Shared Fisheries Resource Management on the Zambezi/Chobe River Systems: Interim Report of the Ngweze/Katima Mulilo Fish Market Survey April 2002 to January 2003

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1. INTRODUCTION

The fish market survey provides information both about the vendors and the fish they sell. This information includes:

- the general patterns of supply to the market, i.e. where fish comes from, when and how much arrives at the market;
- the sizes and species of fish being sold at the market;
- the types of vendors who sell fish, i.e. marital status, where they come from, how they obtain fish, how long they have been fish vendors;
- vendors perceptions of how the market works, i.e. best and worst seasons for selling fish, why they sell dry or fresh fish and the main factors that affect their ability to bring fish to market.

Gaining an understanding of these areas is important for several reasons. Comparing the volume and composition of fish supplied to the market against concurrent fish stock and fishing activity data can provide a better understanding of what factors affect the flow of fish from river to net to market. Furthermore, the degree of similarity between the datasets can be evaluated to see if market-based data collection can augment more conventional stock assessment and catch–effort surveys in a cost-effective manner.

A better understanding of the physical and socio-economic and management factors shaping decision making allows the effects of changes in supply of fish to market to be better anticipated. Finally, the fish market survey has demonstrated a potential space for dialogue and exchange of information between the Ministry of Fisheries and Marine Resources and the fish vendors. This in turn provides a potential to build mutual understanding and trust as well as incorporate fish vending into the decision making process regarding fisheries management.

Over 250 vendor interviews, 1,500 fish deliveries and 3,000 fish length–price measurements have been recorded since April 2002. Data will continue to be collected on a weekly basis until the end of June 2003.

The results presented in this report are drawn from a partial dataset, due to a change in methods after the first three months of the survey. The complete analysis will be provided once the final data are available and will form part of J. Abbott's dissertation, to be published in April 2004.

2. METHOD

It is important to note that the fish market survey did not collect data on every delivery of fish to the market or every vendor who sold fish in the market. The goal of the fish market survey was to determine broad trends in fish supply, vendor behaviour and perceptions, rather than absolute numbers. Consequently, the survey methods, sample sizes and times were designed to adequately represent general market dynamics.

Although data collection began in March 2002, the methods were adapted over the year of the survey implementation. These adaptations were done for two reasons – to better answer the research questions and make the research activities less intrusive to vendors. Sample size was increased, as was the length of sampling events, but some questions were omitted in the case of repeat interviews. As a result, the useable datasets vary in time ranges (Table 1). This means that during the early stages of the market survey, the picture was incomplete, and hence these data have not been included in the report. Data were also collected from several

markets in Zambia and Botswana. Initial results comparing the characteristics of markets in the three countries are presented in Annex 1.

Table 1 Time range of complete datasets for the market survey

Data Type	Time Range
Market supply	June 2002–January 2003
Market layout	May 2002–January 2003
Vendor characteristics and fish price/length	April 2002–January 2003

2.1 Fish supply

On the day of the weekly survey (on or as close as possible to Wednesday), every container of fish delivered to the market was measured between 8a.m. and 10a.m. Based on previous observations, this time range coincided with the majority of deliveries to the fish market. After August 2002, fish deliveries were measured from 8a.m. to 1p.m to confirm that peak numbers of deliveries did occur in the morning.

2.2 Market layout

Before conducting individual vendor interviews, the number and type of fish vendors (i.e. whether they were selling fresh or dry fish) and which stalls they occupied at the market were recorded. Recording which market stalls were occupied and by who had two purposes. First, it made the identification of randomly selected vendors easier. Second, the spatial distribution of market vendors, in addition to their absolute numbers, can be analysed. This analysis can yield important insight on how vendors assert claims to market stalls, especially when there are high numbers of vendors.

Initially, the market layout was recorded at 10a.m., but the time was moved to 9a.m. in September onwards for practical reasons, as the sample size for vendor interviews had increased, hence the surveys had to start earlier.

2.3 Vendor characteristics and fish price/length

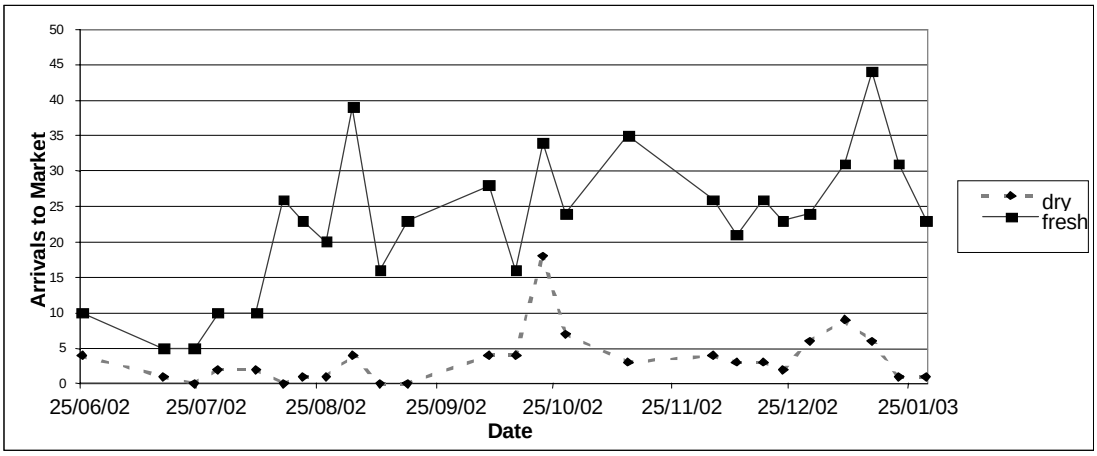
Using the results of the market layout survey, a random selection of equal numbers of fresh and dry fish vendors was made. These vendors, if they consented, would have their fish measured within price intervals (i.e. the largest and smallest fish of the same species within the same price as well as the total number of fish within that interval). In addition, the vendor would be interviewed regarding their family, origin, and supply of fish. As stated previously, the interview forms were adapted to avoid repeat data and vendor annoyance if a vendor was being interviewed on a repeat basis the 10 months that the survey has been running.

