Somali Natural Resources Management Programme

Development of Artisanal Marine Fishery Monitoring: *Methods and Tools*

Consultancy by:

Dr. Rudy Van der Elst
Deputy Director - Research
Oceanographic Research Institute
P.O. Box 10712 Marine Parade
KwaZulu-Natal
Tel: + + 27-31-373536
Fax: + + 27-31-372132
Email: seaworld@neptune.lin.co.za

For

IUCN-The World Conservation Union
Eastern Africa Regional Office
P.O. Box 68200
Nairobi, KENYA
Tel: + + 254-2-890605-12
Fax: + + 254-2-890615/407
E-mail: mail@iucn.unon.org

The Somali Natural Resources Management Programme is implemented by The World Conservation Union's Eastern Africa Regional Office (IUCN-EARO) and financed under the EC Rehabilitation Programme for Somalia

Project No. 6/SO - 82/95 + 6/SO - 83/04

Table of Contents

EXECUTIVE SUMMARY 1
1. BACKGROUND 2
1.1 Terms of reference 3
2. DESCRIPTION OF THE MARINE FISHERIES 4
2.1 Fishery resources 4
2.2 Present fishery situation 5
2.2.1 Institutional structures and legislation 6
2.3 Main types of fishing 6
2.3.1 Industrial 7
2.3.2 Subsistence 8
2.3.3 Artisanal 8
2.4 Historic aspects of the artisanal fishery 8
3. ENSURING SUSTAINABLE USE 10
3.1 Basic considerations 10
3.2 Precautionary approach to fisheries 10
3.3 The need to monitor 12
3.4 Current data collecting initiatives 13
4. PROPOSED MONITORING STRATEGY FOR SOMALILAND 15
4.1 Overview 15
4.2 Data collecting 17
4.2.1 Primary indicators 17
4.2.2 Secondary indicators 20
4.3 Data capture 22
4.4 Validation 22
4.5 Empirical assessment 23
4.6 Annual fisheries report 23
4.7 Analytical assessments: modelling 25
5. FISHERY MANAGEMENT CONSIDERATIONS 27
5.1 Overview 27
5.2 Policy development 27
5.3 Istitutional capacity 28
5.4 Management plan 28
5.5 Application of monitoring results 28
5.6 Research 29
5.7 Awareness, education and public participation 30
5.8 Conservation issues 31
6. COMMENTS ON SPECIFIC BURNING ISSUES 32
6.1 Access and poaching 32
6.2 Subsidies and donations 33
6.3 Landing facilities 34
6.4 Marketing arrangement 34
6.5 Marine protected areas 35
7. CONCLUSION 36
8. ACKNOWLEDGEMENTS 37
9. REFERENCES 38
APPENDIX Schedule of meetings and field visits 40
APPENDIX II Terms of Reference 42
APPENDIX III Artisanal Fisheries Data Collecting Manual 46

1. INTRODUCTION

In order to ensure that the fishery is developed on a sustainable basis so that the resource remains healthy and able to deliver optimal food, employment and recreation to people of the Somali region, it is necessary to manage the fishery. For this to be successful, there needs to be monitoring of trends in catch and effort. In addition, important parameters relating to the growth and size of the fish provide good insight into the health of the fish stocks so that optimal fishing levels can be determined and the fishery developed accordingly. Failure to monitor the fishery will inevitably carry a high risk of ultimate fishery collapse which is associated with social and economic hardship, loss of biodiversity and poor conservation.

Monitoring will require a programme of continuous data collection relating to a number of aspects of the fishery. Each year these data should be collated and scientifically analysed in order to produce a report that will reflect the status of the fishery. On the basis of this assessment and report, the future management, development and possible subsidies can be determined.

This manual contains comments and guidelines to assist fishery personnel in data collecting. Although many of the fishery staff in the Somali region are already well acquainted with these procedures, it is important to have a consistent approach to monitoring so that data sets from different regions and periods may be directly comparable.

---

2. SAMPLING EQUIPMENT

There are several items necessary in order to achieve quality in data collection. These are listed.

- *Scale*

  A calibrated spring balance is fine, although an electronic load-cell would be a great advantage. Periodic checking against known weights is recommended. It is best to have two balances of different capacity so that greater accuracy may be achieved. For the Somali situation an appropriate arrangement would be one scale with maximum of 10kg and another reaching 50 kg.

- *Measuring equipment*

  Although a tape measure can be used to measure finfish, a board is preferable as it gives more consistent linear measurements. A measuring board can be made by simply fixing a tape measure to a flat wooden plank with a stop edge at the zero end. A plastic Vernier caliper is needed for lobster and crab measuring.

- *Writing equipment*

  It is best to record information directly onto data sheets so that no later errors in transcribing occur. However, this often requires an assistant. Where recording is done under 'wet' conditions, it is best to have available a set of soft-lead pencils and to record information on a white perspex slate which is waterproof and can be easily cleaned. Labels made from plasticized paper should also be obtained.

- *Dissecting equipment*

  At least one sharp knife will be needed although other items that may be useful are forceps, bone cutters (for removing otoliths), scissors and a scalpel. Small containers or envelopes for otoliths may be useful.

- *Preservatives*

  Availability of 40% formalin and or alcohol would be useful for specific preservation tasks, although detailed preservation techniques are likely to vary for different specimens.

- *Literature*

  It is important to have access to a modest quantity of literature that will assist in species identification. The recently published FAO guide for Somalia is recommended and several additional publications could usefully be included in a small 'fishery library'. Such reference material should be housed centrally, preferably near the landing site, and available for controlled use by interested parties.

- *Camera*

  Though this may seem expensive, a modest, instamatic-type camera can provide a valuable tool for the confirmation of species identity.

---

3. GENERAL PROCEDURES

It is important to be consistent and adhere to agreed procedures. It is also recognised that the task of data collecting in a growing fishery may become quite onerous and hence decisions will have to be made about priorities. It is best to make such decisions in advance, preferably at the planning stage for the ensuing year. It is most important not to compromise the quality or validity of past data collecting.

3.1 Record keeping

It is recommended that a daily activities book be maintained in which sampling activities, comments, events and perceptions are recorded. This would provide the basis for contributing to part of the annual Fishery Report.

3.2 Species identification

Great care should be taken with the identification of species so that changes in species composition can be detected. This may prove difficult but with some training and experience this should be achievable, especially when taking sub-samples of daily catches. Groupers, snappers, sharks and emperors are especially confusing. Avoid lumping too many species into one category (such as sharks and groupers). Rather retain the occasional specimen and have it identified. A photo record usually works well and can be identified by posting to experts.

3.3 Accuracy and randomness

Be careful about measuring and recording accurately and use appropriate levels of precision. Lengths should be to the nearest centimetre while weights should be to within 1/100 of that species' weight range. In other words, a fish that attains 10 kg would have to be weighed to the nearest 100 grams. Figure 1 illustrates measuring points for fish, rays, crabs and lobsters.

3.4 Zero catches

It is inevitable that fishing vessels may return with no or only a small catch. It is of utmost importance to ensure that such events are fully documented as a zero catch but giving full details about the number of fishers, time out etc. If no vessels launched or a vessel did not actually fish then this should be made clear. It is best to complete a form stating: "no fishing today" to avoid any subsequent confusion.

3.5 *Computers and data processing*

While it is in many ways useful to capture the information onto a computer system, care must be taken in selecting the correct software and procedures. Ideally, a database system should be tailored for this programme which will ensure compatible data sources, validation with input, automatic back-up capacity and regular report generation. In any event, care must be taken to duplicate the data electronically or otherwise and ensure that one set is stored safely at another location.

---

4. DAILY CATCH AND EFFORT

(SEE FORM 1: TOP SECTION)

This form is designed to record information relating to the individual boat's catch and fishing effort. It has been structured to follow data collecting routines that are already underway at several fishery landing sites. These data should be collected for different boat types separately (i.e. canoes and motor boats), on a daily basis, even if no boats put to sea or if no fish were caught. This means that 365 X 2 = 730 such forms should be collected per landing site each year. Details for each entry are discussed.

- **LOCALITY:**

  Record the official name of the landing site and adhere to this name throughout the year.

- **BOAT TYPE:**

  Indicate either canoe, motor boat or any other that may arise.

- **DATE:**

  Given as the actual date DD.MM.YY

- **BOAT IDENTIFICATION:**

  This can be the licence number, name of boat or owner or any other distinguishing feature. It is needed, not so much to record the individual's personal catch, but rather to relate to the catch sub-sample that follows.

- **NUMBER OF FISHERS:**

  This is the total number of fishers on the boat, including the skipper.

- **DAYS OUT:**

  This is the number of days between departure and return. Each day is determined with the passing of midnight. Thus 07h00 to 16h00 = 1 day; 07h00 to 10h00 next day = 2 days. etc.

- **GEAR TYPE:**

  This is given as line, gill net, seine net, trap, etc. If mixed gear is used please indicate this but note the primary gear first.

- **FRESH FISH (KG):**

  Give the weight of that boat's total catch of fresh fish, ungutted.

- **MAJOR FISH SPECIES:**

  As currently practised, record the major fish types in the catch in order of abundance in the catch.

- **SHARK FIN (KG):**

  Here the landed (wet) weight of shark fins is given. Include also sawfish, rays and other species taken for fin.

- **NUMBER OF SHARKS:**

  This figure may have to be recalled by the fisher but it should reflect the number of sharks taken to derive the fin weight in the previous entry.

---

5. CATCH SUB-SAMPLE

(SEE FORM 1: BOTTOM SECTION)

This entry represents a single sub-sample of the boats recorded for that day, one each for canoe and motorised boat. It is intended that this data set will provide a proportional species breakdown for the entire catch. It is important that only one boat is selected from the boats recorded, but it does not matter much which one is selected. This could be randomised or preference could be given to the one with the largest catch so as to obtain a larger data set. It is important to ensure that the Boat Number tallies with that given to the same boat above.

- **BOAT IDENTIFICATION:**

  This is the same as that given to the same boat in the Catch and Effort record.

- **SPECIES:**

  It is important to record all the species caught as accurately as possible. If necessary, provide a photo, diagram or description of the fish for later verification.

- **NUMBER:**

  Indicate the number of individual specimens that were caught by that specific boat for that species...and so on.

- **NON-TARGET SPECIES:**

  Please indicate here any incidental by-catch of animals such as dolphins, turtles, dugongs, sawfish etc. Use number and not weight.

- **RECORDED BY:**

  Please indicate the name of the person who was responsible for recording the majority of this information.

---

providing them with training and equipment in fisheries. (Nur 1988, FAO 1988). Many of these 21 co-operatives were equipped with 8-10m boats with inboard engines and fishing gear. At some sites, ice plants were subsequently installed, especially by the Danish Aid Agency, DANIDA, further assisting the development of artisanal fishing.

The size of the artisanal fishery has varied in time and also depending on the survey data consulted. In 1988, some placed the number of artisanal canoes at 900, motorised boats at 630 and sailboats at 180. It was estimated that only half of these were operational (FAO 1988).

3. ENSURING SUSTAINABLE USE

3.1 BASIC CONSIDERATIONS

It is a well established fact that most of the world's marine fisheries are either fully subscribed or in many cases overexploited. The total global catch appears to have reached its maximum and despite great advances in technology and fisheries science, the prospect of increasing the yield significantly is scant (Mace, 1997). Few of the world's artisanal fisheries have been adequately studied and described in detail, let alone monitored. But, many examples indicate that here too the catches are down, fishers unemployed and socio-economic hardships prevail.

