PART 1:
GENERAL GUIDELINES

1. CITES and the FAO Code of Conduct for Responsible Fisheries

1.1 THE CONVENTION

CITES is an agreement to control the exports and imports of species listed in its appendices. Most importers, such as the European Union and United States of America, are bound by the agreement. Conch is listed under Appendix II. The most relevant part of the convention for Appendix II species are:

"2. The export of any specimen of a species included in Appendix II shall require the prior grant and presentation of an export permit. An export permit shall only be granted when the following conditions have been met:

(a) a Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species; …", and

"3. …[Appendix II species exports] should be limited in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs and well above the level at which that species might become eligible for inclusion in Appendix I."

Appendix I listed species are banned from international trade. If conch were listed under Appendix I, the export trade in conch would essentially cease.

One of the central goals of fishery management is to prevent overfishing. The FAO Code of Conduct for Responsible Fisheries (hereafter referred as the Code) sets out the principles which need to be applied to achieve this. We can reinterpret CITES convention in the terms of the Code. While the Code covers considerably more issues than CITES, CITES requirements fall well within its scope. In fact, perhaps the most important aim of good fisheries management is to maintain the abundance of the stock above the state where it would be considered depleted or have a negative impact on the ecosystem. This should still be above the endangered state, where the species would be included in Appendix I. So, if we apply good management as defined under the Code. CITES conditions are met, the productivity of the resource is maintained and its function in the ecosystem is not impaired.

However, "overfished" and "overfishing" still need to be defined. Typically, a stock is considered "overfished" when exploited beyond an explicit abundance limit considered too low to ensure safe reproduction (FAO Fisheries Glossary[1]). The decision that a fishery is overfished needs to be based on more than opinion. It needs to have a sound basis in science, which depends on data collection and research. It is also critical that a fishery can be clearly seen to be not overfished by people not involved in the fishery.

1.2 NATIONAL CITES AUTHORITIES

Each State signatory to CITES needs to appoint both a Scientific Authority and Management Authority. It is the Management Authority's task to issue and enforce the export permits for all species listed on CITES appendices. The Scientific Authority monitors both the overall exports granted by the State for any quantities of species included in Appendix II and the actual exports of such quantities. Whenever a Scientific

[1] FAO Fisheries Glossary: www.fao.org/fishery/collection/glossary_fishery/1/en

Authority determines that the export of any such species should be limited "in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs and well above the level at which that species might become eligible for inclusion in Appendix I", the Scientific Authority should advise the appropriate Management Authority of suitable measures to be taken.

The primary responsibility of the CITES Authorities is the implementation of the export permit system. Any export requires an export permit, which can only be granted when meeting three conditions. The Scientific Authority of the State of export must advise that such export will not be detrimental to the survival of that species. The Management Authority of the State of export must be satisfied that the specimen was not obtained in contravention of the laws of that State for the protection of fauna and flora, and that any living specimen will be so prepared and shipped as to minimize the risk of injury, damage to health or cruel treatment. The last issue only applies if live conch is being exported. It is the responsibility of these authorities to ensure that exports are from legal catches and those catches do not endanger the conch resource.

As CITES Authorities may deal with many non-fished species, authorities may well be composed predominantly of non-fisheries staff. It is important that the Fisheries Department has representation in each such authority. Misunderstanding the way fisheries work can make it difficult for the authorities to implement appropriate export controls. For small states, it may be necessary to combine the management and scientific roles into a single authority.

2. Fishery biology

Fish stocks have much in common with other exploited living resources, such as goats. Managing fisheries is like managing a goat herd where you must maintain the herd with its own offspring. If you sell too many female goats[2], you will not be able to produce enough young goats in future years to support the herd's productivity and eventually you will have to reduce the number sold. Conversely, if you allow the goat population to increase, they will consume all the available grass and forage and will become thinner, produce fewer kids and will be more likely to die from disease until the herd balances out with births and deaths, reaching its "carrying capacity". Usually farmers prefer to maintain the herd at its optimum size, the size when its productivity is at its maximum, the "maximum sustainable yield". If you replace "goats" with "conch", you have a description of conch fisheries management.

However, there are two important differences between farming and fishing.

You will be uncertain exactly how many conch remain in the sea. Whereas a farmer can count his stock, you can only make an estimate of how many conch you have remaining to ensure the stock can replenish itself. To ensure the estimate is as good as possible, and to make it acceptable to all parties (including CITES), you must use good statistical and scientific methods.

The stock is held in common with all fishers. Where, as sole owner, a farmer can take decisions in his own best long-term interest, fishers can not unless they cooperate. If fishers believe that any conch they leave will be taken by others, from their point of view there is no benefit in leaving enough conch in the sea to replenish the stock. They are therefore encouraged to take as much as they can before the stock is depleted by others.[3] It is management's task to create the circumstance where it is in fishers' best long-term interest to cooperate. This will require setting up a suitable system of access rights, effort control or both as well as an effective management system. A part of that management system must be to ensure the regulations are obeyed because illegal fishing (poaching) may not only directly cause overfishing, but may also undermine the degree to which fishers will cooperate with management.

[2] One male goat can fertilize many females. It is the number of females which control the herd's productivity and growth.

[3] Also known as the tragedy of the commons (*sensu* Hardin). Co-management and individual transferable quotas are fisheries management techniques that try to recreate a sense of sole ownership of the resource.

3. The fisheries management cycle

Fisheries management, like driving a car, should be a "feedback control system". Driving a car consists of the controls (accelerator, brakes, gears and steering wheel) and monitoring (the driver's eyes and ears). When you are driving, you are constantly monitoring the progress and position of your car and taking appropriate action by slowing down, speeding up or changing the direction in which the car is moving. Few people drive without moving the steering wheel or with their eyes shut. Fisheries management also needs controls. In the case of queen conch fisheries, the controls are usually in the form of effort limits, catch quotas, minimum size and closed areas; and eyes and ears in the form of a monitoring programme.

The monitoring programme should do more than simply report on the state of the fishery. It also needs to measure the effectiveness of the controls, to make sure that they are working, and help decision-makers ensure that they are implementing the policy correctly.

3.1 POLICY

Policies set out the principles on which decisions are made. Most policies state that a fishery should be exploited optimally and sustainably. All policies should include an intention for sustainable exploitation and to apply the precautionary approach be applied in making decisions, if the policy is to be consistent with the Code.

To be meaningful, a policy will need to define "optimal", "sustainable" and "precautionary". "Optimal" will need policy to provide further details on what management should aim to maximize, subject to which constraints. For example, the policy may be to maximize fisher income, while not allowing employment to fall below the current level. It will be necessary for the policy to recognize that it is not possible to maximize everything, and "optimal" implies the best that can be done under various constraints. "Sustainable" generally means "catches can be maintained at the desired level for the foreseeable future". The precautionary principle is much more difficult to interpret.[4] Generally, decision-makers should avoid unnecessary risks and irreversible actions, and support research and data collection which will reduce uncertainty. In fisheries this generally also means reducing the amount of fishing.