3. RESULTS

3.1 Fish supply

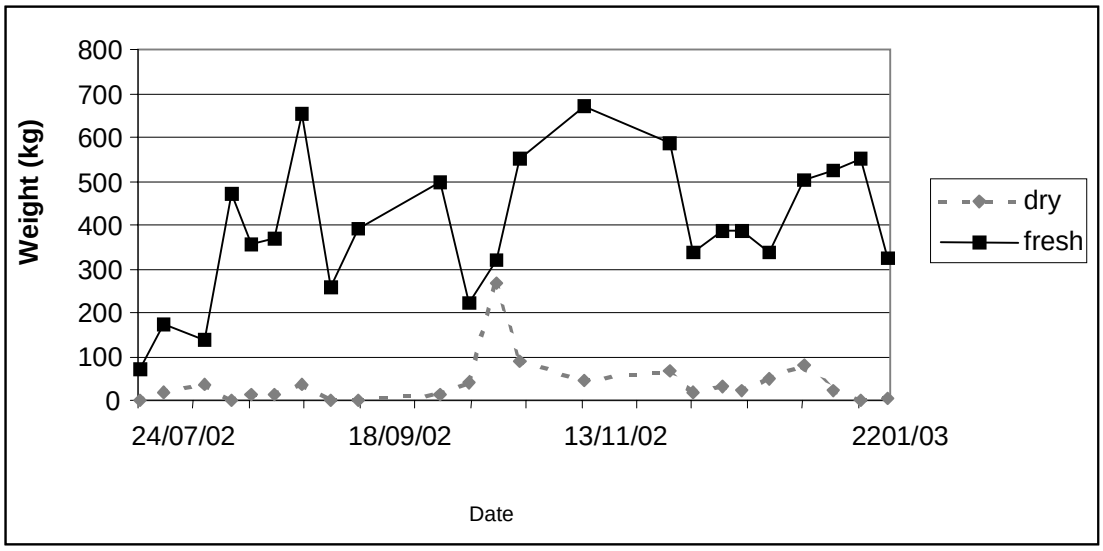
Since June 2002, the delivery of both dry and fresh fish during the peak delivery period (8–10 a.m.) increased and then roughly stabilised (Figure 1). At all times, deliveries of fresh fish exceeded deliveries of dry fish, though the supply of fresh fish appears to be more variable over time than that of dry fish.

Figure 1 Deliveries of fresh and dry fish by vendor to the gates of the Ngweze Market, 8–10 a.m., June 2002–January 2003



Aside from an increase in deliveries, the total weight of all deliveries of fish brought to the market during the sample time has increased as well (Figure 2). No conclusions can be made from the data regarding whether this increase in total weight is due to an increase in the proportion of large fish in deliveries, or simply more fish overall. The weight of fresh fish far exceeds that of dry fish by weight, except during October. The largest volume of all fish delivered was recorded in November.

Figure 2 Deliveries of fresh and dry fish by weight to Ngweze Market 8–10 a.m., July 2002–January 2003



Fish deliveries from 31 different areas or villages were recorded between June 2002 and January 2003 (Table 2). Three areas (Lisikili, Kalundu and Nañombe) accounted for 75 per cent of all deliveries. Further analysis looking at differences in the source of fish according to month, weight and preparation (i.e. fresh or dry) remains to be done.

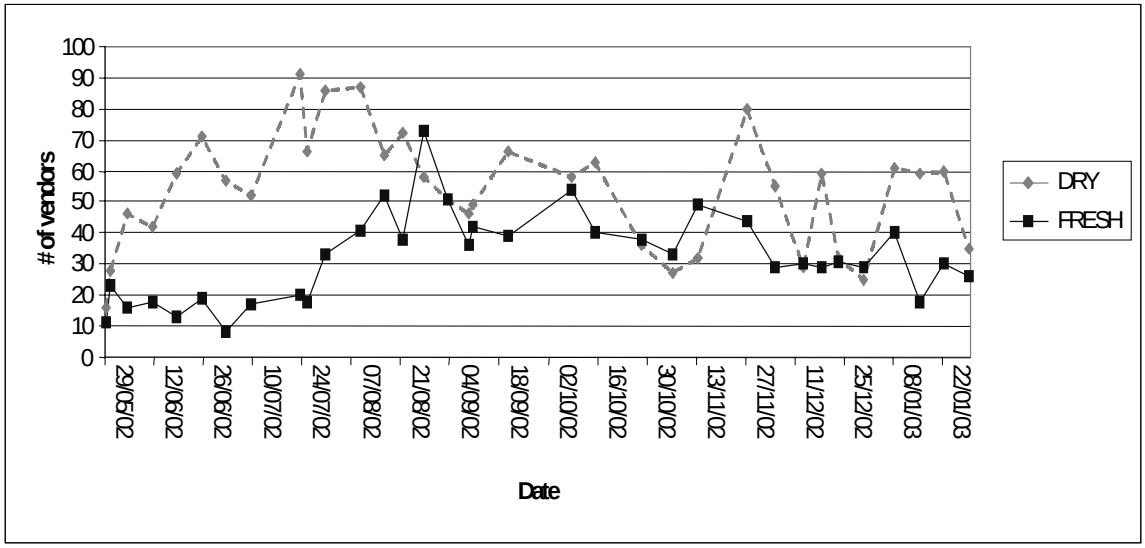
Table 2 Frequency of deliveries by area, to the Ngweze Market, 8–10 a.m., June 2002–January 2003

Village/Area	Number of vendors	Village/Area	Number of vendors
Lisikili	231	Nakabolelwa	4
Kalundu	123	Schuckmannsburg	3
Nañombe	107	Mahundu	3
Kalimbeza	22	Chisambela	2
Malindi	19	Mutwalwezi	2
Libula	13	Kabulabula	2
Sifuha	13	Isize	2
Kanono	11	Ibbu	1
Ihaha	10	Kasika	1
Mbalasinte	9	Nasisangani	1
Ngoma	9	Nfoma	1
Kasuzu	9	Iseke	1
Lusese	8	Manyonga	1
Musanga	7	Natungu	1
Masikili	6	Ibilibinzi	1

3.2 Vendor characteristics

The types of fish vendors (i.e. whether they sold fresh or dry fish) was recorded once a week at 9a.m. or 10a.m. (Figure 3). Overall vendor numbers were highest during August and lowest during November. There were generally more dry fish vendors than fresh fish vendors, with the greatest difference in June and July.

Figure 3 Number of fresh and dry fish vendors occupying market stalls, May 2002–January 2003



Vendors interviewed got their fish from 31 different areas (Table 3). The same three areas (Lisikili, Kalundu and Nañombe) accounted for 75 per cent of the fish sold by the vendors interviewed. The frequency of fish sources identified by randomly sampled interviewers resembles the overall frequency of fish sources identified by deliveries (see Table 2). It is therefore reasonable to assume that the random sample of vendors is representative of the vendors who were active in the market during these dates.

Table 3 Source of fish by area, sold by vendors interviewed, May 2002–January 2003

Area	%
Lisikili	37
Kalundu	20
Nañombe	17
Kalimbeza	4
Malindi	3
Libula	2
Sifuha	2
Kanono	2
Ihaha	2
Mbalasinte	1
Ngoma	1
Kasuzu	1
Lusese	1
Musanga	1
Masikili	1
Nakabolelwa	1
Mahundu, Chisambela, Schuckmannsburg, Mutwalwezi, Kabulabula, Isize, Ibbu, Kasika, Nasisangani, Nfoma, Iseke, Manyonga, Nantungu, Ibilibinzi	<1

Most of the fish sold by those vendors interviewed was purchased rather than caught by family members (presumably at no charge to the vendor) (Table 4). The majority of fresh fish vendors obtained their fish by purchasing from fishermen at the riverside, while most dry fish vendors purchased their fish in their own villages.

Table 4 Means of obtaining fish sold by vendors interviewed, May 2002–January 2003 (%)

Source of fish	Fresh	Dry
Family	16	7
Buy fish at river	35	26
Buy in village	31	57
Travel to another village to buy fish	15	12
Fish vendor	2	-
Market	2	1

255 of the vendors interviewed were women, with only two men interviewed. Most vendors stated that they were married, although a considerable proportion of dry fish vendors were divorced (Figure 4). Similar proportions of each group were single. Very few vendors were widowed.

