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PUBLICATIONS AND PRESENTATIONS ......................................................... 33
1. **Institute Finances**

The Institute had initially been granted $1,300,000.00 for the year 1995/6 which was subsequently cut by $700,000.00 leaving a balance of $600,000.00 implying an over expenditure of 105% by June 1996. By the time the notice of the cut was received the Institute had already withdrawn from Treasury through the Ministry of Environment and Tourism the amount of $625,000.00 for running expenses and another $282,762.00 in the form of direct deductions from our vote for salaries. The Institute will require a further amount of not less than $325,194 to be deducted from the vote for salaries from January to June 1996 hence the 105% overexpenditure stated above. The reasons for such a drastic cut are not yet known.

As reflected in last year’s report a large part of the Institute operations were financed through the Zambia/Zimbabwe SADC Fisheries Project (ZZSFP). It was the same this year (1995) contrary to last year’s expectations that Government funding would increase to take care of some of the activities that are being undertaken under ZZSFP. Phase One of the ZZSFP comes to an end next year and if Government funding does not improve the Institute will be forced to cut back on a lot of activities thereby leading to it not adequately fulfilling its mandate. However it is hoped that when The Department of National Parks and Wild Life Management operates as a Fund the Institute will benefit tremendously under that status.
2. Staffing and Staff Training

Senior Staff

This was a stable year as far as senior staff retention was concerned. Following Ecologist Karenge’s transfer from Lake Mutirikwe Research Station he has successfully taken over duties that were being performed by Ecologist Sanyanga who left to join the University at the beginning of 1995. Duties that were being performed by Ecologist Chifamba were distributed among the rest of the staff and it would seem that this too provided a solution at least for the time being.

As far as senior staff training is concerned, the following people undertook training as follows:

a) Ecologist Mtsambiwa participated in the 5th International course on Data Handling for Tropical Fisheries Management at the International Agricultural Centre in Wageningen, The Netherlands from 8 January to 17 February 1995.

b) Ecologist Songore attended a course on Fisheries Planning and Management organized by the University of Namibia in conjunction with the University of Tromso as part of the regional fisheries training programme of the Southern African Development Community. The course took place from 15 May to 24 August and was held at the University of Namibia.
Ranger Technician Mwera continued to receive on the job training in workshop maintenance from the Project Engineer Hannes Bjarnason. He also attended a short course in Boat Maintenance from 17 to 24 September 1995. This course was organized by ZEMCO for staff who are going to maintain the research vessel R/V Pelican following the overhauling of its engine. He had earlier on attended a course on Managing the Maintenance Function for Results organized by the Ministry of Higher Education Management Training Bureau from 20 to 25 March 1995.

The Executive Officer N. Mukome attended a one month course in Public Sector Financial Management in Swaziland. The course was run by ESAMI the East and Southern African Management Institute from 9 October to 10 November 1995.

Senior Employee M. Ngwarai attended four short courses in Introduction to Micro-computers on 22 February 1995 at CF Tulley; MS Dos from 2 to 3 March 1995 at CF Tulley; Introduction to LOTUS 123 at CF Tulley from 27 to 28 April 1995 and PASTEL Partner Accounting at CF Tulley 3 to 5 May 1995.
f) Stenographer S. Moyo attended two short courses in

(i) WINDOWS 3.1 at Sutherland Computer Services on 17 May and


In addition to the above training programmes, senior staff also attended local and international seminars, conferences and workshops as follows:

i) Ecologist Mtsambiwa attended as an observer the 47th Annual Meeting of the International Whaling Commission (IWC) in Dublin, Ireland from 29 May to 3 June 1995. From 31 July to 4 August 1995 he attended The First Pan-African Fisheries Congress in Nairobi, Kenya, where a paper on Kapenta larval growth was presented. He also attended the Intergovernmental Conference to Adopt a Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities held in Washington D.C. from 23 October to 3 November 1995.

ii) Ecologist Mhlanga attended The First Pan-African Fisheries Congress in Nairobi, Kenya from 31 July to 4 August 1995. A joint paper on hydroacoustic studies on kapenta in Lake Kariba was presented. He also attended the 6th International Conference on the Conservation and Management of Lakes, held in Kasumigaura, Japan from 23 to 27 October 1995. A paper on the control of water hyacinth was presented
at that conference.

iii) Ecologist Lawrence Karenge attended the ACP and EU, African Caribbean Pacific Nations and European Union workshop on Fisheries Research Initiative. This was held at Swakopmund, Namibia between 5 and 8 July, 1995.

iv) All ecologists at the Institute attended the Ecologist Workshop from 26 to 30 June 1995 held in Kariba and Departmental Policy Workshop held at The Natural Resources College at Mushandike from 3 to 6 October 1995.