Numerous reasons have been proposed to explain the collapse of so many resources, most of these being complex mixtures of environmental and man-induced phenomena. **However, most of the blame can be attributed to the absence of effective policy, access arrangements, operational management procedures and biological reference points for monitoring**. In the case of Somaliland there are essentially none of these four components in operation which raises the question of long-term sustainability. Even if good monitoring data were to be made available, without some effective management capacity, the fishery would simply collapse. Consequently, it is imperative that a management strategy be developed that will have broad acceptance and comprise practical and achievable actions to protect fish stocks and the livelihood of people who use them. Until such time that a policy is in place, a Precautionary Management Approach (FAO 1995a) should be adopted. This approach conforms to the 'Code of Conduct for Responsible Fisheries' (FAO 1995b) which is now well accepted internationally and is designed to exercise 'prudent foresight' to avoid undesirable and possibly irreversible fishery situations.

3.2 PRECAUTIONARY APPROACH TO FISHERIES

Full details of the Precautionary Approach to fisheries are not listed and discussed here, but they may be obtained from the FAO (1995a) report. However, specific steps are recommended for artisanal, new and/or developing fisheries, such as those in Somalia. Those of relevance to the present situation have been reproduced here.

- It is imperative to control access to the fishery early, before problems appear. An open access fishery is not precautionary and is likely to collapse.

- Immediately put a conservative cap (or default level) on both fishing capacity and the total fishing mortality rate. This can be achieved by limiting effort or total allowable catch. In addition, attention should be paid to preventing excessive investment in all sectors of the fishery, including the processing sector. The conservative cap should remain in place until analysis of data justifies an increase in fishing effort or fishing mortality. The objective here is to prevent the development of fishing capacity which outpaces the ability of management to understand the effect of existing fishing effort.

- Limit risk to the resource and the environment, use area closures, which are relatively quick to implement and easily enforceable. Such closures provide refugia for fish stocks, protect habitat and provide reference areas for comparison with fished areas. Artisanal fishers have a limited range of operation and thus benefit directly from such closures.

- Establish preliminary biological reference points (such as target and threshold spawner biomass levels) early on in the fishery.

- Encourage responsibility and co-management through fisher involvement, education, local decision making and tenure of rights.

- Encourage viable fisheries without long-term subsidies.

- Establish data collecting and reporting systems early on in the development phase of the fishery.

- Avoid competing fishing pressure from other sectors, such as foreign or industrial fishing.

- Take advantage of any opportunities for setting up experimental and research situations to generate information on the resources. This could be done by contrasting different harvesting strategies on sub-populations, for instance.

3.3 THE NEED TO MONITOR

Just as a business or a bank account needs to be monitored to avoid trading deficits and bankruptcy, so too a fishery requires constant monitoring to ensure long term sustainability and hence maximum sustainable benefit. Decisions have to be made which will require a knowledge of the risk involved. Such decisions are made on the basis of reference points, which include a wide range of quantifiable parameters. These can be "target" reference points such that the optimal fishery situation is achieved or they can be "threshold" reference points, which set the absolute limit beyond which bankruptcy or fishery collapse is probable (Caddy and Mahon 1995).

There are however, different reasons for monitoring a fishery and each of these may have different data requirements or indeed different collecting strategies, not necessarily compatible with each other. Some of the basic monitoring requirements are identified.

- *Resource management*

Here monitoring is undertaken in order to assess the status of exploited stocks and provide a basis for developing management strategies so that the fishery can be sustainably developed. This may include the setting of input and/or output controls. Such monitoring should determine key quantitative parameters and biological reference points for population dynamics and modelling. Also included are data sets that allow subsequent monitoring and hence evaluation of the success or otherwise of specific management actions.

- *Conservation*

Though similar to the above, in this case the monitoring is focused on detecting the status of the resource in relation to its environment, but also takes into consideration biodiversity values, changes in species composition, and significant changes in keystone, indicator or endangered species, etc. Specifically, non-target species e.g. bycatch, will be monitored.

- *Fishery development*

Here collection of the data is primarily motivated to enhance cost-effective fishing techniques, maximising harvest, improving gear technology and enhancing trade etc.

- *Fishery compliance*

In this case, monitoring is undertaken to ensure that management regulations are adhered to or that levies and taxes are collected.

All of the above monitoring objectives are justified and necessary but not all can necessarily be collected together or using the same methods. Data collected for levy purposes is more likely to be falsified and hence impact on stock assessment calculations. Similarly, monitoring for compliance is more likely to generate fictitious data, and hence should not be undertaken in association with the more scientific data gathering techniques. Nevertheless, different data sets collected under different circumstance can provide a powerful validation service and lend considerable confidence to actual use of the data.

In the Somali case, it is suggested that the first two reasons for monitoring are most relevant at this stage.

3.4 CURRENT DATA COLLECTING INITIATIVES

In the past, before disruption to the government systems, several data collecting programmes were implemented. These provided information on levels of fishing effort, major species harvested as well as estimates of total catch which were compiled in the annual FAO global fish landings report. In addition, a number of fishery surveys and investigations by local and foreign scientists and numerous surveys under the auspices of FAO, also provided 'snap-shot' data sets which have been useful. However, it would appear that most of these initiatives were directed at industrial fisheries, leaving the artisanal fisheries largely undocumented.

Despite lacking well developed and funded fisheries infrastructures, a number of individuals and fishery-interest groups have re-initiated monitoring on artisanal fisheries. In particular the project at Berbera, supported by Cooperazione Internazionale (COOPI) and that at Bosaso, by the Ocean Training and Promotion (OTP) group, are commendable. These data collecting projects involve staff who have past experience in various aspects of artisanal fisheries and they are providing reliable data.

The data collected at Berbera, Bosaso and other sites over the past two years or so is most useful in providing an indication of the catch composition, levels of effort and overall nature of the fishery. From these records it would appear that the teleost (bony fish) fishery is essentially in a 'near-pristine' condition. This conclusion is largely drawn from the fact that the species composition reflects a high proportion of known vulnerable species such as groupers. Absent or poor data on the lobster and shark fin fisheries preclude drawing any conclusions at a time when these two fisheries may well be at risk. The format of data currently collected and a preliminary analysis of the Berbera data is appended. It is important to obtain reliable data

early on in a developing fishery so as to obtain a 'pristine' reference point against which changes in composition, biodiversity and biomass can be monitored.

While the data collecting systems already underway are commendable, they will not generate data that will provide adequate insight into quantitative assessment of the fishery. Calculation of effort, identification of individual species and measures of individual fish are inadequate for detailed assessment. The mixing of gear types in the data also creates problems with selectivity. However, with some modification considerable improvements can be achieved. It is thus proposed in this document that the current data collecting systems are used as a foundation on which further initiatives are built.

One outstanding achievement of the data collecting currently underway has been the creation of awareness and building of capacity amongst fishers and the public at large. This provides a valuable basis for further development which is often lacking in other regions of the world, especially at the artisanal level. The skills of the people involved in the data collecting are considered to be competent and during the visit some difficult species of fish were correctly identified. Also of note are the excellent efforts made at Berbera to provide marine biological and fishery related educational experiences to scholars through art projects and other activities.

---

4. PROPOSED MONITORING STRATEGY FOR SOMALILAND

4.1 OVERVIEW

A monitoring programme for Somali marine artisanal fisheries needs to be developed so as to:

- assess the status of the fishery.
- provide scientifically sound data to facilitate stock assessment of individual exploited species,
- provide guidance and decision support on the levels of subsidy and development of the fishery,
- guide the management and sustainable development of these fisheries,
- be practical and achievable,
- be financially realistic and affordable,
- be processed and interpreted by Somaliland-based staff.

The proposed monitoring strategy would comprise a number of distinct components that would integrate into an annual statement representing the status of exploited resources. These stages are schematically represented in Fig 1 with some of the details given in the box below.

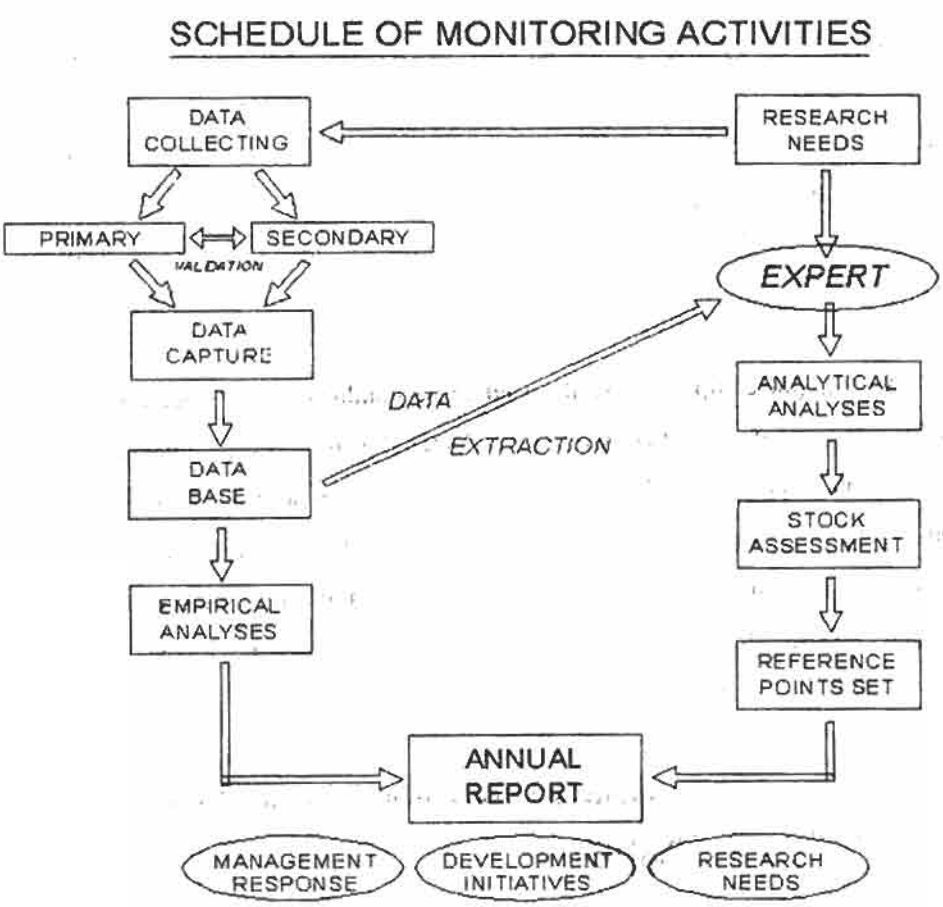

FIG 1: FLOW CHART

- *PRIMARY INDICATORS*

  Species composition of catch

  Fishing effort

  Catch rates

  Catch size-structure

- *SECONDARY INDICATORS*

  Economic parameters

  Gear and technology changes

  Processing and marketing

- *STOCK AND FISHERY MODELLING: ANALYTICAL ASSESSMENT*

  Surplus production models

  Age-based models

  Length-based models

  Target and threshold reference points

It is suggested that the Primary and Secondary indicators will represent the main thrust of the monitoring and form the basis of the data collecting to be undertaken by a fisheries officer at each fishing locality. While the Primary indicators are directly derived from the fishing activity, the Secondary indicators represent indirect parameters of a more socio-economic nature that would provide further insight into the fishery, its trends and sustainable development opportunities.

