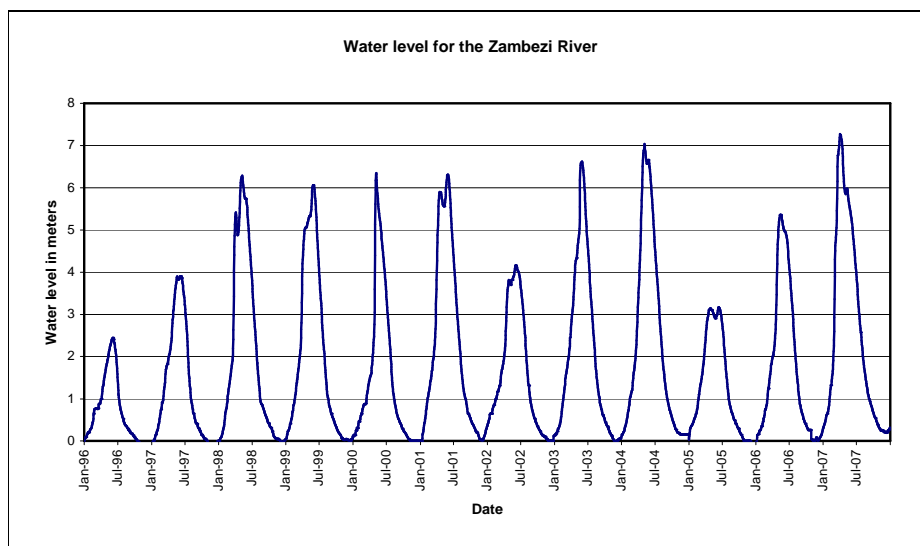


Figure 3. Water level (m) of the Zambezi River at Katima Mulilo for the period 1996 to 2007. (Data received from Namwater).

¹ In 2009 the flood was higher but data are not yet available

1.5 Fishery management approaches and the present situation in Caprivi

1.5.1 Effort regulation

Management of tropical multi-species fisheries in Africa was historically aimed at regulating fishing effort of fishermen. One of the most implemented controlling methods was the introduction of a minimum mesh size for multifilament gillnets. The underlying principle was that to ensure a sustainable fish resource, the juveniles of larger growing species should be protected to allow time for the successful reproduction of the species. This resulted in highly skewed exploitation where catches of the smaller size classes, which naturally had high mortalities, were reduced and the larger size classes of the larger species, which naturally had lower mortality rates, were intensified. This highly selective fishing approach for larger individuals in a species placed an unnaturally high pressure on the highly successful individuals with the necessary genetic material to ensure successful offspring.

Restrictions can also be placed on the number of gillnets allowed for each fisherman. either restricting the number of gillnets owned, or the number of gillnets allowed to be set simultaneously.

In some lakes in Africa with a population driven increase in effort, but where the effort is diversified, the increase in exploitation is biologically less harmful than an increase in investment in more effective sampling gear. The latter usually is selective fishing whereby the commercially important species are targeted to justify the investment.

Certain fishing methods are prohibited in Caprivi such as drag netting, fishing with a lamp during the night, using poison and bashing. With the recent increase in fishing pressure and simultaneous decrease in catch per unit effort, more and more cases of disregarding the present fishery regulations are experienced, fishermen resorting to smaller mesh gillnets, dragging during low water periods and bashing and driving fish into drifting and set nets.

1.5.2 Closed or protected areas

This management approach is primarily implemented for the protection of spawning and nursery areas, and prevention of the destruction of habitats. The regulations stipulated for a Fish Protection Area can be defined in such a way to accommodate local needs. Fish Protection Areas may be community supported, developed in conjunction with the local communities and be of such size that subsistence fishing is still possible. Recreational catch-and-release fishing may be accommodated on payment of fees to communities controlling Fish Protection Areas.

1.5.3 Closed seasons

Closed seasons, where no commercial fishing is permitted, are usually established during a period when communities have alternative ways of generating income. The communities generally accept this method as fishing for subsistence is usually allowed during this period.

A closed season is a method to protect the fish community during the reproduction phase to ensure successful recruitment.

A closed season was implemented (21 December 2006 to 28 February 2007) in Namibia after the fish disease Epizootic Ulcerative Syndrome (EUS) was discovered in the Zambezi River. The outbreak of the disease was the main reason for the closure of the fishing in the Caprivi. Local fishing communities ascribe the significantly improved catches experienced in 2007 after the flood, partly to this closed season. This has motivated fishermen to accept closed seasons as a management approach.

1.5.4 Closed seasons versus Fish Protection Areas

Establishment of closed seasons is one of the management options in the Inland Fisheries Policy and is currently one of the regulations in place in Zambia on the Upper Zambezi River. The closed season lasts from the beginning of December to the end of February. River fishermen are allowed to use hook and line during this period and only for subsistence. The Mwandi Traditional Authority put up roadblocks to confiscate uncertified fish. People have to certify fish caught in the other provinces during these periods if they need to transport fish. Conflicts have been reported between Zambian and Namibian fishermen during the closed fishing season with the crossing of fishermen from Zambian to Namibian fishing grounds. The density of fishermen on the Zambian side is much higher than on the Namibian side (25 times more households were identified on the Zambian side), which further puts pressure on the resource in Zambia.

The reason for the timing of the closed season in Zambia derives from other systems and may not be the most appropriate for the protection of the upper Zambezi cichlids most in need of protection. It is vital that there is a scientific and social rationale behind a closed season and that the impact on the rural community be minimal. Fish and fisheries must both benefit. Although this practice has been in place for several years in Zambia, the impact of the closed season is unknown but it is supported by the strong traditional authority in the Western Province adjacent to the Caprivi. The breeding season for some of the cichlids already starts in late August or early September and continues till April. The cichlids are highly vulnerable to fishing with active fishing gear such as drag nets during the spawning season (when they build and defend nests on sand banks) as well as during the low level period in September to December, when drag netting is rampant on the Zambian side. Timing of closed seasons, if approved as a management measure, thus needs review, in consultation with the Zambian authorities.

Fish Protection Areas may contribute significantly to the survival and the sustainable use of the fish resource along the Zambezi and Chobe Rivers. The advantages of such Fish Protection Areas are the following:

- Smaller areas can be more effectively controlled.
- Devolution of responsibilities to traditional authority level.
- Access to fishing grounds (areas outside the protected zones) is possible throughout the year.
- Protection of these areas will encompass the full biological cycle for all the fish species.
- Protection of all habitat types throughout the year.

- Immediate gratification if recreational anglers compensate for the privilege to practice catch and release within these areas and pay for fishing rights to the community controlling the Fish Protection Area.
- The river system and fishermen will benefit from the Fish Protection Areas, as new recruitment will disperse to the rest of the river system.
- Sufficient effective Fish Protection Areas in a river will prevent collapse of the fisheries even when minimal control of the fishery is possible outside such Fish Protection Areas.

Telemetry studies were conducted to determine the spatial behaviour and habitat utilisation of the economically important fish species in the Upper Zambezi River. These species included *Hydrocynus vittatus*, *Oreochromis andersonii*, *Oreochromis macrochir*, *Serranochromis robustus*, *Sargochromis giardi* and *Hepsetus odoe*. The home ranges, habitat preferences, the mean river stretch used by the fish and the mean distance travelled per individual for each of these species are known. Such studies are important to collect information necessary for the establishment of fish sanctuaries.

The following issues need to be taken into consideration for the establishment of Fish Protection Areas.

- Consent from the traditional authority for (and preferably its motivation for) the establishment of a sanctuary in its area of jurisdiction.
- It should be large enough to incorporate the home ranges of the economically important species (if practical).
- It should include a wide range of habitat types.
- It should include spawning grounds, nesting and nursery areas for economically important species.
- It should be accessible for communities to assist in patrolling the sanctuary.
- It should have the potential to attract recreational fishermen to fish in those waters for a fee.
- The availability of biological data from these areas to study future impacts.

Although these conditions may not all be met when initially establishing a sanctuary, it would be sensible to work towards these goals. The most important point is the consent from the traditional authorities for the establishment of a sanctuary in their region. It is imperative that the communities fully support the concept and are willing to assist in managing the sanctuaries. Without their support, the sanctuaries are destined to fail.

1.5.5 Licensing

Licences can be issued permitting the usage of gillnets, with certain conditions attached, relating to the number of nets, mesh size limitations, net length and even the way a gillnet may be operated. The rationale behind licensing is to record the effort input in a particular system and to identify illegal gillnets. This will also assist in the calculation of the annual yield. Another perceived benefit is the revenue generated when issuing licences, which should be channelled back to the local authorities. Presently licences are only issued by the Caprivi Regional Council in Katima Mulilo and constituency offices making it difficult for rural fishermen to obtain them, thus resulting in many fishing illegally. Generated funds are also

not ploughed back into fisheries management. This issue is addressed in Part 2 of this Management Plan.

1.5.6 Aquaculture

Although not an actual management tool, aquaculture has been seen in the past as a method to alleviate the fishing pressure on the natural resources. Although aquaculture may have a role to play, it has not been very successful in Africa and whether it will alleviate the fishing pressure on the river systems is debatable.

Fish ranching is however, an option for improving food security in rural areas, by stocking isolated pans and ponds with fingerlings and harvesting a few months later before the pans dry up.

1.5.7 Minimum length restriction

Minimum lengths for fish species are included in legislation but are not practical in a dynamic floodplain fishery situation. Designed to protect angling species, the rules are largely irrelevant where catch-and-release is practiced. In the floodplain fishery, where large numbers of fish are caught from drying water bodies, size limits are irrelevant.

1.5.8 Bag limits

Bag limits are also included in the Inland Fisheries Regulations, which state that a recreational licence holder is not allowed more than 10 fish species in the aggregate of any species in one day. Also such a person is not allowed to catch more than 2 tigerfish in one day for recreational purposes. In the light of the modern practice to release most fishes caught, this regulation is again not required to protect fish resources.

1.6 Diverse fisheries operating concurrently in Caprivi

Harvesting of the fish resources at various levels in the Caprivi has different long-term impacts on the fish stocks. The rationale for each of these fisheries is also a factor leading to conflict between stakeholders. The following gives an overview of the diverse fisheries taking place.

1.6.1 Recreational (sports) fishery

Few data are available for the sports fishery, although an initial study was done during 2002 and 2003 to study the impact it has on the resource. Some fishing competitions were subsequently attended and data collected. During the initial survey in 2002 and 2003 it was determined that the number of fishing parties per kilometre was very low with an average of only 0.017 parties/km. The highest frequency was during August and the lowest during January and June. The larger species are considered important for this industry, although

species diversity is becoming increasingly significant with artificial lure competitions becoming more popular. Even international artificial lure competitions are being held which helps to diversify the catches that are targeted by the sports fishery.

Presently the important trophy species for the tourists visiting the area for fishing expeditions are *Hydrocynus vittatus*, *Serranochromis robustus*, *Serranochromis angusticeps*, *Serranochromis altus*, *Oreochromis andersonii*, *Oreochromis macrochir*, *Sargochromis giardi*, *Tilapia rendalli* and *Clarias gariepinus*.

