WORKSHOP ON STOCK ASSESSMENT OF AUSTRALIA'S TROPICAL FISHERIES

Project 91/96

Final Report to the Fisheries Research and Development Corporation

R. C. Buckworth, Project Supervisor

Fisheries Division, Department of Primary Industry & Fisheries
GPO Box 990 Darwin NT 0801
(089) 897648

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DEPARTMENT OF
PRIMARY INDUSTRY
AND FISHERIES

WORKSHOP ON STOCK ASSESSMENT OF AUSTRALIA'S TROPICAL FISHERIES: FIRDC Project 91/96

Final Report to the Fisheries Research and Development Corporation

Summary:

The need to train Australia's fisheries scientists and managers in stock assessment was recognized by the Fishing Industry Research and Development Council (FIRDC). Accordingly, FIRDC provided funding to the NT Department of Primary Industry and Fisheries to conduct a stock assessment training workshop in Darwin. The objectives of the workshop were to provide training and experience in stock assessment techniques, and to apply these techniques to fisheries in northern Australia. These objectives were achieved.

In two sessions, each of three days, the workshop provided training to staff of NT Department of Primary Industry and Fisheries (DPIF), Queensland Department of Primary Industries (QDPI) and the former Bureau of Rural Resources (BRR). The first session, held 22-24 March 1992, was led by Dr Derek Staples of BRR and Mr Mike Dredge, of QDPI. It provided an overview of techniques available for stock assessment, including experience with several of the computer software packages available for estimating population parameters. The recent publication by Hilborn and Walters (1992) was used as a text, with additional material from the Australian Maritime College (King and Bertreaux 1990). Hilborn and Walters (1992) provides several software tools and these were augmented by additional software from various sources, including ELEFAN.

The second session, 24-26 June was led by Mr Norm Hall of the Western Australia Department of Fisheries, with the assistance of Dr Staples. This session concentrated upon the development of stock models based on a suite of tools developed by Professor Carl Walters and modified by Mr Hall. Mr Hall provided instruction in concepts, modelling tools and outline skeletons for several types of models: Delay difference, age-structured, length-structured and spatially-structured models. The delay difference framework was used to develop models for several NT fisheries, including mackerel, gold-band snapper, red snapper and mud crab.

Introduction

Fisheries management agencies typically must make quantitative choices about how a stock should be managed - to address questions such as "what should the total catch be?", "how much development is appropriate?", or "should restraints be imposed on operations in order to provide economic and community benefit?". Stock assessment is the process of developing quantitative predictions of the way a fished population will react to management actions and is thus a vital basis for fishery management decisions.

Although there is a wide body of literature and a large suite of software tools available for stock assessment, it is a numerically intensive and rapidly evolving field. The training provided to fisheries scientists in the past is often not equal to current demands. As revealed in Australia's first National Workshop on Fisheries Stock Assessment, in Canberra in April 1992, it is felt that few Australian fisheries scientists have a high level of competence, and that there was urgent need for training and direction at all levels. Training in stock assessment techniques was embodied in Fishing Industry Research and Development Council (FIRDC) priorities in 1990 and had been recognised in earlier funding of workshops led by Professors Carl Walters and Ray Hilborn and Dr Bill Fox, leading North American stock assessment and fisheries management analysts and educators.

Similar needs were specifically recognized in the Northern Territory. In the Fisheries Division of the Department of Primary Industry and Fisheries, stock assessment training was identified as the major priority for scientific staff. In close proximity to Asia and at the centre of Australia's northern fisheries, Darwin is appropriately positioned as a centre of expertise in tropical population dynamics and assessment. However little training is available in Darwin, with the remoteness of the city and consequent travel costs limiting interaction of NT staff with other Fisheries Departments, CSIRO, the Bureau of Resource Sciences (BRS) or related organizations.

The underlying thrust of this project was to train fisheries science and management staff working on Australia's tropical fisheries in modern stock assessment techniques, using Australian expertise. FIRDC thus provided funding to cover travel by workshop leaders to Darwin to conduct the workshop, and to cover operating expenses.

Project objectives and extent to which these were achieved:

1. *To conduct a workshop to provide fisheries research and management personnel, working on Australia's tropical stocks, with training and experience in various stock assessment techniques.*

This objective was achieved.

Although the application for funding indicated that a workshop of five days duration would be conducted, the partial approval of the grant meant that CSIRO were unable to provide the workshop leaders as originally specified. To accomodate the leadership support provided by the former Bureau of Rural Resources (BRR), WA Department of Fisheries and Queensland Department of Primary Industries (QDPI), it was necessary to divide the workshop into two sessions. Although creating a significantly greater organizational load, this provided the opportunity to develop separate operational objectives and to address slightly different target audiences, with different levels of sophistication, for each session. It also provided for the evaluation of the first session's organization and application of the contents before the second session. Participants were invited from several institutions involved with tropical Australian fisheries science (Table 1). The response from several organizations, however, was that in house-programs addressed most of their stock assessment training needs.

The workshop sessions comprised series of lectures interposed with use of stock assessment software packages or development of models. Participants were requested to complete an evaluation sheet after each session.

The first session of the workshop was held at the Fisheries Division Conference Room, Harbour View Plaza, Darwin on 25-27 March 1992. The minimum level of sophistication required was that of somebody who, for example, would be required to implement a program designed to provide information for stock assessment, and may explain aspects of that program to industry.

Workshop leaders were Dr Derek Staples (BRR), and Mr Mike Dredge, (QDPI). Participants (Table 2) included staff from DPIF, as well as CSIRO and QDPI. The working objective for this session was to provide an overview of stock assessment - its objectives, concepts, the tools available and their the information requirements, examples of their application, limits and misuse, and the de-mystification of the jargon.

A broad range of topics were covered (a summary is provided in Attachment 1), with Hilborn and Walters (1992) used as a text. Experience with the generalized fisheries analysis packages, particularly use of the software provided with Hilborn and Walters (1992) and ELEFAN, was emphasised. Mr Dredge directed games using beads as simulators of fished populations and the sampling effects associated with the estimation of population parameters.

The second session of the workshop was held at the Training Rooms of the Office of the Public Service Commissioner, Harbour View Plaza, Darwin on 24-26 June 1992. The session leader was Mr Norm Hall of the WA Department of Fisheries, with assistance from Dr Derek Staples (BRR). Participants included staff from NT Fisheries Division, BRR, CSIRO and QDPI (Table 3).

The level of sophistication required for this session was higher, with the target audience being those who make stock assessments, design and implement the programs for gathering stock assessment information, or manage fisheries on their basis. The operational objective for the second session was to increase the stock assessment and modelling skills of the participants and was thus almost entirely devoted to computer modelling. It was by necessity more mathematically and computer intensive than the first session.

Mr Hall provided a suite of modelling tools and skeleton models, (developed from a series of models by Carl Walters) and the session consisted of teams developing models with these tools, using their own data where possible. The major goal was thus for each of the workshop teams to develop a model of "their" fishery. Hilborn and Walters (1992) was again used as a general text. QuickBASIC was used as the programming language for the models but examples were also provided for EXCEL and SAS. Mr Hall lectured on the theory and background of the models and assessment process, guided their application and provided direction on possible extensions of the process.

2. *To apply these techniques to problem areas in research and management of fisheries administered by the NT, or which are important to the NT and northern Australia.*

This objective was achieved.

With the first session's aim being to provide an overview, examples used in the first workshop session were usually those provided with the software packages. However, most interest was generated with data supplied by participants - NT barramundi catch and effort data and NPF tiger prawn stock-recruitment data. This gave the participants a more concrete appreciation of the utlity of the packages. In the period between the workshop sessions (and subsequent to the workshops) the packages have been used for exploratory analysis and provided starting estimates of parameters for use in modelling in the second session.