In response to the management needs of a similar fishery on Cahora Bassa, Ecologist at LKFRI gave a two month training course to a Mozambican biologist who will be responsible for managing the fishery (both inshore and pelagic) on Cahora Bassa. The training took place between July and August 1995.

**Junior Staff**

This was also a good year as far as junior staff retention was concerned. However we lost one of the Institute’s best assistants in biological studies through the untimely death of Lloyd Mhango in April 1995. His contribution in this vital area of the Institute’s work will be greatly missed and may his soul rest in peace.
As far as junior staff training is concerned, the following people received training as
follows:

(i) Lameck Chitenga attended a course in Boat Maintenance organized by
ZEMCO for personnel who are going to work with the research vessel
R/V Pelican following the overhauling of its engine. This course was
held from 17 to 24 September 1995.

(ii) All scouts were trained in the use of fire arms following the realization
that it was necessary to guard the Institute's gill-nets during the weekly
Lakeside sampling programme as these nets had become targets for
poachers at night.

3. Staff Housing

The Zambezi River Authority terminated the lease on 8 Mukwa Close and Ecologist
Mtsambiwa who lived in that house moved to 16 Muchirara Avenue, the Institute
house which became vacant with the departure of Ecologist Sanyanga to The
University of Zimbabwe.

The land exchange programme between National Parks and Kariba Town Council was
successful such that the Institute acquired a piece large enough to accommodate eight
senior staff houses. As of December 1995 two houses were nearing completion and
it is hoped that these will be occupied by February 1996. Work will commence on
the next two houses at that stage.

Since there was no movement of junior staff in 1995, there was no problem of housing in this category of employees. However the situation will change as soon as there is movement which means the Institute must continue to explore the possibility of obtaining stands to put up junior staff houses.

4. Infrastructure and Institute Expansion

The construction of office/laboratory block at Binga which commenced in the last quarter of 1994 was nearing completion by December 1995. This station should be fully operational by March 1996. It was not necessary to put up the two staff houses that were proposed as The Management Division of The Department of National Parks and Wild Life Management moved base from Binga to Chete leaving some houses empty in Binga. These houses were offered to the Institute for use. The building materials that had been purchased for construction of the two staff houses at Binga were then shipped to Kariba for putting up the guest house. Work on this guest house will commence when work on the two senior staff houses reported above is complete. Due to numerous problems faced previously in trying to put up the guest house at the original site the Institute decided to put the guest house next to the senior staff houses where the ground is relatively flat.

A lot of progress was made in the extension of the workshop such that a maintenance pit has already been fitted and in use. Sliding gates are being fitted to enclose the
There was no progress regarding the construction of the new Institute at Andora Harbour.

**Vehicles and Vessels**

**Vehicles**

All the old cars, i.e., the landrovers 109 and 110, the Peugeot 504, and the Daihatsu, were mostly off the road in 1995. One of the project cars, the Toyota Hilux, was also off the road most of the time while the other three, the two Landcruisers (25 TCE 60 and 520-089 N) and the lorry, were generally in good working condition for most of the year.

**Vessels**

The engine for the research vessel R/V Pelican was overhauled during the last quarter of 1995. The fast launch Mcheni gave numerous problems such that it was not used much and at one stage plans were under way to get rid of it. The other two fast launches, Mbale and Mvenga, were in good working condition except for the regular need to replace the propellers. Damage to propellers was caused by hitting submerged trees which were becoming more exposed due to receding lake levels.
Inshore Fishery Management

The CAMPFIRE approach to management was intensified with a lot of training of the fishermen undertaken by Agritex with Ecologist Songore co-ordinating the programme. A consultancy report for the setting up of exclusive fishing zones was submitted and the next step will be to consult the fishermen to see how they will respond to the proposed fishing zones. Once these zones are gazetted, the fishermen will be expected through their Fishermen’s Association, to participate in the management of the resource they are exploiting by ensuring that regulations are adhered to. They will also protect their fishing grounds from outsiders.

Sardine Fishery Management

More work was done to promote the setting up of a single kapenta producers association.

