

General principles of traditional harvesting strategies

Our last three articles dealt with a relatively new concept in fishery management, namely Operational Management Procedures (OMPs for short), also loosely referred to as management procedures. We concluded that while the basic principles of OMPs are, under certain circumstances, sound, and likely to become a main thrust of future management regimes, a strict interpretation and implementation of the OMP philosophy could lead to brainless and sometimes senseless management approaches which, during their implementation period, disregard anything which was not considered or known during their development phase (new data, new science, new socioeconomic realities, etc...). The following articles deal with more traditional approaches to fisheries management, focussing on that aspect of management to do with controlling fishing mortality, recognising that fisheries management has many other foci, including for example closed seasons, gear regulations and minimum size limits. Here we use the term harvesting strategies to refer to the area of fisheries management dealing with TACs (total allowable catches) and ABCs (allowable biological catches).

A harvesting strategy is a quantitative rule which relates the scientific data and measurements about a resource and the commercial catch, to a TAC for the forthcoming fishing season. Harvesting strategies may be very simple, e.g.

"Catch 120 000 tons regardless of what the scientific data says"

or they may be very complicated

"Catch 20% of the estimated size of the biomass of spawning biomass, where this biomass is obtained from a combination of survey data and VPA calculations".

There are three kinds of harvesting strategies which form the building blocks and rationale of many of the harvesting strategies in practice. These are the constant catch strategy, the constant escapement strategy, and the constant proportion strategy, as described below.

Constant catch strategy: This is the simplest harvesting strategy. This means that one will opt to harvest a fixed tonnage from the resource, regardless of the resource biomass. In terms of our water figures which we used in earlier articles it means that regardless of the amount of water in the container, you would remove two buckets of water every year. In terms of the equivalent graph of sustainable yield versus resource biomass, a constant catch policy can be represented as a flat line, crossing the sustainable yield curve in two places (Fig. 1). The problem with the constant catch policy is that if the resource biomass is smaller than a critical level (e.g. the left hand crossing point of the constant catch line in Fig. 1, then the resource will decline to extinction. Another problem is that the effort level to achieve the catch may be unrealistically high. An advantage of this strategy is that if the catch happens to be sustainable at acceptable fishing effort levels, then it gives the industry a stable production base.

Constant proportion strategy: In this strategy, one aims to harvest the same proportion of the resource biomass from one year to the next. In terms of our illustrative water figure, this means that the number of buckets removed will be a constant proportion of the amount of water in the container. The plot of this strategy is a diagonal line, as shown in Figure 1. The advantage of this strategy is that catch is responsive to the size of the resource, so that when the resource is small, catch is small, thereby allowing the resource to recover. It is also equivalent to a constant fishing effort strategy, which means that the industry never has to operate at unrealistically high effort levels to achieve the required catch. One of the disadvantages of the constant proportion harvesting strategy is that if one makes a positive error in estimating resource biomass, then the TAC could be very high, exceeding even the resource MSY, with a detrimental impact on the resource.

Constant escapement strategy: This strategy tries to maintain the resource biomass at a fixed level, by driving the biomass to this level as fast as possible. This preferred biomass level would be the biomass at which the Optimal Sustainable Yield OSY is produced (Optimal means biologically

and economically which is not necessarily the Maximum Sustainable Yield – MSY). It means that the harvesting strategy will aim to remove all excess biomass above the preferred biomass level (**B_{OSY}**), and below this level fishing stops completely until **B_{OSY}** is reached. The disadvantage with this strategy is that it is completely impractical because it implies alternatively closing or opening the fishery from one year to the next. The advantage of this policy is academic - it leads to the maximum accumulated catch from a resource over the long term.

In all the strategies listed above, the point where the policy line intersects with the sustainable yield curve is the biomass level which the resource will reach after a long time of fishing under the chosen harvesting strategy. This biomass level is often referred to as the **target biomass** level.

In practice, harvesting strategies in force in South Africa and elsewhere are constructed to have as many of the benefits of the above strategies, without any of their negative consequences. So for example, one would select a strategy with the correct target biomass level. The way that this target is to be reached depends on the harvesting strategy. A constant proportion strategy is the most common approach. However, because of the high degree of variability in fisheries, additional features are built in to reduce instability. For example, there may be an upper limit on TAC, which will be in effect regardless of resource biomass. Similarly, there could be a lower limit on TAC, only to be violated in exceptional circumstances (such as unequivocal evidence that if the TAC is not lowered, the risk of resource collapse is simply unacceptable). One can also put restrictions on how much TAC may change from one year to the next. Next month we will discuss the dynamic effects of changing harvesting policy and what control measures should be in place in order to monitor the performance of different harvesting strategies and its proper execution.

Figures captures

Figure 1: Three different harvesting strategies for a fish resource: constant catch, constant proportion and constant escapement.