A clear link needs to exist between the policy and management actions. Practical implementation of a policy is usually achieved by agreeing what indicators and reference points will be used. Indicators are numbers representing whatever it is that policy is interested in. If employment is important the policy, an indicator could be the number of full time fishers. Any indicator should be straightforward to calculate, reliable and easy to understand. Reference points are values of the indicator which guide management actions. For example, a reference point for the number of full time fishers. Reference points may require more sophisticated analysis to define, but should be based on simple, agreed principles. Reference points generally define conditions in the fishery when some management action will be taken.

Policies should also cover economic and other incentives that encourage overfishing. For example, subsidies for fishing should generally be avoided except where they are applied on a short-term basis. Policies should not encourage rapid investment. Excessive fishing and processing capacity can be very difficult to reduce once it occurs.

[4] For a detailed discussion, see FAO (1996) Precautionary approach to capture fisheries and species introductions. FAO Technical Guidelines for Responsible Fisheries. No. 2. Rome, FAO. 54p.

It is better to avoid overcapacity, as the economic losses associated with too much capital investment can be very high and overfishing is strongly encouraged as investors try to recover their capital. Unfortunately most overcapacity disincentives, such as higher taxes, also tend to be unpopular and may require considerable political acumen to implement.

Some fisheries operate forms of subsidies to achieve the management objective of preventing fishers' incomes from falling below the minimum wage. Many of these subsidies currently encourage overfishing. Management should consider diverting subsidies through means that encourage meeting the requirement for sustainability.

3.2 CONTROLS

Legislation should allow the means to control the exploitation rate of the resource and various other protective measures which reduce the chance of overfishing. It is best to use a variety of controls and not just depend upon one. Controls should always include some limit on fishing effort, or, at the very least, a limit on fishing capacity.

Fishing effort is the work done by fishers to catch fish (days fishing, amount of gear set, etc.). Fishing capacity is the limit on what effort (work) could be applied in the short term. For example, capacity could be the number of vessels available for fishing. The limit on effort (i.e. capacity) would be reached if all these vessels fished all the time that they possible could. Effort controls might force days fishing to be reduced below this limit: vessels could be laid up, for example. However, the capital cost of the vessels (e.g. interest on loans used to purchase the vessels) strongly encourages their use. Therefore trying to maintain effort far below the potential effort capacity becomes very difficult to enforce and represents a significant cost to both industry and management.

3.3 DATA COLLECTION

Data will be needed to monitor the fishery. Data must be collected for objective assessment of the state of the fishery and is necessary for rational, informed decision-making. An efficient and effective data collection system will also be necessary to convince outside observers that the fishery is meeting international standards.

Data are best collected from critical monitoring and control points during catching and processing, which will vary from fishery to fishery. Identifying these critical points forms an important part of an effective management system. Critical points can be identified as being "bottle-necks" in the fishery, where costs of monitoring are low and monitoring can be enforced. Such critical points are often at points of landing and export.

Low-cost approaches fit the data collection system to the fishing industry practices. For example, it is natural for processors to provide purchase receipts to fishers, and routine data collection can include getting copies of such receipts. Getting copies of such transactions need not be onerous to industry, and accuracy is enforced by the businesses involved.

There are four types of monitoring data which can be collected, in order of importance:

- Fishery based indices will monitor the inputs to and outputs from the fishery. Indices usually include catches and fishing effort.
- Abundance based indices will monitor the changes in the population size. A commonly used index is catch-per-unit-effort, but some fisheries are monitored using abundance surveys.
- Biological indices monitor specific aspects of the fish population. An important statistic is the number or weight of females in the population at spawning time. As one male should be able to fertilize the eggs of many females, the ability of the population to replenish itself is usually thought to depend on the number of

females. However, this also depends on the species, and in the case of queen conch, scientists may decide to assume an equal sex ratio between males and females is desirable.

- Socio-economic and other indices are important to monitor the fishery in relation to policies required to meet economic objectives. The simplest indices would be the price of the product, which multiplied by the landings give the revenue from the fishery. Other indices of interest could include the number of employees (licensed fishers and numbers involved in processing, etc.) and costs of the industry.

3.4 DATA ANALYSIS

Raw data needs to be interpreted using models of the fishery. Models are just simple versions of how scientists think the fishery behaves and should capture the most important behaviour of the fishery in relation to management decisions. Because models are only approximations of reality, the advice obtained from them needs careful consideration.

The analysis should produce simple indices, which indicate how well the fishery is doing. Appropriate indices include average vessel catch rates, fishing mortality and the spawning stock biomass. These can be used to indicate the economic efficiency of the fishery, whether the fishery is sustainable and whether the stock is overfished.

3.5 DECISION-MAKING

The decision-making authority needs to be defined. That is, the people responsible for the decisions need to be clearly identified. Decisions need to be documented and transparent, so that how and why particular decisions have been made are clear.

Decision-making must be consistent with CITES and the Code of Conduct. The easiest way to implement these policies is to apply decision rules. Decision rules are management actions which are planned to be applied in response to key changes in indicators. For example, a simple decision rule could be a twenty percent reduction in quota when catch rates fall below some critical level. The difference between decision rules and any other sort of decision making is that the rules are planned in advance. They should be simple and transparent, so that their implications to the fishing industry can be discussed before they have to be applied.

3.6 ENFORCEMENT AND COMPLIANCE

While decisions can be easily made, ensuring they are carried out can be difficult. Enforcement usually consists of direct methods and auditing methods. Direct methods include patrolling by enforcement vessels and spot checks at landing points by fisheries officers. These methods can be expensive, but at least some direct policing at landing sites is recommended. A complementary method creates audit trails, by using documentation and comparing information obtained at different points during the catch to export process. This is a powerful method to enforce rules and regulations set by decision-makers and audit-like documentation is increasingly required for international export by many countries and international organizations, such as CITES.

Enforcing unpopular decisions can be expensive or impossible. Improving the effectiveness of decision-making requires two actions:

- Consultation with stakeholders and participation in decision-making makes decisions better as the concerns of stakeholders are taken into account. Also, if stakeholders understand the problems, they may be more ready to accept decisions resulting in short-term hardship in exchange for long-term sustainable benefits. Co-management is a term implying fisher (and others) participation in management and encourages much of the decision-making to be devolved to the fishers themselves.

- Enforcement is always necessary. Once a few fishers get away with ignoring controls, other law-abiding fishers will see less reason for themselves to follow regulations and controls, and management can break down. Similarly, poaching undermines the management process unless poaching can be suppressed by enforcement activities.

CITES has proved useful in helping countries enforce decisions. However, this is a two-way process and in return managers have to accept interference in policy and the requirement for transparency in decision-making. One complaint against CITES has been the lack of involvement of stakeholders in making CITES policy. CITES regulations have been thrust upon many Caribbean countries who are signatories of the Convention which may make enforcement in some cases more difficult.

3.7 FEEDBACK AND REVIEW

It is important that decision-making undergoes some sort of feedback, whereby the process can suggest improvements, adapt to new situations and learn from its mistakes. Feedback should not just consult with the management authority, government officials and the like, but should include industry and other stakeholders. Reacting to their concerns and including them in the management process should improve management, making it more cost-effective and better enforced.

