

## Introduction

IN THE LAST two decades, the sea fisheries of several tropical countries, particularly in Southeast Asia, have expanded at a pace unmatched in most other areas of the world.

The development of new fishing industries in the region occurred concurrently with an overall increase in fishing pressure from a growing number of artisanal fishermen exploiting nearshore resources, and the areas of conflicts between artisanal and commercial fisheries increased correspondingly.

These growing conflicts, as well as the new trends in the Law of the Sea, have forced many governments to reassess their fishery policy and often, to shift policy emphasis from "development" to "management" issues.

This transition from the development to the management of fisheries is generally very difficult to achieve. The problem is even greater in developing countries where there is often no alternative for the employment and income opportunities which fisheries—even when overcapitalized—can provide.

The transition involves tackling two sets of related problems:

1. The determination of the identity, magnitude and sustainable yields of the available stocks.
2. The formulation, implementation and effective enforcement of management schemes based both on the assessment in (1) and the national goals which the fishery is to help achieve.

# ICLARM's Resource Development and Management Program: The Tropical Stock Assessment Research Project

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Many countries in the region cannot effectively tackle the formulation, implementation, and enforcement of management schemes because step (1) has not been solved, due to the varied and complex nature of the resources and to a lack of trained personnel and funds.

Indeed, most countries in the region often have so limited knowledge of the biology of the stocks under exploitation that the formulation of a realistic management scheme is effectively prevented.

ICLARM's Tropical Stock Assessment Research Project, which forms part of its Resource Development and Management Program, was conceived to identify and overcome the major constraints preventing the development of stock-assessment techniques appropriate to tropical stocks.

During 1978 and 1979, ICLARM prepared a comprehensive review of the theory of fish population dynamics as applied to the tropics, and especially the availability of reliable methods for stock assessment purposes (see Pauly 1979).

Two major areas were identified as urgently requiring research input:

1. Theory and methodology applicable to single-species stocks.
2. Theory and methodology applicable to multispecies (mainly demersal) stocks.

The major constraints for single-species stock assessment were identified to be:

- The lack of growth and natural mortality parameter estimates for most stocks, along with the lack of quick, yet reliable, methods to generate such data.
- The lack of species-specific (time series of) catch and effort data, especially from artisanal fisheries.

The major constraints for multispecies stock assessment were:

- The lack of a simple theory or model into which single-species data could be realistically incorporated.
- The scarcity of (time series of) catch and effort data, by species, which could be used to generate testable hypotheses on the response of tropical multispecies stocks to exploitation.

The identified constraints seem to be generally agreed upon by biologists working on tropical stocks, as con-



firmed in the course of discussions at these recent meetings:

1. The USAID International Workshop on Tropical Small-Scale Fishery Stock Assessment, held at the University of Rhode Island (USA), 19-21 September 1979.
2. The FAO-DANIDA Seminar on the Management of Tropical Demersal Fisheries, held in Bangkok (Thailand), 22 October-2 November 1979.
3. The Second Session of the Standing Committee (of the FAO Indo-Pacific Fisheries Council) on Resource Research and Development, held in Hong Kong, 3-8 December 1979.

At all three workshops, the same consensus emerged: there is a need for new approaches and new methods especially tailored for use in the tropics. The need for a new methodology is particularly felt where multispecies fisheries are concerned, especially because most of these fisheries in Southeast Asia are at present fully developed and in need of comprehensive management schemes.

### ICLARM's Program of Work

In answer to this need, ICLARM has formulated a program which aims at:

1. Developing, applying, and disseminating simple, yet reliable methods for use in the study of the population dynamics of tropical single-species stocks.
2. Developing and testing a theory for rational exploitation of tropical multispecies stocks.
3. Training of staff from developing countries in stock assessment technology.

### Single-species Methodology

This program element is mainly an in-house research and information dissemination project. Several papers in which such methods are presented have been either published or are in preparation.

- Presented at the first and third workshops listed above were two papers

in which a methodology is developed to derive stock-recruitment relationships in tropical stocks.

- Currently in press is a paper in which an empirical equation is derived which allows reasonable estimates of natural mortality to be obtained for any fish stock given its growth parameters and the average temperature of the water in which it occurs.
- Currently being fine-tuned is a computer program which directly extracts the most probable growth parameters ( $L_{\infty}$  and  $K$ ) from length-frequency data sequentially arranged in time, without preliminary dissection of the length frequency data sets into normally distributed subsets ("broods").

This computer program can be used to obtain growth parameters from otherwise intractable data (e.g., data with widely overlapping age groups, cases of multiple spawning, etc.). It also incorporates a feature which allows analysis of seasonally oscillating growth, as exhibited by temperate and subtropical fishes.

This program, which represents a radical departure from traditional methods of length-frequency analysis, will be presented in detail in an issue of the ICLARM Newsletter.

- Finally, a manual entitled "Population dynamics of tropical fishes: A manual with application programs for HP 67, 97 and 41C calculators" is under preparation, to help disseminate methods for calculating growth, recruitment, mortalities, stock sizes and sustainable yields of tropical single-species stocks when appropriate raw data are available.

### Multispecies Methodology

As a preliminary step towards the formulation of a suitable approach to multispecies stock assessment, ICLARM will convene a "Workshop on the Theory and Management of Tropical Multispecies Stocks," the aims of which are:

1. To review the methodology (and "rules of thumb") now being used to assess such stocks.
2. To propose new approaches, with emphasis on those that can be tested on the basis of available data from tropical and other multispecies stocks (see front page article).

The findings of the workshop will be applied in the context of a 2-yr

follow-up project on the various stocks and fisheries of the region.

Meanwhile, in addition to, and as a necessary complement to, theoretical research on problems of multispecies stock assessment, a series of practical case studies are planned, in which well-defined fisheries will be assessed using various available methods. The first of these studies, dealing with fisheries of San Miguel Bay, Philippines, is underway as part of a multidisciplinary study of the biological and socioeconomical basis of the fishery. This is being carried out in association with the College of Fisheries of the University of the Philippines (see Smith 1979).

### Training

In addition to the above research and information dissemination activities, training is incorporated as a major program element. Provisions have been made for internship training of staff from developing countries (in government service or from universities), in the context of the described projects and through periodic workshops convened independently or in association with other institutions. Whenever possible, ICLARM interns will be trained using data from their national fisheries. The first intern from the Philippines will be in place soon.

The ICLARM Tropical Stock Assessment Research Project will be carried out by a team, led by the author and assisted by two ICLARM staff associates (a computer science expert and a statistics specialist), and one or more graduate research assistants in fisheries. Provisions are also made for external consultants, visiting (sabbatical) fellows and pre- and post-doctoral fellows.

### References

- Pauly D. 1979. Theory and management of tropical multispecies stocks: A review, with emphasis on the Southeast Asian demersal fisheries. ICLARM Studies and Reviews No. 1. International Center for Living Aquatic Resources Management. Manila. 35 p.
- Smith, I. R. 1979. ICLARM's traditional fisheries research program. ICLARM Newsletter 2(4): 6-8. ●