Most angling is catch and release, with only large trophy fish kept for mounting purposes. During the international fishing competition held in 2007 and 2008, 83% and 94% of the fish caught were released respectively. These competitions have minimal effect on the fish community as the majority of the fish are released alive. Not all species are hardy and practicing catch and release may not actually benefit all species. *Hydrocynus vittatus* was found to be very sensitive to handling, especially the large individuals, and such individuals may have a lower survival rate after released. During a tagging programme in the Zambezi River, *Hydrocynus vittatus* was successfully handled. It is important to teach anglers the handling of fish to ensure a high survival rate of fish after being released.

1.6.2 Semi-commercial fishery

The semi-commercial fishery is stimulated by lucrative markets in the area, in particular the large-sized Cichlidae that are fetching high prices on the market (more than N\$30 per kg in 2008). This increases selective fishing by fishers to ensure maximum return on their investment, both financial and effort input. Better market opportunities for some species, such as *Clarias gariepinus*, exist outside the Caprivi Region. This species is thus exported to other parts of the country, aided by the greatly improved road links in the area. Another factor is the development of an employment sector based on this fishery. Relative wealthy individuals, who have the capital to invest in some fishing equipment, employ local Namibians and Zambians to do the fishing for them. This further creates a snowball effect where capital investment is increased as the value of the fishery increases and some of the profits are channelled back to the fishery. The Ministry in Zambia therefore restricted the number of gillnets that may be used per fisher to prevent the development of a commercial fishery (mainly for the large cichlids) in Caprivi. Unfortunately these regulations are not effectively enforced. This semi-commercial fishery is presently expanding, at great cost to the subsistence and recreational fisheries.

1.6.3 Subsistence fishery

A subsistence fishery is where the majority of the catch is for own consumption. Although gillnets are also used, the emphasis is not on specific species and is not size related, but rather on the availability of a protein source for daily needs. Some fish, however, are sold to cover basic expenses such as school fees. Traditional fishing gear is also used to target species that are not normally caught in gillnets. Gears used are dependent on flood level and flood stage. Fish species at all trophic levels are sampled and utilised, especially if gillnets are also used. This fishery is very important during periods of drought or scarcity when more people may turn to the river for food. The river then acts as a safety net to help people through difficult times.

A specialist fishery for mormyrids exists at Impalila Island on the rapids of the Chobe and Zambezi Rivers. Special long traps (lukuko) are used only during two periods, during the dark phase of the moon in June and July, by more than 200 fishermen all using traditionally owned sites in the rapids where they hang their traps. Up to 50kg per funnel, mainly mormyrids, is caught.

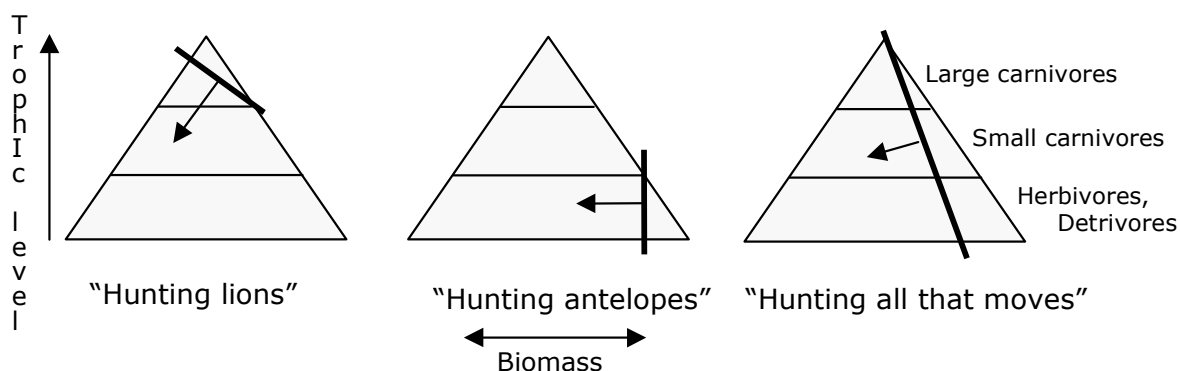


Figure 4. Illustration and explanation (below) from Jul-Larsen *et al.* (2002) of harvesting scenarios applicable to the Caprivi fisheries: “*The trophic levels in a community at which a fishery intervenes. Triangles represent trophic pyramids of animal communities with predators at the apex and animals feeding on primary production and detritus at the bottom. The width of the triangle at any level represents the relative biomass of that level. Black lines represent selective exploitation, arrows the direction of increased pressure. The three triangles each could represent a different fishery, for example: a sport fishery on tigerfish (“Hunting lions”), a gillnet fishery on tilapiine fishes such as the Oreochromis fishery in Mweru comparable to grazers in wildlife (“Hunting antelopes”) and a fully developed fishery in which all trophic levels are harvested proportionally to their biomass (“Hunting all that moves”).*”

The scenario in Figure 4.1 is relevant to the development of a management plan for the Caprivi. A fishery where all size classes are harvested proportionally to their numbers is considered healthier for the fish community and, in the medium to long-term, for the people. This may result in a higher overall yield as the presently unutilised section of the fish community forms part of the harvest. Only a small percentage of the fish community is large fish, presently harvested by the fishery, leaving the majority of the species untouched. The present regulations however prevent the fishery from exploiting all the fish species and this has to be addressed.

1.7 Fisheries management aligned with Community-based Natural Resource Management (CBNRM) approaches

Law enforcement on the Zambezi and Chobe Rivers is weak. Despite the introduction of the Inland Fisheries Resources Act in 2003, a semi-commercial fishery using illegal fishing methods mushroomed due to improved market access. Stakeholders are concerned about the state of the fish resource and are intensely aware that this will impact negatively on the local economy.

The preferred method to effectively implement a management system is to follow a CBNRM approach where the stakeholders with a vested interest in the resource are given the opportunity to manage the resource and have direct input in the development of a management plan. Jones (2008) highlights the following advantages of this approach:

- Experiences gained in the wildlife sector indicate that community-based approaches can work if given rights over natural resources.
- Internationally such approaches were successfully implemented with the right policy and legal frameworks in place.
- Communities in the Caprivi are concerned about the current state of the fish resource and are willing to take ownership and manage it at local level. Several initiatives had already been taken and strategies are in place to curb the unsustainable use of the resource.
- The MFMR will benefit from a community-based approach, whereby fisheries inspectors combine forces with appointed fish guards.
- Policy was approved by Cabinet to promote the devolution of power and management over resources down to local levels.

Fisheries forms part of the daily activities of the communities on the eastern floodplains. Where subsistence fisheries take place in conservancies, they should be fully integrated into the CBNRM approach. Each Fisheries Management Committee should be a sub-committee of the conservancy. If a conservancy, however, is not present in a particular area, the Fisheries Management Committee will operate independently or may collaborate with other resource user groups or committees within the community.

Conservancies are legal bodies already operating in the area with management systems in place for wildlife. Some of the conservancies are in areas with tourist fishing lodges. These also have a vested interest in the well-being of the fish stocks and wildlife overall.

1.8 Present state of the fish stock in the Zambezi and Chobe Rivers

1.8.1 An overview of previous fisheries research conducted in Caprivi

Inland fisheries were under the jurisdiction of Nature Conservation until 1992, when the Ministry of Fisheries and Marine Resources took over. The Department of Nature Conservation conducted earlier research with particular interest in Lake Liambezi. Despite the importance of freshwater fish in the Caprivi and also in the Kavango Region, no official offices were present in these regions. The main office responsible for the inland fisheries resources was at Hardap Dam, 1,000 km from the Kavango Region and 1,500 km from the Caprivi Region. Research in these areas was scaled down to the minimum due to the long distances. Recently, Government offices were established in these regions allowing more detailed research projects. During a WWF funded project “Shared Resource Management on the Zambezi/Chobe Systems in Northeast Namibia: Current Practices and Future Opportunities” official Fisheries staff were first appointed in Caprivi.

The Ministry initiated a monitoring programme at selected stations along the Zambezi, Chobe and Kwando Rivers in 1997 to build a baseline dataset that could be used as a reference point

for future studies. The Ministry linked up with the World Wildlife Fund LIFE-Project in Windhoek to further strengthen the capacity and resource base in the area.

Data collected in the region since 1977 include biological data on the fish stocks, migratory behaviour of selected fish species, socio-economic data on the fisheries and the fish markets, management structures in place, and catches from the subsistence and recreational fisheries. The Ministry also developed the Inland Fisheries Act and Regulations (Act of 2003) based on the Inland Fisheries Policy that was approved in 1995. As can be expected from any new development, teething problems were encountered with the legislation and with the implementation. The fact that the fish resource is also shared with Zambia does not make the management thereof any easier. The Ministry was also involved in several initiatives to set up joint working groups between neighbouring countries to jointly manage these shared resources. Despite the fact that valuable connections were made and some very valuable results were obtained, it could not be sustained. One of the biggest problems was the lack of funds to continue the working relationships between countries once the donors left.

The fish fauna of the Upper Zambezi River received the attention of several scientists in the past, each with his own objectives. Initially the work done on the fish from this area concentrated mainly on the systematics and species lists and include work done by Fowler (1935), van den Berg (1956), Jubb (1958), Guy (1962), Jubb and Gaigher (1969), van der Waal and Skelton (1984), Bethune and Roberts (1991), Hay and van Zyl (1999); Kramer *et al.* (200xx) A comprehensive checklist of the fishes of the Upper Zambezi was published by Tweddle *et al.* (2004). Fish ecological studies were conducted by van der Waal (1976) and Grobler (1987) who both worked on Lake Liambezi, then a very important fishery. Other studies on the fish life of the Caprivi Region were undertaken by van der Waal (1996), Økland *et al.* (2000), Hay *et al.* (2002), Thorstad *et al.* (2002), Økland *et al.* (2002), Koekemoer (2003), Thorstad *et al.* (2003), Næsje *et al.* (2004) and Thorstad *et al.* (2007).

Further studies were conducted on the post harvest activities of the fishing communities (Purvis, 2001), on the subsistence fisheries by Abbott *et al.* (2003), Næsje *et al.* (2003) and Abbott (2005), on the management of the resource by Purvis (2003) and on the Katima Mulilo fish market by Abbott *et al.* (2003). These data were used to develop the Inland Fisheries Resources Act and regulations, but despite the presence of legislation, practical implementation was found to be extremely difficult.

1.8.2 Analysis of data collected between 1997 and 2007.

Data collected between 1997 and 2007 were analysed and a report titled “Analysis of Historic Fisheries Data for the Caprivi Region” (Hay & van der Waal, 2009) was produced.

General conclusions included:

- The gillnet set used by the Ministry gave an accurate representative but not absolute impression of the different fish populations in Caprivi within certain length groups. Factors such as fish behaviour, habitat preferences and flood levels may have an impact on this.
- The gillnets used by the subsistence fishery are such that the larger fish are targeted, thus catching a greater biomass per effort, which also has a higher demand at the fish markets.