Most fish vendors said that they were the heads of household, with ‘spouse’ being the second most common category (Figure 5).

Figure 4 Family status of fresh and dry fish vendors interviewed

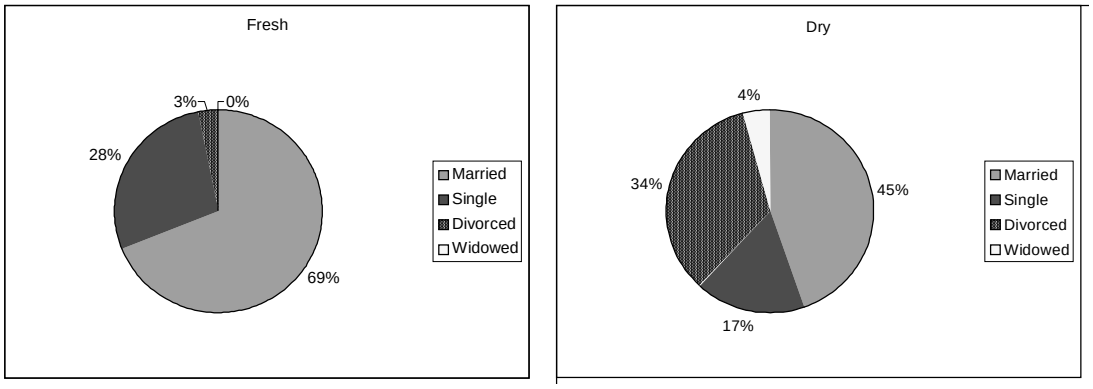
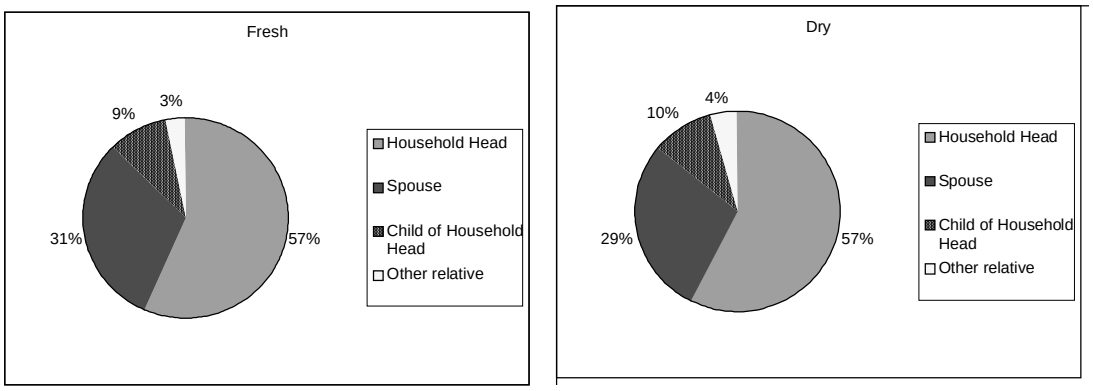


Figure 5 Position in household of fresh or dry fish vendors interviewed



Vendors were asked to identify the best and worst seasons for selling fish and why this was so (Figures 6 and 7). The local names for seasons were used in interviews. The local seasons, equivalents in months and the accompanying environmental conditions are given in Table 5.

Table 5 Local seasons, equivalent months and accompanying environmental conditions

Season	**Litabula**			**Muunda**				**Maliha**			**Mbumbi**	
Month	Nov	Dec	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct
River condition		River levels rising (through the rainy season) slowly to break banks by March and reach peak in May						‘Drawdown’ season as water moves back to channel			Low water period lasting to November	

(Adapted from Purvis, 2002)

No clear patterns emerged regarding which season was best or worse, although a significant proportion of both vendor types said they didn’t know which season was best, usually because they had been selling fish for a relatively short time. Roughly equal proportions of each type of vendor identified *Mbumbi* as the best and worst season to sell fish.

Figure 6 Seasons identified as being the best for selling fish

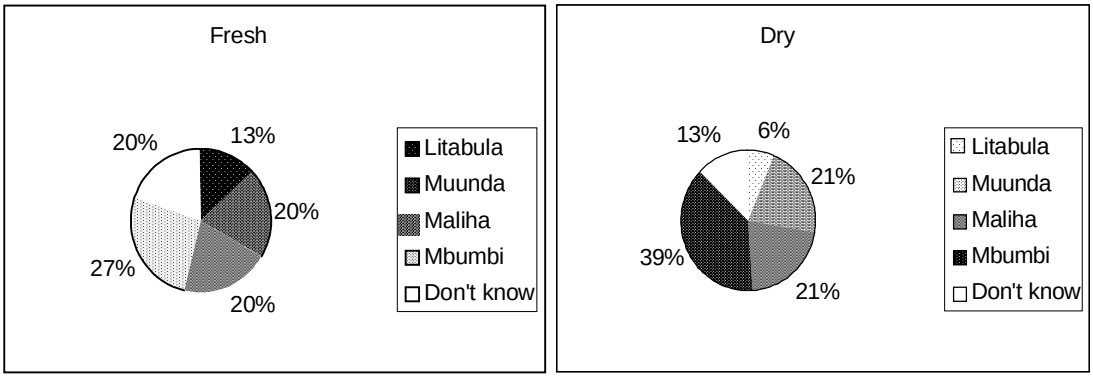
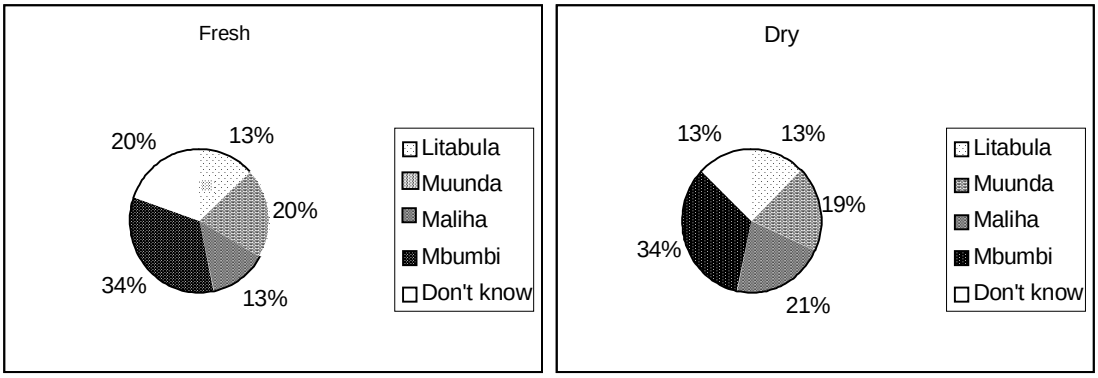


Figure 7 Seasons identified as being the worst for selling fish



Fish vendors cited a broad range of reasons regarding why a season was good or bad for selling fish (Tables 6 and 7). After eliminating repeat interviews and those that answered that they didn't know, the sample size was relatively small (n=66), raising the issue of whether the data are representative. Nevertheless, it is important to note that almost 50% of fresh fish vendors said that certain seasons were best when there was less fish at the market and vice versa.