The permits redistribution exercise was also intensified with recommendations of a maximum of six units and minimum of four units for a large and small company respectively being submitted to Head Office. In addition crocodile farmers fishing to feed crocodiles were requested to buy stock feed rather than harvest from the wild thereby releasing more permits. Further permits would be released by those operators who were willing to sell their companies. That way 58 permits would be released for redistribution. Recommendations were also made to increase the licence fees so as to encourage companies with many units to relinquish some of those units. These
recommendations were met with mixed feelings depending on whether one was a large operator or not. Some operators felt that the exercise would destabilize the fishery as some of the beneficiaries of the redistribution exercise would, due to lack of finance, not be in a position to utilize those permits immediately. Others felt the major victims would be the employees of those operators who would lose permits as they were bound to lay off workers once they lost permits. On the other hand new people would be hired to work under the beneficiaries, implying that some individual would lose jobs while others got those jobs.

**Anti-poaching Operations**

Illegal fishing continued to be one of the major problems in the fishery which led to an intensification of anti-poaching operations in both the inshore and pelagic fishery. These operations resulted in the discovery of illegal landing sites for kapenta in the bushes along the shoreline. It is very difficult to quantify the amount of fish lost through this way placing a lot of doubt in the statistics collected by LKFRI.

A lot of people caught fishing in prohibited waters were given deposit fines and the fish were confiscated as a further punitive measure. Some operators were angered by the confiscation of fish such that they started questioning the validity of regulations thereby leading to increased animosity between the operators and LKFRI. Some of these operators felt that they were being victimized through the confiscation of fish as they were already losing a lot of fish through illegal trade. However it was also felt by the management that it was the responsibility of the operators to ensure security in their own boats and that their employees are aware of the regulations. The
problem is really complicated and there is need for more dialogue between operators and managers. The situation could slightly improve in the inshore areas once the exclusive fishing zones issue is resolved.
M. Z. MTSAMBIWA

PROJECT TITLE:

PRE-RECRUITMENT ECOLOGY OF THE FRESHWATER SARDINE *Limnothrissa miodon* IN LAKE KARIBA (ZIMBABWE).

Project Objectives

a) To investigate the factors influencing recruitment variability of the freshwater sardine *Limnothrissa miodon* in Lake Kariba.

b) To incorporate the knowledge gained in the study into the sardine fishery management strategies.

Work accomplished

Final draft of the Ph D thesis was submitted to the University of British Columbia in Canada under the title:

"Some management aspects of the recruitment ecology of the freshwater sardine *Limnothrissa miodon* in Lake Kariba."

The following pre-recruitment monitoring practices are recommended for improved management of the fishery:

a) Monitoring of the size structure

Monitoring the population through observations of the size distributions of the catch in is an important tool which should indicate the response of the fish biologically to the pressure exerted upon it by the fishing effort maintained in
the fishery.

b) **Monitoring the depth where fishing takes place**

   The shallow areas are dominated by the larval and juvenile stages while the deep end is dominated by adult fish. The depth range 10 to 15 metres where a selectivity curve was calculated, contained representatives of a wide range of sizes indicating that fishing should only be allowed in areas deeper than that depth range.

c) **Monitoring increment width in otoliths**

   Otolith width can be monitored as an indicator of cohort strength i.e. a larval population that has wide rings indicates fast growth which in turn implies high survival rates.

d) **Monitoring age-at-recruitment and age-at-first capture**

   These two stages in the life of the fish should be monitored to ensure that they are interspaced by an age-at-first spawning so that the fish are given a chance to spawn before exposure to full capture by the gear. These three important moments (i.e. age-at-recruitment, age-at-maturity and age-at-first capture) can be monitored by examination of otolith microstructure.

e) **Monitoring larval abundance in the littoral zone**

   In this study larvae were captured in all areas in the littoral zone leading to the hypothesis that the entire littoral zone could be one continuous nursery ground for larval sardine. If this hypothesis is correct, then high or low catches of larvae in the littoral zone should indicate whether there is going to be a strong or weak cohort (age - class).
Work to be done

As outlined last year, there is a lot more that needs to be done to establish where the eggs are laid and where yolk-sac larvae occur. To achieve this, new capture methods that would target the eggs and yolk-sac larvae need to be worked out. The gear used in this study was not suitable for the capture of these two stages.