- The fish populations in the conserved areas differed from that of the fished areas. This change was ascribed to the effects of continuous subsistence fishery pressure in the Caprivi. These changes were: (a) higher fish abundance in the conserved areas, (b) Higher abundance of large fish in the conserved areas, (c) higher abundance of small fish in the fished areas. Structural changes in the fish populations between conserved and fished areas and structural changes were noted over the study period.
- Fish species reacted differently to fishing pressure. Some fish seem to withstand the fishing pressure, e.g. *Hydrocynus vittatus*, *Serranochromis macrocephalus*, *Marcusenius altisambesi* and *Schilbe intermedius*, whereas others have declined and are becoming scarcer, e.g. *Oreochromis andersonii* and *Oreochromis macrochir* have shown signs of over-utilisation.
- A small number of species dominated the catches of the fishery.
- No change in the species composition was found in the Zambezi and Chobe Rivers during the study period. However, a decline in the diversity index was found for the Kwando River which might have been flood related.
- The exploitation rates of *Hydrocynus vittatus*, *Clarias gariepinus*, *Marcusenius altisambesi*, *Schilbe intermedius* and *Serranochromis macrocephalus* confirmed the outcome of the length frequencies stating that these species were not over-exploited, despite being considered important in the subsistence gillnet fishery.
- The two Cichlidae, *Oreochromis andersonii* and *Oreochromis macrochir*, were, however, over-exploited,
- Other larger cichlids, including *Tilapia rendalli*, *Sargochromis giardi*, *Sargochromis codringtonii*, *Serranochromis robustus*, *Serranochromis altus* and *Serranochromis angusticeps* are also considered to be negatively affected but to a lesser degree than the two *Oreochromis* species.
- The species composition in Lake Liambezi had changed since the early 1970s, progressing from a pioneer community consisting of catfish and small insectivorous species to valuable and sought-after, long-lived herbivorous and detritus feeders.
- Higher catches were recorded from Lake Liambezi during the early 1970s.
- Species balance in the region may be affected in the long run by the present fishery with continued decline in catches of certain preferred species.

1.9 Management systems and structures

1.9.1 Fish Protection Areas

The fishery along the Zambezi River is uncontrolled and fishermen are using destructive methods to increase their catches. The present control systems are ineffective and some changes are needed to reduce the fishing impact. One way of doing this is to identify zones that are easy to control and to manage.

Existing legislation makes provision for the establishment of Fish Protection Areas (under the name fisheries reserve). Under Section 22 of the Inland Fisheries Resources Act (2003) the following are stated:

(1) The Minister, on his or her own initiative, or in response to an initiative of any regional council, local authority council or traditional authority, and in consultation with the regional council, local authority council or traditional authority concerned, may

by notice in the Gazette declare any area of inland waters as a fisheries reserve if the Minister considers that special measures are necessary –

(a) to preserve the aquatic environment;

(b) to protect, preserve or rehabilitate the natural environment of fish, related ecosystems including wetlands, lakes, lagoons, nursery and spawning areas, which are essential to maintaining the integrity of an ecosystem, species or assemblages of species;

(c) to promote the regeneration of fish stocks;

(d) to protect fish resources and their environment from destruction, degradation, pollution and any other adverse impacts through human activities that threaten their health and viability.

(2) A person may not in a fisheries reserve declared under subsection (1), without the written permission of the Minister –

(a) engage in any activity for fishing; or

(b) dredge or extract any material or discharge or deposit any waste or other polluting matter or in any other way destroy, disturb or interfere with the natural environment of fish and related ecosystems.

1.9.1.1 Objectives for establishing a Fish Protection Area

The objectives for establishing Fish Protection Areas are:

- Protecting habitats necessary for successful recruitment.
- Protection for large individuals (with high reproduction potential) of territorial fish species.
- Increase in fish biomass.
- Increase in number of large fish.
- Increase aesthetic value for tourists (no gillnetting).
- Decrease in old discarded gillnets responsible for catches of other aquatic animals and even birds.
- A sense of ownership by the community over an area previously seen as “free for all”, even from fishermen from neighbouring countries.
- Incentives for communities to manage and protect demarcated areas.

1.9.2 The main fisheries management activities of the Fisheries Management Committee

- Management of the fisheries in their area, including the Fish Protection Areas, with the authority (Minister shall delegate such power where necessary) to do the following:
 - Make rules for the management of the fisheries in the area under their jurisdiction. This should not be in contravention of any legislation in Namibia.
 - Confiscating nets or any illegal fishing gear used within the area under their jurisdiction.
 - Issue fishing licences.

- Declare any water body under their jurisdiction as a closed area or closed fishing season.
- Identify and appoint fish guards.
- Work closely with other stakeholders in the area such as the fishing lodges, other tourism entities and the MFMR.
- Ensure that monitoring of the resource is conducted.
- Regular report back to the Conservancy Management Committee.

1.9.3 Steps to establish a Community-Based Fisheries Management Unit

The steps outlined below are fully developed in Part 2 of this Management Plan.

- Meetings/workshops with the community that requested the establishment of a Fish Protection Area or other such management measures.
- Include the fisheries management in the conservancy framework (if there is an established conservancy for that area).
- Identify water bodies to be declared as Fish Protection Areas. (Demarcate the boundaries, GPS points).
- Elect Fisheries Management Committee (FMC).
- Identify fish guards for the Fish Protection Areas.
- FMC decides on the rules and regulations for the Fish Protection Area and appoints fish guards to enforce the fishing rules and to monitor the resource.
- Establish written agreements on resource use with lodges in or near the Fish Protection Areas.
- Collaborate with neighbouring countries where Fish Protection Area borders an international boundary.
- Apply to MFMR to gazette Fish Protection Area(s) and for approval for the FMC and fish guards.

1.9.4 Regulations on gear usage and effort

Only gillnets with a minimum stretched mesh size of >76 mm are currently permitted. Drag netting is not permitted and fisherman must register gillnets. The maximum number of gillnets per fisherman is four and these nets should not be set closer than 100 m from each other. Gillnets are also not allowed to close off entire water bodies or to be set across a channel or river stretch.

The increase in use of destructive fishing methods is extremely detrimental to the fish resources, Drag netting is particularly damaging for the Cichlidae (Bream family), removing immature fish in large numbers and also targeting breeding fish on their nests. Drift netting is now increasingly used to target *Hydrocynus vittatus* (Tigerfish), and is also used in conjunction with bashing the water and vegetation to frighten fish from cover into the path of the nets.

Fishing methods that must remain or be declared illegal as they are extremely detrimental to the fish resource are:

- Monofilament gillnets

- Any nets used for dragging
- Any nets used for drift netting
- Bashing water and vegetation to frighten fish out into nets
- Poisons and explosives

Gillnet mesh size regulations should be reviewed to allow exploitation of small abundant species.

Effort regulation is covered by the current legislation. Recommendations are put forward in Part 2 of this Management Plan for simplified regulations whereby the gears referred to above will be prohibited in the national Regulations, while communities will be responsible, with guidance by MFMR, for other regulations pertaining to the particular water bodies contained in their areas of jurisdiction.

1.9.5 Honorary Inspectors

The Zambezi and Chobe Rivers with the adjacent floodplains are complex and difficult to patrol by the Fisheries Inspectors from the Ministry, and thus the nomination of Honorary Inspectors from the region is recommended. The following process is proposed:

- Communities identify potential Honorary Inspectors.
- Minister approves the appointment and delegates the necessary powers.
- Honorary Inspectors receive training.
- Communication protocol is set up to facilitate the flow of information between the Honorary Inspectors and the Fisheries Inspectors from the Ministry.
- Annual workshop to receive feed back from the Honorary Inspectors and to address training needs.

The Honorary Inspectors should receive uniforms to identify them in the execution of their duties. Clear Terms of Reference should be developed for their activities.

1.9.6 Seasonal Closures

The Upper Zambezi River in Zambia is closed to fishing between the 1st of December and the end of February to protect spawning adults and juvenile fish during the breeding season. Breeding, however, starts in August and continues until April.

Seasonal closures therefore need to be reviewed in discussions with the fishing communities.

1.9.7 Limited Access

Limited access is an option where a community can request that the number of gillnets be restricted in a water body belonging to that specific community or that certain criteria be met before a fisherman is allowed to fish in that particular water body. This can also be applicable to a Fish Protection Area if the community feels that certain fishing types should be allowed.

1.9.8 Licensing

The issuing of recreational and gillnet licences should be devolved to the conservancies or sub-khutas and to lodge owners after revision of the legislation to allow such devolution of powers.

1.9.9 Cross border collaboration

The shared nature of the Zambezi and Chobe Rivers complicates the management of the fish resource, especially when legislation of the different countries are not harmonised. Management of the Zambezi and Chobe Rivers, to be effective, needs stakeholders from all countries to develop effective trans-boundary collaboration. A joint committee must be established comprising key stakeholders from the different countries. This should follow agreement on and signing of a memorandum of understanding between the countries. The role of the committee is addressed in Part 2 of this Management Plan.

1.9.10 Inland Fisheries Council

The Inland Fisheries Resources Act makes provision for the establishment of an Inland Fisheries Council chaired by the Permanent Secretary of the Ministry. This council must be appointed as a matter of urgency. The management plan must be presented to this Council and recommended for approval by the Minister. Any changes made to the management plan should first be cleared by the council.

1.10 Research and data needs

1.10.1 Information required for stock assessment

To understand a floodplain fishery and the dynamics of the fish community, high quality data are needed. The following information is necessary to assess the fishery in the Caprivi:

- The biology of the different fish species, especially the commercially important species such as:
 - *Oreochromis andersonii*
 - *Oreochromis macrochir*
 - *Serranochromis robustus*
 - *Serranochromis angusticeps*
 - *Serranochromis altus*
 - *Tilapia rendalli*
 - *Sargochromis giardi*
 - *Sargochromis codringtonii*
 - *Hydrocynus vittatus*
 - *Clarias gariepinus*

including data on:

- Growth parameters
- Length frequencies

- Mortality rates
- Sexual maturity
- Migratory behaviour
- Reproduction
- Food niches
- Habitat preferences
- Time series of standardised experimental sampling gear
- Gear selectivity
- Information on the catches of the subsistence, commercial and the recreational fishery including:
 - Species composition
 - Length frequencies
 - Catch rates
- Information on fishing activities include:
 - Types of gear in use
 - Net lengths and mesh sizes
 - Where and how sampling gear are set and used
 - Fishing effort
- Information on fishing households
- Information from fish markets
- Water quality data
- Water level data
-

1.10.2 Data recording

1.10.2.1 Fishery independent data

The Ministry's research data since 1997 allowed an initial assessment of the fish population of the Zambezi and Chobe Rivers, but a more detailed assessment of the fish stock is needed to predict future trends. The following biological data collection is proposed:

- A standardised multifilament gillnet set with mesh sizes 12, 16, 22, 28, 35, 45, 57, 73, 93, 118 and 150mm.
- Seasonal surveys.
- Use of other gears to supplement the gillnet data, increasing information on smaller species and juveniles of larger species
- Water quality data, especially water temperature, dissolved oxygen, turbidity and conductivity.
- Add Kwando River to the survey schedule.
- Monitor Fish Protection Areas when established.

1.10.2.2 Fishery dependent data

The following protocol for the data collection of the commercial and subsistence fishery is proposed:

- River surveys conducted every second month at selected stations to record fishery activities.

- Local people trained to collect the data.
- Recording of catches at pre-determined landing sites.
- Establishment of a fishery group that will assist with the recording of their catches.
- Frame survey along the Zambezi and Chobe Rivers every third year.
- Two weekly surveys at the Katima Mulilo fish market.

Catches from fishing lodges (including zero catches) should be recorded as should the catches during fishing competitions. Data recorded will be on:

- Rod-hour effort
- Fish species
- Length (cm(0.1)) or weight (kg(0.1))
- Whether the fish was kept or released

Data recording forms with the critical parameters needed are available.