Table 6 Perceptions of best and worst seasons by fresh fish vendors (%)

Best		**Worst**	
Less fish	47	Lots of fish	40
High water	15	Fish moving around	13
Fish not moving	13	Rainy season	9

Table 7 Perceptions of best and worst seasons by dry fish vendors (%)

Best		**Worst**	
High water	27	Lots of fish	26
Fish dries quicker	25	Cool temperatures	20
Less fish	22	Low flood season	14

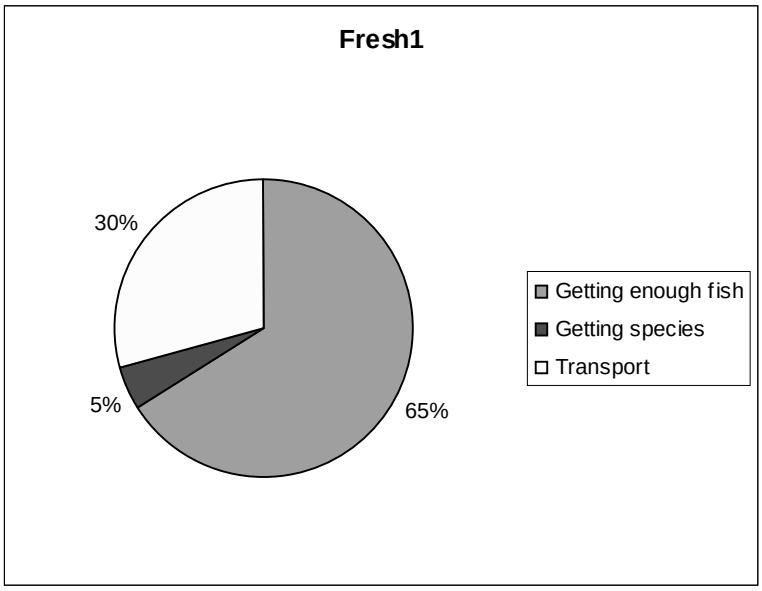
Fish vendors were asked to rank the importance of different factors affecting their ability to sell fish. These factors were:

- getting enough fish;
- getting the sizes of fish they want;
- getting the species of fish they want;

- preparing fish;
- transporting fish to market.

Figure 8 illustrates the most important factors affecting their ability to sell fish by fresh and dry fish vendors. Figure 9 illustrates the second most important factors.

Figure 8 Most important factor affecting ability to sell fish ranked by fresh and dry fish vendors



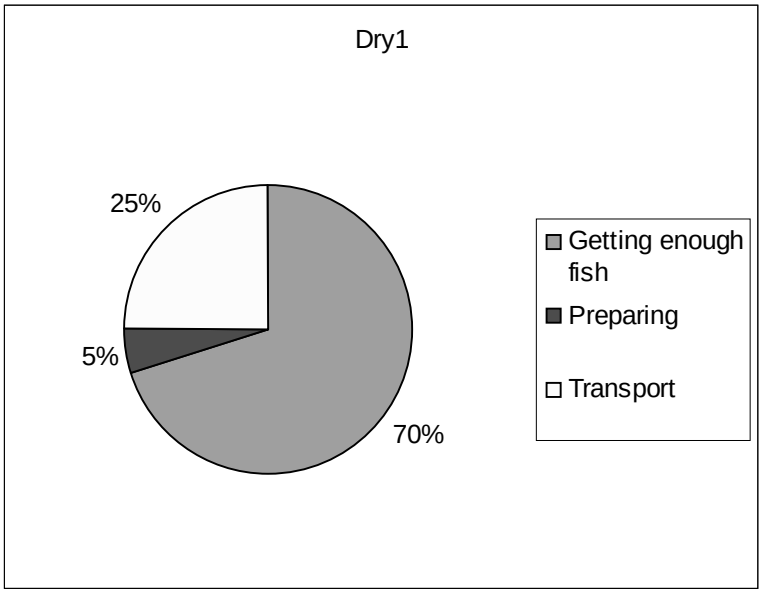
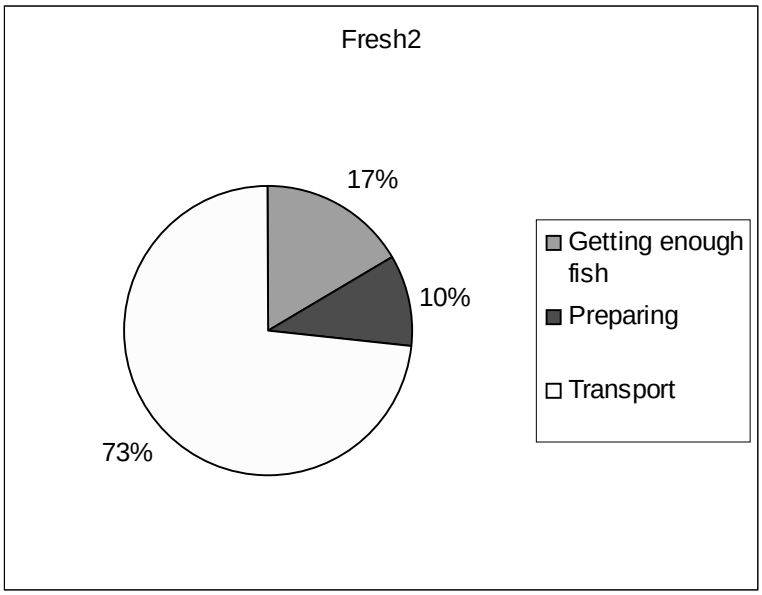
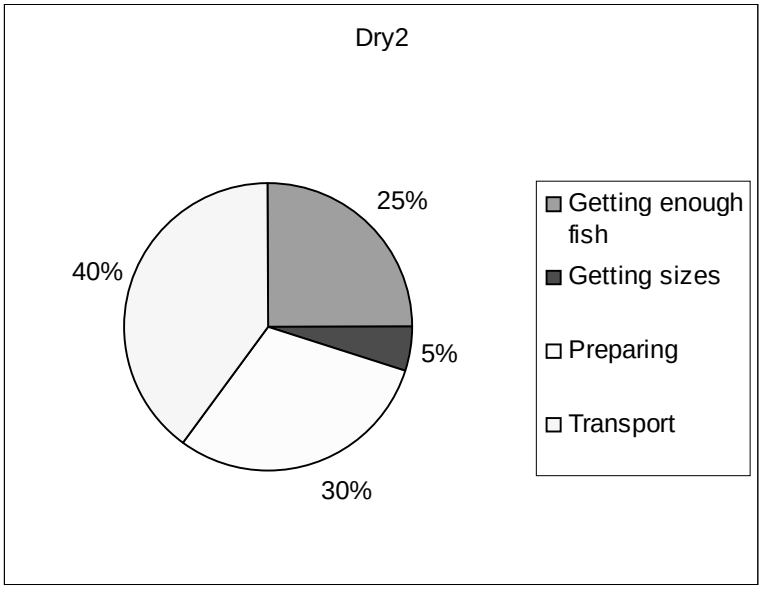


