

new WCPO tuna commission. We have therefore developed a reference point analysis within the MULTIFAN-CL model framework as an example of how this might be applied in WCPO tuna fisheries.

The reference point analysis has been carried out as follows:

1. Estimate population model parameters, including the parameters of a Beverton and Holt stock-recruitment relationship (SRR).
2. Estimate a “base” age-specific fishing mortality vector, F_{age} , various multiples of which are assumed to be maintained into the future; for the yellowfin tuna assessment, the average F_{age} over 1996-2000 was used.
3. For various multiples of F_{age} compute the equilibrium population-at-age, and equilibrium yield using the estimated SRR, natural mortality and other parameters.
4. Compute the equilibrium total biomass, equilibrium adult biomass and equilibrium fishing mortality (averaged over age classes) at MSY. These equilibrium quantities are the reference points.
5. Compare the actual estimated biomass and fishing mortality levels at time t with these reference points. This is done by computing the ratios $B_t^{total}/B_{MSY}^{total}$, $B_t^{adult}/B_{MSY}^{adult}$, F_t/F_{MSY} and their 95% confidence intervals and comparing them with 1.0. Values of F_t/F_{MSY} significantly greater than 1.0 would indicate overfishing, while values of $B_t^{total}/B_{MSY}^{total}$ and/or $B_t^{adult}/B_{MSY}^{adult}$ of less than 1.0 would indicate an overfished state.

Note that these somewhat simplistic notions make assumptions about equilibrium behaviour of the populations. This aspect of reference points, and in particular those based on equilibrium models, has been roundly criticised (with some justification) in some fisheries circles. One criticism is that long-term changes in recruitment might occur through environmental or ecosystem changes that have little or nothing to do with the fisheries. More generally, it is not unreasonable to view many fish populations as being in a continual state of flux with an equilibrium condition never being reached or maintained for any length of time. In reality, therefore, MSY, F_{MSY} and B_{MSY} are “moving targets” and not static quantities. At best, they should be considered as averages over time, and additional analyses undertaken in cases where it is suspected that important non-fishery-induced changes in productivity may have occurred.

Caveats and Biases

The estimated equilibrium yield using a base F -at-age given by the 1996-2000 average is shown in Figure 4. This analysis indicates that, at the 1996-2000 average F -at-age (i.e. a fishing mortality multiplier of 1.0), the equilibrium yield is approximately 300,000 t per year. The maximum equilibrium yield (equivalent to MSY) of about 365,000 t is achieved at a F -multiplier of 2. These equilibrium yields are considerably lower than the actual catches that

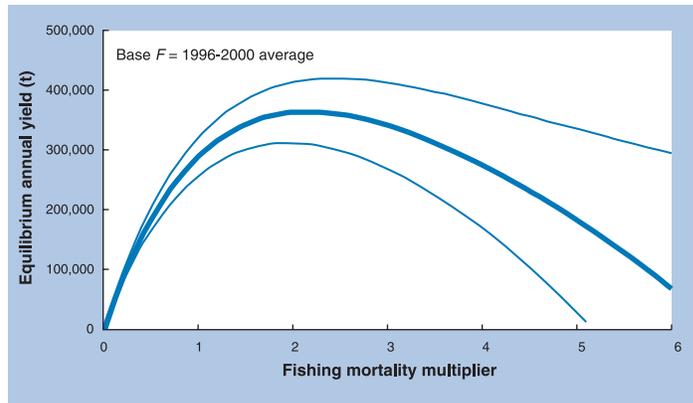


Figure 4. Equilibrium annual yield as a function of fishing mortality, with 95% confidence intervals.

occurred during 1996-2000, which averaged about 425,000 t per year. Does this mean that overfishing is occurring? Not according to this model, which attributes high recent catches to recent recruitment being considerably higher than both the long-term average recruitment and the equilibrium recruitment predicted by the SRR. This underlines the equilibrium nature of the reference point analysis, which in its present form uses only a single SRR to predict equilibrium recruitment in spite of the fact that multiple environmentally-driven recruitment phases may occur for some species. For yellowfin tuna, there is some indication that a high-recruitment phase has occurred post-1975. Had the yield analysis been conducted using a SRR based on this period, then the predicted yields would have been higher and more consistent with recent catches.