1.10.3 Software

Capacity building is needed for staff from the Ministry in the usage of software to conduct the necessary data analysis. Kamutjonga Fisheries Research Centre will play an important role. The specialised software packages to be used are:

- Pasgear, a customised data program for biological analysis.
- Fisat (FAO-ICLARM Stock Assessment Tool) for stock assessment.
- GIS (MFMR's new biologist, Mr D. Nchimo has GIS training)

1.10.4 Tertiary Institutions

Post graduate research by tertiary institutions is strongly encouraged, under agreements with MFMR, and ideally including MFMR staff in the research. to enhance capacity building, and ensure results are published and freely available.

1.11 Data bank

Guidelines.

- All data should be stored at the Kamutjonga Inland Fisheries Institute (KIFI) with duplicate hard copies and databases at the respective regional offices. (Orange River at Hardap, Kunene River at Oshakati, Kavango River at Rundu and the Caprivi at Katima Mulilo).
- Duplicates of all hard copies (habitat and data sheets) should be made immediately after the field survey.
- Data should be entered into Pasgear and a copy of the file made.
- Duplicates of the hard copies and the data file must be stored in a separate building with copies sent to KIFI.
- Pasgear files should also be exported to Excel and stored in this format also.

1.12 Funding

Monitoring surveys to be funded by the Ministry of Fisheries and Marine Resources, including:

- Subsistence and travel allowances for staff members
- Equipment (boats, fishing gear, balances, vehicles, etc.)
- Running costs of boats and vehicles
- Computers and the necessary software

The Ministry should compile a database of existing and new information for the entire Upper Zambezi River System, through a working group of researchers in the neighbouring countries.

**PART 2. MANAGEMENT PLANS FOR SPECIFIC
COMPONENTS OF THE ZAMBEZI/CHOBE FISHERIES
PROJECT**

2 CROSS BORDER COLLABORATION

The shared nature of the Zambezi and Chobe Rivers complicates the management of the fish resource, especially when legislation of the different countries are not harmonised. Management of the Zambezi and Chobe Rivers, to be effective, needs stakeholders from all countries to develop effective trans-boundary collaboration. A joint committee must be established as a priority in Phase 2 of the Project, comprising key stakeholders from the different countries. This should follow agreement on and signing of a memorandum of understanding between the countries initiated by the respective Ministries responsible for fisheries.

The committee will address management issues and will link fishermen and government structures to ensure smooth communication.

2.1 Constitution of the cross border committee

The committee should consist of the following from Botswana, Namibia and Zambia:

- One staff member of the Ministry or Department responsible for fisheries.
- One person nominated by the Regional Council
- One person nominated by the Association of Local Authorities
- Two persons nominated by the Council of Traditional Leaders
- Two persons who, in the opinion of the Minister, have knowledge relating to inland fisheries, the ecosystem or the recreational fisheries in the region

The meeting will be chaired by the staff member of the fisheries department and will annually rotate between the countries.

The committee will be known as the Regional Fisheries Committee and will meet at least twice a year. The committee can be called to meet at any time if urgent matters arise.

2.2 Funding of the cross border committee

Fisheries departments should budget for these meetings including costs for attendance of NGOs and private institutions.

2.3 Project activities in Zambia in Phase 2 of the Project

- The project will seek to ensure close collaboration between Namibia and Zambia. Regular meetings (preferably monthly) must be arranged between the Project, MFMR staff, Katima Mulilo, and DoF staff, Sesheke, to ensure good communication and continuity.

- The project will facilitate activities in Zambia aimed at improving participation of the communities in management of the resources.
- The project will seek to involve, with the approval of DoF, the Royal Establishment in assisting the project and DoF to strengthen participation of the Traditional Authorities in managing the fishery.
- While still at a preliminary planning stage, the project will seek to work with DoF in engaging with Village Action Groups (VAGs), both existing and newly formed, to add fisheries issues to the VAG natural resources management mandate.
- The project will seek to strengthen links with other natural resource management activities in southern and western Zambia, including CCCD and WWF Zambia.

The project will help to facilitate joint activities (monitoring, frame surveys (every three years), enforcement patrols, etc.) between MFMR and DoF.

- The project will seek to harmonise legislation in the two countries to target destructive fishing methods.
- The project will seek to facilitate agreements on permitted fishing methods between communities in both countries.

2.4 Project activities in Botswana in Phase 2 of the Project

- The project will facilitate regular contact between MFMR and the Fisheries Section in Botswana.
- The project will keep Botswana Fisheries Section informed of all project activities.
- The project will seek to harmonise fisheries legislation between Namibia and Botswana in relation to the shared resource along the Chobe River.

3 MANAGEMENT PLANS FOR FISH PROTECTION AREAS IN THE EASTERN CAPRIVI

3.1 INTRODUCTION

During the first phase of the project, provisional agreements were reached with conservancies and village fishing committees for the establishment of Fish Protection Areas in the areas covered by the project. In this component of the management plan, steps are laid down for the establishment and management of the Fish Protection Areas.

In this first section of the Fish Protection Areas management plan, the proposed Fish Protection Areas in the western part of the East Caprivi floodplains are covered. These are shown in Figure 5 and then in more detail in subsequent figures. In the second section of the plan, the proposed Fish Protection Areas at the eastern end of the Caprivi floodplain are covered, i.e. in the Impalila and Kasika Conservancies.

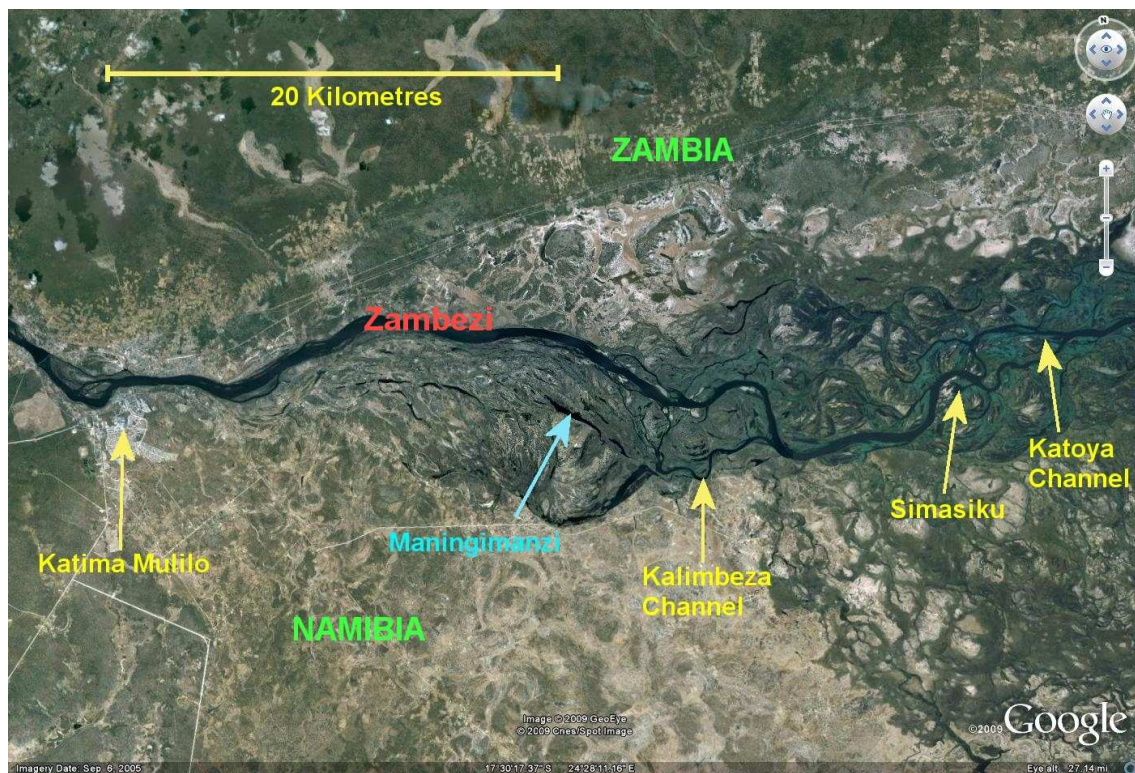


Figure 5. General overview of the positions of proposed Fish Protection Areas in the western part of the East Caprivi floodplains, showing position in relation to the main urban centre at Katima Mulilo. Sikunga Conservancy waters indicated in yellow, Lisikili Fisheries Committee area in blue.

3.1.1 SIKUNGA CONSERVANCY

3.1.1.1 CONSERVANCY COMMITTEE (KALIMBEZA AREA)

Management Targets

1. Kalimbeza Channel Reserve

Primary goal: Implementation and management of Fish Protection Area encompassing Kalimbeza Channel from point where it leaves Zambezi to where it rejoins main Zambezi River. From there the Fish Protection Area continues to upstream boundary of Kalizo Lodge, thereby creating protected area effectively extending to downstream boundary of the lodge (Figure 6).

Aims: To establish the Kalimbeza Channel as a sanctuary for breeding and growth of economically important but over-exploited large cichlid species with a view to the following:

- Enhancing exploitable fish stocks in fishing areas adjacent to the Fish Protection Area because of improved recruitment in, and outward migration from, the Fish Protection Area.
- Improving revenue to the community as a result of increased angling tourism to the lodges in the area. There are two potential major benefits, (a) the lodges are important sources of employment for the local community, and (b) the lodges may pay the community for the rights to fish (strictly catch-and-release angling) in the Fish Protection Area.

Actions:

1. Follow steps below to establish Fish Protection Area as a legal entity:
 - Delineate agreed boundaries of the Fish Protection Area with the Sikunga Conservancy/ Lisikili fishery committee. (N.B. the western end of the channel is controlled by Lisikili and not by the Sikunga conservancy).
 - Assist committees to reach agreement with Traditional Authority on establishing the Fish Protection Area as requested by the conservancy/fisheries committee.
 - On approval, assist in presenting the request to the Regional Council.
 - On approval, assist in forwarding the request via MFMR to the Minister for final approval.
2. Assist Sikunga Conservancy and Lisikili Fisheries Committee, in association with Traditional Authorities, MFMR, Regional Council and adjacent tourist lodges, to draw up management agreement for the Fish Protection Area. (e.g. including catch-and-release angling in Fish Protection Area on payment of fees to conservancy).
3. Assist conservancy/fisheries committee with awareness programme about the implementation of the Fish Protection Area and rules therein.
4. Assist conservancy/fisheries committee with appointment of fish guards to help in controlling activities in the Fish Protection Area.