Figure 9 Second most important factor affecting vendors' ability to sell fish

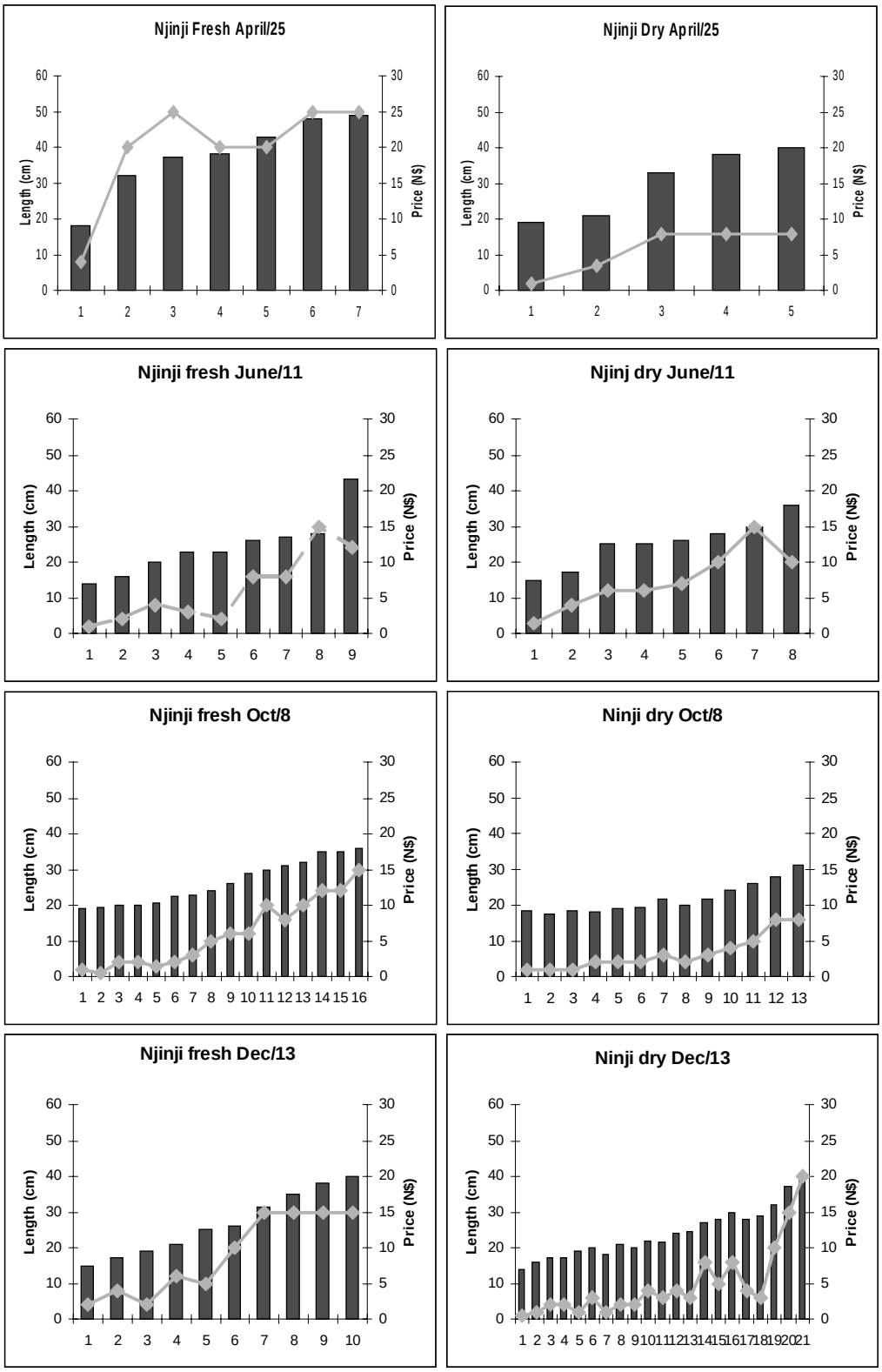




3.3 Fish prices

Each fish vendor interviewed had their stock recorded according to: preparation type (if any, i.e. fresh or dry), number of fish, species, length (head to tail) and price. The fish were divided into price categories and the largest and smallest fish of the same species within that price category were measured. With up to 20 vendors being sampled weekly, the dataset is quite extensive. For this report, four weeks of results from a species known in SiLozi as *njinji*, (Three-spot tilapia, *Oreochromis andersonii*) is used as a representative sample (Figure 10). This species was chosen as it is a relatively common and desirable species with a wide range of lengths. These four weeks were chosen as there were a sufficient number of *njinji* in the market stalls to be sampled to establish trends and also span the months that sampling took place at the market.

Figure 10 Length (bar) and price (line) ratios for fresh and dry *njinji* in four selected sample days April–December[1]



1 Scales are same for all graphs.

The data suggest that there is a relatively linear relationship between the length and cost of a fish. Moreover, at a constant length, fresh *njinji* costs more than dry fish. From April to December, fresh *njinji* appears to drop in value, although the costs for dry *njinji* fluctuate (Table 8).

Table 8 Price comparisons of 20 and 30 cm long *njinji* ($N)

	Fresh		Dry	
	20 cm	**30 cm**	**20 cm**	**30 cm**
April 25	5	21	1	7
June 11	4	15	4 (est.)	10 (est.)
October 8	2	10	1	7
December 13	6	15	2	7

4. DISCUSSION

An important consideration is whether the data from this survey are adequately representative, enabling conclusions to be made about the dynamics of the actual fish market. The values recorded for number of arrivals to market and volume of fish, seen in Figures 1 and 2 are similar, which is not surprising. However, the number of fish vendors in October and November seems to go down (Figure 3) just as the volume and arrivals of fish are increasing. This apparent contradiction may be due to the fact that the time the vendors were counted at the beginning of the sample period shifted from 10a.m. to 9a.m. in September. Alternative explanations may be that the vendors are arriving earlier as spring progresses (hence more fall into our sample period of 8–10a.m.) and are bringing more fish during October and November. From a market dynamics perspective, it could be that there is a shift later in the year, with women bringing fish to market, but selling it to other vendors rather than selling it themselves.

There is considerable fluctuation in the number of arrivals, volume and vendor numbers. The reasons behind these fluctuations are difficult to determine at present, although it is probably a combination of the seasonal fluctuation in the availability of fish and the income generation requirements of fish vendors. Within-month cycles could also exist, where the monthly deposit of government salaries (accounting for the majority of waged labour in the region) sets off a pulse of liquidity and consumption in Katima Mulilo.

It appears that the majority of fish being brought to the market comes from a surprisingly limited number of areas (Tables 2 and 3). If these results are valid, it is important to determine if this is due to abundance of fish, fishers, fish vendors or all three. Moreover, it will be important to consider the proximity of each of these areas that supply fish and their relative access to roads and taxis, as these are the principal means of transport. Most fish vendors report purchasing their fish near to where they live (Table 4), suggesting that the most likely interaction is directly between fish vendors and fishers. Catch–effort and fish stock data are available from these high activity areas that could be used to test this assumption.