Independent reviews, particularly of the technical parts of the decision-making process (i.e. the science), will add significantly to the credibility of the decisions. It is rarely possible for international institutions to study a fisheries management system in depth. Confidence in the management system can come from independent experts who do have the time and local knowledge to study decisions and be satisfied, perhaps through discussion with decision-makers, that the process has met international standards. Local scientists, for example, might be easily recruited from the region's academic institutions.

A useful review system requires independent, reliable information. A fishery monitoring system is required to assess whether management objectives are being achieved. For example, if the management objective is to reduce fishing capacity, fishing capacity will need to be monitored to see how well management is doing.

4. Example of management systems

The following general examples follow implementation of some of the ideas in the manual in four types of fishery: industrial, artisanal, mixed artisanal/subsistence and incidental. These examples have been simplified to illustrate the approach. The reality of day-to-day management needs to consider many details of administration not covered here.

One of the aims of these examples is to promote the idea that good management need not be expensive or complex. Fairly simple procedures may be applied and provide adequate management for smale-scale fisheries, as long as they are well adapted to local conditions.

In looking at the examples, use the background to match most closely with your local fishery. However, all these fisheries have a lot of issues in common, as does conch with other fisheries. Real fisheries will often be a mixture of these different types, or be developing from one type to another. For example, an artisanal fishery may become more industrial as a country's economy develops. It is therefore still worth looking through all these examples even if they do not apply.

4.1 CHECKLIST

Table 1 is a simple checklist of the issues that should be considered when managing a conch fishery (see also Appendix: Fishery checklist). You can check how well the fishery addresses each criterion. This will help to decide which actions might need to be taken to strengthen fishery management. These issues should be covered in the management plan.

4.2 INDUSTRIAL FISHERY

4.2.1 Background

The conch fishery operates mainly on an offshore bank where vessels spend considerable time before returning to land their catch. Vessels are large mother boats each having several catching vessels. The conch are partially processed and frozen at sea. As most harvesting is at depths greater than 10 m, divers use both scuba and hookah gear.

4.2.2 Policy and legislation

The policy is bound by CITES requirements, and the stock is managed so as not to impair the ability of the conch population to replenish itself. This, in practice, means maintaining the population above some level (e.g. 50 percent) of its unexploited size. When the population is at 50 percent of its unexploited size, it is presumed to be at the point of maximum sustainable yield. Once below this point, the stock is considered overfished.

The objective has been to move the fishery to a sustainable exploitation level. In the early years of the fishery, landings were very high and uncontrolled. Rather than change the quota immediately to the lower long-term level, a step-wise quota reduction was agreed with industry to give them time to adjust their capacity and fishing activities.

TABLE 1
Checklist of issues to consider in managing a conch fishery

Checklist	Comment
The fishery is clearly defined	The fishery and management unit need to be clearly identified. A conch stock as a management unit should be defined relatively easily using depth contours. Adult stocks are not thought to migrate through deep water. The fishery includes fleets, gear and "best guess" illegal, unregulated and unreported fishing (i.e. poaching).
An effective monitoring system is in place	Reliable monitoring indices should be available. Monitoring should include indicators and reference points/decision rules for: quantity of conch remaining: biomass and/or spawning stock index; quantity of conch being caught: fishing mortality; economic: revenue, costs and profits from fishing.
The effects on the ecosystem have been considered	The stock needs to be maintained at a level where it will not adversely affect the ecosystem. There is very little information to decide what level this should be. Usual definitions of overfishing have to suffice. Other ecosystem effects could include indirect damage to habitat and environment, although they are likely to be minor. Habitat damage from gears, discarded shells and disposal of conch processing waste are the main potential problems that need to be considered.
Uncertainty has been characterized	Uncertainty needs to be taken into account in decision-making. Decision-makers need to apply the precautionary approach. They need to consider possible bad outcomes from their decisions; whether decisions are reversible should they prove inappropriate and so on. The only effective way to reduce uncertainty is through an active research programme, which includes routine data collection as well as appropriate research projects.
A harvest strategy and decision rules exist	Decision rules refer to specific plans of what to do when the state of the resource and fishery change. Based on the monitoring programme, it should be possible to decide when the fishery changes from a normal to overfished state. Management's focus should reflect the state the fishery is in: Normal phase • The capacity limit and how it will be monitored and adjusted from time to time. • How selectivity might be adjusted to improve yields and protect the spawning stock. • Rebuilding phase • How a temporary reduction in fishing mortality will be achieved. • For how long it will be necessary to maintain the reduction in catches. • Whether and how compensation may be given to fishers and/or the industry.
Independent reviews are undertaken	The stock assessment and management system should meet acceptable international standards and independent reviews should ensure this is the case.
An adequate legal basis exists	Check if the legal basis provides for monitoring, control and enforcement. Laws implementing policy not only exist but are being applied. There also needs to be a method to resolve conflicts and disputes.
There is an effective management system	Clear lines of responsibility exist from political levels which define policy down to technical and enforcement levels where day-to-day management is undertaken. The management structure must be documented in the management plan. Such documentation improves the transparency of the system and allows external review. Co-management is desirable, where stakeholders are actively involved in decision-making and management. Co-management generally improves the effectiveness of management actions.

The fisheries legislation needs to make provision for fishing licensing and registration (local and foreign); fisheries research; fish processing and export licensing; the establishment of a broad array of conservation measures and regulations, such as minimum sizes, close seasons, gear restrictions and marine reserves; and the enforcement of regulations and conservation measures.

The conch fishery is large enough to require a fishing permit specific to conch. Individual quotas (and variants) could be used to avoid overcapacity and encourage sustainability. The fishing industry is vertically integrated, with processors owning or having part ownership in the majority of fishing vessels, which makes the allocation of quotas among processors more likely to improve the economics of the fishery.

As well as covering the objectives and controls above, a good fisheries plan should consider how to help the stock recover if it is designated as being overfished. This should include ensuring that too much capacity for processing and fishing is not overbuilt. As well, management resources should include a contingency put aside by the fishery to cover periods of reduced fishing. Other policies address improving health and safety for fishers and increasing awareness of marine resources in all sectors of society starting from primary school.

A major concern has been to look at ways to reduce poaching. Illegal fishing is seen as a significant problem. An estimate of all illegal catches must be subtracted from the total quota, which is based on the biological productivity of the stock, before the remainder can be allocated to the legal fishery. Clearly there is a direct significant advantage in reducing illegal fishing. Direct enforcement is too expensive, so there is an increasing need to promote international cooperation, perhaps through a regional fisheries management organization as well as participation in regional and international fisheries management initiatives. For example, to facilitate enforcement and to avoid illegal catches being laundered through neighbouring countries, a harmonized closed season should be implemented consistent with other countries with conch fisheries.

4.2.3 Controls and interventions

The fishery is primarily controlled through licensing and an export quota. The export quota is set by the government. Fishers are allowed to use breathing apparatus as the exploited area is in relatively deep water. The number of licences issued and the vessel quota allocation is agreed with the processors, who own the vessels. There is a closed season for conch (August-October) when all catch and trade in conch is prohibited (including importation). Management costs can be recovered using a tax on exports as a percentage of its value. This sort of tax benefits the fishery as it also reduces the incentive to overfish.

Control over the quota has been helped by the monitoring which is necessary for the sanitary standards required for export to Europe and the United States (Hazard Analysis Critical Control Point). Combining monitoring systems has helped implement the conch quota efficiently.

