Bay of Bengal Large Marine Ecosystem Project
and the
Indian Ocean Tuna commission

BOBLME/IOTC –
Stock Assessment Course (Bangkok, TH)
May 20th-24th, 2013
Final Report

Instructors:

Dr. Rishi Sharma*
Dr. Jim Ianelli
Dr. Dale Kolody

* Report author

Background

Despite the importance of fisheries to the Indian Ocean region, scientific monitoring and management are modest, with most stocks lacking modern scientific stock assessments. Without stock assessments, it's impossible to determine whether fish populations are overexploited or, potentially, underexploited relative to their ability to support sustainable yields. At a national level, fishery yields have been flat over the past decade, while the Indian Ocean countries populations have increased, and thus the need for sustainable protein sources has continued to increase. Does the current plateau in fishery yields represent the maximum sustainable yield or is greater harvest possible? If higher yields are possible, do we get there by fishing harder or by rebuilding overfished stocks?

From a scientific perspective, India and other Indian Ocean countries fisheries represent an opportunity to learn about the success and failure of fishery management strategies across a wide diversity of scales and management approaches. Indian Ocean fisheries range from large-scale industrialized fisheries for pelagic fishes like oil sardine, herring, and tuna to artisanal fisheries for nearshore and estuarine species. No single management approach is likely to be effective at all scales. A growing body of research on small scale and artisanal fisheries suggests that despite the lack of traditional top-down management by the central government, many of these fisheries have managed to avoid the "tragedy of the commons" problem where common-pool resources are inevitably degraded (Feeny et al. 1996; Ostrom et al. 1999). At the same time, recent work on community co-management, a widespread approach to management of small-scale fisheries, has elucidated the characteristics of such systems that lead them to be effective (Gutierrez et al. 2011).

There is currently a lively scientific debate about the global status and trends of marine fisheries. The most recent evaluations suggest that, at a global level, populations of exploited marine fish and invertebrate have declined 38% between 1970 and 2007, but have, on average, been stable since the early 1990s (Hutchings et al. 2010). Approximately two-thirds of marine fish populations are currently below the population size that would produce the maximum sustainable yield, but only one-third of marine fish populations are now being fished at rates that will lead to depletion below this level (Worm et al. 2009). That is, for many overfished populations, fishing has been reduced and the stage is now set for their recovery. These conclusions have been criticized[1] for their reliance on a global stock assessment database (Ricard et al. *In press*) in which fisheries from developing countries are seriously under-represented. The developers of that database, the

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[1] http://blog.nature.org/2011/01/daniel-pauly-fish-stock-global-world-fisheries/

only one of its kind, acknowledge this weakness but are limited by the existence and public availability of fisheries data from developing countries like India.

These capacity building initiatives will improve fishery management in the Indian Ocean region, while at the same time increasing our understanding of status and trends of fisheries in developing countries. The data which will be used in these stock assessments already exist, and the work of this project is synthesis, analysis, and capacity building.

Thus using this justification IOTC along with BOBLME held a workshop in Bangkok, Thailand for 5 days between the 20th to 24th of May. The workshop covered all aspects of how assessments are used within the IOTC context and also how to develop and analyse simple to complex models. The teaching was in two modes:
1) Lectures
2) Labs developing concepts presented in lectures.

Introduction

The course covered numerous elements of stock assessment and ecosystem approaches to fisheries assessments. The introduction was made by Dr. Hermes, the NTA of the BOBLME program. The course was taught by Dr. Rishi Sharma (IOTC), Dr. Jim Ianelli (NOAA) and DR. Dale Kolody (CSIRO).

Objective

The objectives of the course were three fold:
a) To convey the basic understanding of data collection programs and their use
b) To demonstrate how these could be used in an assessment through Population dynamic models.
c) To convey basic interactions of fish within an ecosystem.

