An Approach to the Assessment of the Finfish Fisheries of the Caribbean Community

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Abstract

This paper briefly outlines the implications of making a decision on the most appropriate alternative for carrying out stock assessments and the reasons for previous failures to conserve finfish stocks for sustainable use. The Mathews (1987) approach utilizing Age Length Catch-Effort Keys (ALCEK) is briefly reviewed, and a suggested overall approach for the assessment of the finfish resources of the Caribbean Community is outlined. With recent initiatives towards use of the precautionary approach and reference points, Caribbean Community countries are advised to revisit the question of the models to be utilized for the assessment of their fish stocks, paying due attention to the quantity, quality and applicability of data now being collected.

Introduction

The basic purpose of fish stock assessment is to provide advice on the optimum exploitation of living aquatic resources (Sparre and Venema 1992). The assessment activity involves a number of basic steps. The first step is to collect data on the fishery. These data often have to be supplemented by assumptions or even qualified guesses. The data are then processed by applying a set of routines to reduce the data into a few parameters. A prediction of future yield is then made, based on these parameters coupled with some models. The type of model to be used depends on the quality and quantity of the input data.

Preliminary assessments can be based on the relationship between primary and secondary production or comparisons between unexploited and exploited areas with similar environmental characteristics. An intermediate level of stock assessment can be reached by production modeling when time series of catch and effort data are available from a "developing" fishery. Once the fishery has developed, biological sampling schemes can be set up and it becomes possible to use more sophisticated models. Where it is possible to determine the age of a fish from hard parts, age-length keys can be established quarterly during each year, and used to assign ages to length-frequency samples taken from the fisheries. These data can then be used to determine the number of fish in the sea per cohort or age group. Where age of the fish cannot be determined from hard parts routinely, analyses have to be mainly based on length frequencies. In fact, it has been suggested that "as long as the routine age-reading of tropical fish species is still under development, most assessments in the tropical zone will depend on the interpretation of length frequencies" (Sparre and Venema 1992).

In deciding on the "best" management or assessment alternative to be used as the basis for management advice, the fishery scientist should consider the range of effects (whether they be direct or indirect; immediate or long term) arising from each alternative (Gulland 1983). The implications of the final output of the assessment may be non-biological (see for example Mitchell 1979; Mitchell 1982; Panayotou 1982), with the social well-being of fishers and the economic success of the fishing industry being dependent on the effects of the chosen management alternative (Gulland 1983). The recent trend toward inclusion of 'ecosystem concepts' in setting fishery management objectives is thought to be "good and overdue" (Caddy and Mahon 1995).

The failure of fishery managers to conserve stocks for sustainable use has occurred for a number of reasons including poorly defined management objectives; poorly defined conceptual basis for reference points; problems of estimating reference points and stock status; failure to link the assessment of resources to the man-

agement objectives; difficulties of scientists in communicating these problems to managers and fishers; and the failure of management to constrain fisheries to agreed levels (Caddy and Mahon 1995). While some of these fall outside the direct purview of fishery scientists, the need to set clear points of reference for management should provide the impetus for any approach to fisheries stock assessment in the Caribbean Community (CARICOM).

The Mathews Approach

"Wherever an assessment capability is to be established for stocks that are previously unstudied", the suggested approach requires the establishment of a suitable catch and effort data collection system coupled with a system for the collection of monthly size frequencies (Mathews 1987). After provisional length-based analyses have been carried out, with some age validation by means of annual marks on hard parts, a decision is made with regard to the need for further assessment work and/or changes in management strategy. Full assessments are then done using Age Length Catch Effort Keys (ALCEK) (Mathews 1987). If the ALCEK assessments provide essentially similar results to the initial analysis: (a) for small stocks (e.g., landings less than 600 t/yr), then the stock is too small to justify continuous research, and so the annual length-based assessments should be continued; (b) for sufficiently important stocks, ALCEK assessments should be repeated over several years and substituted cohort mortality estimates for earlier catch estimates. After 3-4 years the situation would need to be reappraised. If length-based and ALCEK estimates are similar, and if recruitment is relatively constant, the length-based analyses could be chosen as the basis for assessment provided they are significantly cheaper. If changes or trends in mortality rates are noticed after 3-4 years, ALCEK estimates should be used all the time. If neither approach seems likely to provide reliable assessments, stock assessment must be suspended until a growth curve may be established on the basis of growth checks occurring in hard parts (Mathews 1987).

Sparre and Venema (1992) reviewed the methods to be used according to the type of data available. Five levels of data availability are considered, ranging from a situation where only research survey data are available, to one where all kinds of data, in particular time series of age frequencies, are available. Consideration of these collection levels within the context of the Mathews (1987) approach can be a potentially powerful basis for stock assessment (see also Gulland 1987).

The Suggested CARICOM Approach

The fisheries of CARICOM member countries are characterized by being mainly small scale. It is generally accepted that the island shelf resources are either fully exploited or overexploited. Offshore resources appear to hold some scope for development. It has been suggested that "the net worth of these resources to the islands ... is probably not large enough that (they) can afford to neglect the resources of the island shelves in attempting to realize this potential" (Mahon 1990). This situation is made even more crucial by the non-availability of sufficient financial resources for traditional stock assessment.

Many CARICOM countries do not actually have the capability to carry out a Mathews (1987) type approach to fisheries stock assessment given their need for more and better trained staff. This means that the overall approach to assessment of CARICOM fisheries resources may have to be geared towards minimizing the costs, while maximizing the effectiveness of the assessments that can be done (see, for example, Pauly 1994). With an effective catch and effort data collection system, utilization of Morgan's (1987) suggestions for the combination of length-based and age-based analyses would allow assessments to be made without the formal age validation by means of annual marks in hard parts data required for construction of ALCEKs. Such an overall strategy would still be consistent with the Mathews (1987) approach.