The Modelling and Assessment component would need to be conducted at a more complex scientific level each year, using the data that had been collected during that year. This activity could initially be undertaken as an annual consultancy with outside expertise that should be structured to promote capacity building so that the modelling will eventually be done in Somaliland. It is envisaged that this process will involve the evaluation and interpretation of data, the setting of reference points, and the generation of management strategies, plans and operational management procedures for certain species .

All the information needs to be collated annually and compiled into an annual fisheries report with predetermined and approved structure and content.

The rationale of each monitoring component scheme is discussed and some details of data requirements given. A more comprehensive ***data collecting manual*** has been appended for actual use in the field. (Appendix III)

4.2 DATA COLLECTING

A system of data collecting is envisaged that is relatively simple to implement and builds on some of the data collecting already underway in the region. Several data sheets have been designed that prescribe the format and intensity of collecting (see data collecting manual). The two basic types of data collected concern Primary and Secondary indicators.

4.2.1 Primary Indicators

These are broad fishery-related features which can be determined from relatively simple data collecting initiatives at the major fishery landing sites.

4.2.1.1 *Species composition of catch*

Catches in tropical waters invariably include a large number of species. This is certainly the case in Somaliland where more than 30 species are considered to be of commercial importance to artisanal fishers. As some species are more vulnerable to exploitation than others, it follows that increased fishing pressure can alter the species composition of the catch. Such vulnerable species usually possess one or more of the following characteristics: slow growth, low reproductive potential, limited habitat preference, restricted geographic and/or depth range, highly demersal and resident, complex reproductive strategies (e.g. sex change), high market value, target of competing user groups, etc. There is ample evidence from elsewhere of certain species being more rapidly depleted in a developing fishery than others. This causes a series of declines in specific species as the fishery continues to turn to less valued 'replacement' species, known as serial overfishing. Evidence of this exists in South Africa with the *Sparid* seventyfour (van der Elst & Garratt 1984), with groupers *Serranidae* in the Pacific (Koslow *et al* 1988; Russ *et al* 1995) and elsewhere.

Thus, tracking the percentage contribution of key species to the catch in relation to demand and targeting, can provide a simple but powerful tool to assess overall status of a fishery (Koslow *et al* 1988). Similarly, the proportional relationship between pelagic species and the resident reef fish in the catch gives insight into the conservation status of that resource. Pelagic species are usually faster growing and attain maturity at a younger age, which means they can tolerate higher levels of exploitation than reef fishes.

It is encouraging to note that the potentially vulnerable groups (such as large groupers and snappers) are still in abundant in the Somali regions visited. However, this should not invoke complacency. It should rather be seen as an excellent opportunity to monitor the species composition of catches and thus to detect early any negative changes in its, and by implication, biodiversity and sustainability.

Evidence from the field visit and discussions with local fishers clearly indicate that there is no significant targeting for one or other species. However, this may develop in future and here too lead to changes in catch composition.

The present data collecting does consider the major species groups present in the catch which allows for useful insight into the species dominance. It is clear, for instance, that the species dominance in catches made from motor boats and canoes vary markedly from each other. However, the level of detail is inadequate to make more precise determinations and hence some expansion of this data set is proposed. Essentially, it is recommended that a single daily sub-sample be taken of one randomly selected fishing boat, in order to determine species composition by number . (See data sheet and Data collecting manual).

4.2.1.2 *Fishing effort*

It is of cardinal importance and a prerequisite to successful stock assessment that a regular and accurate estimate of fishing effort is made. There are several reasons for this but most important is the fact that effort information is needed to understand and interpret trends in the fishery, determine levels of fishing mortality and provide input to production models such as the Shaeffer model. Fishing mortality information is also needed in yield per recruit and spawner-biomass per recruit models. Trends in effort are also of value in tracking the behaviour and distribution of fishermen as well as the status of the stock, as declining catches will impact on associated fishing effort. For example, fishers may stay out longer to land the same quantity of fish if stocks are declining, in which case the monthly fishing effort should increase while boat numbers stay constant.

It is, however, most important to define the units of effort so that direct comparisons between data sets from different localities and different periods can be made. For example, the basic unit of effort could be a fisherman-day, a boat outing or even a boat-year, being the number of boats registered. Obviously, a boat year will provide less accurate information than a man-day because it lacks precision about the number of days fished and number of crew. It is most important to define the units of effort at the beginning of a monitoring programme and then to retain these as a permanent feature.

In the case of Somaliland, there are two main indicators of effort that can be readily monitored. The information on effort presently being collected (for example at Berbera) relates to boat-outings, without indication of crew numbers or days fished. While this is certainly of value, it is suggested that with little more effort, this can be expanded to include fisher-days, for each major gear type. This is included in the proposed Daily Landing Record (Form 1). Secondly, it is strongly advised that each boat operating in the fishery should be 'registered' in some way. This should be done in such a way as to be attractive and beneficial to the fishers, possibly by preferentially providing goods and services, such as ice, to those who are registered. It could also be argued that those who legitimately operate in the fishery through registration would be ensuring themselves a fishing right for the future should it become necessary to limit entry. This will induce a sense of 'custodianship' and hence improve responsible attitudes towards the resource. It is further proposed that such registrations are documented in a Boat Register that is maintained by the fishery officer at each major site and updated annually. An example format is proposed in Form 4 of the manual annexed to this report.

There should not necessarily be a cost levied for boat registration, although this could be an ultimate objective. The entire question of right of access, ownership and transfer of rights needs to be resolved although it may be premature to do so at this stage.

The above two approaches for recording effort are simple to implement, likely to encourage user involvement and provide one of the most important primary indicators of the fishery.

4.2.1.3 *Catch rates*

The rate at which fish are being harvested is clearly an important parameter and indicator of abundance. Catch and effort data provide important input parameters to empirical models where the actual performance of a fishery can be monitored. Catch rates are usually expressed in terms of catch per unit effort (CPUE), using the units of effort as defined previously. CPUE is obviously also of value to the fishers themselves as it indicates their success and obviously their profitability.

CPUE can be expressed as catch in number or by weight and it can be given for one species, a suite of species or indeed the total catch. CPUE is not always an easy parameter to interpret, especially in a multi-species fishery where there is no real targeting and hence effort is not necessarily directed at one particular species. Nevertheless, significant changes in the CPUE of single species provide a good indication of stock status. In particular, a drop of 50% or more in CPUE over the virgin or pristine catch rates (which can be theoretically calculated) would

indicate that the MSY level has been exceeded, based on the simple Shaefer model which suggests that maximum sustainable catch is achieved at half the unexploited population biomass.

The proposed Daily Catch & Effort Sheet (Form 1 in the manual) includes a catch sub-sample that notes down the catch by number for individual species of one randomly selected boat for that day.

4.2.1.4 *Catch size-structure*

As fishing effort increases, and more fish are killed, so the period any single fish is likely to survive before capture becomes shorter. Hence, the average fish will become smaller or lighter. The age structure of the stock thus changes, with older fish becoming progressively scarcer in the catch. One way of detecting such changes is to monitor the age or size structure of the catch or the average size of fish landed. This can be readily achieved by taking a modest, randomly selected sub-sample of say 150-200 specimens of a particular species and measuring their lengths at a given time.

Often, the relationship between size and age is not well known and techniques are needed to convert size to age. Where species have a discreet breeding season, and thus a similar birthday, the population at any one stage can be divided into year classes or cohorts. This structure can be processed in a Cohort Analysis or Virtual Population Analysis, which provides an indication of the abundance of each cohort (age) class of the stock as well as estimates of total mortality, Z, fishing mortality, F and hence exploitation rate, F/Z. (Jones 1984, Butterworth *et al* 1989). By conducting such analyses on a regular annual basis means that a trend in mortality can be monitored, providing a useful tool in evaluation of the resource.

Changes in fish size, including mean size, may of course also have an influence on marketability and hence profitability of the catch. Reduced size can furthermore influence spawning potential through reduced fecundity or significantly altered sex ratios in the case of sex changing (protogynous) species such as in the *Serranidae* and *Sparidae*.

4.2.2 Secondary Indicators

There are a number of activities and data sets that are indirectly related to the level of marine resource harvesting and which will fluctuate in accordance with the state of the fishery. These data sets are often related to monitoring activities other than stock status and conservation

assessment which means they can often provide a useful alternative and verification of data sets. Several are discussed here but more may be developed.

4.2.2.1 *Economic parameters*

Many relationships exist between the resource and the economy. The term bio-economics encompasses the interrelationships between the economic forces affecting fisheries and the biological forces that determine the production and supply of fish in the sea (Clark 1985). Most importantly, fishers want to make a profit and hence most fisheries are 'market driven' This applies increasingly to small-scale artisanal fisheries. This means that the costs associated with the actual fishing operations must at least be recovered and that a profit is then made over and above this. This relationship of price/cost ratio is a critical component of fisheries conservation and sustainability because if the ratio becomes too high then biological overfishing is likely to occur (Clark, 1985). This ratio can be altered in two ways: first by increasing the price of the fish and second by reducing the input costs. The latter is achieved through improved technology or through donor support and subsidies of fuel, equipment, ice etc.

The price of fish will change according to supply and demand. Thus, depleted species tend to command increasingly higher market prices. Highly valued species, such as lobster and shark fins, will tend to promote targeting for such species.

Clearly, it is most important to collect and interpret economic data such as price of fish, levels of subsidy or donations, outstanding debts and loans by fishers etc. Such information is in part already being collected and should be formally documented and presented in the proposed Annual Fisheries Report.

4.2.2.2 *Gear and technology changes*

As the fishery develops so changes in the gear can be expected. This may be due to fishers improving their economic position and being able to afford better gear and wishing to improve yield and hence profitability. For example, global positioning systems can reduce searching time and hence reduce the input costs of fuel. However, gear is also often altered or expanded in response to declining catches. Some of the more common examples are the reduction in mesh size, smaller hook sizes, an increase in engine power or the lengthening of fishing lines. The same applies to technological aids such as satellite positioning and echo sounding.

Tracking the gear and technological changes provides yet another feature that can reveal information about the state of resources. A related useful indicator is the actual sale or supply

of fishing gear, bait and fuel. Changes in gear and technology, unfortunately also have the effect of altering the 'unit of fishing effort'. This means that comparisons with past calculations using effort may not be valid today as current effort may be more efficient. Knowledge of such changes are thus important in explaining fishery trends.

It is therefore necessary to provide at least an annual statement on the quantity and description of gear used as well as the technological improvements made during that year. This information should be incorporated into the Annual Fisheries Report.

4.2.2.3 *Processing and marketing*

The post-harvest activities in a fishery are also important. Not only can it result in an improved product that has an enhanced value, and thus profitability, but it can also serve as a useful indicator of fishery status. The amount of ice sold, for instance, may be closely related to the catch or effort. Similarly, the relationship between local consumption and export provides an important indicator of the fishery. This means that records maintained by packing companies, air transport or port authorities are a useful independently collected data set that can also validate fisher-generated information.

4.3 DATA CAPTURE

The daily catch and effort information as well as the length measurements and several other parameters need to be properly recorded and captured to a database during the course of the year. This will ensure that duplicate data is available for safekeeping, that an ongoing fishery assessment can benefit the local fisheries personnel and fisher-community and that the data can be readily processed in analytical models. Although a spreadsheet application provides an attractive initial option it is strongly recommended that a proper database system be adopted, preferably specifically designed with screen-driven and validated entry facilities. This should not be a major or excessively costly task.