Another area that needs attention in future is to establish ways of quantifying larval abundances and relate these to subsequent catch.
W. MHLANGA

PROJECT 1

HYDROACOUSTIC SURVEYS OF KAPENTA (L. MIODON) ABUNDANCE ON LAKE KARIBA

Objectives

The major aim of this project is to estimate the biomass of Kapenta in the lake. This information is used in the management of Kapenta on Lake Kariba.

Work Accomplished

One survey was carried out in February 1995. The other scheduled surveys were not carried out due to boat breakdowns. The problem was compounded by the resignation of two senior researchers at the end of 1994. This resulted in an increased workload for the remaining staff. The problem of staff shortages was partly solved by the transfer of one research officer from Mtirikwe (formerly Lake Kyle) to Lake Kariba Fisheries Research Institute (L.K.F.R.I.).

A paper on the 1994 and 1995 surveys was written up (see publications).

Work To be done

Bi-monthly surveys are to be conducted in 1996. Summary reports will be prepared after each survey.
PROJECT II

HYDROACOUSTIC SURVEYS OF KAPENTA (*L. miidon*) ABUNDANCE ON LAKE CAHORA BASSA, MOZAMBIQUE

Objectives
To determine the biomass of Kapenta in a fishery where commercial fishing has just started. This information can then be compared with that from Kariba, where commercial fishing has been in operation for over twenty years.

The project is also aimed at enhancing bilateral collaboration in the field of fisheries research, particularly in the use of hydroacoustics to assess the abundance of Kapenta.

Work accomplished
Researchers from the Zambia/Zimbabwe SADC Fisheries Project (ZZSFP) and IIP (Instituto de Investigaçào Pesqueira), the Fisheries Research Institute in Mozambique conducted one joint hydroacoustic survey on Cahora Bassa in June 1995. The other surveys could not be carried out due to boat break downs and pressure of work. Researchers who participated in the survey were N. Premegi and W. Mhlanga.

Work to be done
Quarterly surveys are planned for 1996. Kapenta samples from the commercial fishery will be collected on a regular basis.
PROJECT III

ANALYSIS OF ANGLERS’ CATCHES FROM THE TIGERFISH TOURNAMENT

Objectives
The aim of this project is to create a computerized database of the Catch records from this annual sport fishing tournament. This database will then be useful in monitoring the changes (trends) in the fishery. A report will be prepared once all the data has been compiled.

Work accomplished
Data entry continued in 1995 but was delayed due to staff changes.

Work to be done
Data entry will continue and the report which should have been ready by December 1995 will be completed by April 1996.
PROJECT IV

TIGERFISH STUDIES

Objectives

The aims of the current project are:

(a) to make a quantitative assessment of Tigerfish predation on Kapenta and,
(b) to determine gillnet selectivity in Tigerfish.

Work accomplished

Field sampling was continued in 1995 mainly at Lakeside station. The collected data were entered into a database.

Work to be done

Monthly gillnet sampling will continue in 1996. The report on gillnet selectivity should be ready by September 1996. A draft report on feeding studies should be ready by December 1996.

OTHER ACTIVITIES

Supervision of experimental gillnet sampling

The weekly gillnet sampling programme continued during the year. However, the increased incidence of fish poaching is a cause for concern, especially along the shoreline near Kariba town. In order to combat this problem, increased anti-poaching patrols are being undertaken
on a regular basis and offenders prosecuted.

Inshore Working Group

The second meeting of the Inshore Working Group was held at L.K.F.R.I. on the 11th and 12th of December 1995. Participants included researchers from Lake Kariba Fisheries Research Institute (Zimbabwe), Department of Fisheries (Zambia) and CASS Research Fellows. Several papers were presented and a report on the proceedings is currently being compiled.
L. KARENGE

PROJECT I

INSHORE FISH POPULATION STUDIES IN LAKE KARIBA, SAMPLED BY REMOTE TRIGGERED NET (RTN).

Objectives

1. To develop and invent a method of measuring fish biomass or assessing fish populations along the Zimbabwean inshore area of lake Kariba.
2. Estimate inshore fish biomass using the new method.
3. Estimate inshore fish yield by producing models for lake Kariba taking changes in environmental factors into consideration.
4. Make a contribution to further understanding and management of inshore stocks.

State of implementation

The success of this project largely depends on the careful designing of the remote triggered net (RTN). It is hoped the final design of the net will be a highly professional thing that requires important input of professional engineers. The path chosen in making the net is that of trial and error so that what is possible in theory becomes nearly possible in practice.