A vessel register and licensing system should be applied to maintain or reduce fishing capacity to the appropriate level. The register will cover all fishing vessels, but licences are issued specific to the industrial conch fishery. All fishing vessels should be required to register and the register needs to be maintained and kept up-to-date.

Licence allocation for conch fishing is conditional upon meeting various requirements. These are clearly printed on the back of the licence. The conditions are designed to make monitoring and enforcement much easier. Adding them explicitly to the issued licence document helps ensure that fishers are fully aware of their obligations.

A future control which could be introduced would be a vessel monitoring system (VMS). This consists of units aboard the mother vessels which record the time and location while the vessel is at sea. These units, with supporting legislation to avoid tampering, can allow implementation of closed areas without expensive enforcement. Implementation would depend upon obtaining reasonable support across industry and the availability of reliable cheap VMS units.

An important concern has been poaching. While direct enforcement, through patrol vessels for example, has not been undertaken because of the expense, control

through trade (i.e. CITES) has been used to apply pressure to reduce illegal fishing. Nevertheless, improved international cooperation will be required to eliminate this problem.

Any management actions aiming to promote less efficient gears are likely to be strongly resisted by the fishing industry. Gear controls often increase industry costs and therefore gears are difficult to ban once they have been adopted by industry. As most depths fished are below ten metres, banning compressed air diving is not possible in this fishery. Other depth limits are not currently enforceable.

Health and safety standards for fishers[5] may justify various controls which also happen to increase costs or decrease fishing efficiency. The most important requirement for any diving fishery is a minimum level of training amongst divers. Divers need to be aware of the potential problems associated with diving, particularly long-term health problems associated with poor diving practices. Industry should be able to organize fishing activities efficiently to minimize bottom-times for divers with little increase in costs. Trying to enforce controls at sea is difficult, but government can help through supporting fisher organizations which support divers through education and other benefits.

It is not possible to enforce shell-based size limits, but meat weight limits could be applied, although meat weight controls would protect the fishery to only a limited degree (see Section 9.4). If a minimum meat weight size limit is being applied, the level of processing needs to be taken into account. This requires precise definitions of processed categories and conversion factors, which may need a special research programme to estimate. Exporting of "chopped or diced" conch should be prohibited without written permission from the management authority.

In general, controls should be chosen so that they are enforceable and can be shown to have the desired effect on the fishery. An effort control should be applied to cap the maximum effort which can be applied in any year. A quota control should ideally be set on total catch rather than on exports and additional controls, such as marine reserves, can be used to reduce the risk of overfishing.

4.2.4 Indicators and reference points

The stock has been monitored primarily through biomass surveys. These surveys have been conducted by divers swimming fixed distances over the bank counting and measuring conch (see Section 8.4). By conducting a large number of such transects, the total biomass of conch has been estimated.

An alternative index is being developed using catch and effort data to decrease dependence on expensive surveys. Collecting catch and effort data can be difficult to start where industry is not used to providing such information. Once started, however, it can be the least onerous and least expensive source of information on stock size. Once data on catch per unit of effort (CPUE) has been established as an accurate index, the frequency of surveys can be reduced or could be conducted on an ad hoc basis, decreasing management costs.

The survey data can be used in three ways:

1. The biomass can be monitored directly. Decreases in quota (or illegal fishing) should produce higher estimates of biomass in the medium term. Conversely increases in the quota should decrease the biomass. This allows management to set controls and then check they are achieving their objective in terms of stock size.
2. A model has been applied to interpret the survey data and estimate the maximum sustainable yield (see Section 8.2.5). This sets the maximum quota that could be allocated. Applying the precautionary approach, and allowing for illegal fishing, has meant that the quota is set below this figure.

[5] See the International Labour Organization Sub-Regional Office for the Caribbean (www. ilocarib. org. tt) for general information on health and safety issues and worker representation.

3. Another way to assess the state of the stock has been to compare two survey areas, one fished at the current average rate and the other not fished (because it is inaccessible or protected). The assumption is that the areas not fished have the same density of conch as the whole area would if unexploited. This assumption needs careful review, but nevertheless such comparisons can give general indications as to the state of the stock.

The density estimates can also be used to identify potential areas for closure. Information from surveys are more likely to influence closures for industrial fisheries, as it is possible to enforce closed areas based on depth or habitat or observed conch density using vessel monitoring systems. Additional sampling might be suggested for the proposed closed area to verify that it will achieve management objectives, such as protecting 5 percent of the spawning stock.

All commercial catches should be recorded through purchase receipts and processor records. Logbooks can be required for commercial vessels at sea for more than one day. This allows more accurate recording of both catch and effort, but requires the cooperation of the fishing industry. Catch size composition can be obtained through random sampling of all the landings. Other non-industrial catch and effort data should be estimated through sampling programmes.

Population size structure data collected from the processing plants and survey could prove useful in future, in particular for estimating the illegal catch, but is difficult to interpret (see Chapter 7) and therefore is not currently used. Scientific research will be required to make effective use of these data.

Where meat weight is being used as a control or indicator, random samples will be needed from processors. It is recommended that measurements are taken before processing and with only the digestive glands removed. This allows the maturity and sex also to be recorded. The proportion of meat weights below any regulation will also be obtained from these data to indicate compliance. While as has been noted, a meat weight control is of limited use for this species, monitoring meat weight is still useful for assessing the effectiveness of other controls. For example, a marine reserve designed to protect undersize conch should raise the average conch size if effectively enforced.

A biomass dynamics model will be used to set limit, precautionary and target reference points for total catch and effort. The default population model should be the logistic unless another can be shown to fit the available data better.

Regular assessments of the data should be carried out. It is not necessary, or even desirable, that assessments be carried out every year. It is however necessary that monitoring of indicators be continuous. A fall in indicators should initiate an assessment.

It will be necessary to demonstrate that the chosen management controls can affect the fishery. For example, reducing quotas should result in increases in the CPUE index. This can and should be verified by management.

Longer-term research should be coordinated in the region. Models for growth and mortality are a priority. Not only do estimates for parameters need to be refined, but explicit measures of uncertainty are also required. Ideally, a default growth and mortality model paradigm should be agreed among scientists.

4.2.5 Decision-making

The primary control, the total allowable catch (TAC), has been arranged between government and industry and is based on scientific advice. Ultimate authority rests with the Minister for Fisheries, although decisions have been made on the advice of the fisheries department. The TAC is allocated to the different parts of industry through a committee. Industry takes a significant role in management decisions which encourages industry to abide by them.

Due to their size, industrial fisheries are involved in decision-making through representation rather than participation. This requires organization of industry at the different levels of government, fishing and processing to ensure all interests are represented and that representatives have a mandate. Setting up organizations may require government support. Representation is most easily achieved by establishing a fishery advisory council that can discuss and recommend actions to government.

4.2.6 Enforcement and compliance

Exporters must possess a licence issued from the relevant government department, not necessarily the fisheries department, although fisheries should be consulted. Exporters also require a CITES permit for each export consignment. The CITES permit should always be approved by the fisheries department whether the fisheries department is the designated scientific authority or not.