4.4 VALIDATION

The validation of data collected should be identified as a specific task of the data collecting programme. It is most important to generate different data sets that can be used to compare similar parameters. For example, there should be collation between total landings, ice sales and fishing gear issued at a particular landing site. By comparing such data sets, the fisheries officer will at best be able to add confidence to the data or at worst be able to identify suspect data sets.

Validation can also occur at the data entry level. For example, the presence of certain species, their normal size range etc., should all be screened and tested before capture into the data base.

4.5 EMPIRICAL ASSESSMENT

The primary and secondary data types should be processed into a more useful format at the end of a month and then combined at the end of each year. The precise nature and structure of the information may vary, depending on the data itself and also on the capacity of the responsible official. Ideally, the database will be developed with an analysis component so that the basic information is provided 'automatically'. Suggested parameters and format are given under the section dealing with the compilation of the annual report.

4.6 ANNUAL FISHERIES REPORT

It is imperative that all the information and data collection is represented in one annual document for interpretation, analysis and future action. This suggests the need for an annual fisheries report that would have a predetermined structure to ensure compatibility between regions and periods. Preferably, such a report will be produced for each major landing site, with amalgamation of all these reports into a major report for the region that would also include year-on-year trends. Every attempt should be made to have the reports available within six months after year-end. The following components are proposed as minimum requirements.

- *Year in overview*

This section, of about two pages, could be similar to an executive summary and would provide the fisheries official with an opportunity to relate not only hard facts, but also impressions, opinions and other qualitative information that may otherwise not emerge in the normal process of data analysis.

- *Key statistics*

Here the main data sets are presented in processed format, tabulated and/or graphed, preferably on a monthly basis. The following sections should be included.

  - *Fishing effort*:

    Number of boats per type, operational, dormant and in disrepair

    Number of fishing licenses in total

    Number of fishing licenses issued during year

    Number of fishers, outings and outing-hours

➢ *Landings*:

Total catch in weight or number as appropriate

Species compositions

Catch frequency: how often species appear in the catch

Catch per unit effort (CPUE) per species

➢ *Development*:

Gear usage

Equipment, gear and tackle sales or donations

Subsidies and donations

➢ Marketing:

Ice sales

Export statistics from airport and harbour

Processing procedures and quantities

- *Gear and Equipment*

Here, details of the equipment used in the fishery should be described and, if possible, quantified. Not only should individual boats be quantified in terms of their type and length but details of outboard and inboard motors, fishing aids such as echo sounders, two-way radios and GPSs, as well as actual fishing gear and quantities should be provided.

- *Conservation & Biodiversity*

Providing details of by-catch, endangered or vulnerable species, habitat degradation and other issues relevant to the overall conservation situation. Ultimately this section could contribute to a 'State-of-Environment' report for the coastal resources.

- *Public relations, awareness and compliance*

A section dealing with special events, such as school education initiatives, fishery 'open days', visitors, marine highlights, newspaper reports, strandings etc. Also included can be a general comment about compliance and transgressions, such as poaching by foreigners, as well as formally charged transgressors of fishery regulations and agreed protocols.

- *Staffing, training and education*

Reflecting the voluntary and part-time and permanently employed staffing support. Training that was undertaken, including courses, meetings and conferences attended. Training and capacity building needs can also be expressed here.

- *Financial considerations*

It is important to present a credible and transparent image of fishery monitoring and management. This is in part achieved by having available an annual report that includes financial statements. This could include the departments own financial resources, the origin of such resources (e.g. from levies, donors, ice sales etc) as well as the level of subsidies and donations received in cash, material or kind.

- *Reports and publications*

This section would include a list of all reports written of relevance to the fishery situation in that region. A comment about availability of literature and special 'bibliographic' acquisitions could also be included.

- *Conclusions and future plans*

Here the overall concluding comments about the status of the fishery would be documented, based on the main sections of the report. It would also include notes on recommendations, needs and a specific section dealing with future planning. Included in such planning should be the stated objectives of the fishery management procedures and the targets that need to be attained.

4.7 ANALYTICAL ASSESSMENTS: MODELLING

Although empirical assessments will provide an indication of the performance of the fishery, ultimately, more complex assessment will be needed to ensure that management strategies and Operational Management Procedures (OMPs) for individual species can be developed and adhered to. Much of the data that will be collected in terms of this programme should suffice for such assessment. Additional data points can be 'imported' from fisheries elsewhere and extracted from the literature, such as growth rates, mortality estimates etc. In time it may prove necessary to conduct limited research to determine key input parameters if such information is not available.

It is recommended that modelling procedures are developed for the Somali artisanal fishery by conducting an annual 'year-end' audit of data and modelling exercise. Initially this may have to

be done by an outside consultant (perhaps only a week or two) but the emphasis should be on developing such capacity within Somaliland and the entire Somali region. This will not only provide essential data needed for future management, development and conservation but will provide opportunities for Somali students to gain practice in modern-day fisheries science and to develop techniques applicable to the local situation.

---

5. FISHERY MANAGEMENT CONSIDERATIONS

5.1 OVERVIEW

No amount of monitoring or data collecting will achieve sustainable fisheries or fishery development in isolation. There needs to be a policy framework, institutional capacity and a workable management plan. Few of these components currently exist in Somalia and hence attention will have to be given to their development, preferably with some urgency. Although comprehensive details are beyond the scope of this study, guidelines are provided to assist with their initiation and ultimate development.

5.2 POLICY DEVELOPMENT

A basis for success in any fishery management programme is the development and subsequent popular acceptance of a fisheries policy. Though many countries 'infer' policy from their fisheries legislation, this should not be seen as a substitute for a formal policy. Such a policy determines many aspects of marine resource exploitation, especially the questions relating to access and ownership.

No formal fisheries policy document exists for the Somali region, although the Somaliland Fisheries Law of 1996 does include some specific policy guidelines. Similarly, it is believed that different coastal communities or clans have also formulated their own approach or policy towards marine resource exploitation.

The development of a fisheries policy is a major task that involves not only fisheries science but also social, economic and political considerations. It is especially difficult to develop a fisheries policy in a region where there is no political harmony between regions, such as in the Somali region. Nevertheless, it is considered advisable to obtain comment and opinion from the different regions concerning policy and to collate this into a regional document. Although this may have to be a separate consulting task, possibly executed through a mechanism of questionnaires, it is imperative that Somalis themselves draw up and approve the final policy.

South Africa has just undertaken a two year policy development process that involved a great many fishers and cost about 1 million US$. (Anon, 1997). Though it may not be a perfect document, the South African experience could provide a useful baseline. (Footnote: Copies are available on request from ORI).

5.3 INSTITUTIONAL CAPACITY

Clearly there is a need to improve institutional capacity although this should be undertaken in a gradual and structured way. It is important to recognise that there are four distinct areas of activity within the fishery management process, namely monitoring, data analysis, scientific assessment leading to regulation and compliance with such regulations. All are interdependent and hence capacity in each needs to be developed in context with the others. While the monitoring component is now being attended to, the other two areas of activity also need to be developed. In particular, attention should be given to developing capacity in fishery law enforcement. While a high level of co-management is desirable, it is most important to develop structures that will provide the enabling legislation and capacity to introduce enforceable rules and regulations. The present legislation is not adequate for this purpose.

5.4 MANAGEMENT PLAN

It is imperative that a management plan for small-scale artisanal fisheries be drawn up and that a time scale is agreed on to achieve this. Such a plan should include a series of operational or dynamic management procedures (OMPs) for individual species or groups of species. Such OMPs would identify appropriate reference points and biological indicators and would also specify the targets and limits in the fishery for such indicators (Caddy and Mahon 1995) Thus, for example, the spawner biomass per recruit of a particular species may be set at an optimal (target) and a limit (threshold) level, say 40% and 20% respectively. The management procedures and implications associated with each level of this reference point will have been previously negotiated and developed and thus automatically implemented.

The management plan should also consider socio-economic factors which could include profitability of the fishery, subsistence needs and traditional use of resources.

5.5 APPLICATION OF MONITORING RESULTS

The proposed monitoring programme is designed to generate a reasonable quantity of data that will be statistically adequate for fishery and stock assessment, yet realistic in terms of financial and manpower demands. The value of such data is not merely confined to scientific analysis of the fishery but has a range of additional useful applications.

It is recommended that the data is initially processed in a long-hand or spreadsheet method, and presented as indicated in the Annual Report structure. (see 4.5). This should be followed by the development of a screen-driven database which will generate basic outputs as required.

- *Fishery assessment*

The data generated directly from the fishing activities will provide the basis of an empirical assessment. Such assessment becomes more useful with time as it tracks 'performance' of the fishery over a period. Once a few years of data have been collected then trends will begin to emerge which may assist in the formulation of management procedures. The analytical or modelling use of the data will provide a more instant "snapshot' of the state of the resources in the fishery.

- *Fishery development*

Not only should the fishery be developed on a biologically sustainable basis, but its participants should also be operating with an economically and socially sustainable future. Data generated through the monitoring can contribute to this by assisting fishers in evaluating the efficiency and profitability of their operations.

- *Capacity building and awareness*

Data that is generated from the fishery is inherently interesting and if presented appropriately, can play a role in promoting awareness and involving community participation. The display of monthly trends in the fishery, outstanding catches and rare species, for example, should be encouraged and a notice board or newsletter created for this purpose.

5.6 RESEARCH

At this stage it is not considered necessary to launch into a major fisheries research programme, at least until such time that clear research needs have been identified and appropriate staff and funding secured. However, there are several aspects of concern that will require almost immediate research attention. These can be tackled on a *ad hoc* basis by local staff, possibly supported by consultants. Some of these are identified.

- *Species identification*

A large number of species being harvested are presently not being properly identified. In some cases this may not be serious but for sharks and groupers this presents a significant shortcoming that can threaten stocks. It is therefore suggested that an identification field trip is undertaken, in conjunction with a fishery identification training course. Reference material should also be available and ORI will make two sets of appropriate documents available, especially relating to sharks.

- *Lobster assessment*

Despite several past publications, there remains serious doubt about the true identity of the spiny lobsters being harvested. Reports suggest that these may be *Panulirus homarus*, the so-called Natal crayfish, a species that primarily occurs off KwaZulu-Natal in South Africa. More important is the need to rapidly conduct a preliminary stock assessment of this species because of its high value and apparent very high exploitation rates. This can be achieved at reasonable cost.

- *Stock assessment and modelling*

This task will need to be undertaken, at first with support of outside consultants. This should take place once the yearly data has been processed and should include an assessment by analytical analysis of the status of stocks. In particular, attention will have to be devoted to evaluating the fishery in terms of target and threshold biological reference points.

- *Database development*

A relatively simple computerised database needs to be developed specifically for the Somali situation. This need not be an enormous task and should rather be built on an existing platform than be developed from scratch. Such a programme would include screen-driven entry, verification and validation, where possible, and 'automatic' generation of key results.

It will be desirable to progressively develop a research programme and hence specific research needs must be identified. Where possible, such a programme should be focused on solving real problems rather than academic achievement and in particular, be used as a mechanism for capacity building in the region.

5.7 AWARENESS, EDUCATION AND PUBLIC PARTICIPATION

The fishery data collecting, management and subsequent control should not be done by a few individuals in isolation. In order to achieve success there should be a high level of public participation, contributing to co-management situations. This will contribute to the general level of education relating to fisheries conservation and wise use and should also contribute to a voluntary approach to compliance with the prescriptions of a management plan. It has already been demonstrated by people in the region that there is a general interest in the topic of fisheries. This should be built upon and it is suggested that the some specific tasks are considered.