In session 2, teams were formed on the basis of interest in a particular fishery (where possible), and these fisheries modelled (Table 4) under Norm Hall's guidance and using the set of modelling tools he provided. Fisheries important to northern Australia were thus modelled by the participants of the second session. Use of the models in the management of the fisheries will require their further development.

The NT mackerel troll fishery data set was used as a general example of the application of the model skeletons to available data. Skeletons for logistic models incorporating observation error and process error (biomass models), age- and length-structure, spatial processes and fleet dynamics were provided. While guidance on the use of these models was given, the limited time available allowed the use of only the biomass models during the workshop. The session thus provided the participants with the experience of using the least complex of the

formats, and the means with which to extend these to more elaborate and alternative models as experience grows and needs become apparent. The agenda and course notes provided by Mr Hall are included in Attachment 2.

Research results and application:

Results of the workshop have yet to be applied to industry, in an explicit sense. However, the workshop sessions provided knowledge and experience in stock assessment and techniques which should be applicable in most fisheries research and management programs, and through these, to industry. Future elaboration of the models developed in the workshop, or application of the modelling framework, will be used in the analysis and management of fisheries in northern Australia. As a general goal, the assessments are to be used as a means of summarizing information on stocks, evaluating uncertainty and clarifying research direction. The models developed in the wokshop are listed in Table 4; applications for some of these models are:

Mackerel: The model of the NT troll fishery for spanish mackerel is being used to summarize information from the NT returns system and with biological information, will be used for stock assessment. It is possible that this will be extended to include Western Australia and Queensland Gulf of Carpentaria fisheries. As data are provided from research and management programs, the assessments should become more precise and will be used to indicate research directions and become the basis of management of the fishery.

Mudcrab: It is planned that the model for mudcrab stocks be extended from a simple logistic model to a spatial model. This will provide a basis for the assessment of industry moves for regional management of the mud-crab fishery, and allows the possibility of an adaptive management strategy.

Red snapper (Lutjanus malabaricus): Progress with the model developed in the workshop will allow it to be used as an alternative approach in future assessments of northern stocks of this species by the Northern Fisheries Research Committee Stock Assessment Working Group.

Shark: Norm Hall extended the model skeletons used in the workshop to northern shark stocks (which were not examined in the FIRDC-funded workshops) during the Australia-Indonesia Workshop on Arafura Sea Fisheries (Darwin, November 1992; Anon. 1992). While not providing definitive assessments, the modelling process served to bring the available information together. It also underscored the need for the diverse data sets on northern shark to be collated and carefully evaluated and documented before they can be used more effectively. A program to address this need is being developed within the Fisheries Division.

Chinese Acetes fishery: *Acetes* are the basis of large fisheries in China and throughout much of the tropics and sub-tropics. The delay-difference model indicated that the current available data were not sufficiently acurate to allow stock assessment, probably due to inadequate information on fishing power (Xiao in press).

Within the Fisheries Division, a follow up program is to be implemented to maintain the momentum in stock assessment provided by the workshop. Details of this program are included as Attachment 3.

Evaluation

Benefits:

The major benefits of the program were that, as stated in the objectives, participants were provided with training and experience in stock assessment techniques, through lectures on stock assessment, by gaining experience with a wide range of software tools for various stock assessment problems, and by developing models for data sets with which they were familiar.

Although as yet to be realized, very concrete benefit should be provided as the models are elaborated, documented and applied to management of fisheries; benefit should also accrue to participants and the fisheries with which they work as the training of the workshop is applied. By holding the workshop in Darwin a benefit for the NT was that a larger number of staff received training than could otherwise be achieved. This was in terms of both absolute numbers and composition. High level staff (eg Assistant Secretary), as well as technical staff, were able to attend for parts of the workshop. Such staff would seldom receive support to attend similar workshops interstate.

The model skeletons provided by Norm Hall, although currently difficult to access without his detailed guidance, represent a step in the development of a more easily useable package.

The workshop also had the effect of enhancing communication between participants and leaders and thus their respective institutions. In this sense, workshop leaders being from three separate institutions (and the majority of participants from another organization) was to advantage.

Course format, content and organization:

Along with verbal comments received and personal observation, evaluation sheets distributed to course participants after each workshop session (Attachment 4) allowed an appraisal of the conduct of the workshop.

Responses on the whole were very positive. It is most noteworthy that the workshop leaders received considerable commendation, verbally or in responses on the evaluation sheets. This reflected their effort in preparation and presentation of the sessions.

Session 1

All 14 respondents from the first session regarded the workshop as "worthwhile", and provided a better appreciation of stock assessment. Only the Assistant Secretary felt that it could not be applied in his work. The best aspect of the course was identified either as the overview and range of topics and exercises provided, or as the quality of workshop leadership. These points were also included by other respondents as comments.

To most respondents problems related to hardware, software or operating system difficulties were the "worst aspect". With the range of software used, it is doubtful whether all problems with hardware, operating systems and software could be eliminated, especially considering the different outlooks, levels of experience and motivation of participants.

One perceptive response was that in some cases, modelling using ELEFAN or similar packages was "too easy" - answers could be developed with little understanding of underlying principles or knowledge of the data.

Most respondents thought that the workshop content was well balanced but more application to biological data from local fisheries was suggested.

Ways in which respondents intended to apply the training reflected their work positions. Thus management officers would use it for interpretation, research officers would use the packages with their own data and a technical officer dealing with industry, for communication and discussion. Intended follow-ups to the session included application of the software packages, further reading and use of Hilborn and Walters (1992) and attendance at further training courses. Regular revision was also suggested.

Session 2

After the second session, 14 (of 16) responses were positive but two respondents (fisheries management officers) responded that the exercise was only partially worthwhile, as the model development process (as opposed to interpretation) would be difficult to apply in the course of their current work.

The best aspect of the session, to most respondents, was the use of "local" data and the hands-on approach, or the overall content. Good leadership and direction were again emphasised by several respondents. The proportion of the available time required for typing in computer code and debugging was generally regarded by most as the worst aspect of the session.

Most respondents reported a better appreciation of the stock assessment topics but more application of the models to different data sets (or similar comments) was the aspect of the session most cited as requiring more emphasis. Most also indicated that they would attempt to apply the modelling framework in the course of their future work.

There was general support for a revision scenario which involved monthly review of the models. Most respondents indicated that, as their follw up to the session, that they would revise the modelling work and make further application of it to their work.

In addition to providing more time in the workshop for more extensive coverage of the various topics, it was suggested that if repeated, the course should require less typing of code and more prior training in the use of the software.

Difficulties encountered:

The major operational difficulty encountered was the need to engage workshop leaders other than as originally planned, though probably in most respects this was ultimately to advantage. There was a greater load for the principal investigator, in negotiation and planning with the workshop leaders, and in conducting two separate workshop sessions. This was, however, offset by the excellent performance of the workshop leaders and the advantages conferred by operating two workshop sessions. Minor operational difficulties have been indicated above.

Although the plans for the workshop suggested that participants would take a project approach, this proved to be only appropriate for the second session. The level of documentation of these projects has so far been relatively low. This probably relates to the complex nature of the models: the stage achieved with most of the models in the workshop was near the beginning of the modelling process rather than its completion, so that documentation should come after further work with the models.

Conclusions and Recommendations

The workshop was successful in most aspects. The objectives were achieved and benefits to fisheries management in general, as participants apply their skills, should continue to accrue.