The project has started with a small model net which is triggered by electromagnets designed by engineers from the University of Zimbabwe Engineering Department. There was no formal arrangement with the engineers therefore there is need to draft a contract in order to engage them on a full time basis to make the RTN net. The small model net was
successfully tested in aquaria at the Lake Kariba Research Institute and served the purpose of explaining how remote triggered nets operate.

The model net is going to help us design a prototype net which is a net that has the qualities that we are looking for which can also be tested in the field and improved upon.

**Work to be done**

Once the prototype net has been built field work to test it will commence. Testing the prototype net will involve many things such as how it performs in various habitats, what is the reaction of fish as the net is lowered and triggered both in shallow and deep water. The net will also be tested for the period it has maximum advantage i.e. during the day or night. All the observed limitations of the net will be noted down with the hope of finding final solutions.

Once the final RTN has been made and found to be working as planned all habitats in selected sites will be sampled along the inshore area of the lake. The data to be collected include fish biomass, populations, length frequency, gonadal state and sex of fish. If possible the operation of the RTN at each site will be recorded by an underwater video camera.

**Future activities**

The data collected, if found to be of high quality, will be analysed and the results submitted as a Ph.D thesis with the University of Zimbabwe. An application to register with the University of Zimbabwe as the project is starting will be done before February, 1996.
UPDATE ON CATCH EFFORT DATA RECORDING SYSTEM

State of implementation

Commercial catch and effort data for kapenta was received and entered into the relevant database by hired data capturers at the Institute. At present all the data has been entered except data for December, 1995 which had not arrived by the time this report was being prepared.

Kapenta fishermen also send samples to the Institute from which length frequency data is extracted. Kapenta length frequency data for 1995 has not been entered into the relevant database, mainly because this activity was given low priority.

Artisanal catch and effort data, from the gill net fishery is collected by scouts who visit selected fishing villages each month. Due to manpower shortages an average of six villages were visited in 1995. The data has been entered into the database up to October, 1995 and will be updated by the end of January, 1996. The catch and effort database now has a time series ranging from 1974 up to the present.

When scouts visit fishing villages they also collect length frequency data of fish from the gill net fishery. Collection of length frequency data from the artisanal fishery started in May, 1995 and all the data has been entered into the database.

The Lakeside experimental gill net program started during the late 1960s and still continues up to the present time. This data has been entered into the database up to December, 1995.

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The kapenta and the artisanal catch and effort data has also been summarised and the results appear in two statistical reports which are the Institute report and the Zambia/Zimbabwe SADC Fisheries Project combined statistical report which were produced during 1995 and hence contain data up to the end of 1994.

**Work to be done**

There is need to enter the kapenta length frequency data into the relevant database. All the data needs to be cleaned. i.e. corrected for errors.

**Future activities**

There are plans to introduce co-management of the inshore fishery between the authorities (National Parks) and the fishermen. Such a system should encourage the fishermen to keep accurate gill net catch and effort records which they could send to the Institute at no cost to them. If the fishermen send their own data willingly then that data will not only be more accurate but will be obtained more cheaply than the present system of sending scouts to collect catch and effort data from villages for ten days each month.
Background

The need for an extension programme for fishermen came as a recommendation from a participatory workshop on management of inshore fisheries of Lake Kariba (Machena & Moinuddin 1993). Agritex, a government agricultural extension agency was given a mandate to carry out extension services for the Lake Kariba artisanal fishermen. This was to be done in close collaboration with Lake Kariba Fisheries Research Institute. The actual fishermen’s training needs were identified through some brainstorming sessions and case study analysis which involved fishermen, Lake Kariba Fisheries Research Institute, Campfire Coordinating Unit and Agritex. These sessions were carried out within the fishing camps. Information obtained from these sessions was used to develop a training programme.

Objectives of the Training

- to develop management capacities and institutional structures that will promote decision making amongst the fishing communities
- to develop fishermen’s capacities and skills in the use, repair and maintenance of fishing gear
- to develop fishermen’s capacities to process and preserve their catches so as to reduce
post harvest losses

- to develop fishermen’s basic financial management skills so that they can plan and use their resources efficiently.