Recruitment effects such as noted above can bias status determinations based on a comparison of catch and MSY. A comparison of F with F_{MSY} is better from this point of view as the effects of recruitment are removed. The ratios of F_t/F_{MSY} and $B_t^{adult}/B_{MSY}^{adult}$ are shown in Figure 5. F_t/F_{MSY} has been beneath the overfishing reference point throughout the time series. Also, while adult biomass has fallen recently, $B_t^{adult}/B_{MSY}^{adult}$ has remained above 1.0, indicating that the population has yet to reach an overfished state under the definition used here.

A Conclusion and Cautionary Notes

On the basis of the reference point analysis, we would conclude that yellowfin tuna is not currently overexploited in the WCPO. However, it is necessary to add two notes of caution. First, while overall MSY-based reference points are not exceeded, the model results show that the tropical regions are more heavily exploited than the WCPO as a whole. Such sub-regional differences in exploitation will need to be considered in future management regimes. Secondly, models such as MULTIFAN-CL are relatively data intensive and depend on accurate fishery statistics (as do all fishery models). For much of the WCPO, the

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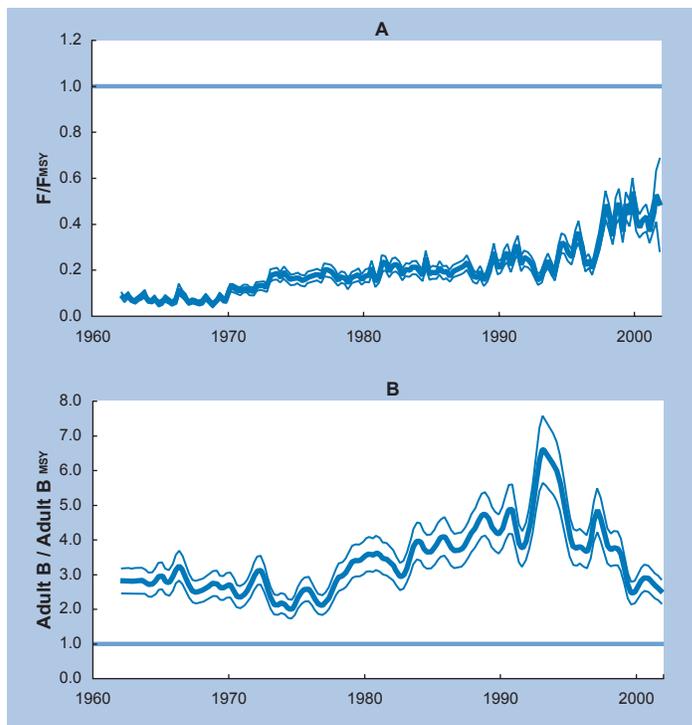
tuna fisheries data are of a high standard. However, the data available for the large catches (around 30% of the WCPO total) of relatively small tuna in the domestic fisheries of Philippines and Indonesia are considerably uncertain and errors in the data could significantly influence the assessment results. Tuna fisheries data collection in this region will need to be strengthened and this is likely to be a priority of the new WCPO Tuna Commission when it comes into force.

References

Hampton, J., and Fournier, D.A. 2001. A spatially disaggregated, length-based, age-structured population model of yellowfin tuna (*Thunnus albacares*) in the Western and Central Pacific Ocean. *Marine and Freshwater Research* 52: 937–963.

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Figure 5. Ratios of (A) F_t/F_{MSY} and $B_t^{adult}/B_{MSY}^{adult}$ with 95% confidence intervals. The horizontal lines at 1.0 in each case indicate the overfishing (A) and overfished state (B) reference points.



Fisheries Research in Brief

DNA Test to I.D. Shark Fins

A new genetic test may help pinpoint the shark species that are most at risk of finning, and help police the widely banned practice as well.

According to conservation geneticist Mahmood Shivji of the Guy Harvey Research Institute in Fort Lauderdale, Florida, it is almost impossible to identify the species of a disembodied shark fin. So Shivji and colleagues developed a DNA test to determine the species of a fin, and with it identified 75 dried shark fins from the Hong Kong commercial market.