It is important that all products are inspected before export. Inspection covers health as well as conservation requirements. The primary aim of the conservation requirement is to makes sure the various information on the permit application matches the shipment, including: (1) the total weight of product being exported; (2) the level of processing of the meat ; and (3) the average meat weight compared to the minimum meat weight for the level of processing, if this control is applied. Random sampling of the frozen product is difficult, however, and most meat weight sampling should be conducted during processing.

The fisheries department issues both the CITES permit and the health certificate, after the shipment has been inspected by an authorized officer. It is from these various forms that the export data are collected. Hazard Analysis and Critical Control Point (HACCP) and conservation monitoring are combined as much as possible to minimize red tape and make controls as efficient as possible.

Enforcement at sea is more problematic. The only realistic option is to incorporate random checks with other coastguard activities, notably drug interdiction. Mostly this depends on the enforcement officers at sea simply understanding the fishery and fishery regulations and developing greater cooperation between the fisheries department and the enforcement agency. This can be achieved most easily by convening a joint committee between fisheries and all other parties interested in marine enforcement. This will allow fisheries officers to be taken on patrols, ensure enforcement officers know what to look for in relation to the fisheries regulations, and so on.

An important component of enforcement against poaching is to negotiate the requirement that all fishing vessels are clearly marked so that they can be identified from the air as well as from sea. Infringements can then be reported to the flag state. The policy aim of increasing international cooperation will make this information gathering more effective.

4.2.7 Feedback and review

A national CITES scientific committee is responsible for reviewing CITES issues, of which conch is one concern. The committee, made up of independent scientists and people from institutions interested in conservation, has reviewed both the science and decision-making. It reports directly to CITES on its findings. The reviews have included interviews with government staff.

4.3 ARTISANAL FISHERY

4.3.1 Background

Most fishing occurs on wide shallow banks of sand, seagrass, algae and reef habitat suitable for conch. There is sufficient area to support a commercial fishery employing a significant number of fishers with their own vessels exploiting conch, landing around

200 kilos whole meat each fishing day. They depart in the morning and return mid to late afternoon, usually landing at one of several processing plants that purchase, clean and pack the conch for export. Shells are usually removed and discarded at sea. There is local consumption of conch, but it is thought to be low compared to the quantity caught for export.

4.3.2 Policy and legislation

The policy for an artisanal fishery is broadly the same as that for the industrial fishery. This means maintaining the stock above 50 percent of its unexploited state is the primary objective. More generally, it is the policy to apply regulations consistent with maintaining or restoring populations of marine species to levels that can provide the maximum sustainable yield. However, because employment tends to be a more important consideration in artisanal fisheries, other policies may be developed which are more orientated to maintaining and extending livelihood opportunities.

An obvious way to increase employment is to make better use of the resource locally rather than allow increases in fishing effort. Therefore the policy includes encouraging all meat processing to be local, developing uses for the conch meat waste (process into protein for animal feed, for example), and developing uses for the shells. This last includes procedures for obtaining the meat which avoids damaging the shell, as well as encouraging local artists to create jewellery and curios from shells.

Given that information on artisanal fisheries will be harder to obtain than for industrial fisheries due to economies of scale, management of risk needs to be considered. This will need implementation of a precautionary approach based on the available information and analysis. As a result the TAC is always set such that it is very unlikely to exceed the maximum sustainable yield in any one year. In addition, a closed area (or appropriate gear controls) can be useful in guaranteeing the protection of a proportion of the stock.

A desirable aim would be to maintain current fisher earnings. This is a difficult policy to implement however, as any reduction in catches to protect the stock implies a reduction in fisher income. It should be noted that any control that conserves the stock, such as TAC, marine reserves or closed seasons, by necessity must reduce catches to be effective unless they are being used to prevent future threats to the resource. One way to protect fisher income is to apply a limited entry policy, where only professional fishers are allowed to fish conch for export. This, unfortunately, is directly opposed to the need to provide employment as it would prevent new entrants to the fishery. The policy needs to balance the need to protect earnings and the employment that the fishery provides.

4.3.3 Controls and management interventions

The fishery is primarily controlled through licensing and an export quota, which is calculated based on a target TAC. There is also a small area closed to fishing, a closed season to spread the catches more evenly through the year, and fishers are not allowed to use breathing apparatus, but must free dive.

The export TAC was set up largely as a result of CITES requirements. The export TAC is controlled both locally and internationally through customs. Most exports go through Miami, the United States of America, where they must be accompanied by a CITES form issued by the government indicating the part of the TAC which the export constitutes. Quotas as parts of the TAC are allocated to the processors.

The number of licences are limited, but are not controlled by management. While any national can get a licence, the number of eligible people in the population is small, making numbers of full-time licensed fishers limited. The processing sector is similarly licensed, although they do not only process conch; they also buy lobster and scale fish from fishers.

Various management controls might be considered for increasing local employment. For example, an export tax based on the exported weight would encourage 100 percent local processing rather than processing abroad. More innovative interventions could be to develop a market and methods to give greater value to landing the shell, which are currently discarded. This could allow better enforcement of shell based controls as well as improve returns to the fishery.

4.3.4 Indicators and reference points

All fishing vessels should be registered. A survey may need to be conducted to initiate a register if none already exists. Registration of artisanal vessels is more difficult than industrial vessels, because the vessels are usually more dispersed and there are more of them.

If catch is not available, a vessel survey should be undertaken to estimate current total catch. The survey would cover vessel activity and catch per unit effort.

Size composition sampling should be carried out on the landed catch. Catches should be chosen at random and size recorded for all samples (e.g. meat weight). A sub-sample should be selected ensuring it covers the widest range of catch size to estimate conversion parameters between various measures, such as processed and unprocessed meat weight.

Fisher interviews can be conducted to obtain fishers' views on the productivity of the stock. This is not only useful in estimating the current state of the stock, but also is a useful move towards co-management, which should improve enforcement.

Data can and should be shared between countries to enable those with little information to develop a monitoring programme immediately. Setting up such a system could form one of the tasks undertaken by a regional fisheries management organization.

Data collection for long-term monitoring purposes relies mainly on the processing industry. Every processor must complete forms indicating the daily landings from each vessel. At the end of each month the processor sends the completed form to the fisheries department where the data is entered into a database.

The data reported by industry is used to calculate the total landed catch, by adding up all the reported daily landings, and the total effort, by counting all the landings that have been made. Each landing reported for a boat represents a day's fishing for a boat, the fishing effort.

A standard fishery model is used to interpret the catch and effort data. By analysing past behaviour of the fishery, it is possible to estimate the abundance of conch relative to the unexploited stock size and estimate the current productivity of the stock. It is necessary to know both to set an appropriate quota.

If an insufficient catch-effort time series is available, the process can be initiated with a conch survey in much the same way as that suggested for the industrial fishery. The survey scale should be commensurate with the size of the fishery, and therefore require fewer samples sites than for an industrial fishery.

The primary indicator for this fishery is CPUE and estimated biomass relative to the unexploited biomass. Biomass is estimated using the catch and effort time series, any survey biomass estimate and a biomass dynamics model (see Section 8.2). The analysis is not difficult, and can be repeated each year to assess how well the fishery is doing. The model provides an expected CPUE at the MSY point, so that the observed CPUE (catch per day) can be directly compared to this value. If the CPUE falls below this figure for a number of years, action can be taken to raise it by reducing the quota.