The format and content of the workshop, given the objectives, was appropriate. The concept of asking participants to develop a project (see original application for funding in Attachment 6) was useful and should be applied, if possible, in similar future workshops. Responses of participants suggest that a major constraint was the length of time available in the course. This could in future be addressed by lengthening the sessions, or by reducing content. Similar workshops in the future could contain several modifications to increase benefit:

1. They could be placed within a much larger course structure, allowing participants to undertake background reading, training with operating systems and software and so provide more relatively more time for content rather than operation;

2. To ensure the maximum benefit from models developed, a follow up procedure should be instituted (as an example, a proposal for the NT's Fisheries Division is detailed in Attachment 3);

3. Workshops of similar length should perhaps contain a narrower range of topics, depending upon the level of sophistication of the participants;

4. Time for documentation of projects could be included within the workshop, in the simplest case via a short pro-forma;

5. To reduce the load on the workshop leaders, the number of leaders should be increased.

Scientific papers and publications resulting from the project

A brief article reporting the workshops (Attachment 5) has been submitted for inclusion in the next edition of *Takestock*, the stock assessment newsletter published by BRS.

Manuscripts in preparation associated with the workshop are:

Hall, N. W., and Buckworth, R. C. An assessment of stocks of the narrow-barred Spanish mackerel, *Scomberomorus commerson* , off northern Australia. (to be submitted to *Can. J. Fish. Aquat. Sci.*).

Lloyd, J. A, and Ramm, D. C. Review of information on goldband snappers (*Pristipomoides* spp.) off northern Australia. *NT Dept. Prim. Ind. Fish. Fish. Rep.*

Acknowledgments

This project could not have been achieved without out the considerable efforts of the workshop leaders and the gracious support of their respective institutions. I thus wish to thank Dr Derek Staples (BRS), Mr Norm Hall (WA Fisheries) and Mr Mike Dredge (QDPI) for their valued contributions. The modelling tools used as the basis of the second session of the workshop were modified from those developed by Prof. Carl Walters of the University of British Columbia, and he is gratefullly acknowledged. The Office of the Public Service Commissioner kindly provided the use of its training room facilities for the second session.

References

Anon. (1992). Australia-Indonesia Workshop on Arafura Sea Fisheries: Stock Assessment Working Group Report. 9-13 November 1992 Darwin. Unpublished Report to Bureau of Resource Sciences, Canberra.

Hilborn, R., and Walters, C. J. (1992). 'Quantitative Fisheries Stock Assessment.' (Chapman & Hall: London).

King, M. and Beurtreaux, Y (1990). "Fisheries biology and management." Unpublished course notes, School of Fisheries, Australian Maritime College, Launceston.

Xiao, Y (in press). The biology of *Acetes*. *Oceanogr. Mar Biol. Ann. Rev.* **31**, 1-181.

Table 1. Institutions invited to participate in the stock assessment workshop.

Northern Terrritory University, Darwin	James Cook University, Townsville
Western Australian Marine Research Laboratories, Perth	Queensland Department of Primary Industry, Deception Bay and Cairns
CSIRO Marine Laboratories, Perth	CSIRO Marine Laboratories, Cleveland
Bureau of Rural Resources, Canberra	Australian Institute of Marine Science, Townsville

Table 2. List of Participants, First session of NT stock assessment workshop, Darwin 25-27 March 1992.

NAME	AFFILIATION	COMMENTS
D Staples	BRR	Workshop leader
	DPIF:	
R Buckworth	R & D	
A Coleman	R & D	
N Gill	R & D	
R Griffin	R & D	
I Knuckey	R & D	
J Lloyd	R & D	
D Ramm	R & D	
R Slack-Smith	R & D	
R Willing	R & D	
Y Xiao	R & D	
C Calogeras	Management	*
P Hall	Management	*
P Herden	Management	*
R Lea	Management	*
T Wood	Management	
D Grey	Executive	*
R Pyne	Executive	*
B Barker-Hudson	Executive	*
M Dredge	QDPI	Workshop leader *
J Glaister	QDPI	*
J Robbins	QDPI	*
C Robins	CSIRO	

* Partial attendance

TOTAL PARTICIPANTS 23

Table 3. List of Participants, Second session of NT stock assessment workshop, Darwin 25-27 March 1992.

NAME	AFFILIATION	COMMENTS
N Hall	WAMRL	Workshop leader
D Staples	BRR N	Workshop leader
R Buckworth	R & D	
A Coleman	R & D	
N Gill	R & D	
R Griffin	R & D	
I Knuckey	R & D	
J Lloyd	R & D	
D Ramm	R & D	
G White	R & D	
Y Xiao	R & D	
R Willing	Management	
P Pender	Management	
T Wood	Management	
M Maliel	BRR	
E Adjei	BRR	
A Courtenay	QDPI	
N Gribble	QDPI	
C Robins	CSIRO	
TOTAL PARTICIPANTS	19	

Table 4. Record of models built and contacts, June session of FIRDC stock assessment workshop.

Fishery	Model name	Contact
NT mackerel	QBNWMACK	R. Buckworth, NT DPIF
barramundi, Daly R.	MODEL	R. Griffin, NT DPIF
Lutjanus. malabaricus, Arafura Sea	NEWF1	D. Ramm, NT DPIF D. Staples, BRS
Acetes, China	YONG	Y. Xiao, NT DPIF
Goldband snapper, Timor	GBSNAP	J. Lloyd, NT DPIF
Box		D. Staples, BRS
Penaeus indicus, Joseph Bonaparte Gulf	JBG	R. Willing, NT DPIF
NT mudcrab	NEWCRAB	I. Knuckey, NT DPIF

WORKSHOP ON STOCK ASSESSMENT OF AUSTRALIA'S TROPICAL FISHERIES

Project 91/96
Fisheries Research and Development Corporation

Attachments to Final Report

Attachment 1

Summary notes: Stock Assessment Workshop, Session 1.

Attachment 2

Agenda and course notes: Stock Assessment Workshop, Session 2.

Attachment 3

Fishery Stock Assessment Program, Fisheries Division, Department of Primary Industry and Fisheries (NT).

Attachment 4

Workshop evaluation questionnaires.

Attachment 5

Article describing Stock Assessment Workshop, submitted to *Takestock*.

Attachment 6

Application to Fishing Industry Research and Development Council, for funding "Workshop on Stock Assessment of Australia's Tropical Fisheries"

Attachment 1

Summary Notes on First Session of NT Stock Assessment Workshops

General:
The first session of the workshop was held at the Fisheries Division Conference Room, Harbour View Plaza, 25-27 March 1992. A list of participants is attached.

Leaders:
Dr Derek Staples, Bureau of Rural Resources.
Mike Dredge, Queensland Department of Primary Industries

Objectives:
Aquaint people who are required to make or interpret stock assessments with what stock assessment is about - its objectives, concepts, the tools available, examples of their application, limits.and misuse, the information requirements, de-mystification of the jargon.

Sophistication:
The minimum level required would be of somebody who, for example, is required to implement a program designed to gather information for stock assessment and may explain to industry the basis of that program eg a senior Technical Officer.

Themes:
Several themes - approaches to the way stock assessments or their components should be produced and advice given - were emphasised across the topics presented.
Some of these were:

Models are a useful **tool**. They should not be taken too literally, properties should be explored and should be tested wherever possible;

Apply scientific method - observation-hypothesis-prediction-testing-modified hypothesis. Experimental design is important;

Management games are a useful tool for illustrating the difficulties inherent in applying some models used for fishery management;

Use the various stock assessment packages to develop a feel for properties of data sets, and for different analyses. Apply the outputs of these packages with caution;

Models **do not** replace the need for quality data, and use should be made of all data available;

Beware the slick model - the quality of the interface is not necessarily related to the realism or utility of the model, yet the slick model will always have a big impact;

The cost/consequences of **not** collecting information is often not made explicit, despite the management consequences this may bear. This point is often not recognized by research, management or funding agencies. A major problem with the use of ITQs. This is magnified for time series data.