As of August 2002, the team had DNA fingerprints for blue, dusky, porbeagle, silky, and longfin and shortfin makos, which are commonly found on the global market. Shivji plans further testing to expand the coverage to the 35 species of shark that are most commonly fished, and believes the test is fast and simple enough for conservation agencies to use.

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(see Shivji, M., et al. Genetic identification of pelagic shark body parts for conservation and trade monitoring. *Conservation Biology*, 16, 1-13, (2002))



Abstract: Status of the U. S. Western Pacific Tuna Purse Seine Fleet¹

Robert Gillett, Mike A. McCoy, and David G. Itano

This study focuses on aspects of the dynamics of the United States tuna purse seine fleet, and is intended to increase the information available for management of Western Pacific tuna resources.



U.S. purse seiner in Pago Pago harbor.

The authors review the fleet's history, describe major interest groups, and discuss various factors affecting its operation, as well as forces influencing its future. To carry out the study, the authors supplemented their experience with and knowledge of the U.S. fleet with interviews of numerous important stakeholders, including present and past U.S. vessel owners and managers, fishing vessel operators, representatives of several tuna processing companies, representatives of the U.S. tuna industry, and tuna fishery managers.

Study Topics and Analysis

Specific topics addressed are:

- the movement of the fleet from the Eastern Pacific to the Western Pacific;
- fishing patterns;
- specifications of the fleet;
- stakeholders in the fleet; and,
- major issues confronting the fleet.

The study analyzes positive and negative factors affecting the fleet, and identifies the most important threats to its survival; it also views current issues in light of how the fleet coped with previous threats from the mid-1950s to the late 1980s.

Information about the future of the U.S. fleet is conceptually divided into three categories:

- opinions expressed by other studies and individuals;
- assertions that can be made with some degree of confidence; and,
- speculation based on information in this report and other sources.

Viability of the Fleet

The authors subsequently explore the management implications of both a declining fleet and the demise of the fleet. Four

¹This report is available in its entirety as a PFRP Technical Report: SOEST Publication #02-01 / JIMAR Publication #02-344.

major factors are described as threatening the continued viability of the fleet: (1) low or stagnant prices; (2) the fleet's high costs of production; (3) the reduction of advantages for basing in American Samoa; and (4) the underlying threat of a lack of generational continuity in vessel-owning families.

With respect to the fleet's future, many of the factors causing the downward trend in U.S. vessel numbers will probably persist. Conversely, a recent change in a trade arrangement with Andean Pact countries will have a favorable impact on the fleet. Most of the events that have had a major effect on the U.S. fleet in the past (both negative and positive) have been largely unexpected.



The dock at Starkist Cannery in Pago Pago.

Fleet Ownership and Coping with Change

In the longer term, the composition of the fleet with respect to ownership is likely to evolve and be made up of more corporate-owned vessels and vessels owned by individuals who have other than strictly financial reasons to stay involved in the industry. This change may be similar to what has occurred in U.S. agriculture, with its continued evolution from family-owned farms to corporate, or agribusiness ownership.

The study also describes the management implications of two possible change scenarios for the U.S. fleet, and identifies as some of the most likely consequences:

- the entry of additional fleets into the Western Pacific and a consequent increase in overall effort in the fishery;
- degradation of the quality of fisheries data and flag state responsibility; and,
- increases in FAD-related fishing.

Finally, several indicators point strongly to the U.S. Government continuing its role in management of the Western Pacific tuna fishery should its purse seine fleet cease to exist; these indicators include experience in the Eastern Pacific, where the U.S. fleet is no longer active.

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This report was prepared in August 2002 for the Pelagic Fisheries Research Program at the University of Hawai'i. Robert Gillett and Mike McCoy are a Fiji-based Director and a Kona, Hawai'i-based Associate, respectively, at Gillett, Preston and Associates, which provides consulting services for fishery and marine resource assessment, as well as development and management projects. David Itano is a Research Associate with the PFRP in Honolulu, and can be reached at ditano@iniki.soest.hawaii.edu. Gillett can be reached at gillett@connect.com.fj, and McCoy at mmc@aloha.net.