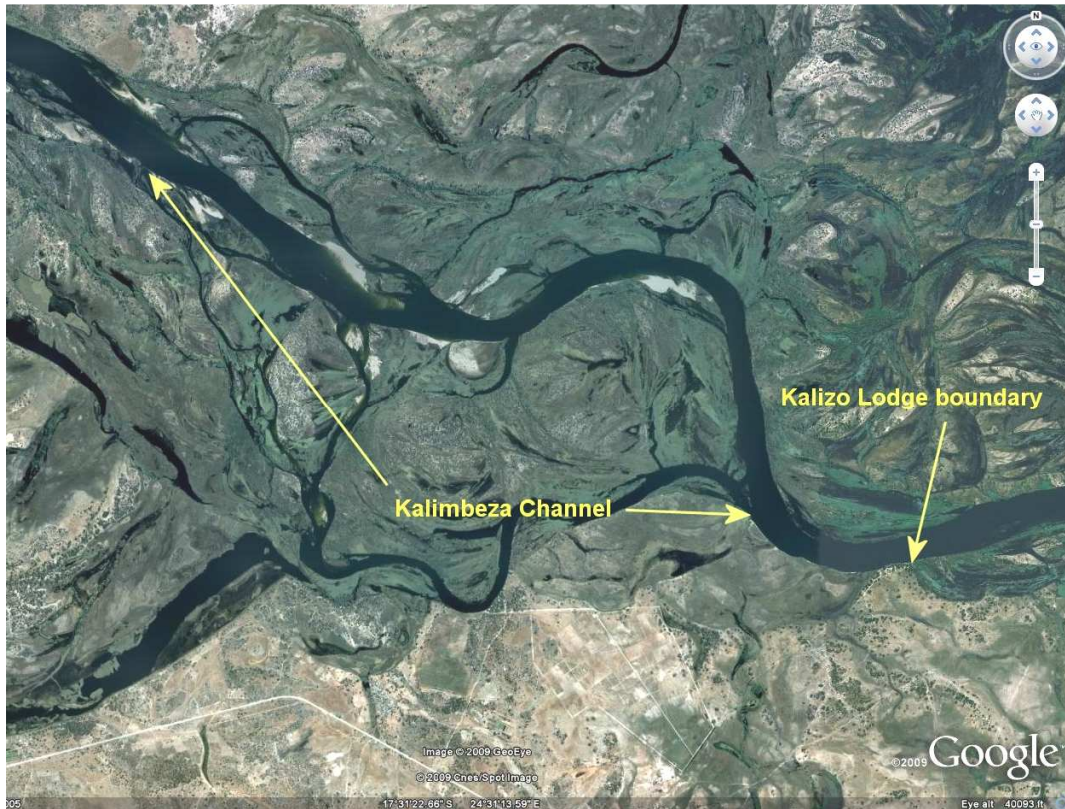


Figure 6. Proposed boundaries of the Kalimbeza Channel Fish Protection Area:
 Upstream entrance to channel: 17°30'50" S, 24°30'30" E
 Downstream exit from channel: 17°32'00" S, 24°33'00" E
 Downstream boundary of Kalizo Lodge, Zambezi South bank: 17°32'24" S, 24°34'07" E

2. Simasiku and Katoya Fish Protection Areas

Primary goal: Implementation and management of Fish Protection Areas in the Simasiku lagoon and the Katoya Channel (Figure 7). The Simasiku lagoon is connected by a permanent channel to the main Zambezi River, and consists of a roughly triangular area of open water and aquatic vegetation. Katoya Channel is a narrow straight channel through a raised area of floodplain.

Aims: To establish the Simasiku lagoon and the Katoya Channel as sanctuaries for breeding and growth of economically important but over-exploited large cichlid species. Simasiku is an important nursery area for the large cichlid species. Katoya Channel was formerly known for its large cichlids, popular with anglers and with local fishermen, but has now been targeted using destructive methods (dragnetting and bashing). Protection is therefore urgently needed with a view to the following:

- Enhancing exploitable fish stocks in fishing areas adjacent to the Fish Protection Area because of improved recruitment in, and outward migration from, the Fish Protection Area.

- ✦ Improving revenue to the community as a result of increased angling tourism to the lodges in the area. There are two potential major benefits, (a) the lodges are important sources of employment for the local community, and (b) the lodges may pay the community for the rights to fish (strictly catch-and-release angling) in the Fish Protection Area.

Actions:

1. Follow steps below to establish Fish Protection Areas as legal entities:
 - ✦ Delineate agreed boundaries of the Fish Protection Areas with the Sikunga Conservancy committee.
 - ✦ Assist committee to reach agreement with Traditional Authority on establishing the Fish Protection Areas as requested by the conservancy committee.
 - ✦ On approval, assist in presenting the request to the Regional Council
 - ✦ On approval, assist in forwarding the request via MFMR to the Minister for final approval.
2. Assist Sikunga Conservancy Committee, in association with Traditional Authorities, MFMR, Regional Council and adjacent tourist lodges, to draw up management agreement for the Fish Protection Areas (e.g. including catch-and-release angling in Fish Protection Area on payment of fees to conservancy).
3. Assist conservancy committee with awareness programme about the implementation of the Fish Protection Areas and rules therein.
4. Assist conservancy committee with appointment of fish guards to help in controlling activities in the Fish Protection Area.

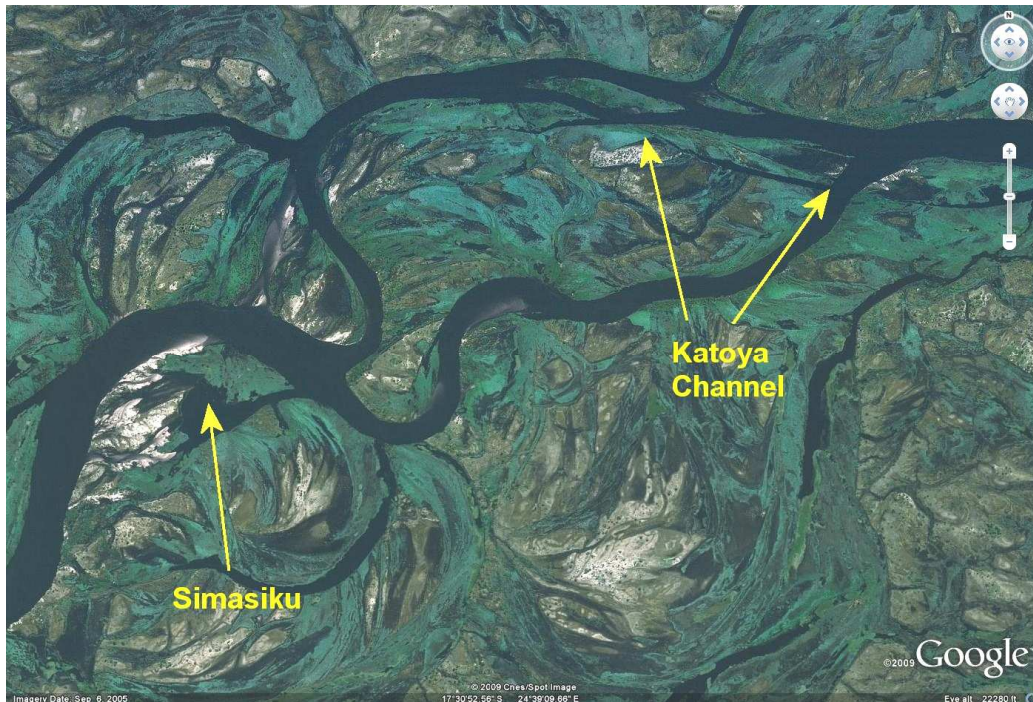


Figure 7. Simasiku Lagoon and Katoya Channel proposed Fish Protection Areas, boundaries as follows:

Simasiku lagoon entrance: 17°31'00\"S, 24°38'10\"E; Top left corner of reserve: 17°30'55\"S, 24°37'35\"E; Bottom left corner of reserve: 17°31'15\"S, 24°37'40\" E.
 Katoya channel entrance: 17°30'13\"S, 24°40'3\"0 E; Upper limit of channel: 17°30'00\"S, 24°39'40\"E.

3. Mpunga Channel (Malindi village) possible reserve

Primary goal: Investigate possibility of establishing a Fish Protection Area in Mpunga Channel. Following developments in the three proposed Fish Protection Areas above, the Sikunga Conservancy is also interested in creating a further Fish Protection Area in Mpunga Channel. At this stage, no detailed implementation is planned. If the Fish Protection Area comes into existence during Phase 2 of the project following successful implementation of the other three Fish Protection Areas, establishment and management will follow the same course of action as the other Fish Protection Areas.

3.1.2 LISIKILI FISHERIES COMMITTEE

Management Targets

Maningimanzi Reserve

Primary goal: Implementation and management of Maningimanzi Lagoon (Figures 5 and 8) as a Fish Protection Area.

Aims: To establish the Maningimanzi Lagoon, a 3 km long cut-off channel, linked at high water to the Zambezi via Kalimbeza Channel, as a sanctuary for breeding and growth of economically important but over-exploited large cichlid species with a view to the following:

- Enhancing exploitable fish stocks in fishing areas adjacent to the Fish Protection Area because of improved recruitment in, and outward migration from, the Fish Protection Area.
- Improving revenue to the community as a result of increased angling tourism to the lodges in the area. There are two potential major benefits, (a) the lodges are important sources of employment for the local community, and (b) the lodges may pay the community for the rights to fish (strictly catch-and-release angling) in the Fish Protection Area.

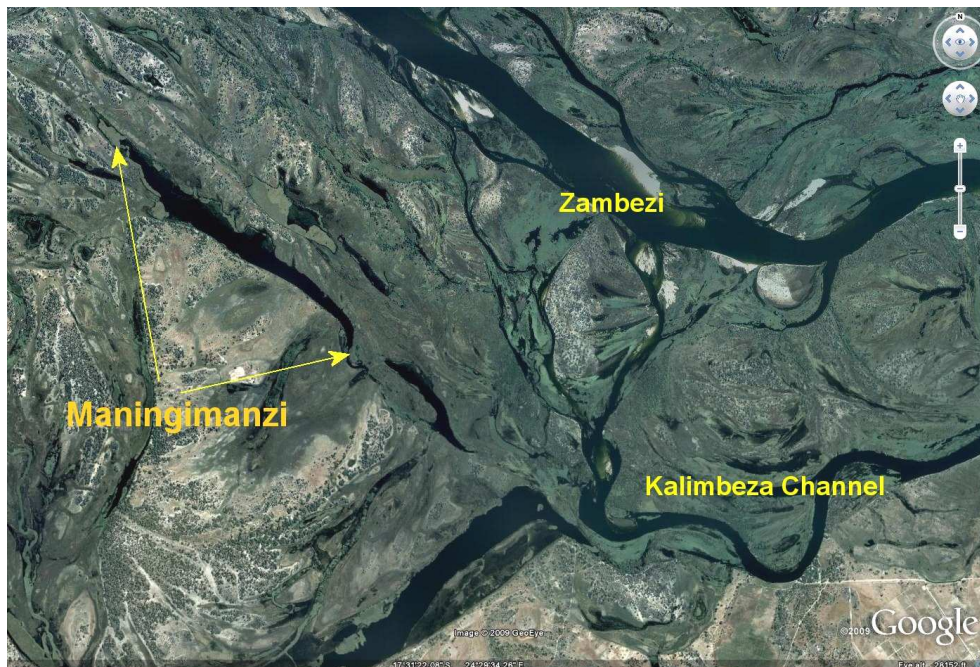


Figure 8. The Maningimanzi proposed Fish Protection Area, boundaries as follows:

Upstream end: 17°30'20"S, 24°27'29"E.

Downstream end: 17°31'25"S 25°28'43"E

Actions:

1. Follow steps below to establish Fish Protection Area as legal entities:
 - Delineate agreed boundaries of the Fish Protection Area with the Lisikili Fisheries committee.
 - Assist committee to reach agreement with Traditional Authority on establishing the Fish Protection Area as requested by the committee.
 - On approval, assist in presenting the request to the Regional Council
 - On approval, assist in forwarding the request via MFMR to the Minister for final approval.