The **most** should be made of opportunities to collect different sorts of data as fisheries develop, as different sorts are available at different stages eg estimation of M early in a fishery's development;

Advice for fishery management should very clearly describe how the problem was defined, what bounds were placed, what assumptions and simplifications made, and error ranges given for any prediction.

Such advice should be provided in the form of a decision table rather than as a parameter estimate for a biological reference point.

Accessory material:
A glossary of stock assessment terms used by BRR

Course notes for an Australian Maritime College course on stock assessment (by Mike King and Yvette Bertreaux)
Several computer packages in use at BRR, some developed there and also including:
the Complete ELEFAN (NT Fisheries has also purchased this package);
software included (Public Domain) with the new Hilborn & Walters publication, and its description; and
software produced by Bill Fox and by AMC (PD also).

Structure:
In most sessions, the workshop leader introduced and described a topic, then an application of the topic was examined on computer - as a simulation game, or including data supplied by participants or provided with the various packages. In the sessions directed by Mike Dredge, sampling from populations of coloured beads was used as an analogue of tagging experiments. Considerations associated with different assessment techniques - such as the types of data required, data analysis aspects, statistical problems and management consequences - were introduced as appropriate.

Outline:
What is Fisheries Management?
Economic, Biological, Social, Political advice contribute to mangement decisions.
Management objectives from each outlook
Definition of Stock Assessment
Stock assessment -essential considerations
Developing, fully exploited and over-exploited fisheries
Management questions at each stage
information available/required at each stage
The general biomass population model
Biomass $_{(t+1)}$ =Biomass $_{(t)}$ +Recruitment - Mortality
Types of models used in stock assessment
Biomass (production)
Age structure
Fishery (fishermen) dynamics
Ecosystem (multispecies)
Spatial models
The necessity to establish bounds of models
The Unit Stock concept
Model application
Parameter estimation - choice of model, parameter estimation, testing
eg length-weight - non-linear or linear?, extrapolation, sampling design
Data requirements and sources
The need for contrast in data
The use of CPUE as abundance estimator
linear, hyperstability or hyperdepletion

Biomass models
Schaefer/ Fox models etc
dangers - lack of signal until over-exploited, "one-way trip"
failure of assumptions
simplistic, dogmatic acceptance
Growth
data - from length frequencies
aging of hard parts
pitfalls - sampling errors, misinterpretation of modes, incorrect aging definition
von Bertalanffy model
correlation between parameters
Mortality
Using a DeLury model, sampling difficulties (bead games)

Estimation of mortality coefficients from catch curves
Using periods of light fishing to estimate M, especially for sedentary animals
Yield per Recruit Analysis - yield under differenet fishing regimes
Requires growth and mortality information, age of first capture
F0.1 - an arbitrary fishing intensity estimated using Y/R modelling
Stock and Recruitment relationships
Beverton-Holt, Ricker models
distribution of errors, environmental factors
difficulties of definition of spawner, recruit biomass/numbers
use of YPR to estimate recruitment
Catch-at-age methods=dynamic pool
Virtual population analysis, Cohort analysis
MUST have good estimates of M (natural mortlaity)
Terminal F method
problems: changing catchability, difficulties with stock definition or ageing, **M**
Statistical catch at age - multiple regression approach
Length-based methods
use growth information to convert length data to age composition
approximate methods for determining mortality rates
length-based VPA (Jones)
use of age-length key
Delay-difference methods (Deriso-Schnute)
hybrids-biomass dynamic models with biologically meaningful parameters
conceptually good, difficult to use; still being evaluated
"The Real World"
Models require contrast that usually only occurs with over-exploitation
Risk with different options not usually evaluated, difficult
Adaptive management includes contrast and evaluation of risk: but DIFFICULT
difficult to reduce level of fishing
decision tables recommended over MSY or ESY or SY
Overview - which assessments available at different stages - attached.

Attachment 2

Agenda and course notes : Stock Assessment Workshop, Session 2.

Stock Assessment Workshop - Darwin - June 1992.

Agenda

Wednesday June 24

9.00 Introduction - Rik Buckworth

9.15 Overview of workshop

Acknowledgement to Carl Walters re programming tools.

Difference between last workshop and current workshop.

Combination of modelling activity interspersed with discussion on other aspects.

Types of models to be developed, and data requirements.

9.30 What output must our models produce?

We must know what we are wanting to produce before we start building the models. This will be our plan and provide the strategy for the modelling that we do?

Define their subjective harvesting policy.

Describe the strategic potential of modelling as a tool for research.

9.45 Morning Tea

10.00 First modelling task - Delay-difference models

Need to introduce group to the modelling tools.

Define the structure of the delay-difference model, and specify the algorithm that we shall use to fit this.

Show them how to program it.

1. Read the data
2. Declare the variables
3. Define the state update routine
4. Define the state initialisation
5. Declare the plots

12.00	Lunch
1.00	Observation versus Process error
1.10	Calibration
	Least squares
	Amoeba & Gauss Newton methods Maximum likelihood Bayesian approach
	Fitting model to data.
2.00	Harvesting Policy
2.30	Afternoon Tea
2.45	Fleet dynamics
3.30	Stochasticity
4.30	SAS
4.45	Excel
Thursday	June 25
9.00	Developing a model - the stages
	Control variables Indicator variables Exogeneous variables
	Use of life history
	Leave hooks - empty subroutines.
9.30	Age structured model
9.45	Morning Tea
10.00	Age structured model (cont)
11.00	Digression - Boot-strapping
11.05	Confidence regions
12.00	Lunch
1.00	Auxiliary data
2.00	Sensitivity

2.30	Afternoon Tea
2.45	SPAs and tuning
3.30	Likelihood of models
	Decision analysis EVPI Certainty Equivalent
4.30	Multi-species interactions

Friday June 26

9.00	Spatial modelling
9.30	Length structured models
9.45	Morning Tea
10.00	Length structured models (continued)
11.00	Biological reference points
12.00	Lunch
1.00	Risk Analysis
1.45	Evaluation of control laws
2.30	Afternoon Tea
3.00	Modelling strategy - how to make it work!

Strategic Potential of Modelling

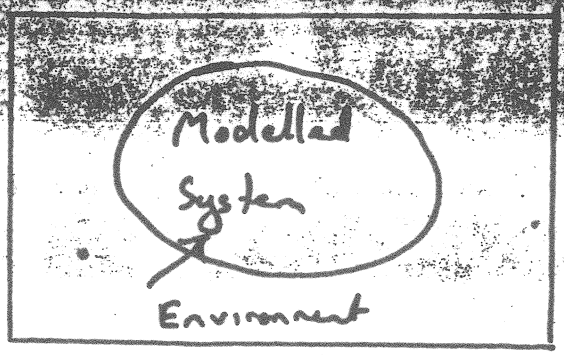
1. Provides a formal approach that encourages use and testing of data / knowledge

2. Provides a mechanism to encourage peer review

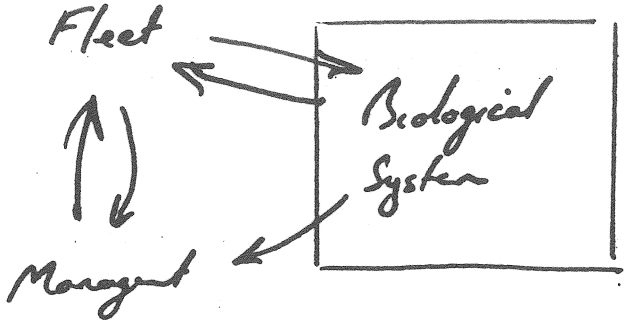
3. Provide direction for research ensuring that it is (a) relevant
   (b) cost effective
   (c) justifiable

4. Allows communication

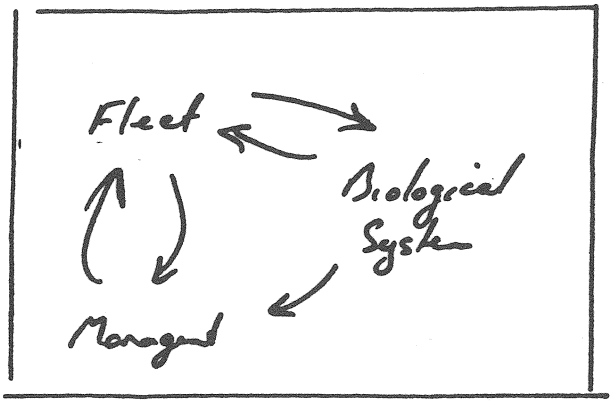
Model



Traditional



Current



Basic Structure of Simulation Run

1. Setting up the data, etc

PREPAREMODELDATA - reads the raw data into arrays

Called at Beginning of Run

- POPULATIONREAD
- REGULATIONREAD
- GROUTHREAD
- EFFORTREAD

} - reads parameters associated with spreadsheets

2. Initialising the System State

Called at start of each Simulation Run

SETINITIALSTATE - Sets up the initial system state for the model.