Some results, such as those regarding the best and worst seasons for selling fish (Figures 6 and 7) seem contradictory, as equal proportions of fish vendors seem to have different perceptions of the same season. However, the rationale behind these perceptions (Tables 6 and 7) do give some explanation of this apparent contradiction. While the seasons come at the same time for everyone, it affects different types of fish vendors in different ways, depending on how they get their fish, whether they sell fresh or dried fish and how often they come to

the market. Indeed, fish supply and transport to the market are evidently important factors to most fish vendors (Figures 8 and 9).

The value of fish does not appear to differ as much over time as would be anticipated by normal models of price response to supply and demand (Table 7 and Figure 10). There are several possible explanations for this result. First, the sample species and dates may not have been suitable for analysis and a larger dataset from grouped species and dates may have to be attempted. Second, the severe economic hardship arising from the drought currently affecting the region may have had a double effect on prices, where more people are turning to fish vending to make money and less people have money to buy fish.

These initial results arising from a broad analysis suggest that many of the factors affecting market dynamics will only become apparent by analysis at the vendor level over varying time periods. Particular attention will be paid to disaggregating the results on several levels, rather than just distinguishing between fresh and dry fish vendors. Moreover, the gaps in the dataset at the beginning of the sample period, due to the evolution of method are more apparent now than before. Consequently, a continuation of sampling will have to continue at least until June 2003 to allow for adequate analysis and comparison within and between the market, catch effort and fish stock datasets.

Once the year-long market dataset has been assembled using consistent methods, regression analysis will be used to see if correlations between time, vendor characteristics, behaviour and perception can be determined. The results will be made available in James Abbott's Ph.D. dissertation.

ANNEX 1 CHARACTERISTICS OF SELECTED FISH MARKETS ON THE ZAMBEZI–CHOBE RIVERS IN NAMIBIA, ZAMBIA AND BOTSWANA

1. INTRODUCTION

This annex examines some characteristics of fish markets in Zambia and Botswana that are supplied by the fisheries resources of the Zambezi–Chobe river system. The results described in the interim report above, suggest that price, supply and composition are strongly influenced by seasonal fluctuations in fish biomass and availability to fishers. Socio-economic factors such as infrastructure, degree of commercialisation and available livelihood options have equally important, though not easily quantifiable, effects on market characteristics. This annex specifically addresses issues of price and market dynamics. A more inclusive set of factors will be explored in greater detail in James Abbott's Ph.D. dissertation, to be finished in early 2004.

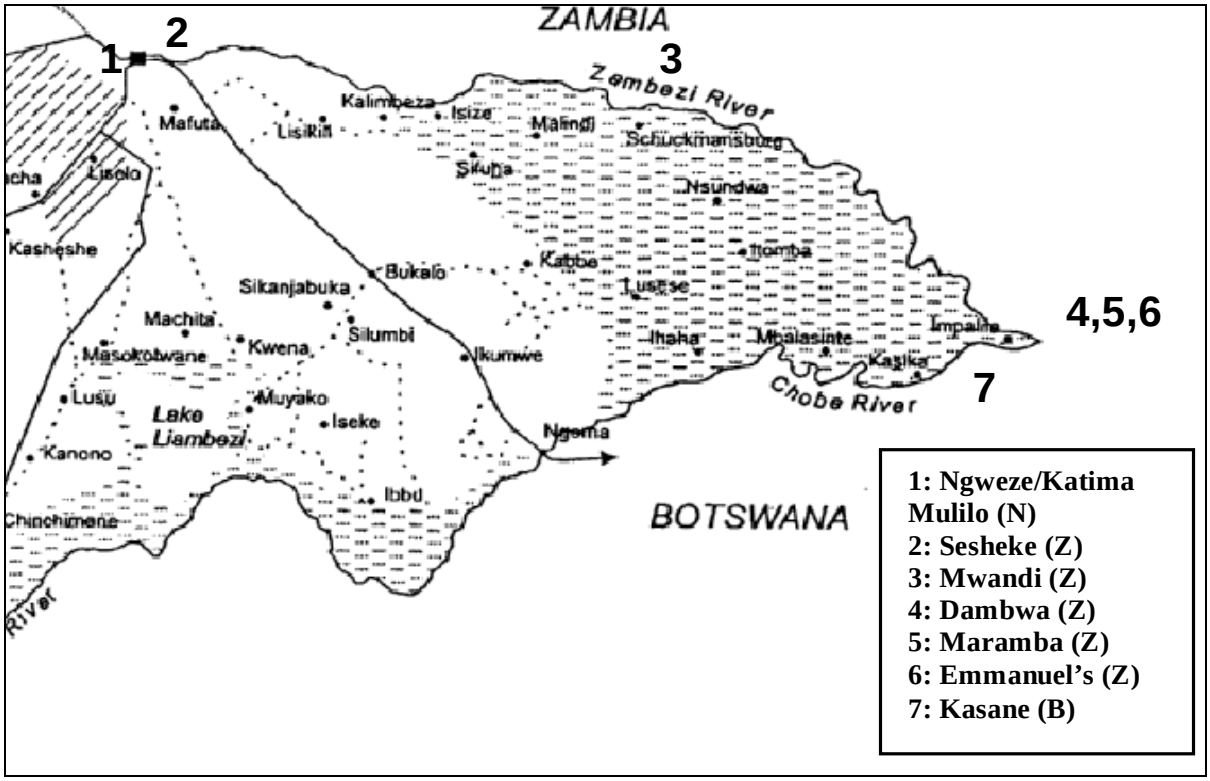
The general goal of the project of which this market survey is part, is to expand the understanding of fish resources and fishing livelihoods to include the entire Zambezi–Chobe river system. This means that the results from the Ngweze/Katima Mulilo fish market survey cannot be assumed to be representative of the characteristics of all markets in the region that depend, in whole or part, on fish coming from these rivers. Given that the areas of Botswana, Namibia and Zambia that fall within the Zambezi–Chobe river system appear to contrast considerably from a socio-economic context it is important to understand how these differences influence their fish markets.

Increased insight regarding the characteristics shaping supply, composition and demand for fish coming from the Zambezi–Chobe river system can be applied in at least two ways. The feasibility of applying the method currently used for the Ngweze/Katima Mulilo fish market survey to other fish markets in the region can be assessed and any need for adaptation or expansion of inquiry can be identified. Furthermore, the findings can be used to inform current discussion regarding potential management of the fisheries resources of the Zambezi–Chobe river system.

2. METHOD

The Zambia market surveys were carried out in early August 2002, while the Botswana market survey took place in late November 2002. The Ngweze/Katima Mulilo market surveys have been ongoing on a weekly basis since March 2002. All of the markets sampled are in towns or settlements along the Zambezi or Chobe Rivers (Figure 11).