- *Holding an 'open day*

Where the community can observe the monitoring procedures, touch-specimens and other activities such as preparation and preservation of fish for human consumption, improved fishing techniques, videos etc.

- *Preparing pamphlets , posters or newspaper articles*

This is already partly underway and should be strongly encouraged.

- *School education*

By continuing the visits to schools and providing illustrated talks, the fishery officer will have direct access to a large section of the community

5.8 CONSERVATION ISSUES

Management of the fishery should look beyond issues of the fishery itself. Although the fisher-communities visited during the May 97 survey displayed a remarkably sensitive attitude to the by-catch of vulnerable species, consideration must nevertheless continue to be given to other environmental considerations which have broader conservation implications. The by-catch of possible endangered animals should be noted and controlled if necessary. Examples could be dugongs, humpback dolphins, turtles, sawfish and others.

The use of specific fishing techniques that have negative environmental impact should be minimised. Anchoring on top of coral reefs, dragging nets over fragile sub-stratum's and using poorly managed traps that can become lost "ghost traps" and continue to catch fish or damage the substrate for long periods.

Although probably beyond the control of artisanal fishers, care should be taken not to impact negatively on ecological processes, both along the shore and at sea. Care should be taken with littering and dumping of refuse such as fishing line and net fragments (which kill corals) and fuel for example. Artisanal fishers tend to have a limited range of fishing, hence the effects of urban and port development may impact quite heavily on this sector of the fishery.

---

6. COMMENTS ON SPECIFIC BURNING ISSUES

Following discussions with Somalis interested and affected by fisheries, as well as personal observations made, it was apparent that a number of burning issues exist in the region that require urgent attention. Some of these are directly related to artisanal fishing operations while others are indirect effects that impact on fisher attitudes and hence collaboration. These are discussed and several recommendations made.

6.1 ACCESS AND POACHING

Ownership and right of access to marine resources are amongst the most fundamental and important components of fisheries management that need to be established if sustainability is to be achieved. Without a formal policy on access, fisheries invariably collapse and the dependent fishers suffer accordingly. This was highlighted at the recent World Fisheries Congress held in Brisbane where numerous types of ownership and access arrangements were described. (van der Elst *et al*, 1997). Many of these function well for specific communities and situations. However, 'open access', where no input or output controls exist, was seen to be the single most damaging threat to sustainable fisheries development as it does not develop a sense of ownership and responsibility amongst its users. Instead, it promotes 'mining-out' operations where competition tends to induce fishers to maximise their own catches in case others take the harvest. Very few developing countries do in fact have structured systems of access.

Access to resources can broadly be grouped into two categories:

(*a*) offshore industrial resources that may range to the outer limits of the 200 nm EEZ and which may attract international interest and,

(*b*) inshore resources that are primarily accessible to coastal and artisanal fishers of the country concerned.

For inshore resources, some systems of access have been created in regions where local communities have historically fished one region and hence developed a sense of custodianship, such as in the Tanga Province of Tanzania. In such cases, shared management and control over access is possible giving rise to a level of co-management between users and one or more levels of government. However, too offshore resources, where international access rights are requested, the system of access needs to be negotiated at both regional and national levels.

In the Somali region, there is no formal system of allocating access. In the case of inshore resources, local communities, usually clan-based, have assumed ownership and responsibility for marine resources within range of their locality and equipment capabilities. In some, for

example at Elayo, access by neighbouring fishers is granted provided this is requested and that it is clearly of a subsistence or artisanal nature. Unauthorised entry to 'local' fishing grounds is strongly rejected although the ability to enforce access is often lacking. This was indicated to be the case in the artisanal fishery at Zeila. Nevertheless, cases were reported where local fishers have used force to arrest or drive away poachers.

Even if the Somali region was to resolve its political problems, the prospect of developing a fair and equitable fisheries access system are extremely remote. By far the best option would seem to be to build on the local ownership structures which could eventually develop into a level of co-management. Each region under clan control would have to be identified and claimed according to a reasonable set of criteria. Where conflict over claims occurred, these would have to be subjected to arbitration and mediation. There is every reason to believe that a system of local ownership can be more formally developed and achieved. If each of these regions was to apply similar methods of access, monitoring and control, then a regional authority could more naturally develop, based on common interests rather that conflicts.

A more serious problem is that of access to offshore resources. Currently, there is no single entity in the Somali region that can give such rights and it is unlikely that foreigners will seek permission from a range of coastal communities. Consequently, there is growing evidence that significant 'poaching' by foreign fleets is taking place. Not only was this persistently claimed by all the fishing communities consulted but at least two vessels have been apprehended by local militia for poaching in clan waters. Regrettably, these were believed to be EC member ships, a fact that creates considerable distrust for various EC initiatives.

Until such time that there is a more centralised regional fisheries authority, foreign fleets should not harvest fish from Somali waters, especially not within the 12 nm territorial range off the coast where there is certain to be an impact on the artisanal fishery. Efforts should be made by EC partners to assist with some surveillance of illegal fishing, especially if this is done by vessels belonging to EC countries.

6.2 SUBSIDIES AND DONATIONS

One of the greatest problems facing the world's and individual fisheries is the level of subsidisation and over-capacity (Mace 1997). It has been shown convincingly that where costs associated with a fishery are not internalised, the ultimate fate of that fishery carries a high risk of collapse (van der Elst *et al* 1997). At all costs, this situation must be avoided in the Somali region. While it is tempting to provide donor support to struggling fishers, such schemes need

to be very carefully managed. An example of this is the Red Cross activity providing fishing equipment to coastal communities as a humanitarian gesture. Though well intended, this practice can lead to abuse of the fishery and frequently ends up with middlemen who then "sell" the equipment to subsistence fishers. Many tons of netting have already been placed amongst coastal communities and this further compromises a managed approach to fisheries. Ultimately, it will be the fishers themselves who suffer when the stocks collapse. It is strongly recommended that the exact quantities and distribution of the equipment be documented and that this process of donating be reconsidered. A similar plea was made by Haakonson in 1983.

Similar concern must be expressed about those wishing to install processing plants, provide vessels, subsidise fuel etc. All such costs must be debited to the fishery itself. The current practice in Berbera where fishers purchased tackle and ice on short-term credit was impressive and should be further developed.

6.3 LANDING FACILITIES

At most places the landing facilities for artisanal fishers are appalling. There are few places where small vessels can moor at all tides, nor are there clean slipways to assist with physical offloading. Yet, port development and management is good at several localities. Besides the direct benefit to fishers, the creation of a modest fishery slipway is a key element in providing a central point for data collecting. At Bosaso, and to some extent at Berbera, the fishers can land at any of several sites, making control and centralised data collection virtually impossible. This further compromises the levels of hygiene associated with so many sites.

It is recommended that specific fishery landing sites be identified and developed in order to promote centralised data collecting and monitoring activities. These need not be sophisticated but should simply assist the fishers with loading and other activities. This may involve limited dredging, repairing slipways or providing safe anchorage. Such a gesture is certain to win great goodwill amongst fishers and will promote higher levels of collaboration and co-management.

6.4 MARKETING ARRANGEMENT

Not surprisingly, the artisanal catch at several sites is being purchased by middlemen who dispatch the product to other markets, mostly international. While this may generate much needed additional revenue for the fishers, it also holds inherent threats for the fishery. Several resources are of such high value that they have become major targets without any knowledge of their sustainability. This involves especially spiny lobsters and shark fins. It would appear that the real and full benefits of these resources are not being transferred to the fishers and that it is

distinctly possible that in the near future these stocks could collapse. Although such marketing arrangements are difficult to control, some measure of documentation is needed to remain vigilant. As an example, it was suggested by some that as much as 600 mt of inshore lobster is exported from Bosaso. If these figures are true and, as suspected, these are tail-only weights, then the total catch could be 1,200 mt, which is a valuable resource (about 22 million US$), but quite possibly not sustainable. Clearly, then, caution must be expressed that the fishery is not being driven by middlemen only.

6.5 MARINE PROTECTED AREAS

One of the most attractive of fishery management options is the creation of marine protected areas (MPA). Not only are they often more readily implementable and enforceable, but they are of special benefit to artisanal fishers. The reason for this lies in the fact that artisanal fishers have a limited range of fishing, with most harvesting taking place close to the fishers' homes. This places great emphasis on protecting local stocks and not just the overall resource. Well planned MPA's can achieve this by safeguarding breeding population of reef fishes for replacement of the fished areas.

In the case of Berbera and possibly other sites there is further potential benefit. Close to the Port there is an outstanding fringing coral reef with rich aggregations of fish and other marine life. Although tourism is all but absent in the region, it is certain that within time, this reef within a few minutes of the town and port, could be a major diver attraction. Such non-consumptive use could provide fishers that own boats the prospect of running dive charter operations which can be very lucrative.

---

7. CONCLUSION

The development of small scale fisheries in much of Africa has not been without its problems. Huge donations of cash, equipment and expertise have often not contributed to the improvement of either the fishery or indeed the environment. It would appear that the Somali situation has components that can prove to be different. The inherent capacity that exists in the fisher community and especially in the fishery officers are likely to be significant attributes. The initiatives already underway, in part supported and conceived by COOPI, are also a good indication of potential success with sustainable development of the artisanal fishery sector. Equally important is the seemingly 'healthy' state of many finfish stocks, a further cause for optimism.

Clearly many hurdles do remain, not least the establishment of government structures that can implement a fisheries plan and indeed see to the actual development of such a plan. The uncertainty over the identity and stock abundance of inshore lobster and sharks is a particular cause for concern.

Overall, the impression has been gained that modest and well planned support for fishery development and monitoring is likely to be beneficial to the welfare of coastal fisher communities yet sustainable in an conservation context. There should be attempts to develop closer collaboration with the fisher communities and associated clans, which also aids regional collaboration. The use of consultants is proposed for a few identifiable tasks but these should be designed to develop national or at least regional fisheries science capacity in the Somali region.

---

8. ACKNOWLEDGEMENTS

The spontaneous support and hospitality received from those directly and indirectly associated with artisanal fishing in the Somali places visited was outstanding. Special thanks are due to Yusuf Abdullahi Nur, the fishery officer at Berbera who shared much knowledge and provided an excellent guiding service. Also of great assistance were Omar Hagi Ahmed Dubad, Saed Ali Mahamoud, Osman Darror Hassan and Ibrahim Abdi Boqorre, all from Berbera. In Bosaso, Dr Franco di Roberto (Africa '70) was most helpful, as were Abdulahi Daib (OTP) and Osman Abdullahi Mohamud. The EC technical support office and ECHO air-service are also thanked. Dr Rod Salm, IUCN EARO was part of the field visit and provided much useful advice and guidance.

The content of this report were considerably enhanced by several staff from the Oceanographic Research Institute in Durban, especially, Bruce Mann, Dr Anesh Govender. Laura Naidoo and Nat Kistnasamy assisted with final production.

---

9. REFERENCES

BUTTERWORTH, D.S., PUNT, A.E., BORCHERS, D.L., PUGH, J.B. & HUGHES, G.S. 1989. A manual of mathematical techniques for linefish assessment. *South African National Scientific Programme* report 160. FRD Pretoria.

CADDY, J.F., and MAHON, R. 1995. Reference points for fisheries management. *FAO Fisheries Technical Paper*. No 347: 83 pp.

CLARK, C.W. 1985. Bioeconomic modelling and fisheries management.

ELMER, S. 1985. Somalia, technical assistance for marketing and cooperatives. Short report to FAO: 13pp

FAO. 1988. Somalia, Fishery country profile. 5pp.