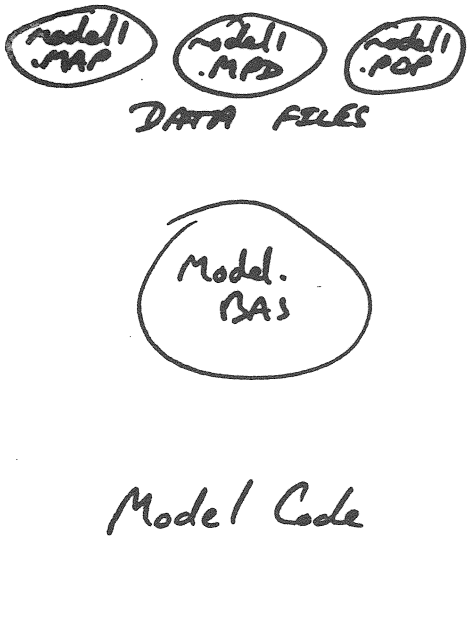
3. Update of System State

Called at each time step of the simulation

GETNEWSTATE - Calculates the new system state for the model at the end of the time step.

Setting up a new simulation

1. Create a new directory and make this the default directory
2. COPY \SKELTON*.* .
3. EDIT SKELTON.MAK
   Modify SKELTON.BAS to model.BAS
4. REN SKELTON.* model.*
5. EDIT ~~QBSKEL~~ QBSKEL.BAT
   qb model /l: c:\models\modlib
6. REN QBSKEL.BAT QBmodel.BAT
7. REN SKEL1.* model1.*
8. QBmodel
   Modify main module
   model(1).FilenamePrefix = "model1"



Production Models

Schaefer

$$dB/dt = rB - rB^2/k - qfB$$

Hence, a discrete analogue:

$$B_{t+1} = B_t - C_t + rB_t - rB_t^2/k$$

Genprod

$$dB/dt = rB - rB^m/k - qfB$$

Hence, a discrete analogue:

$$B_{t+1} = B_t - C_t + rB_t - rB_t^m/k$$

Delayed Production Model

$$dB_t/dt = rB_t + aB_{t-w} - (r+a)B_t^m/k - qfB_t$$

Hence, a discrete analogue:

$$B_{t+1} = B_t - C_t + rB_t + aB_{t-w} - (r+a)B_t^m/k$$

Delay-difference Models

Parameters: $M, q, \alpha, \rho, w_k, k, N_1, SRR$

$$B_{t+1} = s_t B_t + \rho s_t B_t - \rho s_t s_{t-1} B_{t-1} - \rho s_t w_{k-1} R_t + w_k R_{t+1}$$

Easy to Implement Algorithm

1. Set an initial stock size, B_1
2. Set an initial stock number, N_1, or an initial mean body weight, $\bar{w}_1$, and calculate $N_1 = B_1 / \bar{w}_1$
3. Set up the first k years of recruitment, $R_1 \ldots R_k$

	Year	Biomass	Number	Recruits
	1	B_1	N_1	R_1
	2			R_2
$k=$	3			R_3
	4			
	⋮			

4. Set or determine the exploitation rate, $h_t = 1 - \exp(-q E_t)$, and calculate the total survival rate, $s_t = S(1-h_t)$, where $S = \exp(-M)$.
5. Calculate the catch, $C_t = h_t B_t$, and the spawning stock, $P_t = B_t - C_t$
6. Calculate and store the recruitment to occur in year $t+k$, R_{t+k} from the SRR.
7. Predict next year's biomass

$$B_{t+1} = s_t [\alpha N_t + \rho B_t] + w_k R_{t+1}$$

8. Predict next year's numbers

$$N_{t+1} = s_t N_t + R_{t+1}$$

Delay - difference Models - Equilibrium

$$R_e = N_e(1-s)$$

$$\bar{\omega}_e = \frac{s(\alpha - \omega_h) + \omega_h}{1-\rho s}$$

$$B_e = \omega_h R_e / \left(1 - \frac{s\alpha}{\bar{\omega}_e} - \rho s\right)$$

Model Calibration

1. Least squares

$$SS = \sum_{i=1}^{n} \omega_i (Y_i - \hat{Y}_i)^2$$

2. Maximum Likelihood

$$L = \prod_{i=1}^{n} Pr\{Y_i | parameters\}$$

$$Pr\{Y_i | parameters\} = \frac{1}{\sigma\sqrt{2\pi}} \exp\left[-(Y_i - \hat{Y}_i)^2 / 2\sigma^2\right]$$

3. Bayesian Probability

$$Pr\{Hypothesis | data\} = \frac{Pr\{Data | Hypothesis\} \times Pr\{Hypothesis\}}{\sum Pr\{Data | Hypothesis\} \times Pr\{Hypothesis\}}$$

Non-Linear Estimation

1. Choose a starting set of parameters
2. Calculate the objective function
3. Modify the parameters and go to step 2.

Non-linear estimation algorithms simply choose the parameters in such a way that there is successive improvement in the objective function.

AMOEBA

GAUSS-NEWTON – with step-size adjustment

Likelihood

d_i = Observation$_i$ - estimate$_i$

$L\{d_i|\text{Parameters}\} = \exp[-d_i^2 / 2\,\sigma^2] / [\sigma\sqrt{(2\pi)}]$

If each observation is independent,

$$L\{\text{Data}|\text{Parameters}\} = \prod_{i=1}^{n} L\{d_i|\text{Parameters}\}$$

Bayes Theorem

$$\Pr\{\text{Hypothesis}|\text{Data}\} = \Pr\{\text{Data}|\text{Hypothesis}\} \times \Pr\{\text{Hypothesis}\} \Big/ \sum \Pr\{\text{Data}|\text{Hypothesis}\} \times \Pr\{\text{Hypothesis}\}$$

1. List all possible hypotheses

   - bound and discretize the possible parameter values.

2. Set a prior probability for each hypothesis, normalised so that the sum of all prior probabilities is equal to 1.

   - "uniform prior" - all hypotheses are considered equally likely.

3. Set up a likelihood function to calculate the probability of the data if the hypothesis is true.

Fleet Size

Ref: Hilborn and Walters (1992) p135.