MHLC— Evaluation and Comment

Anna Willock

Following is the fifth in a series of commentaries on the Multilateral High-level Conference on the Conservation and Management of Highly Migratory Fish Stocks in the Western and Central Pacific (MHLC). The goal of this series is to share the evaluations of scientists and other parties who are well informed about the MHLC, its Convention and evolving Commission, in the hope that continued frank discussion can contribute to the most effective and mutually agreeable implementation of the Convention.

We have accepted the assessments of persons recommended as knowledgeable about MHLC and are seeking additional comment. Our principal criteria are that contributors are familiar with the proceedings, the science and the proposed management schemes, and are willing to answer the same questions, with an opportunity for open comment.

Comments, questions, and requests for inclusion as a contributor may be addressed to Editor, PFRP News, MSB 313, 1000 Pope Road, Honolulu, Hawai'i 96822, or e-mailed to andercox@hawaii.rr.com, or jsibert@soest.hawaii.edu.

General Questions

1. *MHLC conferences attempted to resolve international concerns and develop a formal means of managing Highly Migratory Fish Stocks in the Western and Central Pacific. Do you feel this goal was achieved by the conferences? Why or why not?*

While the MHLC process has not in itself resolved international concerns relating to stocks in the broader Western and Central Pacific Ocean, it has resulted in development of a fairly detailed framework through which it is now possible to address such concerns as they arise. The need for such a formal structure, enabling both conservation and management of highly migratory fish stocks on the high seas, and integration with measures implemented by Pacific Coastal States, has long been recognized in the region, including in the 1979 convention establishing the Forum Fisheries Agency.

With regard to science, there already existed well-developed processes for cooperating on research in the region, particularly through the activities of the Oceanic Fisheries Programme. However, adoption of the new Convention now moves the provision of scientific advice into a more formal (and political) setting as the Convention mandates action to be taken based on this advice.

2. *Do you feel MHLC7 was a good conclusion to these meetings? Why or why not?*

Perhaps the most positive outcome of MHLC7 was that the Convention was adopted. The final text is disappointing in that it

contains unwelcome compromises in a number of important areas, including the chambered voting system, the reversal of the onus of proof in relation to port states' ability to prohibit landings or transshipments of catches in their ports, and the potential for conflict to emerge between management arrangements north of 20°N and those in the rest of the Convention area. Nevertheless, the fact that a number of countries, at the conclusion of the conference, were moving away from previous agreements, made it likely that further negotiating sessions would have resulted in further weakening of the text.

MHLC7 clearly drew to a close the first stage in development of a conservation and management regime for the broader Western and Central Pacific—yet much of the momentum and good will generated by earlier negotiating sessions was lost in doing so. MHLC7 created a great deal of frustration and dissatisfaction on the part of many participants, particularly in reaction to the eleventh-hour changes to decision-making provisions, and the refusal by some participants to agree to adoption of the final text.

3. *Should there be an MHLC8, and if so, what should be addressed at this meeting?*

The question of whether there should be an MHLC8 has already been superseded by the holding of two Preparatory Conferences. The creation at Preparatory Conference I of a working group devoted to considering scientific issues, including technical concerns and mechanisms for the delivery of science, was very welcome. This removed the risk that resolution of scientific issues would be overshadowed by administrative and budgetary considerations, which are being discussed in a separate working group.

Specific Questions Regarding MHLC

1. *In terms of research and data gathering, what advantages do you feel the MHLC Convention has over other conventions dealing with highly migratory fish stocks (e.g., IATTC, IOTC, ICCAT, CCSBT)?*

The MHLC Convention had the advantage of being negotiated after the adoption of the United Nations Fish Stocks Agreement (UNFSA). This meant that detailed guidelines and obligations relating to data collection and research for highly migratory fish stocks had already been agreed to at an international level. While there was still a high level of debate over some of these obligations, the UNFSA provisions provided a solid basis upon which to develop the MHLC text.

A further advantage of the MHLC Convention is that it draws on the experience under other conventions – both negative and positive. As an example, the explicit ability of the MHLC Commission to engage independent scientific experts to provide it with advice is a major advantage over some other conventions, and a step toward trying to ensure that science is not politicized.

A key advantage for the success of research and data gathering under the MHLC Convention is that the region already has well-

established institutions and cooperative mechanisms for this purpose, providing a sound basis for developing the detail of protocols specified under the Convention.