Long-term monitoring would depend on being able to generate annual CPUE by fishing ground. CPUE is the indicator of choice to monitor biomass as it is usually the cheapest method and can be maintained over a long time period. Short breaks in the

series do create a problem, but total catch time series must be complete. Total catches measure the impact of the fishery on the stock and must be recorded and be available.

It is important that the catch and effort monitoring be robust to changes in available capacity. Such monitoring should form a core activity of the management and scientific authorities. Much of the monitoring of commercial catches should use records completed by processors and other purchasers. The scientific authority only needs the ability to collect, check and store these data.

If possible, stock surveys can be conducted to provide a fishery independent assessment of biomass. Such surveys are valuable as they provide a check on CPUE as well as providing an independent assessment on the scale of the fishery, and are often used to improve assessments. If CPUE is being monitored, however, they need not be frequent.

The main concern with using CPUE is that there will be changes in catchability. Catchability is the scaling parameter between biomass and the CPUE variable. It can change if vessels become more efficient, for example, or if management controls the way vessels fish (e.g. introducing a minimum size control). Stock surveys can be used to bridge such changes. Vessel register data can be used to standardize CPUE for many changes in fishing power.

Stock assessments require contrasts in the data in terms of population depletion and growth to allow accurate estimates of appropriate controls. Periods of depletion, in particular, may not be considered desirable. However, if it is to be verified that chronic overfishing is not taking place, a period of reduced fishing mortality after monitoring is in place should be applied to estimate the rate at which the population increases in response.

The state of the stock should be maintained above the overfishing point. Standardized CPUE as a proportion of the estimated unexploited CPUE can be used as the biomass indicator. There are two reference points:

- 50 percent unexploited CPUE precautionary: the indicator falls below this point a rebuilding programme is implemented (CPUE should be monitored during rebuilding or a set recovery period applied).
- 30 percent unexploited CPUE limit: a fishery falls below this point, the fishery should close.
- The secondary aim is to maintain the fishing mortality below levels which could drive the fishery into an overfished state.
- f_{MSY} limit: effort should be reduced to be below this level where yield is maximized. f_{MSY} (effort at the maximum sustainable yield) is the fishing effort which theoretically maximizes the total catch from the fishery.
- f_{TEY} target: this is the fishing effort required to move the stock to some optimum level which can be defined using socio-economic indicators. f_{TEY} (effort at the target economic yield) should be adjusted to approach the target level as quickly as possible. A socio-economic target should be developed immediately and can be based on average costs, conch price and/or on fisher interviews. It can be refined through further socio-economic research.

4.3.5 Decision-making

Ultimate authority and therefore decisions, rest with the fisheries authority. However, the authority takes advice from a scientific committee and decisions going against this advice would have to be justified.

The scientific committee assesses evidence based on a stock assessment. The stock assessment mainly assesses the impact of management actions on the catch rate of fishers. Setting a reduced TAC should increase the average catch taken on a vessel fishing day. Conversely, higher TACs will decrease the catch taken on a day's fishing. The limit reference point, the level that management aims to maintain the catch rate

above, is around 200 kilos per day, as this is estimated to be the maximum sustainable yield point. In addition, the scientific committee needs to apply the precautionary approach, so higher catch rates are preferable.

There is no formal review process for the assessments or management. However, the scientific committee is made up of local experts as well as government scientists, so that the advice is independent. Local scientists also take part in regional fisheries workshops where informal reviews can also take place.

4.3.6 Enforcement and compliance

Although the TAC is set based on landings, the landings are controlled through export quotas allocated to each processor and not enforced directly. The yield from processing is 40 percent of the TAC. Once the export quotas are met by processors, the fishery is closed and no further landings undertaken. Stockpiling conch for the following season was a problem, but has been discouraged and is not permitted.

Other controls are enforced directly by fishery department patrols. In particular, poaching vessels from other states have been caught and prosecuted. The information required to catch such poachers has usually been based on information from fishers or police surveillance. Regular fishery patrols have proved difficult and costly to maintain.

4.4 ARTISANAL/SUBSISTENCE FISHERY

4.4.1 Background

The fishery is very similar to the artisanal fishery described above, with individual small vessels collecting and landing conch within each day. The catch is used for local consumption, including tourist outlets, as well as sold for export.

Unlike the previous examples, catches may be landed at numerous sites and over a number of islands. Catches then may be consolidated for processing and export, or distributed locally for subsistence or commercial purposes. The more diffuse nature of the fishery makes monitoring difficult, which needs to be taken into account in the fisheries management.

4.4.2 Policy and legislation

The policy is bound by CITES requirements, and the stock is managed so as not to impair the ability of the conch population to replenish itself. However, direct control over the subsistence fishing is not possible and subsistence fishing is more difficult to monitor. Only a proportion of the catches can be recorded.

The primary objective is to maintain the stock for local consumption. The amount of fishing that goes on for local consumption is related to the islands' population size and the alternative employment opportunities that exist. Any yield beyond that used locally can be exported. Hence, the exported catch provides a buffer protecting the local market and subsistence. This policy will clearly only work if the local demand is less than the maximum sustainable yield.

Implementing this policy is not easy as the total catch and state of the resource is largely unknown. An initial operational objective would be to maintain the CPUE at a level that is not significantly different from the previous 10 year average until further scientific information is available. If this objective is met, it would suggest that at least the situation has not worsened and the current fishery is sustainable. Similarly, if there has been no overall decline in CPUE over the last 5–10 years, the total export quota could be set to the average exports over the same period.

Another indicator of overfishing is for divers to dive to greater depths as they deplete shallow water resources. Enforcing a maximum depth is difficult, but depths can be monitored by, for example, recording maximum depth recorded on dive depth metres

or dive computers. This can be compared with the bathymetry of the shelf to indicate where most exploitation is occurring. At the same time, the risk of decompression sickness associated with scuba diving can be reduced through requiring certification of all divers, perhaps introduced over a five year time frame.

While it will not be possible to control the number of subsistence fishers, artisanal fishers might be controlled through licensing. Only licensed fishers might be allowed to sell to processors for export, for example. However, the policy will need to balance the needs for employment and earnings.

There is also a policy to protect critical habitats for conch from exploitation and degradation. This is most easily done by declaring marine reserves and applying protective legislation to prevent any practices, including fishing, which threaten the reserve ecology. However, marine reserves on shallow water banks may be less easy to define and patrol than other habitats such as coral reefs or mangrove.

Another conservation objective would be to maintain the average marketable meat weight at a level that is not significantly different than the previous 10-year average and maintain non-compliance levels with respect to the marketable meat weight at or below the current level. As meat weight does not increase beyond maturity, this is a crude control and cannot be relied upon to prevent overfishing. Meat weight is still worth monitoring as it should indicate changes in the population or fishing practices, but should have lower priority compared to other activities.