FAO. 1983. Some considerations on strategies and policies for fisheries development presented in selected case studies. Secretariat of the expert consultation on strategies for fisheries development with particular reference to small-scale fisheries. *FAO.FISH REP*. No 295: 16-37.

FAO. 1995a. A precautionary approach to fisheries. Part 1: guidelines on the precautionary approach to capture fisheries and species introductions. *FAO Fisheries Technical Paper*. No. 350, Part 1. Rome, 52pp.

FAO. 1995b. Code of conduct for responsible fisheries management. FAO, Rome: 1-41.

FRAZER-BRUNNER, A. 1952. Local and scientific names of fishes collected on the coast of the Trust Territory of Somalia. *FAO pamphlet FAO/52/8/5222*

GULLAND, J.A. 1966. Manual of sampling methods in fisheries biology. Part 1: sampling methods.

FAO Manuals in Fisheries Science No 3.35 pp

GULLAND, J.A. 1975. Computation and interpretation of biological statistics of fish populations. *Journal of the Fisheries Research Band.* Bulletin 191: 1-382.

HAAKSONSEN, J.M. 1983. Somalia's fisheries case study. in: FAO, secretariat of the expert consultation on strategies for fisheries development with particular reference to small-scale fisheries. *FAO.FISH REP*. No 295: 16-37.

HELDER, K.P. 1994. General information sharks, lobsters and seacucumber products. Report for Ocean Trade Promotion in Bosaso, 13pp

JONES, R. 1984. Assessing the effect of changes in the exploitation pattern using length composition data. *FAO Fisheries Technical Paper* No 256, 1-118. Rome.

KERR, J.K. 1983. Somalia, prospecting surveys and demonstrating fishing. A report to FAO, 13 pp plus figures.

KOSLOW, J.A., HANLEY, F. & WICKLUND, R. 1988. Effects of fishing on reef fish communities at Pedro Bank and Port Royal Cays, Jamaica. *Marine Ecology Progress Series*; Vol 43: 202-212.

LOVATELLI, A. 1996. EC Rehabilitation programme for Somalia - Artisanal Fisheries. Final Report. EU Somalia Unit, Nairobi: 226p.

MACE, P. M. 1997. Developing and sustaining world fisheries resources: The state of the science and management. Proceedings of the 2nd World Fisheries Congress. Brisbane. July 1996: 1-20.

NUR, A.H. 1988. Somalia putting heavy emphasis on its fisheries. *World Fisheries* vol. 37, No 10: pp 2-3.

OTP, 1996. Information brochure on Ocean Training and Promotion Programme.

RUSS, G.R., LOU, D.C. and FERREIRA, B.P. 1995. A long-term study on the population structure of the coral trout *Plectropomus leopardus* on reefs open and closed to fishing in the central Great Barrier Reef, Australia. *reef research centre Technical report* No 3. Townsville: 30pp.

SINCLAIR, M. 1987. Somalia, promotion of the small-scale marine fisheries. A report to the FAO: 24 pp

VACCARELLA, R., PASTORELLI, A.M., MARANO, G. 1985. Osservazioni sulla pesca a strascico oceanica praticata dalla marineria pugliese lungo le costa somale (O. Indiano) *Oebalia* vol XI-2: 633-653

VAN DER ELST, R.P. and GARRATT, P. 1984. Draft management proposals for the Natal reef fishery. Unpublished report, Oceanographic Research Institute, Durban: 20 pp.

VAN DER ELST, R.P., BUTTERWORTH, D., BRANCH, G., COCHRANE, K. & WICKENS, P. 1997. How can fisheries resources be allocated. Who owns the fish? Proceedings of the 2nd World Fisheries Congress, Brisbane July 1996: 307-314.

VAN DER ELST, R.P. (ed) 1996. Towards a policy for marine environmental conservation in KwaZulu-Natal. Oceanographic Research Institute, Durban: 31 pp.

--- o0o ---

APPENDIX I

ITINERARY AND SCHEDULE OF CONTACTS DURING FIELD VISIT

ITINERARY AND SCHEDULE OF CONTACTS DURING FIELD VISIT

21/4/97	Depart Durban for IUCN:EARO: Nairobi
22/4/97	Discussions with IUCN staff: Rod Salm Discussions with Marcello Ottaviani, Technical Fisheries Adviser to the E.C. Somali Unit Discussions with Red Cross (CRC), notably Rod Charters and Jorge Eglin concerning distribution of fishing equipment and proposed CRC training courses in fisheries.
23/4/97	ECHO Flight from Nairobi to Berbera. Accommodated in EC compound operated by EC Technical support office. meeting and discussions with Yusuf Abdullahi Nur, past director of fisheries research in the region and currently working for COOPI at the Berbera Fish Centre.
24/4/97	Continued meetings at the Berbera Fishing Centre and also time spent observing catches and recording of data. Also met with local fishing elders, Omar Hagi Ahmed Dubad, Saed Ali Mahamoud, Osman Darror Hassan and Ibrahim Abdi Boqorre. Visited fishing zones near Berbera, including very disadvantaged subsistence fishers.
25/4/97	Accompanied fishers to sea and conducted brief underwater surveys to assess habitat, fish abundance and diversity. Also assessed fishery data and possible approaches to sampling. Compiled initial data sheets.
26/4/97	Echo flight to Bosaso and met by Dr Franco di Roberto of Africa 70. Met with local party chief General Mohamed Abshir and his council of leaders in the SSDF party. Discussed general fishery related problems. Also met with Mr Ponga, the UNDP chief and discussed marketing and processing aspects of the fisheries. Later met with Mr Abdulai Moosa Yusuf (Nkruma), deputy governor for the region. Detailed discussions were also held with Messrs. Abdulahi Daib, Osman Abdullahi Mohamud and staff at the Ocean Training Programme (OTP). Mr Abbas, a local engineer and expert also contributed to our discussions. Later also held discussions with Bosaso port development authorities, including Mr Howard Clarke
27/4/97	Departed early for site inspection of fishing enterprises in the region of Bosaso.Included were freezer plants, landing and processing sites. A further meeting was held with Mr Abdulai Moosa Yusuf (Nkruma) on future fisheries planning. Also received visit from NGO called SHILCON, concerning environmental issues. Included were Messrs. Mohamed Ismael. Mohamoud Farah and Abdi Hagi Nor, who is the District Commissioner for the Bari region. Mr Saed Khalie Yusuf joined at a subsequent meeting.
28/4/97	Undertook survey of smaller fishing villages, especially Elayo and met with community elders there.
29/4/97	Departed for Djibouti. Also visited fishing markets in Djibouti and held informal discussion with fishers there concerning threatened species and cross-border fishing.
30/4/97	Departed for Nairobi.
31/4/97	Departed for Durban.

---o0o---

APPENDIX II

TERMS OF REFERENCE OF THE FISHERY MONITORING CONSULTANCY

Development of fishery sector monitoring methods and tools

Terms of Reference

1. INTRODUCTION

As part of the EC Rehabilitation Programme for Somalia, IUCN is undertaking a natural resources management Programme to assist the EU develop adequate and flexible strategies and methodologies for the conservation and sustainable use of the natural resources in Somalia. The first phase objectives of the Programme are:

- to establish a basis for the conservation of Somalia's natural resource assets from further deterioration
- to promote and consolidate the links between natural resource management and conservation, and the improvement in the welfare of the local communities of Somalia
- to provide guidance and advice to the EC Rehabilitation Programme for Somalia on natural resources and environmental matters

The initial first phase, characterised as a strategic planning period, aims to address all the necessary programmatic and operational preparatory work to establish a sound basis for the implementation of field-based natural resource management activities *per se* or activities in support of, or benefiting from, other sectors of the EC Rehabilitation Programme for Somalia.

The Somali fisheries sector has been identified as having a high economic potential for contributing to the rehabilitation and development of Somalia. The coastal reef and off-shore fisheries, by many pre-1990 accounts, are highly productive in terms of demersal and pelagic fishes and crustaceans. The fishery resources are exploited commercially by artisanal fishing communities and offshore foreign industrial fishery companies with certain target species namely shark, tuna and lobster. The donor community, led by the EC, is planning to provide technical assistance to the Somali artisanal sector in areas of production, processing and marketing of fishery products.

IUCN, under its Somalia Natural Resources Management Programme, is undertaking preliminary assessments with an aim of identifying ecological priorities and developing conservation and sustainable management initiatives for the fisheries sector. An initial review reveals that there is very little information on actual fishery stocks and off-takes. Following discussions between the EC and IUCN, it has been decided that IUCN will develop practical and appropriate monitoring methods and tools for collecting data on fish landings. Data collection on sizes and sex of species caught can provide valuable insights in fishery dynamics and contribute towards the elaboration of sustainable management practices.

These methods and tools will be devised for use by local fishing communities and fishing centres/associations, and disseminated by local and international NGOs involved in the fisheries sector.

2. OBJECTIVES

The objectives of the activity are to:

- Assess current data collection methods of fish landings used by local fishing communities, fish centres and ports, NGOs, and traders;
- Identify practical data requirements for effective monitoring of fisheries, in particular for vulnerable or threatened species (e.g. turtles, sharks, lobsters, etc.);
- Elaborate simple, practical and user-friendly data-collection methods and tools for use by local fishing communities, fish centres and ports, local administrations, NGOs and traders.

In order to meet these tasks, it is proposed that three separate phases, each with their specific tasks, will be undertaken between April and December 1997. These phases are:

- The First Phase: Preliminary survey and assessment based on literature review and field visit. Based on this, elaboration of proposed set of data collecting and monitoring options that recognise current situation in Somalia.
- The Second Phase: A consultative process with relevant national and international stakeholders on the applicability of proposed set of options
- The Third Phase: Evaluation and testing of the monitoring procedures, and data analysis and interpretation of data for purposes of sustainable management.

The following tasks relate to the first phase described above.

3. SPECIFIC TASKS

In order to attain the above-mentioned objectives, the Contractee will be responsible for undertaking the following:

- Based on field visits to designated fishing communities, fish centres and ports, local administrations, and traders, assess and analyse the types of data collected from fish landings.
- Based on discussions with international and local NGOs involved in the fisheries sector (in particular those funded through the EC Somalia Rehabilitation Programme), identify and assess monitoring initiatives that are in place, or are planned, and review data collected from these initiatives.
- Based on an assessment of all commercial species fished, identify data requirements for their effective monitoring and substantiate how data collected can contribute towards sustainable management of the particular fisheries.
- Based on the above, elaborate practical data-collection methods and tools for use by local fishing communities, local administrations, NGOs and traders.
- Explore opportunities for the testing of the methods and tools during the course of the field trip and based on discussions with local and international organisations, among others.

- Identify requirements for the application of the data-collection methods that include training, potential users and their location, costs, and human resources and institutional requirements for the utilisation of the monitoring information gathered, and mechanisms to ensure compliance within EC Somalia Rehabilitation Programme funded projects.

The contractee's report will include, among others, the following:

- description of the assessment of fishery monitoring activities currently applied by local fishing communities, fish centres, ports, traders and NGOs.
- description and assessment of the data requirements for monitoring selected fisheries, and how data can contribute to sustainable fishery management.
- A proposed set of data collecting and monitoring options that will recognise the current situation in Somalia and identify the requirements for the application of the proposed set of options.
- Annexes containing maps, data, and user-friendly pamphlets for applying methods and tools.

The Contractee will report to the IUCN Somalia Natural Resources Programme Coordinator.