No of vessels = V_t

Profit/Vessel = (C_t/V_t) x Value of Fish

- Fixed cost per vessel

- Variable cost per vessel.

dV/dt = Profit per Vessel / Cost of a new vessel

Hence, $V_{t+1} = V_t$ + Profit per Vessel / Cost of a new vessel

Harvesting Policy

$$h = \begin{cases} \gamma (S - \delta)^{\theta} & \text{if } S > \delta \\ 0 & \text{if } S \leq \delta \end{cases}$$

$\theta = 0 \Rightarrow$ Constant catch

$\theta = 1, \delta = 0 \Rightarrow$ 'Constant' effort

$\theta = 1, \delta > 0, \gamma > 0 \Rightarrow$ 'Constant' escapement

$$h = b_0 + b_1 S \qquad 0 \leq b_1 \leq 1 \qquad -S_{max} \leq b_0 \leq +S_{max}$$

$b_1 = 0, b_0 > 0 \Rightarrow$ Constant catch

$b_0 = 0 \Rightarrow$ Constant effort

$b_1 = 1, b_0 < 0 \Rightarrow$ Constant escapement

Policy Performance

1. Average harvest
2. Variability in annual harvest
3. Proportion of time that the fishery is closed.

Method:

For a specific policy, use a Monte Carlo simulation to determine the variables above.
Repeat for different policy choices.

SPA Method

1. For each cohort,
   (A) Calculate the number in the last age class, by
      (a) assuming that the cohort is complete;
      (b) using the specified fishing mortality, F_t, of the oldest age class; or
      (c) using the age specific catchabilities, and the fully rrecruited F in the last year to calculate the fishing mortality for the age class in the last year.
   (B) Using the 'exact solution' to calculate $N_{a,t}$ for each age and year, working backward through the cohort.
2. Use the regression equations to calculate the estimates of the stock size.
3. Compute the objective function as the sum of squared deviations of estimated stock size from observed stock size (possibly logged).
4. Modify the parameter estimates, using a non-linear minimisation algorithm, repeating the calculation until the objective function is minimised.

SPA - Parameters

1. M (or M_a, mortality at age, a)

2. For all years but the first, F_t, the fishing mortality of the oldest age group.

   Note: The number of parameters required may be reduced by assuming that the cohort(s) are complete. That is, no fish are alive after a certain age, hence

   $$N_{a+1,.} = 0$$

3. Fully recruited F for the last year.

4. Partial recruitments (i.e., age specific catchabilities, q_a)

5. Regression coefficients relating independent indices of stock size (possibly by age) to the actual stock size.

VPA Terminal F Assumption

Given F_t,

$$N_t = C_t \ (F_t + M) \ / \ [F_t \ (1 - \exp(-(F_t+M)))]$$

Forward VPA

$$N_t = C_t/s_t + C_{t+1}/(s_t s_{t+1}) + \ldots + C_{t+n}/(s_t s_{t+1} \ldots s_{t+n})$$

and, if s_t is constant, such that $s_t = s$,

$$N_t = \sum_{i=t}^{i=t+n} C_i \ / \ s^{i-t+1}$$

Identify Alternative Hypotheses

1. Fix any parameters that are reasonably well known at a set of nominal values.

2. Pick a leading variable (or two) from the remaining set of uncertain parameters. For example, initial unexploited stock, or a stock-recruitment parameter that measures the slope of the SRR at low stock sizes.

3. Select a reasonable range of these leading parameters, to cover the uncertainty.

4 For each set of leading parameter values, estimate the remaining parameters from the observed data.

5. Eliminate 'redundant' sets of parameters, if they lead to the same policy predictions.

Expected Value of Prior Information (EVPI)

1. Construct a decision table that predicts the expected performance for each hypothesis over a range of policy choices. This will be the average of a number of Monte Carlo simulation runs.

2. Determine the best choice for each model (hypothesis).

3. Calculate average performance across models (preferably weighted by the probability of each model).

4. Select the best average. The policy that gives the best average performance is the best non-adaptive choice.

5. Calculate the average across models of:

   Best for Model - Best Average across models

   This is the EVPI. It is the value a sole proprietor would be willing to pay to determine the true model.

Expected Value of Prior Information (EVPI)

1. Construct a decision table that predicts the expected performance for each hypothesis over a range of policy choices. This will be the average of a number of Monte Carlo simulation runs.

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3. Calculate average performance across models (preferably weighted by the probability of each model).

4. Select the best average. The policy that gives the best average performance is the best non-adaptive choice.

5. Calculate the average across models of:

   Best for Model - Best Average across models

   This is the EVPI. It is the value a sole proprietor would be willing to pay to determine the true model.

Attachment 3

PROJECT PROPOSAL

DIVISION:

FISHERIES DIVISION

DIVISION STRATEGIES:

Develop and maintain the data base and the biological, technical and economic information necessary to underpin effective fisheries management and industry development.

Monitor indicators of the need for action to conserve stocks.

Expand the community understanding of the functions and philosophy of fisheries management.

TITLE:

Fishery Stock Assessment Program.

OBJECTIVES:

1. To development the stock assessment competence of the Fisheries Division staff.

2. To ensure that the best assessments available are used in the management of Northern Territory fished stocks.

3. To develop quantitative fishery performance indicators for inclusion in Fishery Management Plans.

4. To use stock assessments to evaluate and give direction for Fisheries Research and Development and Fisheries Management programs.

5. To encourage the documentation and publication of the material used in Northern Territory stock assessments.

6. To seek opportunities to enlist external expertise both in the assessment process and as peer review, by liaising with other workers and institutions with expertise in stock assessment or related disciplines. In this way, a network of individuals and institutions that can jointly improve the quality of Australian tropical fisheries stock assessment will be developed.

7. To develop the Northern Territory's Fishery Division as a centre of expertise in tropical fish stock assessment.

8. Promote understanding of the principles and information needs, and the interpretation and application of stock assessment programs among client groups.

BACKGROUND:

Fishery stock assessment is at the core of most R & D programs within the Division. This program aims, by providing coordination, evaluation and drawing in expertise, to improve the development and application of stock assessments within the Fisheries Division. Ancillary aims include the concomitant development of expertise in stock

assessment techniques and communication with client groups. Training and model development were given a considerable boost during 1992 with FRDC-funded workshop sessions. It is highly desirable that the momentum provided by these be maintained and extended.

METHODOLOGY:

In monthly sessions, the stock assessment framework in each fishery will be examined in turn. Each fishery will be examined over two meetings. In the first, the current status of the assessment for that fishery will be presented- the model used, the data upon which it was based, current information needs and research directions, the management background. To enhance the training benefit of the program, opportunities should be taken for the in-depth examination of particular aspects of the program (eg in the case of barramundi, the depletion experiments). In evaluation of the current stock assessment ways in which the modelling process for that stock(s) might be advanced will be explored, and any alternative approaches will be suggested.

At the second session on that fishery, documentation of the stock assessment's status will be expected. There will be appraisal of the alternative approaches. Suggested future directions for the program will be developed.

LOCATION:

Fisheries Research & Development Laboratory, Darwin.

BENEFITS TO INDUSTRY:

By developing the best stock assessment basis for the management of fishery stocks both the fishing industry and the community will enjoy the maximum benefit from the exploitation of renewable fishery resources.

By promoting the understanding of stock assessment issues and clarification of management objectives, improve communication between government, industry and the community.

ESTIMATES OF EXPENDITURE AND SOURCES OF FUNDS BY FINANCIAL YEAR FOR DURATION OF PROJECT:

This project works across programs, with an underlying goal of the more effective definition and realization of objectives within other projects. The basic aim of this program is coordination and direction. As stock assessment is a goal of most of our fisheries R&D programs, expenditure related to stock assessment is already allocated within individual programs, with percentage participation also already covered in those programs.

PERSONNEL ASSOCIATED WITH PROJECT (1992-1994).

D Slack-Smith
R Buckworth (coordination)
I Knuckey
J Lloyd
R Lea
P Pender
Shark fishery biologist
D Ramm (coordination)
R Griffin
Y Xiao
A Coleman
T Wood
R Willing
(to be appointed)

Other Fisheries Division or Departmental staff will be encouraged to attend on an interest or need basis.