2. Assist Lisikili Fisheries Committee, in association with Traditional Authorities, MFMR, Regional Council and adjacent tourist lodges, to draw up management agreement for the Fish Protection Area (e.g. including catch-and-release angling in Fish Protection Area on payment of fees to Lisikili community).
3. Assist committee with awareness programme about the implementation of the Fish Protection Area and rules therein.
4. Assist committee with appointment of fish guards to help in controlling activities in the Fish Protection Area.

3.1.3 IMPALILA CONSERVANCY

Management Targets

Kasaya Channel Fish Protection Area

Primary goal: Implementation and management of Fish Protection Area encompassing Kasaya Channel linking Zambezi River to Chobe River (Figures 9 & 10).

Aims: To establish the Kasaya Channel as a sanctuary for breeding and growth of economically important but over-exploited large cichlid species with a view to the following:

- Enhancing exploitable fish stocks in fishing areas adjacent to the Fish Protection Area because of improved recruitment in, and outward migration from, the Fish Protection Area.
- Improving revenue to the community as a result of increased angling tourism to the lodges in the area. There are two potential major benefits, (a) the lodges are important sources of employment for the local community, and (b) the lodges may pay the community for the rights to fish (strictly catch-and-release angling) in the Fish Protection Area.

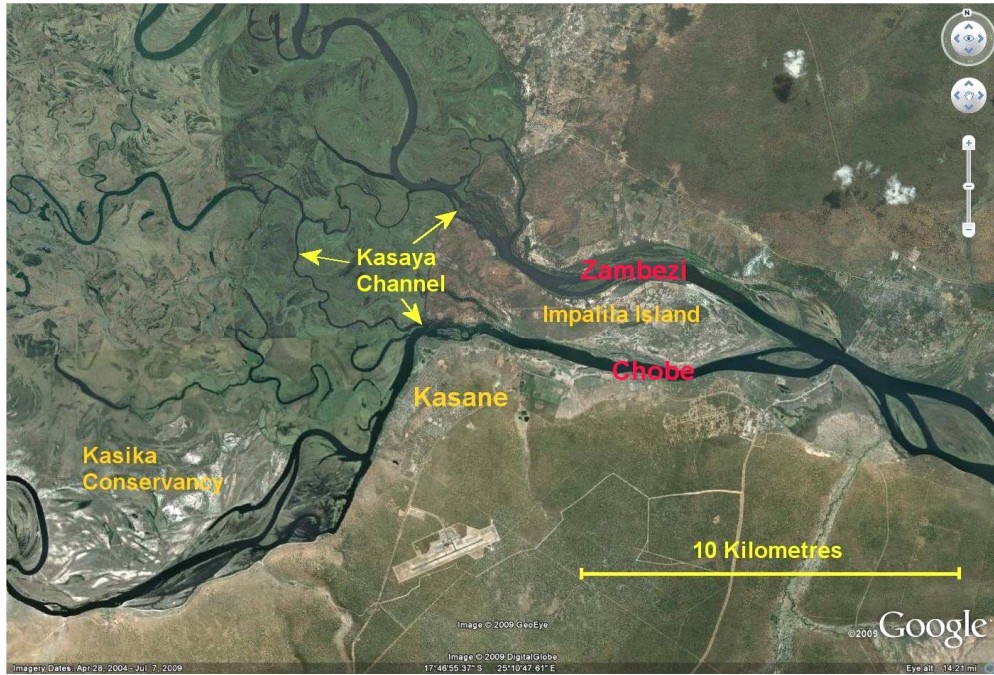


Figure 9. The eastern end of the Caprivi floodplain, indicating the areas of Impalila and Kasika Conservancies and the position of the Kasaya Channel, highlighted in Figure 5 below.



Figure 10. Extent of the Kasaya Channel, highlighted in yellow, boundaries as follows:
 Exits Zambezi River: 17°44'43"S, 25°09'32"E;
 Enters Chobe River: 17°46'40"S, 25°09'37"E.

Actions:

1. Follow steps below to establish Fish Protection Area as a legal entity:
 - 🐟 Delineate agreed boundaries of the Fish Protection Area with the Impalila Conservancy committee.

- Assist committee to reach agreement with Traditional Authority on establishing the Fish Protection Area as requested by the conservancy committee.
 - On approval, assist in presenting the request to the Regional Council
 - On approval, assist in forwarding the request via MFMR to the Minister for final approval.
2. Assist Impalila Conservancy Committee, in association with Traditional Authorities, MFMR, Regional Council and adjacent tourist lodges, to draw up management agreement for the Fish Protection Area (e.g. including catch-and-release angling in Fish Protection Area on payment of fees to conservancy).
 3. Assist conservancy committee with awareness programme about the implementation of the Fish Protection Area and rules therein.
 4. Assist conservancy committee with appointment of fish guards to help in controlling activities in the Fish Protection Area.

3.1.4 KASIKA CONSERVANCY

Management Targets

Potential Fish Protection Area(s) in channels adjacent to Kasaya Channel

Primary goal: Implementation and management of Fish Protection Area(s) in old channels to the west of Kasaya Channel (Figure 11).

Aims: To establish one or more Fish Protection Areas in old channels as sanctuary(s) for breeding and growth of economically important but over-exploited large cichlid species with a view to the following:

- Enhancing exploitable fish stocks in fishing areas adjacent to the Fish Protection Area because of improved recruitment in, and outward migration from, the Fish Protection Area.
- Improving revenue to the community as a result of increased angling tourism to the lodges in the area. There are two potential major benefits, (a) the lodges are important sources of employment for the local community, and (b) the lodges may pay the community for the rights to fish (strictly catch-and-release angling) in the Fish Protection Area.

As indicated in Figure 11, there are several channels, the main one of which is currently choked with vegetation (*Papyrus*) at one point, impeding access.

Actions:

1. Follow-up on contacts made so far with conservancy committee to establish the feasibility of creating one or more Fish Protection Areas in the channels of Kasika Conservancy.

2. Follow steps below to establish agreed Fish Protection Area(s) as legal entities:
 - 🐟 Delineate agreed boundaries of the Fish Protection Area(s) with the Kasika Conservancy committee.
 - 🐟 Assist committee to reach agreement with Traditional Authority on establishing the Fish Protection Area(s) as requested by the conservancy committee.
 - 🐟 On approval, assist in presenting the request to the Regional Council
 - 🐟 On approval, assist in forwarding the request via MFMR to the Minister for final approval.
3. Assist Kasika Conservancy Committee, in association with Traditional Authorities, MFMR, Regional Council and adjacent tourist lodges, to draw up management agreement for the Fish Protection Area(s) (e.g. including catch-and-release angling in Fish Protection Area(s) on payment of fees to conservancy).
4. Assist conservancy committee with awareness programme about the implementation of the Fish Protection Area(s) and rules therein. Assist conservancy committee with appointment of fish guards to help in controlling activities in the Fish Protection Area(s).

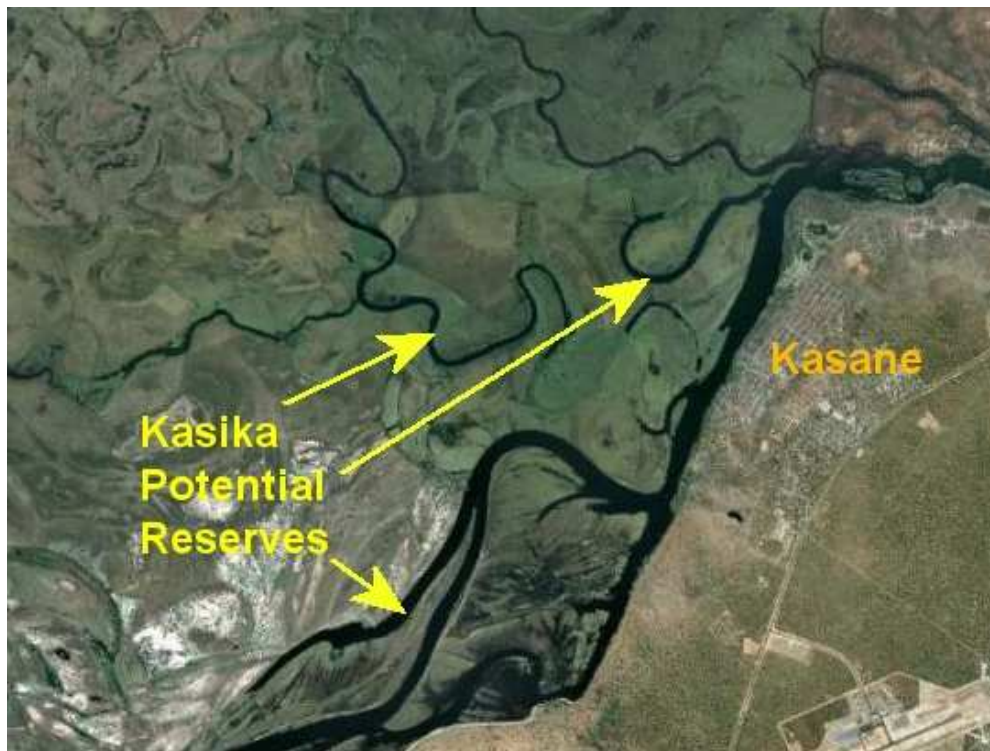


Figure 11. Section of Kasika Conservancy area, showing channels to be assessed as potential Fish Protection Areas.

4 MANAGEMENT PLAN: ACTIVITIES CONDUCTED WITH COMMUNITIES IN PROJECT OPERATIONAL AREAS IN NAMIBIA, AND POSSIBLE AREAS FOR NEW PROJECT INVOLVEMENT

Activities relating to the establishment of Fish Protection Areas are covered in a separate section of this document. In this section, other activities to be conducted with each conservancy/fisheries committee during the course of the project are summarised.

4.1 SALAMBALA CONSERVANCY

- Assist with publicity material for the conservation of the Caprivi killifish (a unique colour form of *Nothobranchius kafuensis*) in the pans of Salambala Conservancy.
- Assist in coordinating the Salambala Conservancy Committee and Lake Liambezi Fisheries Committee for the east side of the lake, based in Muyako.
- Assist conservancy/fishery committees in monitoring fisheries developments on Lake Liambezi.
- Assist in coordination with NRF/UNAM fisheries research programme (if the research programme is approved).
- Assist in coordination with Traditional Authority Chinchimani on the west side of the lake.
- It is assumed that recommendations for modifications to current fisheries regulations are approved and passed into legislation. Provided this is so, project will guide conservancy, fisheries committee and Traditional Authority in formulation of subsidiary regulations suitable for the local fish stocks and fisheries activities, and assist in the establishment of the agreed regulations.

4.2 LISIKILI FISHERIES COMMITTEE

- It is assumed that recommendations for modifications to current fisheries regulations are approved and passed into legislation. Provided this is so, project will guide fisheries committee and Traditional Authority in formulation of subsidiary regulations suitable for the local fish stocks and fisheries activities, and assist in the establishment of the agreed regulations.
- The area under Lisikili contains several long cut-off channels that are not subject to the destructive practices used in the main river channel and accessible side channels and lagoons. Two of these, Maningimanzi Lagoon and Lake Lisikili are under consideration

as Fish Protection Areas. Because of the limited fishing activities currently practised on these lagoons, there are several options that might be considered during the next project phase. These are:

1. Arrange experimental angling visits to Maningimanzi to assess potential for tourism. If trial angling shows high potential, make Maningimanzi a Fish Protection Area as proposed and committee invites interest from lodge owners to enter into partnership to develop recreational fishing in the Fish Protection Area on payment of fees. A subsidiary campsite on the bank of the lagoon is a viable option. Access would be by car during the dry season, by boat from the lodge(s) during the floods. A small (4 m) boat powered by a 5-15HP engine will allow effective coverage of the lagoon. A small electric trolling motor would also be an attractive option.
2. If angling potential is limited, allow the present small-scale fishery with 13 dugout canoes to continue. Local legislation should restrict the entry of new fishermen to the lagoon.
3. Review, in a similar way, the suitability of Lake Lisikili as a Fish Protection Area. This lake may prove unsuitable as an angling water, but may be an important sanctuary for breeding cichlids. In this case, the lake may be designated as a Fish Protection Area for breeding purposes and traditional fishing methods that do not harvest the large cichlids may be allowed. The project should assist with assessment of the fish fauna in the lake and advise on suitable legislation.