The courses were organised and run at Gache Gache and Chalala fishing camps. Arrangements were made with the local schools for accommodation and LKFRI was responsible for all the logistics. Agritex provided resource persons and some training materials. Participants were drawn from all fishing camps the idea being to train a core group of fishermen in each camp. The core group would then be useful in subsequent training of the rest of the fishermen.
PROJECT II

ENFORCEMENT AND COMPLIANCE WITH FISHERIES REGULATIONS WITHIN THE INSHORE FISHERY ON LAKE KARIBA: CAN CO-MANAGEMENT APPROACH BE THE SOLUTION?

Introduction

The responsibility for regulating and managing the fisheries resources in the whole of Zimbabwe as well as Lake Kariba lies within the Ministry of Environment and Tourism. Within the Ministry, the Department of National Parks and Wildlife Management is responsible for the fisheries development policy and is empowered by the Parks and Wildlife Act No. 14 of 1975 with the support of amendments and Statutory Instruments. The Director of National Parks and Wildlife Management is responsible for the general supervision of all matters relating to fisheries under the Act. The Director is also responsible for the preparation and continual review of fisheries plans based on the best scientific information available. The plans are to ensure optimum utilization of fishery resources consistent with sound conservation and management principles.

There are two types of fisheries on Lake Kariba, the inshore fishery and the offshore pelagic fishery. In this study, focus will be put on the inshore fishery. A number of regulations have been put in place to ensure conservation of inshore fish species. These include the following:

* mesh size regulation (minimum mesh size to be used is 4" stretched)
* closed areas (rivers, river mouths and areas adjacent to National Parks)
* licencing
An important management issue that is of concern is the regulation on the allocation of fishing grounds among artisanal fishermen. Commercial gill-netting on the Zimbabwean side of the lake started in 1962. In preparation for the inshore fishery bush clearing was done in selected areas of the future lake bottom prior to dam closure. Out of a total of 5400 square kilometers, only 954 square kilometers, within a 20 meter contour below maximum water level, was cleared of trees for establishment of good fishing grounds. Areas adjacent to National Parks Estates have been closed to gill-net fishing. Fishing boundaries for the inshore fishery have been changed about three times.

Considerable difficulties are being encountered by the enforcing authorities in ensuring that the fishermen comply with regulations. Empirical evidence has shown a high level of violation in Basin 5 (Sanyati Gorge) during the fall season. Mean annual arrests for the area for the period 1990 to 1995 have been within the range of 30. Although arrest figures are not always a clear indication of total violations due to problems of non detection and changes in enforcement effort, they do however give a rough indication of the gravity and magnitude of the problem. The mean figure is only for fishermen with fishing permits found fishing in protected areas.

Table 1: Annual arrests of legal fishermen fishing in closed areas

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</tr>
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<tbody>
<tr>
<td>No of arrests</td>
<td>7</td>
<td>24</td>
<td>23</td>
<td>35</td>
<td>41</td>
<td>50</td>
</tr>
</tbody>
</table>

Figures were obtained from one of the two National Parks Stations monitoring the area.
The sheer number of violations suggests the severity of the problem and the need for understanding the factors that contribute to the noncompliance problem. Noncompliance can be a principal cause of the failure of fishery management and conservation programs. One of the major activities of fisheries management authorities is the need for constant promotion of compliance through monitoring and enforcement. Monitoring identifies instances of noncompliance with regulation whilst enforcement is often seen as the tool for bringing noncomplying units into compliance through recovery of any economic advantage obtained by the violator. Such action may deter the violator and his peers from further violating regulations. Compliance is therefore required for the achievement of the goals of resource management.

This study focuses on compliance within the inshore fishery of Kariba (Zimbabwe). A theoretical framework for explaining compliance behaviour of the inshore fishermen will be developed.

Objectives of the study

* To describe the incidence of noncompliance of artisanal fishermen with regulation pertaining to closed areas (areas adjacent to Parks Estates, rivers and river mouths) and other fishermen's fishing zones as well as mesh size regulation on Lake Kariba.

* To identify factors responsible for the observed noncompliance and develop and test a theoretical model of compliance that extends the traditional deterrence model of compliance.
To test the hypothesis that a fisheries co-management approach can significantly improve compliance in the inshore fishery on Lake Kariba.