RESOURCE IMPLICATIONS FOR OTHER DIVISIONS/REGIONS:

Occasional and informal consultation with biometrician and economists. If applicable other departmental resources will be used on an adhoc basis. In the long-term, closer involvement with other institutions (eg NTU, other State Fisheries organizations) will be encouraged.

Follow up to NT Stock Assessment Workshops

1.Revision of stock assessment topics

These are the topics we covered in the first session of the Stock Assessment Workshop (some very briefly) in April, and I think are a good starting point for an outline for revision. Most of the topics are covered in Hilborn and Walters (or Ricker or Gulland etc etc); we have the AMC course notes and have received permission from ICLARM to make as many copies of ELEFAN as we want, and we should be able to chase up any other stock assessment software we need. If you wish to be a discussion leader for a particular topic and have a firm date in mind, fill in the table below. Otherwise we can develop a timetable in the first few sessions.

Topic	**who?**	**date**
An overview of types of models used in stock assessment		
The use of CPUE as abundance estimator		
Biomass models (Schaefer/ Fox models etc)		
Growth		
Mortality		
Yield per Recruit Analysis		
F0.1		
Stock and Recruitment relationships		
Catch-at-age methods=dynamic pool		
Virtual population analysis, Cohort analysis		
Terminal F method		
Statistical catch at age - multiple regression approach		
Length-based methods		
Approximate methods for determining mortality rates		
Length-based VPA (Jones)		
Use of age-length keys		
Delay-difference methods (Deriso-Schnute)		
Risk Analysis in Fisheries Management		
Adaptive management		
Other...		

2.Revision of stock assessment models

Model	who?	date
mackerel troll fishery		
saddle tail		
goldband		
mudcrab		
barra		
pearl		
shark		
JBG prawns		
Acetes		
others		

The Norm Hall Ten-Point Plan

DEVELOPMENT AND APPLICATION OF MODELS

1. Devise the hypothesis (Hypothesise)
2. Program the model - verification
3. Calibrate (Tune) to data
4. Validate
5. Explore the uncertainty:
    - Confidence regions
    - Bootstrapping
    - Manually - playing with the parameters.
    - Sensitivity
6. Effort fleet dynamics
7. Controls - management options - Control laws
8. Stochasticity
9. Plan - Decision Table
10. Evaluation of Control Laws

Attachment 4

Please return to Rik Buckworth

NT Stock Assessment Workshop

Evaluation of Session 1 **Name**_____

What proportion of the first session did you attend? _____**%**

Do you think the first session of the workshop was worthwhile?

Yes/No_____**Comment**_____

_____

What was the

best aspect? _____

worst aspect? _____

Do you think you have a better appreciation of what stock assessment is about (the tools available, what data requirements are, the jargon involved)?

Yes/No_____**Comment**_____

Will you be able to apply it in your job?

Yes/No_____**Comment** (How)?_____

_____

Which topics should have had

more emphasis? _____

less emphasis? _____

What will you do to follow up the first session of the workshop?

_____

_____

Comments

_____

_____

_____

_____

Please return to Rik Buckworth

NT Stock Assessment Workshop

Evaluation of Session 2 **Name**_____

What proportion of the 2nd session did you attend? _____%

Do you think this session of the workshop was worthwhile?

Yes/No_____**Comment**_____

_____

What was the

best aspect? _____

worst aspect? _____

Do you think you have a better appreciation of these aspects of stock assessment :

Delay difference models **Yes/No**_____ **Comment** _____*Age structured models* **Yes/No**_____ **Comment** _____

Length structured models **Yes/No**_____ **Comment** _____

Harvest policy **Yes/No**_____ **Comment** _____*Risk analysis* **Yes/No**_____ **Comment** _____ Which topics should have had

more emphasis? _____

less emphasis? _____

_____

_____

If this course were to be repeated, what changes would you make?

_____

_____

_____

_____

Will you use the model skeletons and tools in your work?

Yes/No_____Comment_____

Will you use the model skeletons and tools for your own interest?

Yes/No_____Comment_____

As a follow-up to this session, it is proposed that a monthly (?) review of models, one at a time, is proposed. Would you be willing to participate, or suggest an alternative?

Yes/No_____Comment_____

_____

_____

What will **you** do to follow up the second session of the workshop?

_____

_____

_____

Do you have any suggestions about the software tools provided (<u>all</u> comments welcome)

_____

_____

_____

_____

Other Comments

_____

_____

_____

_____

_____

Attachment 5 Article submitted for publication in *Takestock*

Northern Territory Stock Assessment Workshops

Most research and management officers in Australia's fisheries institutions contribute to or interpret stock assessments, yet at the First National Stock Assessment Workshop earlier this year it was very clearly underlined that few feel competent in this field. With FRDC-funding, the NT's Fisheries Division have begun to address this problem with a training workshop series, for fisheries scientists and managers. The series was both extensive, looking at the basis of stock assessments and management approaches, and intensive, providing a development framework for specific fisheries. The workshops were attended by staff of NT Fisheries Division, QDPI, BRR and CSIRO.

Led by Derek Staples of BRR, the first of the workshop series (in March) introduced the basic concepts and an array of techniques and tools available for stock assessment: the underlying ideas, estimation of parameters, and modelling using some of the packages available. We used ELEFAN, fishery simulation software developed by Mike King of the Australian Maritime College, and the software tools from Hilborn and Walters' "Quantitative Fisheries Stock Assessment". While most of the exercises used sample data sets furnished with the software, the most interest was generated when we used data with which participants were familiar- NT barramundi and NPF tiger prawn data. In an escape from the tyranny of computers, Mike Dredge of QDPI also led some games demonstrating the estimation of mortality and exploitation rates. The workshop gave us an appreciation of the extent of both the field of stock assessment and of the tools available.

Norm Hall led the second workshop, in June, with Derek Staples assisting. This introduced more difficult concepts and emphasised the use of stock modelling to maximize the use of any information available and to make predictions. Norm made a software framework developed by Carl Walters a little more friendly and provided skeletons of delay-difference, age-structured, length-based and spatial models. The emphasis during this session was on providing experience in using models, and we concentrated mostly on Northern Territory fisheries - including mackerel, gold-band snapper, and mudcrab. We consequently now have models of several fisheries in various stages development and the experience of an intensive modelling exercise.

To me probably the strongest message that came from these workshops was that stock assessment is definitely a process more than a result, requiring constant development and testing - probing uncertainties by using alternative methods, looking for the additional meaning provided by extra and different types of data, and so on.

I certainly would recommend that other institutions conduct similar workshops. But, while those of us who attended have a greater appreciation of stock assessment topics, are we more competent? At this stage I would say "a bit"!. While the workshops have given us stimulus and equipped us with some tools, the greatest benefits should accrue as we follow up the workshops. To ensure that this happens we have instituted a program where each of the fishery models we developed will be examined in turn, with the assumptions and areas of uncertainty being probed in depth. Alternative models or parameter estimations will be examined and the research and management implications assessed. Documentation of these assessments will provide benchmarks of progress in the understanding of each of the fisheries.

Rik Buckworth.

A Postscript: The Indonesia-Australia workshop on demersal and pelagic fisheries (Darwin, 9-13 November, reported elsewhere in this issue) saw intensive assessment of northern Australian tropical snapper and shark stocks. The experience provided by the training workshops allowed the contribution of the NT staff attending to be that little bit more effective.

Attachment 6

FISHING INDUSTRY RESEARCH AND DEVELOPMENT TRUST FUND - APPLICATION FOR GRANT

SECTION 1 - PROJECT TITLE

Workshop on Stock Assessment of Australia's Tropical Fisheries.

SECTION 2 - KEYWORDS

Workshop, stock assessment, training, tropical fisheries

SECTION 3 - OBJECTIVES

1. To conduct a workshop to provide fisheries research and management personnel, working on Australia's tropical stocks, with training and experience in various stock assessment techniques.