4. STAFFING

The contractee will be assisted by a national consultant who will act as a translator and resource person and who will be contracted by IUCN. The Contractee will work in close collaboration with the IUCN Marine Coordinator and the EC Fisheries Consultant.

5. TIME SCHEDULE

The Contractee will be responsible for ensuring the timely completion of the above-mentioned tasks as per the following schedule:

- 22 April: 1 day in Nairobi
- 23 - 30 April: Field mission to Berbera and Bosasso
- 1 - 23 May: 10 days preparing above-mentioned report and proposing a time-table for undertaking the Second and Third Phases

APPENDIX III

ARTISANAL FISHERIES DATA COLLECTING MANUAL

Table of contents

1. INTRODUCTION 1

2. SAMPLING EQUIPMENT 2

3. GENERAL PROCEDURES 4

3.1 Record keeping 4

3.2 Species identification 4

3.3 Accuracy and randomness 4

3.4 Zero catches 4

3.5 Computers and data processing 5

4. DAILY CATCH AND EFFORT 6

5. CATCH SUB-SAMPLE 8

6. MONTHLY CATCH AND EFFORT 15

7. LENGTH FREQUENCY SAMPLING 18

8. BOAT REGISTER 22

1. INTRODUCTION

In order to ensure that the fishery is developed on a sustainable basis so that the resource remains healthy and able to deliver optimal food, employment and recreation to people of the Somali region, it is necessary to manage the fishery. For this to be successful, there needs to be monitoring of trends in catch and effort. In addition, important parameters relating to the growth and size of the fish provide good insight into the health of the fish stocks so that optimal fishing levels can be determined and the fishery developed accordingly. Failure to monitor the fishery will inevitably carry a high risk of ultimate fishery collapse which is associated with social and economic hardship, loss of biodiversity and poor conservation.

Monitoring will require a programme of continuous data collection relating to a number of aspects of the fishery. Each year these data should be collated and scientifically analysed in order to produce a report that will reflect the status of the fishery. On the basis of this assessment and report, the future management, development and possible subsidies can be determined.

This manual contains comments and guidelines to assist fishery personnel in data collecting. Although many of the fishery staff in the Somali region are already well acquainted with these procedures, it is important to have a consistent approach to monitoring so that data sets from different regions and periods may be directly comparable.

---

2. SAMPLING EQUIPMENT

There are several items necessary in order to achieve quality in data collection. These are listed.

- *Scale*

  A calibrated spring balance is fine, although an electronic load-cell would be a great advantage. Periodic checking against known weights is recommended. It is best to have two balances of different capacity so that greater accuracy may be achieved. For the Somali situation an appropriate arrangement would be one scale with maximum of 10kg and another reaching 50 kg.

- *Measuring equipment*

  Although a tape measure can be used to measure finfish, a board is preferable as it gives more consistent linear measurements. A measuring board can be made by simply fixing a tape measure to a flat wooden plank with a stop edge at the zero end. A plastic Vernier caliper is needed for lobster and crab measuring.

- *Writing equipment*

  It is best to record information directly onto data sheets so that no later errors in transcribing occur. However, this often requires an assistant. Where recording is done under 'wet' conditions, it is best to have available a set of soft-lead pencils and to record information on a white perspex slate which is waterproof and can be easily cleaned. Labels made from plasticized paper should also be obtained.

- *Dissecting equipment*

  At least one sharp knife will be needed although other items that may be useful are forceps, bone cutters (for removing otoliths), scissors and a scalpel. Small containers or envelopes for otoliths may be useful.

- *Preservatives*

  Availability of 40% formalin and or alcohol would be useful for specific preservation tasks, although detailed preservation techniques are likely to vary for different specimens.

- *Literature*

  It is important to have access to a modest quantity of literature that will assist in species identification. The recently published FAO guide for Somalia is recommended and several additional publications could usefully be included in a small 'fishery library'. Such reference material should be housed centrally, preferably near the landing site, and available for controlled use by interested parties.

- *Camera*

  Though this may seem expensive, a modest, instamatic-type camera can provide a valuable tool for the confirmation of species identity.

---

3. GENERAL PROCEDURES

It is important to be consistent and adhere to agreed procedures. It is also recognised that the task of data collecting in a growing fishery may become quite onerous and hence decisions will have to be made about priorities. It is best to make such decisions in advance, preferably at the planning stage for the ensuing year. It is most important not to compromise the quality or validity of past data collecting.

3.1 Record keeping

It is recommended that a daily activities book be maintained in which sampling activities, comments, events and perceptions are recorded. This would provide the basis for contributing to part of the annual Fishery Report.

3.2 Species identification

Great care should be taken with the identification of species so that changes in species composition can be detected. This may prove difficult but with some training and experience this should be achievable, especially when taking sub-samples of daily catches. Groupers, snappers, sharks and emperors are especially confusing. Avoid lumping too many species into one category (such as sharks and groupers). Rather retain the occasional specimen and have it identified. A photo record usually works well and can be identified by posting to experts.

3.3 Accuracy and randomness

Be careful about measuring and recording accurately and use appropriate levels of precision. Lengths should be to the nearest centimetre while weights should be to within 1/100 of that species' weight range. In other words, a fish that attains 10 kg would have to be weighed to the nearest 100 grams. Figure 1 illustrates measuring points for fish, rays, crabs and lobsters.

3.4 Zero catches

It is inevitable that fishing vessels may return with no or only a small catch. It is of utmost importance to ensure that such events are fully documented as a zero catch but giving full details about the number of fishers, time out etc. If no vessels launched or a vessel did not actually fish then this should be made clear. It is best to complete a form stating: "no fishing today" to avoid any subsequent confusion.

3.5 Computers and data processing

While it is in many ways useful to capture the information onto a computer system, care must be taken in selecting the correct software and procedures. Ideally, a database system should be tailored for this programme which will ensure compatible data sources, validation with input, automatic back-up capacity and regular report generation. In any event, care must be taken to duplicate the data electronically or otherwise and ensure that one set is stored safely at another location.

---

4. DAILY CATCH AND EFFORT

(SEE FORM 1: TOP SECTION)

This form is designed to record information relating to the individual boat's catch and fishing effort. It has been structured to follow data collecting routines that are already underway at several fishery landing sites. These data should be collected for different boat types separately (i.e. canoes and motor boats), on a daily basis, even if no boats put to sea or if no fish were caught. This means that 365 X 2 = 730 such forms should be collected per landing site each year. Details for each entry are discussed.

- **LOCALITY**:

  Record the official name of the landing site and adhere to this name throughout the year.

- **BOAT TYPE**:

  Indicate either canoe, motor boat or any other that may arise.

- **DATE**:

  Given as the actual date DD.MM.YY

- **BOAT IDENTIFICATION**:

  This can be the licence number, name of boat or owner or any other distinguishing feature. It is needed, not so much to record the individual's personal catch, but rather to relate to the catch sub-sample that follows.

- **NUMBER OF FISHERS**:

  This is the total number of fishers on the boat, including the skipper.

- **DAYS OUT**:

  This is the number of days between departure and return. Each day is determined with the passing of midnight. Thus 07h00 to 16h00 = 1 day; 07h00 to 10h00 next day = 2 days, etc.

- **GEAR TYPE**:

  This is given as line, gill net, seine net, trap, etc. If mixed gear is used please indicate this but note the primary gear first.

- **FRESH FISH (KG):**

  Give the weight of that boat's total catch of fresh fish, ungutted.

- **MAJOR FISH SPECIES**:

  As currently practised, record the major fish types in the catch in order of abundance in the catch.

- **SHARK FIN (KG):**

  Here the landed (wet) weight of shark fins is given. Include also sawfish, rays and other species taken for fin.

- **NUMBER OF SHARKS**:

  This figure may have to be recalled by the fisher but it should reflect the number of sharks taken to derive the fin weight in the previous entry.

---

5. CATCH SUB-SAMPLE
(SEE FORM 1: BOTTOM SECTION)

This entry represents a single sub-sample of the boats recorded for that day, one each for canoe and motorised boat. It is intended that this data set will provide a proportional species breakdown for the entire catch. It is important that only one boat is selected from the boats recorded, but it does not matter much which one is selected. This could be randomised or preference could be given to the one with the largest catch so as to obtain a larger data set. It is important to ensure that the Boat Number tallies with that given to the same boat above.

- **BOAT IDENTIFICATION**:
  This is the same as that given to the same boat in the Catch and Effort record.

- **SPECIES**:
  It is important to record all the species caught as accurately as possible. If necessary, provide a photo, diagram or description of the fish for later verification.

- **NUMBER**:
  Indicate the number of individual specimens that were caught by that specific boat for that species...and so on.

- **NON-TARGET SPECIES**:
  Please indicate here any incidental by-catch of animals such as dolphins, turtles, dugongs, sawfish etc. Use number and not weight.

- **RECORDED BY**:
  Please indicate the name of the person who was responsible for recording the majority of this information.

FORM 1 - DAILY CATCH AND EFFORT

ARTISANAL FISHERY STATISTICS
DAILY CATCH AND EFFORT

LOCALITY .... BOAT TYPE..... ..... DATE..... .....

BOAT IDENTITY	NUMBER OF FISHERS	DAYS OUT	GEAR TYPE	FRESH FISH (KG)	MAJOR FISH SPECIES	SHARK FIN (KG)	NUMBER OF SHARKS

CATCH SUB-SAMPLE

BOAT IDENTITY ....

SPECIES	NUMBER	SPECIES	NUMBER

NON SPECIES TARGET (By Number)

DOLPHIN.....

TURTLE..... .....

OTHER..... .....

RECORDED BY:.....

FORM 1 - DAILY CATCH AND EFFORT

TIRAKOOBTA KALLUUMEYSIGA XEEBAHA
WAX SOO SAA IYO TAAFTA MAALINLAHE AH

MEESHA .... **NOOCA DOONTA** ..... **TAERIIKH** .....

LAM DOONTA	TIRADA KALL/ SATO	MAELMEHE LA BAXAY	NOOCA QALAB KALL	KALL DARAY AH	NOOCYADA UGN BADAN	DHEGO LIBAX (KG)	TIRADA LIBAAX

QEEXID WAX SOO SAOR

LAIN DOONTE ....

NOOCA	TIRO	NOOCA	TIRO

NOOCYAD IYO TIRADA (NOOCYADA AAN JEEDIN)

HOMBORO.....

QUBO..... .....

QAAR KALE..... .....

WAXA DIIWAENGELIYEG:.....

5.1 SHARK CATCH AND EFFORT

(see Form 1B)

This form is designed to record information relating to the individual boat's shark catch and fishing effort. It has been structured to follow data collecting routines that are already underway at several fishery landing sites. It was developed by Yusuf Abdullahi Nur of the COOPI Berbera Fish Centre and reflects that some motorised boats target sharks and remain at sea for longer duration than those targeting fresh fish. Data should be collected for different boat types separately (i.e. canoes and motor boats), on a daily basis or at least per trip basis. Details for each entry are discussed.

- **LOCALITY:**

  Record the official name of the landing site and adhere to this name throughout the year.

- **BOAT IDENTICATION AND OWNER:**

  Indicate either canoe, motor boat or any other that may arise along with name and identification. Also indicate owner of boat.

- **DATE:**

  Given as the actual date DD.MM.YY

- **DAYS OUT:**

  This is the number of days between departure and return. Each day is determined with the passing of midnight. Thus 07h00 to 16h00 = 1 day; 07h00 to 10h00 next day = 2 days. etc. Include dates (DD.MM.YY) of departure and return.