To understand core competency of the students attending a course survey was developed initially so target instruction would be at the level required based on this survey (Appendix 1)

Approach

The course was run in the format of lectures followed by examples (see Appendix II for agenda). Numerous lectures were covered on the following:
1) Ecosystems and Biomes where fish interact with the region they reside, and how the feed on areas that have high primary production (as an attribute of oceanic features, tidal mixing or upwelling patterns).
2) Life history and how these factors are important in understanding the population dynamics.
3) Sampling design and collection of catch and effort data.
4) Basics of Stock Assessment.
5) Climate Forcing and the effects on ecosystems
6) Spawner and Recruit

For accessing material preseted in the workshop one can look at the Website developed for this (*https://sites.google.com/site/stockassessmentbkk2013/home*).

Workshop Effectiveness

29 A survey was designed for feedback after the course (Appendix III). The course was developed to build capacity in stock assessment knowledge in the region and this workshop presented some basics of stock assessment and their value. In order to understand if it were useful to the audience a survey was developed that would address the utility of the material presented and whether the course should be modified somewhat. Results of the survey were given in Table 1 after Appendix IV.

Workshop Feedback

28 people attended from 8 different countries in the Bay of Bengal Region. These individuals were from varied background, but primarily scientists, managers or biologists in their respective agencies. There was a clear deman for more such trainings in the region (Appendix IV, Table 1). In addition, the course had very positive feedback, all participants learned a lot, and wished that more such trainings were available and more time would be given to these workshops.

Future Courses

Course presentation material in electronic format were handed to the participants for making their understanding clearer. Based on the feeback future courses will be held in the region again covering simialr material in more depth in the region. The focus would again be on advanced stock assessment techniques and will require computers and a computer labs for training. Such course would probably be focussed on lesser individuals and more intensive on programming and computer techniques to be used in the preparing for an assessment.

Appendix I:

Pre-workshop survey

	Experience			
Software	None	Some	Moderate	Uber
Excel				X
R (Splus-like)			X	
Bugs, (WinBUGs Brugs)		X		
SAS		X		
Matlab	X	X		
C++ (or C)			X	
Linux/unix			X	
Batch files/scripts			X	
Other compiled language			X	
Other software			X	
Statistics				
Fitting models to data			X	
Likelihood functions			X	

Please state what you would like to gain from this workshop or provide any other comments or questions you may have.

Please state what stock assessments you have conducted or responsible for?

Please state your role in your department, and how this workshop will benefit you in the future for your work?

Appendix II: IOTC Basic and Advanced Stock Assessment Training

PREPARED BY: IOTC SECRETARIAT & BOBLME

Course outline

The course will cover basic fisheries stock assessment principles and types of data analyses. This will include statistical evaluations of data leading to estimates of stock abundance and productivity. Methods will build form simple surplus production models through yield per recruit and age structured approaches.

Overview

The objectives of this course are the following:

1) To understand basic concepts of population dynamics models and how to develop them on a species context for management.
2) The second part of the course is designed to introduce cutting edge computational tools to evaluate and understand how to collect and analyze data for ecological and environmental studies. This will primarily be done with the help of labs and tools in Excel and R.
3) An advanced version of this course will focus on programming, visualizing data, using integrated assessment models like SS-III and Multifan-CL. So, more in depth learning will occur on Topic 5 and 8 so that length based models are also included.

Course outline

1) Introduction   Day 1 AM
   a. Workshop participants overview- Rishi
   b. IOTC Process Overview- Rishi
   c. Data sets and fishery issues- Jim & Rishi
   d. Defining management objectives, pretty good yield - Jim
2) Survey of population dynamics and stock assessment applications   Day 1 PM
   a. Ocean habitats and species interactions - Rishi
   b. Fisheries management definitions - Rishi
   c. Ecosystem and multispecies methods - Jim
3) Data analysis
   a. Use of R http://www.statmethods.net/ Dale
   b. Excel basics- Jim
   c. Fishery exploratory analysis-Jim
4) Sampling systems
   a. Estimating catch - Rishi
   b. Survey methods - Jim
   c. Introduction to tagging programs - Dale
5) Growth estimation and life history   Day 2 AM
   a. Organizing available data - Jim