4.3 POSSIBLE AREAS FOR NEW PROJECT INVOLVEMENT

4.3.1 Kavulavula Emerging Conservancy

This proposed conservancy has approached the project field staff for guidance and assistance in management of the natural resources in the conservancy.

4.3.2 Schuckmannsberg

The community has requested assistance in setting up volunteer fisheries committee. The community has also indicated interest in establishing the Lutanga Channel as a Fish Protection Area. This channel, over 8 km long exits the Zambezi River at 17°32'00"S, 24°49'00"E, and re-enters the Zambezi at 17°31'45"S, 24°53'00"E.

4.3.3 Lusese Conservancy

The Lusese Conservancy is a very important fishing area. Lusese requests assistance in setting up a system whereby the conservancy committee becomes responsible for sustainable management of the fish resources in addition to the other natural resources in the area.

4.3.4 Others

At present the project is restricted to the Zambezi/Chobe river systems. Interest has been expressed by conservancies on the Kwando River and thus the project should remain open to assistance in other areas where lessons learned can be applied.

5 FUNCTIONS OF CONSERVANCY & VILLAGE FISHERIES COMMITTEES

- Fisheries committees form the primary link between fishing communities, the Traditional Authority, the MFMR, and the Zambezi/Chobe Fisheries Project.
- Committees listen to the concerns of fishermen, assist fishermen to reach agreement on issues faced in the fishery, and communicate the needs and decisions of the fishing communities to the project and to MFMR.
- Committees disseminate information provided by the MFMR, Traditional Authority, MFMR and the project back to the fishing communities.
- Committees, once revised regulations are gazetted to empower them to manage the resources under Section 29(2)(c) of the current Act (or the equivalent in the revised Act), will be responsible for the formulation of by-laws particular to their area.
- In formulating new by-laws through a participatory approach with the fishermen in their area, committees will seek, and be guided by, advice from the project/MFMR to ensure that the proposed by-laws are supported by the latest scientific knowledge.
- Committees will, with the assistance of the project/MFMR, be responsible for informing all fishermen in their areas of the regulations and any new by-laws, with the assistance of the project/MFMR.
- Committees will be able to call in the enforcement section of MFMR to assist in dealing with recalcitrant fishermen who refuse to obey Regulations and by-laws.
- As committees will have authority under agreement with the Traditional Authorities to assist in managing the resources, they will have the authority to take offenders to be dealt with under Traditional Authority laws.
- In future, if legislation is agreed to devolve licensing to the communities instead of the Regional Council, agreements will be formulated through MFMR and the Traditional Authorities to determine how the licences will be issued and how the licence fees will be used to benefit the communities. The committees will play an important role in this process.

6 REVISION OF FISHERIES ACT AND LEGISLATION

6.1 *Reasons for revision and steps to be taken under this Project Management Plan*

Revision and simplification of the current complicated regulations is a priority for the next phase of the project. To support empowerment of the communities to manage their own natural resources, including fish, a two-tier set of regulations is proposed.

The first is a proposal for simplified laws that should apply throughout the fishery to target those gears that are most destructive to the fish resources. These must be **few in number, simple, all-encompassing and, MOST IMPORTANTLY, enforceable**. There should be no ambiguity and thus no confusion in implementation.

The second set of regulations relates to empowerment of the communities to manage their own resources. The present Fisheries Act (Inland Fisheries Resources Act, 2003) explicitly provides for community involvement in management through Section 29(2)(c). This section states: “provide for the establishment of inland fisheries committees for purposes of managing the fisheries in particular water bodies or in particular areas and define the functions, powers and duties of such committees”.

After recognising (as per Section 29(2)(c) of the Act) the committees set up in the project area, the proposed revision of the present regulations should allow local by-laws to be promulgated. These will be formulated on the basis that the Caprivi Floodplains contain a wide variety of fish habitats and thus variation in species composition, necessitating different fishing methods. Permissible methods should be agreed by the communities with advice from the project and MFMR. The latter is then responsible for ratifying the locally agreed regulations.

A high priority is placed on changing the present licensing system, whereby licences are issued by a single officer in the Regional Council in Katima Mulilo. This results in low uptake of licences by fishermen living far away from Katima Mulilo and negates the purpose of a licensing system, i.e. a method of controlling effort levels in the fishery. Instead, it becomes merely an inefficient and unfair method of raising revenue for the Regional Council. It is therefore proposed that the legislation is changed to devolve responsibility for licensing to the fishing communities.

Steps to be taken under this management plan are therefore:

- Prioritise revision of Act and regulations (by Project and MFMR with legal advice).
- Translate proposed regulations into SiLozi.
- Agree revised regulations with conservancy/village committees.
- Agree revised regulations with Traditional Authorities and with Regional Council.
- Gazette agreed revised Act and Regulations.
- Gazette formal recognition of committees (under Section 29(2)(c) of current Act or its equivalent in revised Act).

- Assist recognised community committees in formulation of local by-laws to suit water bodies under their direction.
- Assist communities in education and publicity about the regulations and local by-laws
- Gazette local by-laws (including formal agreements with lodge owners and angling organisations for catch-and-release fishing in Fish Protection Areas).
- Agree, through consultation with all parties, a workable system to devolve responsibility for licensing to the communities and, in the case of recreational angling licences, to the tourist lodges and recognised angling organisations.

6.2 Recommendation on simplification of regulations relating to prohibited fishing methods in Caprivi

At present, a set of revised regulations is under consideration by MFMR. It is proposed that these are reconsidered as a priority at the start of the Phase 2 of the project, by the project and MFMR, with advice from CBNRM experts. The aim will be (a) to simplify the overall regulations to concentrate on the few destructive gears, and (b) provide for empowerment of the communities (under Section 29(2)(c) of the Act) to promulgate local by-laws. Recreational angling regulations should also be reviewed through agreements with official angling representatives (e.g. angling club nominees, lodge owners).

The most destructive gears in this fishery that threaten the very survival of both valuable marketable fish and the tourist recreational fishery should be the subject of non-negotiable prohibition, These are:

- Dragnets. These are mounted differently to gillnets and are instantly recognisable. A simple legal definition can be prepared.
- Monofilament gillnets. They increase effective effort five-fold on species that are already over-exploited.
- Drifting gillnets. The only permitted gillnets should be set in a fixed manner. The law should also prohibit setting fixed gillnets across entrances to lagoons and backwaters, and restrict nets set across channels to not more than 50% of the channel width, as in existing regulations.
- Driving fish into gillnets by beating the water and bankside vegetation.
- Poisons and explosives.

Prohibitions must extend to possession of the gears, not just use of the gears. This means that a shop selling prohibited gears (specifically monofilament gillnets) or fisherman possessing such a gear (monofilament net or dragnet) is as guilty of an offence as the fisherman using them.

6.3 Potential further regulations necessitating consultation with the fishing communities

6.3.1 Night-time curfew

It is proposed that a night-time curfew, as done in Botswana, should be unconditionally imposed on the main river channels to prevent drifting, beating, and drag netting. Elsewhere on the floodplains, there may be reasons for guarding gears overnight, such as theft or animal damage and thus curfews may only be feasible with full agreement of the traditional authorities.

6.3.2 Gillnet mesh regulation

The presently proposed mesh regulations are unsuitable for any of the waterbodies in Caprivi for two major reasons:-

1. They prohibit the use of gillnets with stretched meshes between 25 mm and 50 mm (1-2"). These nets are very useful in exploiting abundant, openwater fish species that provide a valuable source of food in the community (provided they are set in fixed positions and are not used as dragnets or in conjunction with beating the water and bankside vegetation). Nets of 25 mm mesh catch the shoaling *Brycinus lateralis* and *Barbus poechii*. Nets up to 50 mm mesh catch *Schilbe intermedius* in abundance, mormyrids, small cichlid species (*Tilapia sparrmanii*, *Pharyngochromis acuticeps*, *Pseudocrenilabrus philander*) and *Synodontis* spp. These nets catch very few juveniles of the larger cichlid species because these juveniles inhabit areas of cover to protect them from tigerfish predation and nets are not easily set in such habitats. Gillnet catches from the Upper Zambezi (primarily Barotse floodplain) during the 4-Corners Project biodiversity surveys show the abundance of *Schilbe intermedius*, mormyrids and *Brycinus lateralis* from mesh sizes <50 mm (Tweddle *et al.*, 2004).

2. The 75 mm (3") minimum mesh is unsuitable for a fishery aimed at larger cichlids and tigerfish. These 3" nets mainly catch cichlids between 20 and 25 cm in length, i.e. not yet mature and at a size where they have survived beyond the initial very heavy juvenile mortality. They are relatively immune to tiger predation (which acts on fish up to 15 cm in length) and therefore move more freely in open water, and they are at the most rapidly growing (in terms of mass) phase of their lives. This is the stage in which they should be protected from fishing.

Therefore, if mesh size regulations are adopted as a management area in some areas of the system, such as main river channels, to ensure optimum exploitation, it should only be done with the agreement of the traditional authorities. It is suggested (to be reviewed during the decision-making process) to allow 25-50 mm mesh nets and to have a prohibition on nets from 50-95 mm mesh.

Consideration may also be given to prohibit any mesh sizes greater than 105 mm mesh. This would ensure that any cichlid that avoids capture while growing through the size range exploited by 95-105 mm mesh nets (effectively 3¾ and 4" nets) would then become a major asset to the fishery in two ways: (a) the larger the fish the greater the reproductive potential (because increase in egg numbers increases exponentially with length and it avoids selective

pressure towards smaller, slower-growing and earlier maturing fish); and (b) the larger fish become trophy fish for anglers and improve the tourism value of the fishery.

6.3.3 Mosquito nets and other gears

The use of mosquito nets is the source of much debate. The use of mosquito netting and shade cloth in a destructive manner lining larger gears will be totally prohibited by the ban on dragnets, hence no further legislation is necessary.

Bed mosquito nets are widely used for small fish at culverts and in drying pools on the floodplains and provide abundant valuable protein to the communities. Provided they are not used to catch juveniles of valuable larger fish species, their use may be agreed under the regulations formulated by local community committees in agreement with MFMR. The use of new, insecticide-treated nets should be discouraged by the community leaders, and such nets must not be used in closed water bodies as the chemical is lethal to fish.

6.3.4 Fish fences and other barriers

Fences have been used in conjunction with traps since time immemorial to catch fish migrating between pools on the floodplain and off the floodplain into river channels. It should be specified in the regulations that only presently established locations should be legitimised, to prevent their spread to entrances to large lagoons that are important for fishing and for tourism.