4.4.3 Controls and interventions

One of the most important interventions will be an education and awareness programme. For any subsistence fishery, there will be a reliance on self-enforcement. It is therefore important that the fishing community and the public understand why there is concern for conch, so that they understand what controls there are and why they are being applied. Most people are, on the whole, law-abiding, and will not flout regulations when they are understood and they agree with them. It is also important that not just fishers are targeted. Fishers are often influenced by the wider community, so the whole community needs to be in broad agreement with government interventions for them to be successful.

Direct controls will mostly target the export fishery. An export quota can be applied and adjusted in response to the monitoring programme. In addition, licensing might be used to control fishing effort for export. It is usually difficult to control local subsistence fishing through licensing, as this is seen as an infringement of the right to collect food, so full effort control will not be possible.

Other controls might be applied to the gear and fishing activities themselves. An education programme together with a progressive requirement for scuba certification should reduce health risks. Hookah (direct feed from a compressor) may be banned and the number of compressed air tanks taken aboard per diver can be limited. It also may be wise to require that a spare scuba rig is hung from the boat at a depth just below three metres to avoid rapid ascents. Finally, decompression treatment should be available to divers, and, if necessary, a tax levied to ensure this is available to all fishers.

The distributed nature of the fishery makes closed areas or marine reserves a useful tool to reduce risks of overfishing, but implementation and in particular enforcement may be difficult unless the fishers themselves support the initiative.

4.4.4 Indicators and reference points

The diffuse nature of the landings makes monitoring catches (and effort) difficult, but not impossible. Landings can be sampled using trip interviews, which provide an estimate of average CPUE. This can be raised by the total effort to obtain total catch, using, among others, fishing activity and a frame survey or vessel register.

Unfortunately sampling can be so low, and frame surveys out of date, making these estimates of catch and effort very poor. If no reliable catch and effort information is available, other methods need to be used.

Trip interviews can be used to draw out more detailed information on fishing activities. Number of air tanks used with average and maximum dive depth can not only give a better estimate of effort, but can be used to estimate the annual mean depth dived by all divers. Compared to a bathymetric map, this can give some indication of where divers are operating, and whether they might, for example, be depleting the shallow water resources.

Even if catch and effort information can be obtained, it may difficult to interpret until a reasonable length time series has been built up (at least 10 years). Hence reference points may be difficult to propose. Initially CPUE can be compared to an historical reference point (e.g. last 5 years average) to identify trends.

Export quotas should be recorded, so it will only be the subsistence catch and catch sold through local outlets which will not be covered. Landings sold through local restaurants and stores can be monitored through purchase receipts. However, while main restaurants can be monitored this way, temporary stores and markets often do not produce reliable data. The most reliable way in terms of estimating all catches is through a consumption survey. This involves asking various households and groups (e.g. tourists) what they have eaten over a fixed time period. As conch will be only one product, it makes sense for a consumption survey to cover everything that people eat, including other types of fish and food stuffs. This makes the survey much more efficient as information is valuable to agriculture, tourism and health as well as fisheries departments, so costs can be shared. The sample from the survey can be raised to totals using population census surveys.

A biomass survey will make interpretation of catch and effort easier as well as providing estimates of an indicator, reference point and controls itself. Total catch divided by total biomass gives some indication of the exploitation rate. A level below ten percent indicates fishing is at a safe level. An average density of conch well above 50 per hectare would also suggest a safe population, but densities below 50 do not automatically imply overfishing as density will be habitat dependent.

If earnings are an indicator, current earnings will need to be assessed from this fishery. A simple indicator is the catch per fisher, which can be estimated from trip interviews and can be used to detect trends. If a comparison is required between the fisher earnings and a national minimum wage, the absolute earnings will be required from revenue and costs which is a much more difficult task, but again can only be obtained from interviews and gathering price information.

Indicators for marine reserves would include the proportion of conch biomass protected (from a biomass survey), and the proportion of the various types of habitat within the area, which would require a habitat map of the fished area. Water quality and pollution could also be monitored within the marine reserve, although control of these indicators would be beyond the control of fisheries management alone. The number of infringements (fishing activity within the reserve) per year would give some indication of compliance. Repeated mapping, using remote sensing for example, could be undertaken to monitor change in habitat quality and area, although this would form a wider activity than just dealing with the conch fishery.

For health and safety objectives, the relevant indicators would be the proportion of divers holding a diver certification (e.g. PADI) and the number of fishers reporting with decompression sickness per year. There are no acceptable levels except zero percent decompression sickness rates and one hundred percent diver certification.

4.4.5 Decision-making

Participation of fishing communities directly in management decision making becomes more important as fisheries become smaller and more diffuse. This particularly applies to the location and extent of closed areas and closed seasons. Whether these initiatives are a success or not very much depends on the level of consultation which has taken place.

The level of consultation will largely depend on the size of the fishery. Larger fisheries are likely to be limited to representation through a fisheries advisory committee or similar institution. For small fisheries, decisions might be made directly by meetings of fishers. Representation may still play a role where fishing communities are spread out among islands. Representatives can take individual community decisions and concerns to higher level meetings.

The more participatory management decisions are the more important education in fisheries management becomes. In all cases, it is important the decision-makers understand the issues they are dealing with. Many decisions are difficult to make, implying a loss of income in the short term, with the hope of greater income in the future. Rational decision-making requires a good understanding of the outcomes and risks resulting from management actions.

An annual quota will need to be set. It is recommended that this is not subject to arbitrary decisions, but a simple decision rule should be decided upon which can be applied over a number of years. For example, a consumption survey together with a population census can estimate the total catch for local use. The population and tourist census should also be able to estimate trends, which should allow an export quota to be adjusted automatically each year to maintain the current catch until the next consumption survey. This would set a reasonable control on catches until further information becomes available.

4.4.6 Enforcement and compliance

Compliance will depend to a large extent on getting the fishing community to agree with the policy being implemented. This involves not only winning the "hearts and minds" of the community, but conducting a consultation where the management listens and reacts to community's views. This may mean rejecting controls even where there is strong outside pressure to implement them. On the other hand, poaching undermines the community-based compliance, and rigorous enforcement is required to prevent local fishers feeling that they are not in control of the amount of fishing going on.

Direct enforcement through policing activities has only a limited role in these sorts of fisheries. It is nevertheless important that antisocial behaviour is curtailed and policing supports the community's decisions. Education of fishers is particularly important to improve compliance in these types of fisheries.

Some regulations, such as minimum size can be enforced on land through beach patrols at landing times. Most likely this would have to be combined with data collection activities. Separating enforcement from monitoring is often not possible, but may compromise the monitoring data.

Effective minimum size enforcement would require shells to be landed. In commercial fisheries, where catches are large and the shells need to be removed at sea, a minimum size control is not likely to be enforceable unless there are very frequent inspections at sea.

The level of non-compliance can be monitored with respect to minimum size regulations. By random sampling at landing or during processing, the proportion of the catch below the minimum size (or that breaks other regulations) can be estimated. This can be used in scientific assessment as well as monitoring the effectiveness of enforcement activities.

4.5 NON-DIRECTED FISHERY

4.5.1 Background

There is no commercial conch fishery. Conch are harvested mainly opportunistically, rather than through a directed fishery, such as bycatch in a fishery directed at spiny lobster. Anecdotal information and local knowledge suggest that only small quantities are harvested mainly for shells, which are polished and sold as curios to tourists; and/or the meat is usually consumed by the harvester or sold privately and not openly at markets.