2. *What are the disadvantages of the MHLC Convention with regard to data collection and research?*

It is probably a little early in the life of the Convention to identify weaknesses related to data collection and research; any such weaknesses are more likely to emerge once the arrangements have been fully tested against practical and political considerations. Discussions at the first meeting of the Scientific Coordinating Group, held in late July 2002, should quickly identify deficiencies in the text.

However, one potential disadvantage in the Convention as it stands relates to the engagement of scientific experts, whose involvement is not mandatory and so is open to debate. The potential purview of the independent experts is also fairly wide, which raises budgetary considerations. A point related to budgetary considerations is that Coastal States will need to balance the level of resources devoted to in-zone research with those devoted to regional research. This is an important consideration for small island countries and the regional organizations that support their in-zone research needs.

3. *What do you consider to be the major obstacles facing the scientific arrangements associated with the Commission?*

While not so much an “obstacle,” the Commission (and its supporting scientific arrangements) will need to be structured to ensure that there is not a myopic focus on the four main tuna stocks at the expense of other issues of increasing international concern; these include bycatch of sharks and turtles, and development of ecosystem-based approaches to management. Related to this will be the need to continue developing innovative approaches to scientific research and analysis in the region, while at the same time ensuring that such research remains relevant to the questions that will need to be answered to develop management responses within the context of the Convention. This will rely in part on scientists being able to communicate effectively to the Commission the relevance of innovative work.

4. *What do you consider to be the major obstacles facing the MHLC Commission over the next few years?*

A major pragmatic factor facing the future Commission will be acquisition of adequate funding for the range of activities under its mandate. Given the geopolitical nature of the region, donor organizations will most likely be forced to decide where to direct limited funds, including how to divide funds between support for existing regional institutions and obligations under the new Commission.

The absence of Japan in the Preparatory Conferences is also a concern; Japan’s positive contribution to the future Commission will be important to its success, not only because Japan is a major distant-water fishing nation and Coastal State under the Convention, but also because it possesses well-established expertise in scientific research.

Finally, the issue of allocation of fishing effort or catch has already appeared on the horizon. A major challenge for the MHLC Commission will be to avoid the implosion being experienced in other fisheries organizations over this issue, which has left them almost paralyzed and so unable to address other conservation and management issues.

5. *In the wake of MHLC7, how will management of high-seas fisheries in the Western and Central Pacific change over the next ten years?*

Ten years is a relatively short time frame for a Convention that is not yet in force. However, the fact that there will be a forum to discuss and make binding decisions on management of the high seas will in itself be a major change in the region.

The current global impetus to address the problems of illegal, unregulated and unreported fishing should have major repercussions for the Western and Central Pacific. In particular, over the next ten years the notion of “freedom of fishing” hopefully will be further qualified through legal challenges and more extensive accession to the UNFSA. Resolution of allocation issues in the region should also affect the high seas by providing part of the solution to unregulated fishing.

With regard to the form that management measures may take, trade-related and market-based measures are emerging as a tool to supplement at-sea monitoring, control and surveillance within regimes dealing with high seas fisheries— and it is likely that we will see some form of certification or documentation developed in the Western and Central Pacific to address what will be similar problems in this region.

6. *As far as scientific research is concerned, what needs to be done during the approximately 3 years of Preparatory Conferences that take place between adoption of the text and enactment of the Convention?*

The Preparatory Conferences’ expectations for scientific research are reasonably clearly set out in the terms of reference for the working group on scientific structure and provision of interim scientific advice. It will be essential that agreements are reached during this period on the means of delivery of scientific advice to the Commission, and on protocols for the collection and organization of data. Furthermore, the working group has also been asked to delineate a process by which the Preparatory Conference can receive advice on the status of the four main tuna stocks. This

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links with Resolution I of MHLC, which enables the Preparatory Conference to recommend conservation and management measures for the stocks prior to the Convention coming into force. Although any such measures would only be applied on a voluntary basis, such a mandate is crucial given the concerns about the status of yellowfin and bigeye that have emerged in recent meetings of the Standing Committee on Tuna and Billfish. To place any such advice on the status of stocks in context will also require the development of reference points (both target and limit) for at least each of the key tuna stocks.

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