

## **...An assessment to determine if one's circumstances or expectations conform to reality....**

The American Heritage® Dictionary of the English Language: Fourth Edition. 2000.

## **A Practical management and control of renewable resources**

All the theoretical principles discussed in previous articles carry very little weight if they cannot be practically implemented and enforced. There are two problems involved. Unlike terrestrial resources, most of the management decisions for fisheries are based on information about populations that are unobservable (it is very difficult to convince fisher to cut their quota, when you cannot show them that the population is actually declining to dangerous levels). The other problem is that policing the sea is extremely difficult, and so marine resource regulations can easily be abused, e.g. fishers will off load catches at sea to other vessels, target for fish other than those in the permit, or declare different catches to what are actually landed. In order to counter this problem, one has to do two things. First of all, the theoretical analysis has to be transformed to a more down to earth level, and secondly, an enforcement structure must be implemented which does not rely on fisher's goodwill. The following section deals with practical control and enforcement options and discusses their feasibility.

### **1 Stock assessment**

The effective management of living marine resources depends on the existence of monitoring programmes for the collection of essential data. Although the most important quantity in any monitoring programme is the annual landed catch, additional information on annual fishing effort and the breakdown of the catch by fish length class and fish age class is also needed on an annual basis. A variety of biological data, including for example the age at which fish reach sexual maturity, their body weight for a given size or age, and their susceptibility to being caught by the fishing gear also has to be collected.

The data which needs to be collected for each resource is determined by the particular approach which has been adopted for its management. In the next two articles we will outline various quantitative approaches to fisheries management, while details for specific fisheries will be given in later articles.

The basic problem in stock assessment is to estimate the sustainable yield curve for the resource, and the present biomass of the resource. This information can be used together with a formal harvesting strategy, to set TAC levels for the fishery.

Quantitative approaches for monitoring and assessing the size and productivity of marine resources can be classified into those which are based on direct counts and measurements made at sea, known as direct resource assessment techniques, and those which are based on mathematical calculations performed on data collected from the commercial catch, which are known as indirect resource assessment techniques. Below are examples of direct methods for stock assessment.

#### **a) Tagging**

Release of tagged fish back to the sea can provide valuable information about certain biological parameters and about the size of the resource. A tagged fish which is recaptured has been in the sea for a known period of time, and was released at a known site. From the date and position of recapture one can therefore work out how much the fish has grown over a known period of time, and how far it has moved since it was released. Growth rate is important in determining the productivity of the resource, and movement direction and rate is important for determining annual migration patterns of the stock.

The number of tagged fish which are recaptured by the commercial fishery compared to the number of tagged fish which were released gives some indication about the size of the stock. For example, if 100 000 fish are tagged and released, and only 100 are found in the commercial catch for the year, then this indicates that the commercial catch is very small compared to the size of the stock. However, if 30 000 fish are recaptured within a year, it suggests that the commercial catch is very large compared to the size of the stock. A rule of thumb is that the stock size is roughly the commercial catch multiplied by the number of fish released, and divided by the number of fish recaptured.

### **b) Surveys**

Surveys at sea can be designed for a variety of species, in one or more of their life stages. So for example, a survey can be designed to estimate the density of anchovy eggs on the anchovy spawning grounds, using specially designed nets. Hydro-acoustic techniques based on reflection of sound waves are used to estimate the biomass of juvenile and adult stocks of anchovy along the South African coastline. The size of the hake resource in South African waters is estimated by conducting experimental bottom trawls at pre-defined sites. Densities of rock lobster stocks are estimated by surveys in which traps are set at a large number of locations across the entire habitat of the resource.

### **c) Fishing trials**

In addition to research surveys, fisher always want to optimise their fishing gear and fishing techniques. This could be for different reasons, either to achieve a good catch rate, a preferred catch size composition, to target for certain species etc. or to comply with conservation regulations. For example, in the South Africa pelagic fishery there is a separate TAC for anchovy (about 300 000 tons) and pilchard (about 40 000 tons), which often occur in mixed shoals as juveniles. Small scale trial fishing is conducted to determine whether the percentage of pilchards is low enough to permit fishing for anchovy.

The main advantage of the methods described above is that they are not biased by commercial considerations. In other words area selection, targeting for fish size or species, deployment of less or more sophisticated gear type and other logistic and commercial consideration do not effect the resource index derived from such analytical methods and the derived statistics has a relatively small variance. The main problem with the methods described above is that they are very limited in their scope mainly due to the high cost which is associate with direct methods of assessment. As a result the amount of tagged fish, the area covered in a survey and amount of fish sampled in fishing trails is very small compared to the actual size of the resource. Small sample sizes are associated with low confidence levels and high statistical errors. For this reason indirect methods of assessment which rely mainly on performance statistics from commercial fishing operations are of considerable importance in fisheries management due to their large sample size. These indirect techniques of stock assessment suffer from other problems and are the topic of discussion of our forthcoming article.