Both established souvenir retail stores and itinerant salesman are involved in the sale of conch shells. A significant number of shells are imported. Local conch populations are believed to be typically much smaller that those of neighbouring islands.

Since there is no commercial conch fishery, no resources have been allocated to the assessment of this resource in the past. The status of the resource is therefore unknown.

4.5.2 Policy and legislation

The general policy of maximizing economic benefits while conserving the resource applies to conch even though it is not a targeted species. However, in economic terms conch may not be significant, and therefore the primary objective may simply be conservation.

It may be decided that there is insufficient information on conch to develop any operational management objectives. Therefore, a first objective would be to determine the status of the fishery and begin consultation to develop reasonable objectives. Information on conch could include location of resources, the level of fishing effort, market demand, export and imports.

If it is determined that there is no significant fishery for conch (for example, catch: biomass < 5 percent only a minimum level of management will be required. This would consist of continued monitoring of imports and exports, and the fishery so that action can be taken if conch exploitation increases. Otherwise conch should be explicitly included in any ecosystem management initiatives (e.g. marine protected areas).

Alternatively, if it is determined that conch is being heavily fished (i.e. the resource size is very small), the most cost-effective option may be to discourage fishing of conch. It may be not be possible to eliminate fishing altogether.

This is the type of fishery where "passive management" may be most appropriate. Passive management sets up controls such as minimum size and closed areas, but does little, if any, monitoring of the day to day activities of the fishery. The controls need to be stringent enough that they ensure the resource is conserved, but need only be reassessed and changed infrequently.

A permit should be required for import and export of all conch shells whether to or from CITES member countries or not. For meaningful management, all exploited conch needs to be monitored. It is possible to operate a personal limit on exports as long as this remains small. This avoids unnecessary red tape on trivial quantities, as long as the managers remain sure that these quantities are trivial.

Fisheries management policy may apply an ecosystem approach, where conch is one component. Within the shallow water tropical ecosystem, conch have an important niche, and juvenile conch in particular contributes to the diet of many predators. An ecosystem approach should guarantee conch and their habitat are protected, along side other species which share their habitat.

4.5.3 Controls and interventions

With the exception of an export control (e.g. a personal limit on shells or meat carried), trip limit (bag limits) and size limits, controls and interventions should probably not be limited to conch, but conch should be covered by the fishery controls that exist. As part of fisheries management, government should probably have several controls and interventions in fisheries, and each of these should consider conch as one of the species covered. These should include, for example, overall effort and fishing capacity controls and gear restrictions such as a requirement for scuba training certification.

It is not recommended that a no-take zone specific to conch is implemented, but marine protected areas which contain significant conch biomass are recommended. These should provide protection for the conch within these areas as well as other species and the habitat.

All imports and exports should be controlled. If conch is not thought to be threatened, a personal export limit can be applied of a few shells or pounds of meat which does not require an export permit. If the resource is thought to be threatened, all exports should require a permit and the personal limit essentially set to zero.

Where landings are monitored and the shell is landed, a minimum shell/lip size can be enforced. Enforcing meat weight is not recommended if it is not already done, although meat weight might still be useful as a monitoring indicator.

Other more expensive options such as directed controls on conch will not be cost effective. Any regulations on conch should be enforced while conducting other activities. Minimum size regulations and bag limits for conch, together with other species, can be checked during beach patrols. By combining activities, the efficiency will be increased and some direct enforcement might be possible. What will be possible will depend upon what other activities are being undertaken, which will therefore have a bearing on the controls applied.

4.5.4 Indicators and reference points

For this sort of fishery, the critical indicator is the catch to biomass ratio. If the catch is only a very small proportion of the biomass, management only has to maintain the *status quo*. If catches are a high proportion of the biomass, further action might be needed.

Catches can be obtained from trip interviews and consumption surveys, in the same way as for other fisheries. With catch and effort monitoring, catches of conch can be obtained in the normal way as long as conch, where it is caught, is recorded. Without catch and effort monitoring (for example, where subsistence and recreational fisheries are not surveyed), a consumption survey and/or curio survey can be conducted. As all imports of conch should be recorded, these can be taken from the estimates obtained from consumption and shells. Where conch is taken as bycatch, the effort recorded by the directed fishery can be used.

Conch should only be a small part of any data collection. Any data collection exercises, such as trip interviews, need to ensure that conch are included. This might be done by having conch as an explicit item in interviews, catch measurements and so on. For an incidental fishery, data collection should not be conducted on conch alone, as this is not only inefficient, but understanding conch catches may require knowing what other species were caught on a trip.

As with any fishery, surveys can be undertaken to identify and map conch grounds, determine stock densities, identify stakeholders and fishing effort. As conch is not a directed fishery, any survey should set out to cover conch as only one component. For all data collection activities, efficiency is an important consideration. It is not appropriate to take limited resources away from other species which are more heavily exploited or more threatened.

Simple, easy to collect indicators should be chosen to monitor whether management needs to carry out any interventions. Once it has been determined that the stock is only lightly fished, for example, the main aim would be to have an indicator of a change in circumstances that would warrant either a reassessment or immediate intervention. For example, at each trip interview, the interviewee could be asked whether they have caught any conch today, the last trip, and/or this month as a qualitative indicator. An indicator might then be the proportion of trips in which conch are caught in a year. If this proportion changes +/- 20 percent a reassessment might be considered necessary, so that the original biomass surveys would be re-conducted. Standard indicators as described for other fisheries, such as CPUE, can be also used, but may not be appropriate. Where a species is only taken infrequently, CPUE can be a poor indicator of stock size.

4.5.5 Decision-making

Conch in this fishery would require no special decision making mechanisms. Fisheries advisory committee, government departments, community managers, CITES and other decision-making authorities would also deal with conch. The most appropriate management options for an incidental species like conch are either to discourage fishing or maintain the *status quo*. In either case, the systems in place should be able to deal with the decisions required.

4.5.6 Enforcement and compliance

There would be two key enforcement activities: public awareness and controls on exports. Any other enforcement activities for the fisheries where conch occurs as an incidental catch, such as effort controls and marine reserves, would also cover conch by default.

It is important that the public are aware as to the state of the conch resource and are discouraged from catching it, if it is suspected that it is overfished. A moratorium on fishing may be the best way to rebuild an economically minor resource, and may be acceptable to the fishing community if they understand why the moratorium is in place. Alternatively, a bag limit can be applied, so only a maximum of one or two conch per day per person might be landed. This would allow incidental fishing, but keep exploitation to a very low level. It may appear to be easier enforcing a complete ban on fishing conch, but if this would be very unpopular, a bag limit may be the most effective overall control.

The most likely controls on exports would be an overall quota, a personal export limit and/or a minimum meat weight. The overall export quota is an important tool for controlling exploitation and may need to be reduced or reduced to zero if overfishing is detected. Imports can still be used to supply the local trade. If designated as overfished, the export personal-limit should probably be reduced or set to zero. Imported conch shells and curios could still be exported, but would require an accompanying certificate issued to the shop selling the curios. This can be enforced by customs, but most tourists would automatically comply with a conservation export requirement once made aware of it.