   b. Approaches to growth estimation - Jim

   c. Maturity/spawning characteristics- Jim

   d. Sharing information from other stocks -Jim

6) Population models   Day 2 PM

   a. $B_{t+1} = B_t + R_t + G - C_t$ - Rishi

   b. Extend by age - Jim

   c. Depletion methods - Jim

7) Per recruit analysis

   a. Spawning biomass – Jim/Dale/Rishi

   b. Yield – Jim/Dale/Rishi

   c. Harvest rate – Jim/Dale/Rishi

8) Age Structured Models   Day 3 AM

   a. Basics - Jim

   b. Fitting w/ assumptions - Jim

9) Length-based extensions   Day 3 PM

   a. Overview of principles - Jim

   b. Available complex packages – Jim/Dale

   c. Fitting an age structured model to length frequencies in excel - Jim

10) The Management Strategy Evaluation Process & Simulations Overview - Dale   Day 4 AM

11) Estimating spawning stock and recruit relationships (SR) - Rishi

12) Climate Forcing and Effects - Rishi

13) Dataset examinations Part I - All   Day 4 PM

14) Dataset examinations Part II -All   Day 5 AM

Appendix III: Survey on Advanced Stock Assessment course in Thailand

Please answer the questions as to relevance (1 being most irrelevant and 5 being most relevant).

1. What is your role within Department of Fisheries in your country?
Biologist ⬭   Manager ⬭   Scientist/Research ⬭ Academia ⬭

2. Did you find this course useful?
1. Not relevant ◯ 2. Somewhat relevant ◯   3. Relevant ◯   4.Useful in job ◯ 5. Highly Relevant ◯

3. Would you want another course as a follow up in more depth?
1. No ◯ 2. Unsure ◯   3. Maybe. ◯   4.Yes ◯   5. Undoubtedly Y ◯

4. Would you want a programming (R and C++) course to be the focus?
1. No ◯   2. Unsure ◯   3. Maybe ◯   4.Yes ◯   5. Undoubtedly Yes ◯

5. Do computer labs make some of this material easier to understand?
1. No ◯ 2. Unsure ◯   3. Maybe. ◯   4.Yes ◯   5. Undoubtedly Yes ◯

6. What areas in BOBLME countries would require some analysis?

Inland ◯   Marine ◯ Both ◯

7. Did you bring your data to analyze in this workshop?

Yes ◯   No ◯

8. Do you understand the limitations of your dataset?

Yes ◯   No ◯   Maybe ◯

9. Will there be more efforts to collect data that is useful to SA's?

Yes ◯   No ◯   Maybe ◯

10. Is there a need for more workshops and trainings of this sort in the region?

Yes ◯   No ◯   Maybe ◯

11. Overall course rating.

1. Not relevant ◯ 2. Satisfactory ◯   3. Good. ◯   4.Excellent ◯   5. Outstanding ◯

Other comments

Appendix IV: Results Tabulated for Survey

Question	OUTCOME					
	Biologist	Manager	Scientist/Researcher	Academia		
Q1	4	5	19	0		
	Response 1	Response 2	Response 3	Response 4	Response 5	No response
Q2	0	0	6	16	6	
Q3	0	1	1	14	12	
Q4	0	0	5	15	6	2
Q5	0	0	1	17	10	
	Inland	Marine	Both			
Q6	0	13	15			
	Yes	No	Maybe			
Q7	26	2				
Q8	25		3			
Q9.	24		3			1
Q10	27		1			
	Response 1	Response 2	Response 3	Response 4	Response 5	No response
Q11	0	3	11	8	5	1

*Note multiple responses were given on this
Other comments
Excellent course. Thanks
More training based on data collected in LOA. Follow up in one year for Hilsa Fisheries Working Group.
Country based training would be more useful
Thanks
Time too short to absorb all this material. More training required.
Beginner course required for some people as even basic population parameters for stocks need to be estimated.
Need more time
Such training essential for BOBLME for SA
Lab exercises more relevant with real data.
Organize data for workshop so we can analyze data from assessment at workshop
Need documents and references in hand before workshop
Excellent training

Appendix V: Pictures from course