7 REVIEW AND MONITORING OF THE MANAGEMENT PLAN

- The state of the fish stock will be monitored by the project, MFMR and DoF.
- Any changes in the fish population will be reported to the Inland Fisheries Council, once established.
- Any proposed amendments to the Act or to the management plan will be presented to the Inland Fisheries Council for endorsement and then a recommendation forwarded to the Minister for approval.
- The Chief Fisheries Biologist in the Caprivi will prepare relevant reports.
- Implementation of legislation and the management of the Fish Protection Areas will be monitored and an annual report submitted to the Inland Fisheries Council.
- Report on the implementation of legislation will be the responsibility of the Senior Fisheries Inspector.
- The conservancy/village committees, in collaboration with the Senior Fisheries Inspector, will prepare the reports on the Fish Protection Areas.

8 SUPPORT FOR FISH RANCHING

- Provide technical assistance, on ad-hoc basis, to on-going fish ranching activities implemented during the NNF Lead fish farming programme.
- Assist in maintaining the current programme in the project area, i.e. the Caprivi floodplains, supplementing new activities implemented in pilot project areas through the new Country Pilot Partnership (CPP) project.

9 REFERENCES

- Abbott, J., Hay, C., Kalonga, M., Næsje, T.F. and Purvis, J. 2003. 2002 Joint frame survey of the Upper Zambezi River (Namibia/Zambia). DEA research paper. 39 Pages.
- Abbott, J., Hay, C., Kapirika, S., Næsje, T.F. and Purvis, J. 2003. Shared Resource Management on the Zambezi/Chobe Systems in Northeast Namibia: Current Practices and Future Opportunities: Report of the Ngweze/Katima Mulilo Fish Market Survey April 2002 to January 2003. 20 Pages
- Abbott, J.G. 2005. Fishing for a living: Subsistence and income uses of a common property resource in the Upper Zambezi Floodplains. D. Phil. Dissertation. Nicholas School of the Environment and Earth Sciences, Duke University. USA.
- Aquaculture Act. 2002. Government Gazette of the Republic of Namibia.
- Bethune, S. & Roberts, K. 1991. Checklist of the fishes of Namibia for each wetland region. *Madoqua* 17(2): 193-199.
- Curtis, B., Roberts, K.S., Griffin, M., Bethune, S., Hay C.J. & Kolberg, H. 1998. Species richness and conservation of Namibian freshwater macro-invertebrates, fish and amphibians. *Biodiversity and Conservation* 7, 447-466.
- Fowler, H.W. 1935. Scientific results of the Vernay-Lanf Kalahari expedition, March to September 1930. *Ann. Transv. Mus.* 16(2): 251-293.
- Grobler, H.J.W. 1987. 'n Vis-Ekologiese Studie van die Liambezimeer in Caprivi, Suidwes-Africa. Ph.D. dissertation. Rand Afrikaans University, Johannesburg, RSA.
- Hay, C.J., van Zyl, B.J., van der Bank, F.H., Ferreira, J.T. and Steyn, G.J. 1999. The distribution of freshwater fish in Namibia. *Cimbebasia*: 15: 41-63.
- Hay, C.J., Næsje, T.F., Breistein, J., Hårsaker, K., Kolding, J. Sandlund, O.T. & van Zyl, B.J. (2000). Fish populations, gillnet selectivity, and artisanal fisheries in the Okavango River, Namibia. Recommendations for a sustainable fishery. NINA.NIKU Project Report no.10. 105 pages.
- Hay, C.J., Næsje, T.F., Kapirika, S., Koekemoer, J., Strand, R., Thorstad, E. & Hårsaker, K. 2002. Fish populations, gillnet catches and gillnet selectivity in the Zambezi and Chobe Rivers, Namibia, from 1997 to 2000. NINA.NIKU Project Report no.17.88 pages.
- Inland Fisheries Resources Act. 2003. Government Gazette of the Republic of Namibia.
- Jubb, R.A. 1958. A preliminary report on the collections of freshwater fishes made by the Bernard Carp Expedition to the Caprivi Strip, 1949, the Lower Sabie River, 1950 and to Barotseland, 1952. *Occ. Pap. Natn. Mus. Southern Rhod.* 22B: 177-189.
- Jubb, R.A. & Gaighher, I.G. 1969. Check list of the fishes of Botswana. *Arnoldia (Rhod).* 5(7): 1-22.
- Koekemoer, J.H. 2003. A fish ecological study of rivers and floodplains in the Eastern Caprivi, Namibia. M.Sc. thesis. Rand Afrikaans University, Johannesburg, RSA.

- Kolding, J., Ticheler, H. & Chanda, B. 1996. Assessment of the Bangweulu Swamps fisheries. Final Report prepared for WWF Bangweulu Wetlands Project, SNV/Netherlands Development Organisation, and Department of Fisheries, Zambia. 51 p.
- Kolding, J., van Zwieten, P., Manyala, J., Okedi, J., Mgaya, D. & Orach_Meza, F. 2005. Lake Victoria Environmental Management Programme. Regional Synthesis Report on Fisheries Research and Management. Final Report.
- Mendelsohn, J. & Roberts, C. 1997. An Environmental profile and atlas of Caprivi. Directorate of Environmental Affairs, Windhoek Namibia.
- Ministry of Fisheries and Marine Resources. 2005. White Paper on the Responsible Management of the Inland Fisheries of Namibia.
- Næsje, T.F, Hay, C.J., Kapirika, S., Sandlund, O.T. & Thorstad, E.B. 2001. Some ecological and socio-economic impacts of an angling competition in the Zambezi River, Namibia. NINA.NIKU Project Report no. 14. 31 pages.
- Næsje, T.F., Hay, C.J., Nickanor, N., Koekemoer, J.H., Strand R. & Thorstad, E.B. 2004. Fish populations, gillnet catches and gillnet selectivity in the Kwando River, Namibia. NINA.NIKU Project Report no.27.64 pages.
- Næsje, T.F., Hay, C.J., Purvis, J., Hamukuaya, H., Kapirika, S. & Abbott, J. 2002. Shared Resource Management on the Zambezi/Chobe Systems in Northeast Namibia: Current Practices and Future Opportunities. NINA.NIKU Project Report no.18. 71 pages.
- Næsje, T.F., Strand, R., Hay, C.J., Purvis, J., Thorstad, E.B., Abbott, J. and Nickanor, N. 2003. Shared Resource Management on the Zambezi/Chobe Systems in Northeast Namibia: Current Practices and Future Opportunities: River fisheries study: February 2002- February 2003. 44 Pages.
- Økland, F., Hay, C.J., Næsje, T.F., Chanda, B. & Thorstad, E.B. 2002. Movements and habitat utilisation of nembwe (*Serranochromis robustus*) in the Upper Zambezi River. Implications for fisheries management. NINA.NIKU Project Report no. 20. 25 pages.
- Økland, F., Hay, C.J., Næsje, T.F., Chanda, B. & Thorstad, E.B. 2007. Movements of, and habitat utilisation by threespot tilapia *Oreochromis andersonii* (Teleostei: Cichlidae) in the Upper Zambezi River, Namibia. - African Journal of Aquatic Science 32(1): 35-38.
- Økland, F., Hay, C.J., Næsje, T.F. & Thorstad, E.B. 2000. Movement and habitat utilisation of cichlids in the Zambezi River, Namibia. A radio telemetry study in 1999-2000. NINA.NIKU Project Report no. 11. 18 pages.
- Økland, F., Thorstad, E.B., Hay, C.J., Næsje, T.F. & Chanda, B. 2005. Patterns of movement and habitat use by tigerfish (*Hydrocynus vittatus*) in the Upper Zambezi River (Namibia). Ecology of Freshwater Fish. 2005. 14: 79-86.
- Purvis, J. 2001. The post harvest fisheries sub-sector on the Eastern floodplains Caprivi. Ministry of Agriculture, Water and Rural Development.
- Purvis, J., Abbott, J., Næsje, T.F. and Hay, C. 2003. Shared Resource Management on the Zambezi/Chobe Systems in Northeast Namibia: Current Practices and Future Opportunities: Existing fishery management systems and implications for future management. 30 Pages.

- Stephanus, K., Fuller, B & Msangi, J.P. 2002. Shared Fisheries Resource Management on the Zambezi/Chobe River Systems: Household survey. University of Namibia. Namibia.
- Thorstad, E.B., Hay, C.J., Næsje, T.F., Chanda, B. & Økland, F. 2002. Movements and habitat utilisation of tigerfish (*Hydrocynus vittatus*) in the Upper Zambezi River. Implications for fisheries management. NINA.NIKU Project Report no. 19. 28 pages.
- Thorstad, E.B., Hay, C.J., Næsje, T.F., Chanda, B. & Økland, F. 2003. Movements and habitat utilisation of threespot tilapia in the Upper Zambezi River. Implications for fisheries management. NINA.NIKU Project Report no. 23. 22 pages.
- Thorstad, E.B., Hay, C.J. Næsje, T.F & Økland, F. 2001. Movements and habitat utilisation of three cichlid species in the Zambezi River, Namibia. *Ecology of Freshwater Fish*. 10: 238-246.
- Thorstad, E.B., Hay, C.J., Næsje, T.F., Chanda, B. & Økland, F. 2003. Space use and habitat utilisation of tigerfish and the two cichlid species nembwe and threespot tilapia in the Upper Zambezi River. Implications for fisheries management. NINA.NIKU Project Report no. 24. 22 pages.
- Thorstad, E.B., Hay, C.J., Næsje, T.F., Chanda, B. & Økland, F. 2004. Effects of catch-and-release angling on large cichlids in the subtropical Zambezi River. *Fisheries Research*. 69: 141-144.
- Thorstad, E.B., Hay, C.J., Næsje, T.F., Chanda, B. & Økland, F. 2005. Movements and habitat utilization of nembwe, *Serranochromis robustus* (Günther, 1864), in the Upper Zambezi River. *African Zoology*. Vol. 40(2): 253-259.
- Thorstad, E.B., Hay, C.J., Økland, F., Nickanor, N. and Næsje, T.F. 2007. Spatial behaviour and management of greenhead tilapia (*Oreochromis macrochir*) in the Zambezi River, Namibia. NINA Project Report no. 287.30 pages.
- Turpie, J., Smith, B., Emerton, L. & Barnes, J. 1999. Economic v of the Zambezi Basin wetlands, Zambezi Basin Wetlands Conservation and Resource Utilization Project. IUCN Regional Office for Southern Africa, 346 pp.
- Tweddle, D., Skelton, P.H., van der Waal, B.C.W., Bills, I.R., Chilala, A. & Lekoko, O.T. 2004. Aquatic biodiversity survey for the “Four Corners” Transboundary Natural Resources Management Area. Final Report – July 2004. Report for African Wildlife Foundation, xviii+202 pp.
- Van den Berg, W.J. 1956. Report on native fishing methods and fish from the Upper Zambezi and Mashi Rivers. Bernard Carp Barotseland Expedition July/August 1952. *Piscator* 37: 42-47.
- Van der Waal, B.C.W. 1976. ‘n Vis-Ekologiese studie van die Liambezimeer in die Oos-Caprivi met verwysing na visontginning deur die Bantoebevolking. Ph.D. dissertation, Rand Afrikaans University, Johannesburg, RSA.
- Van der Waal, B.C.W. & Skelton, P.H. 1984. Check list of fishes of Caprivi. *Madoqua* 13(4): 303-320