Significance and justification of the study

Policies that attempt to bring about compliance are often built on an economic model of individual behaviour. Such a model presupposes that individual decisions are made in response to a rational cost-benefit calculus. Further it is assumed that this calculus can be successfully manipulated from the outside through monitoring and enforcement activities. Such activities aim at increasing the cost side of the cost-benefit calculus for the individual. This essentially is the deterrence theory. The proposed management plan for the artisanal fishery on Lake Kariba is the adoption of the fisheries co-management approach. Co-management approaches to communal resources have proved to be effective in the sustainable utilization of wildlife under the CAMPFIRE (Communal Area Management Programme for Indigenous Resources) programme in Zimbabwe (Machena & Moinuddinn 1993). The CAMPFIRE programme confers benefits and responsibilities of proprietorship over wildlife to the inhabitants of communal lands (Martin 1986, 1994, 1994b, as quoted in Machena & Kwaramba, in press). Machena & Moinuddin (1993) argue that the CAMPFIRE approach can be applied to the artisanal fishing communities on Lake Kariba through granting proprietorship over the inshore fish resources in defined "exclusive fishing zones". This is perceived as a possible approach that could lead to the participation of fishermen in the management of the inshore fisheries of the lake and eventually better management strategy. To be able to quantify the impact of this approach, baseline data on both compliance and non-compliance need to be collected. However the co-management approach involves moral, legitimacy and social influence variables that have been found to complement the efficiency
goal in many enforcement programmes by encouraging voluntary compliance and thus reducing the need for large expenditures on enforcement inputs (Viswanathan, 1994).

The study

The organisation of the study will be as follows:

* An overview of the Artisanal fishery on Kariba (Regulations, enforcement programmes and practices).
* Historical background of boundaries and regulations changes.
* Important aspects and variables of the artisanal fishery.
* Literature review of published and unpublished socio-economic data of the fishery.
* Literature review of material related to the study of compliance.
* Testing of theoretical models of compliance behaviour in relationship to socio-economic conditions of the artisanal fishery on Lake Kariba.
* Summary and Recommendations on Policy Implications.

Compliance with Regulations - the theory

The literature on compliance behavior shows that three major influences are critical in determining compliance with a law or regulation. These are deterrence, intrinsic factors, and extrinsic factors. The deterrence factors are forces that either increase or decrease the monetary cost-benefits of an individual who contemplates noncompliance with a law or regulation. These relate to the benefits from a violation and the costs of a violation. The benefits in the case of the fishery will depend on the biological conditions in the fishery and value of fish that can be landed from the illegal fishing zone. The cost will be the expected
value of the penalty from the violation activity if the fisherman is detected and arrested. The expected cost will depend on the probability of detection and conviction and the amount of penalty imposed on the violator. This directly depends on the level of enforcement and the expediency of the legal authorities.

Non-monetary intrinsic factors that influence compliance behavior are the internalized norms and moral obligation levels of the individual. These consists of two factors, one, the moral obligation of an individual to comply with the regulation that arises from his own internalised values about right and wrong, and secondly, the individual’s assessment of the legitimacy of the enforcement agencies and institutions. Moral obligation appears largely to be a function of the socialization process and moral development level. The legitimacy of the enforcement agency is likely to depend on the process and outcomes of its enforcement of the regulation.

Non-monetary extrinsic factors that influence compliance behavior are the behavior of others and social norms. The behavior of peers and other significant social factors have been reported in the literature to influence an individual’s compliance decision.

It is one of the main objectives of this proposal that a compliance behavior model that incorporates the aforementioned factors be developed for the purpose of analyzing compliance behavior that will help in coming up with the right management mix for the Lake Kariba Inshore Fishery.
The Study Area

The Kariba Eastern basin (Basin 5) has been chosen because of its long standing history of conflict between fishermen and Law enforcement agents. Because of its proximity to Kariba Town which is the main fish market and also easy access by both road and water, violations have been reported to be rampant in this basin (Sanyanga, 1995). Law enforcement operations have been very intense in this area and records of arrests and court cases can be easily accessed. Previous frame surveys (1990 and 1993) and annual fisheries statistics reports (Sanyanga, et al 1993, Karenge et al 1994) show that this basin represents an area where there is intensive fishing effort. About 45% of the total number of fishermen on the lake are within this basin alone. This area also has the best spots for anglers. Most of the ethnic fishing groups are well represented and both co-operatives as well as independent fishermen are also represented. The most prominent breeding rivers for inshore fish species are found in this area.

Method of Data Collection

The bulk of the data for this study will be collected using a standardised questionnaire and face-to-face interviews.

Reference will also be made to the fisheries socio-economic database already established and records of arrest from National Parks which is the law enforcing agent.
PUBLICATIONS AND PRESENTATIONS