With the collection of maturity stage information, the results of Spawning Stock Biomass per Recruit (SSBR) analyses could be used for the provision of management advice. The collection of the input parameters (weight-specific fecundity, weight or length-at-maturity, and size-specific sex ratios; Phillip 1994), would have to be added to the task of data collection.

While length-structured Virtual Population Analysis (VPA) may be preferable to the use of methods requiring the collection of effort statistics (Munro 1983), small developing countries such as the member states of the CARICOM must remain cognizant of the important role that catch and effort statistics play in national accounting (and thus often in the fiscal justification for the data collection program). Additionally, when the more complex analytical methods

cannot be utilized as a result of paucity in either quantity or quality of the data collected, simple approaches such as analysis of trends in catch per unit effort may be the only recourse left to developing countries.

Fig. 1 (after Murray et al. 1996) represents the strategy envisioned for the provision and utilization of fisheries management advice based on catch, effort and biological data collected on the pelagic, reef and slope fish species in and among CARICOM countries. This strategy utilizes a level of data collection consistent with what Sparre and Venema (1992) have referred to as "case D5" involving multiple time series of catch and effort, length-frequency and biological data, with a small amount of age-frequency data obtained from the commercial fisheries, but without "research survey" time series (FAO Fisheries Department 1993).

Provision of Management Advice

CARICOM governments need to know what effects different management measures would have on fish stocks and on future catches, and thus decisionmakers need scientific advice about the state of the stocks. Practical decisions need to be taken after considering a range of economic, social and political factors. Thus, biologists have to determine the effect of different possible alternative actions, so that others with the wider set of responsibilities can determine which alternative is most satisfactory. In recent times, "... there have been attempts to apply threshold management measures aimed at maintaining catches at current depleted levels, or avoiding further stock decline ..." (FAO Fisheries Department 1993; see also Caddy and Mahon 1995). Of course, given that this may mean maintaining stocks at overexploited levels, these should rather be seen as attempts to stabilize effort in a manner that would prevent the status of the stock from further declining (R. Mahon, pers. comm. 1997). It is perceived that "... a more effective approach to setting and enforcing management targets is needed ..." (FAO Fisheries Department 1993), and this has "formalized" the concept of "reference points" which "have been around since MSY and $F_{0.1}$ were invented" (R. Mahon, pers. comm. 1997). A target reference point indicates a state of a fishery and/or resource which is considered to be desirable and at which management action, whether during development or stock rebuilding, should aim. A limit reference point indicates a state of a fishery and/or resources beyond which it is considered to be undesirable to go and which management action should avoid (Caddy and Mahon 1995). Effective management requires a set of rules and should be based on both target and limit reference points (Caddy and Mahon 1995).

The performance of a reference point under situations of increased uncertainty will depend largely on information generated by both the management system and the research being carried out. It is also dependent on whether the fisheries management agencies within CARICOM react promptly to the available information. Most reference points are dependent on the validity of the population models generating them for their accurate formulation (FAO Fisheries Department 1993), as well as the confidence level with which the current state of the fishery is known. The approach suggested in Fig. 1 is predicated on the basic assumption that traditional reference variables and points are suitable for CARICOM fisheries. Given the more recent initiatives towards a precautionary approach (Garcia 1994) and the use of reference

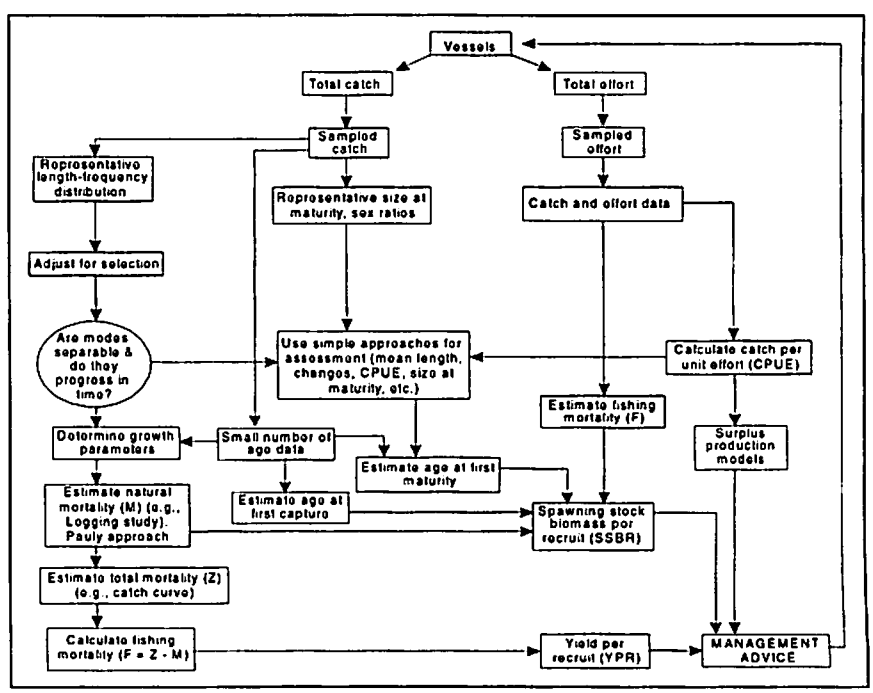

Fig. 1. Flow diagram showing the strategy for the use of data in the assessment of CARICOM fisheries resources (Murray et al. 1996).

points for management (FAO Fisheries Department 1993), the CARICOM countries would be well advised to revisit the question of the models to be used for the assessment of their fish stocks, with due consideration being given to the quantity and quality of the data now being collected, and the applicability of these data to the available models.

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