- **NUMBER OF FISHERS:**

  This is the total number of fishers on the boat, including the skipper.

- **GEAR TYPE AND NUMBER USED:**

  This is given as line, gill net, seine net, trap, etc. If mixed gear is used please indicate this but note the primary gear first.

- **NUMBER OF SHARKS:**

  This figure may have to be recalled by the fisher but it should reflect the number of sharks taken to derive the fin weight.

- **NAME OF SHARKS:**

  Record the major shark types by name (Somali or English) in order of abundance.

- **MALE/FEMALE:**

  For each shark caught, record whether it is male or female.

- **WET SHARK FIN (KG):**

  Here the caught (wet) weight of shark fins is given. Include also sawfish, rays and other species taken for fin.

- **DRY SHARK FIN (KG):**

  Here the landed (dry) weight of shark fins is given. Include also sawfish, rays and other species taken for fin.

- **BY CATCH:**

  Please indicate here by incidental by-catch of animals such as dolphins, turtles, dugongs, sawfish, etc. Use number and not weight.

- **RECORDED BY:**

  Please indicate the name of the person who was responsible for recording the majority of this information.

FORM 1B - DAILY SHARK CATCH AND EFFORT

ARTISANAL FISHERY STATISTICS
DAILY SHARK CATCH AND EFFORT

LOCALITY:..... BOAT TYPE:..... OWNER:.....

DATE:.....

DATE OUT	NO. OF FISHERMAN	GEAR AND NO. USED	NO. OF SHARKS CAUGHT	NAME OF SHARK SPECIES	MALE/ FEMALE	WET FINS (KG)	DRY FINS (KG)

BY CATCH: NO. OF TURTLES:.....

NO. OF DOLPHINS:.....

OTHERS (NAME & NO.).....

RECORDED BY:.....

FORM 1B - RECORDKA MAALIN KASTA DABIDA LIBAAX BADEEDKA

TIRAKOOBTA KALLUMEYSIGA XEEBAHE
WAX SOO SAA INO TAAGTA MAALIN LAHE
AL

MEESHA..... NOOCA DOONTA..... NINKA DOONTA LEH:.....

TAERIIKH.....

TAARIIKH	TIRADA KALL/SATE	QALAB KALIUN	TIRO LIBAX	MAGACYADA LIBAAX BADEEDKA	LAB/DHE DIG	DHEGO QOYEN (KG)	DHEGO QALALAN (KG)

NOOCYAD IYO TIRADE (NOOCYADA AAN JEEDIN):

IMISA XALBO HOMBORO:.....

IMISA XALBO QUBO:.....

QAAN KALE & IMISA XALBO:.....

WAXA DIIWANGELIYEY:.....

6. MONTHLY CATCH AND EFFORT

(SEE FORM 2)

This form is similar to that currently in use and merely provides a summary of the daily catch and effort sheets for each month of the year. The data is presented for canoe and motorised boat separately. Completing this form is thus a desk-top exercise. It is recommended that the form is nevertheless filled in daily so as to provide a measure of control and validation over the daily data sheets. Many of the data details and headings correspond to the Daily Catch and Effort Sheet.

- **DAY OF MONTH:**

  This is the date of each day and is already printed on the form.

- **NUMBER OF BOATS:**

  Is the number of boats (canoes or motor boats) that were recorded as having returned that day. i.e. the total number of the boat number indicated in the daily sheet.

- **TOTAL FISHING CREW:**

  This is the total number of fishers recorded for that particular day and represents the total of the 'number of fishers' column in the daily sheet.

- **TOTAL FISHER DAYS:**

  This is the total man days fished and is thus the sum of all the individual 'days out' multiplied by the 'number of fishers' on the daily sheet. Do not total the two columns before multiplication.

- **FRESH FISH (KG):**

  This is the sum of the same column in the daily sheet.

- **MAJOR FISH SPECIES:**

  This is the summary of the same column in the daily sheet.

- **SHARK FIN (KG):**

  This is the summary of the same column in the daily sheet.

- **NUMBER OF SHARKS:**

  This is the summary of the same column in the daily sheet.

FORM 2 : MONTHLY CATCH AND EFFORT

ARTISANAL FISHERY STATISTICS
MONTHLY CATCH AND EFFORT

LOCALITY .... ***BOAT TYPE*** .... ***MONTH*** .....
YEAR .....

DAY OF MONTH	NUMBER OF BOATS	TOTAL FISHING CREW	TOTAL FISHER DAYS	FRESH FISH (KG)	MAJOR FISH SPECIES	SHARK FIN (KG)	NUMBER OF SHARKS
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
TOTALS							

RECORDED BY:.....

FORM 2 - WAX-SOO-SAARKA IYO TAAGTA A BIL WALBA

TIRAKOOBTA KALLUMEYSIGE XEEBAHA

WAX SOO SAERKE IYO TAAGTA BIL WALBA

MEESHA .... *NOOCA DOONTA* .... *BISHA* .....

SANNADKA.....

MAELINTA	TIRADA DDONYAHE	ISUGEYN TIRADA KALL/SATO	ISUGEYN MAALMEHA	KALL GOYAN	NOOCYADA UGN BADAN	DHEGO LIBAEX (KG)	TIRADA LIBAAXA
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
TOTALS							

WAXA DIIWAENGELIYEG:.....

7. LENGTH FREQUENCY SAMPLING

(SEE FORM 3)

Information on the size composition (length frequency) of fish stocks forms an important component of data necessary for the scientific evaluation of exploited resources and should be collected as an ongoing requirement for all fisheries. If length is subsequently related to the age of fish then mortality rates can be determined. Length analyses can also contribute to estimates of growth and gear selectivity.

Length frequency data should ideally be collected for all species harvested but as a minimum requirement, the most important species need to be identified. A list of such key species is appended. It is of great importance to be sure of the species identity.

Lengths should be measured on a random basis. This means that the batch to be measured should be an unsorted sample. A decision should preferably be made to measure lengths in a catch before that catch is actually seen or sorted. If necessary divide the catch into manageable but unsorted sub-samples. Care should be taken to refrain from measuring particularly large, small or unusual specimens. If any of the specimens has a damaged tail, try not to discard the specimen but rather 'estimate' its size. It is usually the larger fish that are damaged, hence omission could bias the results.

All finfish should be measured in *fork length* (FL) to the nearest centimetre class interval. Fork length is the measure taken from the tip of the snout to midline of the tail fin, with the fish lying flat on a measuring board. This also applies to sharks, as seen from the diagram. Where the fish does not have a distinctly forked tail, as in the case of many groupers, then the midline of the tail fin is still used as the end point (see diagram). One centimetre size class interval implies that the measurement recorded is the lowest whole centimetre. Thus 100.5 cm= 100; 100.1 cm= 100; 99.9 cm= 99 etc.

In the case of lobsters, the carapace length should be measured, as indicated in the diagram, using Vernier calipers. Crabs should be measured across their shell width while octopus should simply be weighed. Should stingrays be harvested then these are measured across the width of the body. For details see the diagram.

The size or class intervals into which the lengths will eventually be divided will depend on the size range of the species and the complexity of its population structure. As a rule, it is recommended that the size range of that species in the catch should consist of 15 to 25 size classes and that for most classes the number of specimens should not be less than 10. (Gulland 1966)

The optimal size of the sample of fish to be measured actually depends on the mean length and its variance, factors that only become evident with time (Gulland 1966). However, a sample of about 150 to 200 fish per month of each of the key species or, if less are caught, then the total number caught for that species should be measured. It may be preferable to measure the daily sub-sample of the catch, although these records may need to be supplemented by the rest of the catch in order to attain reasonable numbers of key species.

Where possible, it is a good idea to obtain fish from different samples reflecting separate localities and harvesting methods.

All the length information is recorded on the special length frequency data sheet of which an example is attached.

FORM 3 - LENGTH FREQUENCY MEASURES

ARTISANAL FISHERY STATISTICS LENGTH FREQUENCY MEASURES

LOCALITY .... *CATCH METHOD ....* *DATE ....*

FORK LENGTH	SPECIES NAME:	NO	FORK LENGTH	SPECIES NAME:	NO	FORK LENGTH	SPECIES NAME:	NO
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		

Recorded by:..........................

FORM 3 - CABBIRAADDA DHERERKA KALLUUNKA

TIRAKOOBTA
KALLUUMEYSIGE
XEEBAHA

CABBIRAADLA
DHERERKA
KALLUUNKE

MEESHA............ ...... *HABKA KALLUMEYSIGA ....* *TARIIKH ....*

DHEREKA	NOOCA KALL	LAM	DHERER KALL	MAGACA KALLUUNKA	LAM	DHERER KALL	MAGACA KALLUUNKA	LAM
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		
1			1			1		
2			2			2		
3			3			3		
4			4			4		
5			5			5		
6			6			6		
7			7			7		
8			8			8		
9			9			9		
0			0			0		

WAXADIIWAENGELIYEG:.......................................

8. BOAT REGISTER

(SEE FORM 4)

The keeping of a boat register holds many benefits. Not only does it provide a record of vessels in the fishery with their dimensions etc., but it also provides another estimate of fishing effort. It is suggested that this form should be kept up to date and that a final 'clean' copy be produced at year-end for interpretation in the Annual Report. Some details to the headings are given.

- **BOAT REFERENCE NUMBER:**

  This is preferably the official number given or else any identification number by which the vessel can be recognised. It may be useful to introduce a numbering system related to the port of origin. Hence BER01 would be vessel 1, operating primarily from Berbera.

- **NAME OF OWNER:**

  Is the name of the owner or operator as convenient.

- **TYPE OF BOAT:**

  This would be either canoe, motor boat or any other that may be appropriate.

- **LENGTH OF BOAT:**

  Is the overall length in metres of the craft.

- **ENGINE POWER (HP):**

  Give the nature and power, eg. 2X40hp outboard or 1X25hp diesel inboard.

- **MAXIMUM CREW:**

  Please record the maximum number of crew that is at time taken to sea, including the skipper.

- **FIRST YEAR IN THE FISHERY:**

  This is the year when this boat was first seen to operate at the given locality. If not known, an estimate will suffice.

- **AVERAGE MONTHLY OUTINGS:**

  This will be an estimate. In the case of broken vessels or those belonging to 'dormant' fishers, this figure will be zero. Give the outings undertaken during the main fishing season.

---o0o---

FORM 4 : BOAT REGISTER

ARTISANAL FISHERY
STATISTICS
BOAT
REGISTER

LOCALITY ..... ***YEAR*** .....

	BOAT REF. NUMBER	NAME OF OWNER	TYPE OF BOAT	LENGTH OF BOAT	ENGINE POWER (HP)	MAXIM. NUMBR CREW	FIRST YEAR IN FISHERY	AVGE MONTHLY OUTINGS
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

RECORDED BY**.....**

FORM 4 : DIIWAANGELINTA DOONGAHA

TIRAKOOBTA KALLUUMEUSIGA

DIIWAANGELINTA DOONYAHA

MEESHA ..... *SANNAD* .....

	LAMBER DOON	HANTIILAHE	NOOCA DOONTA	DHERER	AWOOD MATOR (FARAS)	TIR BAXAARI	SANADKE HAWLGAL	CELCELIS BIXITAAN BILLE
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								
16								
17								
18								
19								
20								
21								
22								
23								
24								
25								
26								
27								
28								
29								
30								

WAXA DIIWAENGELIYEG:.....

Figure 1 : Illustrative guide for measuring fish species