Figure 11 Location of fish markets in the Zambezi–Chobe river system



Adapted from Purvis (2002)

Unlike the survey of the Ngweze/Katima Mulilo fish market, the surveys carried out in Zambia and Botswana were brief and limited in scope. The Zambia surveys used the same survey method used for Ngweze/Katima Mulilo (measurement of fish and prices), however the Botswana survey was largely qualitative, without systematic measurement or random selection of fish vendors. The difference in method used for the Botswana survey was due to a relatively high level of suspicion on the part of vendors and government alike regarding questions about fish vending. This attitude reflects the generally fragile state of relations between Namibia and Botswana, especially around the area of the Chobe River.

3. RESULTS

3.1 General market characteristics

An important step in comparing the fish markets of the region is by describing their relative position in the spatial and economic landscape of the towns or cities in which they are located (Table 9). These distinctions are of course arbitrary and certainly not exhaustive.
Nevertheless, such distinctions give at least a preliminary impression of how the fish markets vary.

Table 9 Socio-economic characteristics of Botswanan, Namibian and Zambian markets found in the Zambezi–Chobe river system

Socio-economic characteristic	Botswana	Namibia	Zambia[1]
Fishing as a livelihood	Limited	High	High
Transportation infrastructure	Good	Good	Varied
Source of fish	Rivers	Rivers	Rivers and aquaculture
Suppliers of fish	Namibians and Zambians	Namibians and Zambians	Zambians
Market infrastructure	Poor	Good	Varied
Market regulation	Price regulation	Gate fees	Livingstone markets have municipal regulation and vendor committees
Market volume (numbers of fish and vendors)	Low	High	Varied
Relative strength of currency	High	Medium	Low
Relative price of fish	High	Medium	Low

[1] Botswana and Namibia have one formal fish market each, while the Zambian stretch of the Zambezi River has five markets (Sesheke, Mwandi, Maramba, Dambwa and Emmanuel's Fish Shop). The latter three markets are in Livingstone.

The Ngweze/Katima Mulilo market is located in the administrative and economic centre of the Caprivi Region of Namibia. The market itself is located near the commercial centre and across the road from a large shopping complex. Access to the market from other parts of the region is relatively good, due to well-maintained tarmac and gravel roads, as well as an extensive transport system of semi-formal taxis. Fish arrives from diverse points throughout the eastern Caprivi floodplain. Anecdotal evidence suggests that at least part of the fish is caught and/or supplied by Zambian fishers. Moreover, it is reasonable to assume that there are occasionally Zambian vendors at the market, given the frequency that it is cited as a complaint by Namibian vendors and the intermittent sweeps by the authorities to check nationalities and expel non-authorised foreigners.

The infrastructure of the Ngweze/Katima Mulilo market is reasonably good, with purpose-built structures, effectively demarcating the market into zones for vending of different types of produce. All vendors must pay a daily market fee, and stall use is on a first come, first served basis. The market committee is responsible for maintaining hygiene in cooperation with the vendors. Beyond that, there is very little involvement in activities of fish vendors by the market committee, except for enforcing the opening and closing hours.

Approximately 96 stalls are available for fish vending, although vendors may occupy more than one stall or several vendors may occupy one stall. Vendors typically bring their own fish to market. Those vendors selling fresh fish use a variety of means of to keep their stock fresh, either by using wet burlap or defunct refrigerators as coolers, with blocks of ice purchased nearby.

The Kasane market in Botswana is located in a rapidly growing administrative and tourist town. Like Ngweze/Katima Mulilo, the road system and transportation is relatively good. The market itself is somewhat rudimentary and unplanned, with semi-permanent structures and

little administration. There are approximately 25 stalls at present. Fresh fish is kept on wet burlap or in portable coolers. Although the area around the market was undergoing some rebuilding in December 2002, it was unclear if this would enhance or limit the market infrastructure, as the legal status of the market is unknown. The market is adjacent to a petrol station and across from a recently built row of grocery and department stores, which may have implications for the future of its present location.

Like the Katima/Ngweze market, fish arriving to the Kasane market appears to come entirely from Namibia and Zambia. The lack of fish from Botswanan waters is due to most of the Chobe River on the Botswana side being within strongly enforced National Park boundaries. The vendors are a mix of Namibians and Batswana, although it appears that the imposition in October 2002 of a new 15 per cent value added tax on fish entering Botswana has lowered the number of Namibians crossing the river to sell fish. Consequently, some Namibian vendors sell their stock to Botswanan vendors at the customs gate, rather than pay duty.

While there appears to be little administration of the Kasane market itself, there is a certain level of intervention from the Botswana government. A price ceiling for fish is imposed and Namibian vendors have complained that immigration laws are sometimes used as a coercive force to favour Botswanan vendors. Given the stark economic gradient between Namibia and Botswana, few Namibian vendors would risk being barred from entry to Kasane by asserting their position against the government.

The Zambian markets present interesting contrasts, both within and between countries. In Sesheke and Mwandi, the relative isolation and limited economic potential of the two towns is reflected in the limited infrastructure, stock and number of stalls. The commercial structure of these towns consists of small shops, spread along the main road. There were approximately 15 stalls, made out of simply built wooden tables. Some of the fish at Sesheke were frozen solid, though no one appeared to be using ice. The majority of vendors interviewed at Sesheke got their fish by purchasing it from fishers.

Mwandi, approximately 90 km downstream from Sesheke, is accessed by a very poor road. It is the seat of the traditional authority as well as being roughly halfway between Sesheke and Livingstone, and as such benefits to a certain degree from regional traffic. Nevertheless, Mwandi is still quite isolated and its fish market is the smallest of all those surveyed. There are approximately 12 stalls, constructed in the same manner as those in Sesheke. No refrigeration or ice blocks were seen. Roughly equal proportions of vendors interviewed got their fish either from their own family or by purchasing it from fishers. No market administration was apparent.

The Sesheke and Mwandi markets fall under the jurisdiction of Western Province, which technically prohibits fishing for three months each year, starting in December. Due to the limited capacity of the Zambian Department of Fisheries in this area, the enforcement of this regulation is apparently through limiting the movement and sale of fish. The survey interviews revealed that to a certain extent fish sales go down during the closed season, but many vendors avoid the authorities by selling house to house rather than at the market.

The three fish markets sampled in Livingstone – Dambwa, Emmanuel's and Maramba – were the most organised in terms of supply and administration. Emmanuel's Fish Market is a private, self contained enterprise close to the commercial centre of Livingstone, while Dambwa and Maramba are public markets located next to the suburbs of Livingstone.

Emmanuel's Fish Market keeps stock in large electric coolers, where whole frozen fish are sold according to weight, rather than length as in other markets. The owner of Emmanuel's used to purchase large bream from fishers on both sides of the Zambezi, however, this has recently stopped as there are apparently not enough fish available to make it worthwhile. Fish comes instead from Lake Kariba and nearby aquaculture operations. Large individuals of non-bream species, such as bottlenose (*Mormyris* spp.) were also on sale.

The Dambwa and Maramba markets both have a clear administrative structure, with municipal inspectors and law enforcement. There are approximately 90 fish stalls in each market, consisting of low concrete benches, with the entire fish market area enclosed by a metal grilled shed. The supply of fish in these markets is entirely different to that in the other markets surveyed. Rather than fish vendors bringing their stock to market, these markets have a system where orders are placed at the riverside with fishers and middlemen. The fish are delivered in large lorries and a designated head of the vendor's committee distributes the orders to ensure that everyone receives the correct order of fish. No coolers were seen, although all vendors used beds made from a frond-like aquatic plant to keep their fish fresh. The vendors in Dambwa have access to a deep freezer at the market where they can store their fish overnight, for a fee.

It should be noted that frozen fish (bream, probably from Lake Kariba) was also for sale at the local supermarket in Livingstone. Moreover, *kapenta* (a small minnow-like species, largely caught in Lake Kariba and dried) was found in most large and small shops in Livingstone.

3.2 Price variation

To examine if the price of fish varied between the different markets surveyed, selected fish prices from the Zambian market survey were compared against those from the Ngweze/ Katima Mulilo fish market (Figures 12 and 13). The data were collected within the same seven days in August, hopefully controlling for any potential seasonal variation. The species of bream known in SiLozi as *Muu* (greenhead tilapia; *Oreochromis macrochir*) was chosen as a representative species, as it is common enough in all four markets to have sufficient sample size for comparison.

Figure 12 **Length (bar) and price (line) ratios recorded for fresh *Muu* in Zambian markets in early August 2002. Intervals 1–4 are from stalls in Sesheke, 5–9 are from stalls in Mwandi and 10–11 are from stalls in Maramba (the Dambwa fresh fish data are unavailable). Original prices have been converted from Zambia Kwacha to Namibian Dollars at the market rate of 430 Kwacha=$N1**

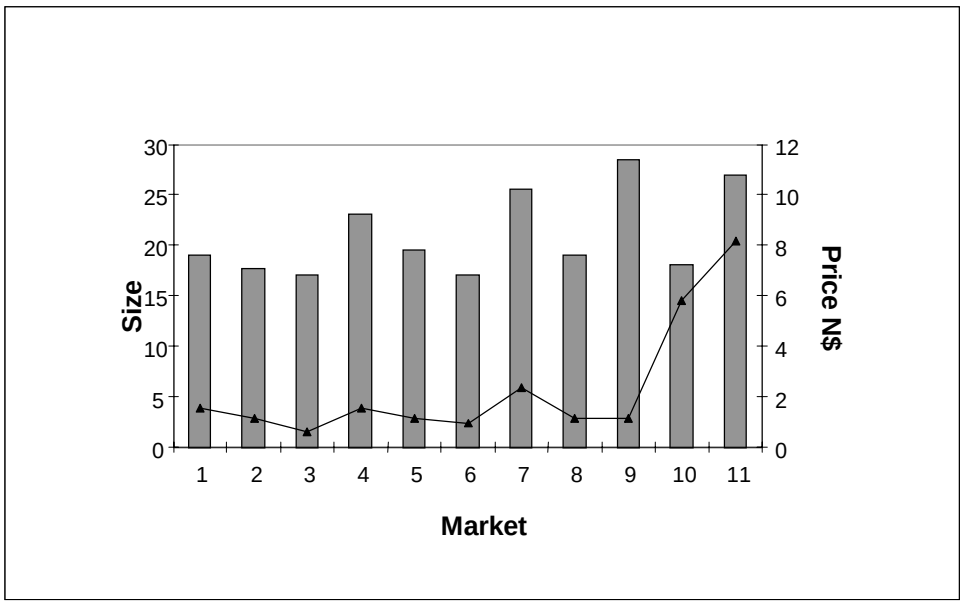
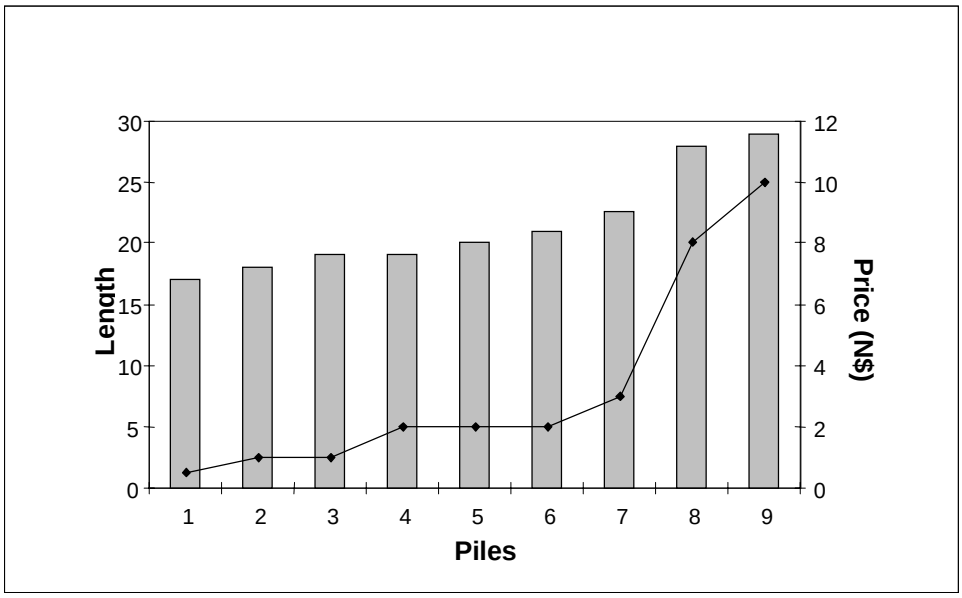


Figure 13 **Length (bar) and price (line) ratios recorded for fresh *Muu* in the Ngweze/Katima Mulilo market on August 14, 2002**



Prices recorded for fresh *Muu* in Zambian markets in early August 2002 suggest that there is a difference in the relative value of the species – it appears to be lower in the smaller and more isolated markets of Sesheke and Mwandi than in the urban setting of Livingstone. Zambian markets overall have lower prices than those at the Ngweze/Katima Mulilo market in Namibia.

Specific values for fish sold in the market in Kasane, Botswana are not available, due to factors mentioned in the methods section. However, there is a price ceiling imposed by the

Kasane Town Council of 10 Botswana Pula for a fish (1 Pula=$N2 at informal exchange rates). Qualitative results from the Kasane fish market survey indicate that the price of fish sold there is slightly higher than at the Ngweze/Katima Mulilo fish market.

4. DISCUSSION

This preliminary survey description, while brief, demonstrates that there are significant differences in how markets along the Zambezi–Chobe river systems obtain and sell fish. Hence, it is reasonable to assume that perceptions towards management of fisheries resources and the attendant costs and benefits to each stakeholder (i.e. fishers, vendors and consumers) vary. Several lines of inquiry could aid in understanding the degree of variation. These include:

- length–frequency and species composition of fish sold by vendors;
- a clearer understanding of the different routes of fish supply to each market and distinguishing any long or short term trends;
- household studies of the role of fish in the diets of consumers who depend on markets to supplement their protein needs.

Some of these points raised above will be addressed in James Abbott's Ph.D. thesis, to be published in early 2004. However, a standardised sampling method, based on the regular market survey carried out at Ngweze/Katima Mulilo would be necessary to provide a dataset that is sufficiently large to allow comparisons between markets.