2. To apply these techniques to problem areas in the research and management of fisheries administered by the NT, or which are important to the NT and northern Australia.

It is intended that the workshops be conducted in April or May 1992.

SECTION 4 - JUSTIFICATION

The need for training Australia's fisheries scientists and managers has long been recognised and indeed is embodied among FIRDC's funding priorities. In the Research Branch of the NT's Fisheries Division, a recent skills audit identified the need for further training in stock assessment techniques as the major priority for scientific staff.

Training workshops such as those conducted by Carl Walters and Ray Hilborn were supported by FIRDC and were generally regarded as being successful. However, the major constraint on attendance by NT personnel was the cost of sending staff interstate. Attendance at workshops in conjunction with the annual conference of the Australian Society for Fish Biology is subject to similar restrictions. While most Research and Fisheries Management officers are required to make or interpret stock assessments, only a small number have had the benefit of attendance at the stock assessment workshops. Mobility of NT staff is also a problem: of the four staff sponsored to the Walters and Hilborn workshops by the NT, two have since taken positions interstate.

With its proximity to Asia and at a central position in Australia's north, Darwin is an appropriate site for a centre of expertise in tropical population dynamics and stock assessment. However, there is little opportunity for training in these topics beyond undergraduate level in Darwin, and the

remoteness of the city limits interaction with staff of other Fisheries Departments, CSIRO or related organizations.

This program aims to make use of the expertise of the Population Dynamics group of CSIRO's Division of Fisheries Research. Other workers in tropical fisheries research and management, from interstate, will also be given the opportunity to attend at the expense of their own institutions. By conducting workshops in Darwin, the benefit to the fisheries off Australia's northern coast will be maximised and the development of Darwin as a centre of expertise in Asia will be given impetus. To this end, participation by staff and post-graduate students of the Northern Territory University will be expressly invited.

The program is mainly designed to overcome a lack of training opportunities in the Northern Territory, but it is emphasised that the fisheries around NT are of national significance. This is borne out by the fact that of the present eight professional- grade personnel in Fisheries Research, six are at least partially engaged in research into fisheries administered by the Commonwealth, or are employed through Commonwealth-based funding (FIRDC or NORMAC).

SECTION 5 - PROPOSAL IN DETAIL

(a) Plan of Operation

(i) Method of Procedure

The program has three phases:

1. Identification of stock assessment projects which course participants could undertake, and preparation of data for analysis;

2. The workshop, which includes examination of the prepared data sets as specific examples; and

3. Preparation of the analyses for publication.

Funding is requested to cover a fee equivalent to costs to CSIRO for preparation of the workshop material and travel by workshop leaders to Darwin to conduct the workshop. Operating costs (hire of additional computers, software and incidentals) are also requested.

Performance Criteria: While the outcome of a training program may be difficult to assess in the short term, the documentation of projects by participants will be indicative of success. Ultimate benefit will accrue over several years, as contributions to management of fisheries and as publications.

(ii) Facilities Available

The Department of Primary Industry and Fisheries has a conference room and meeting facilities, computers, software and other office equipment and will provide secretarial support.

(b) Support Data

(i) Previous work in this or Related Fields

The Population Dynamics group of CSIRO Fisheries Division is a centre of expertise in stock assessment. The group has contributed to research and management of many of Australia's major fisheries, including southern bluefin tuna, orange roughy, abalone and the Northern Prawn Fishery. Dr. Sainsbury provided a month long course on tropical fisheries management at post-graduate level to an international group of South American fisheries researchers in Mexico in 1985.

Research and management is conducted by the Northern Territory in the areas of demersal finfish (trapping, droplining and trawling), mudcrabs, barramundi, pearls, pelagic and prawn fisheries.

SECTION 6 - RESEARCH PRIORITY

Within FIRDC's five year plan, the proposal lies within the area of "Dissemination of information", in establishing a workshop that addresses specific training needs.

SECTION 7 - TRANSFER OF RESULTS TO INDUSTRY

This project is industry-oriented in the sense that skills developed in the workshop will be applied to commercial fisheries. Wherever possible, results of projects will be communicated not only as scientific publications (refereed papers or Fisheries Reports of this Department) but also as industry-oriented publications (Australian Fisheries, Professional Fisherman), and through *ad hoc* information handouts distributed to interested fishermen and industry members, "on the wharf", or through industry bodies.

PROFORMA 'A'

FOR NEW APPLICATIONS

SECTION 8 - PREDICTED COMMENCEMENT & COMPLETION DATE

Commencement Date 1 / 7 /91

Duration of Project: one year *Completion Date :* 30 / 6 / 92

SECTION 9 - REQUESTED BUDGET

Item	**Requested 1991/92**
	$
Salaries & Wages	nil
Operating Expenses	17610
Travel Expenses	4620
Capital Items	nil
TOTAL	**22230**

SECTION 10 - FUNDS SOUGHT FROM OTHER SOURCES

SOURCE

This program does not explicitly seek funds from other sources.

SECTION 11 - FINANCIAL CONTRIBUTION OF APPLICANT

Salary and on-costs for coordinator (10%)	$	5,388
Salaries for NT participants (15 X 5% of $35000)	$	26,250
Conference room facilities, computers, video cameras, secretarial support, tea facilities (5 days @ $200)	$	1,000
Total	$	**35,728**

SECTION 12 - DETAILED BUDGET

		Estimates for 1991/92
	$	
Salaries		
Total Salaries	**$**	**nil**
Travelling Costs		
Fares		
2 X Hobart-Darwin-return @ $1274	$	2548
Allowances		
TA., 7 days @ $146	$	1022
TA., 7 days @ $115	$	805
Accommodation	$	0
Vehicle costs		
car hire 7 days @ $35	$	245
Other (nil)	$	0
Total Travel	**$**	**4620**
Operating Costs		
Fee to CSIRO for workshop leaders	$	13,500
Extra computer hire (3 for 1 week @ $470)	$	1410
Projection panel	$	500
Software, additional copies	$	2000
diskettes, stationery, video film	$	200
Total Operating	**$**	**17,610**
Capital Costs		
Total Capital	**$**	nil
Total Proposed Expenditure	**$**	**22230**
Date of compilation of financial data:		3/1/91

SECTION 13 - ORGANISATION

Head Responsible for Project Mr. D. L. Grey

Name of Organization:
Fisheries Division,
N T Department of Primary Industry and Fisheries

Address
GPO Box 990
City: Darwin **State:** Northern Territory **Postcode:** 0801
Telephone 089-897673 **Fax** 089-813420
Telex: AA 85240

SECTION 14 - PROJECT SUPERVISOR

Name R. C. Buckworth

Address
GPO Box 990
City: Darwin **State:** Northern Territory **Postcode:** 0801
Telephone 089-897608 **Fax** 089-813420
Telex AA 85240

SECTION 15 - STAFF INVOLVED ON PROJECT

NT DPIF:

R. C. Buckworth	M.Sc.	Coordinator

CSIRO:

K. J. Sainsbury	Ph.D.	Workshop leader
R. Campbell	Ph.D.	Workshop leader

SECTION 16 - ADMINISTRATIVE CONTACT

Name Mr. Grant Rowe

Address
Fisheries Division
Department of Primary Industry and Fisheries
GPO Box 990
City: Darwin **State** Northern Territory **Postcode:** 0801
Telephone 089-894397 **Fax** 089-811475
Telex AA 85240

FINANCIAL INFORMATION

(i) **Industry Contribution**

No funds are being sought from industry

(ii) **Justification of Information in**

The fee to CSIRO is based on cost recovery of salaries and on-costs for Dr. Sainsbury and Dr. Campbell incurred during a three week period of preparation and the week of the workshop.

Relative priority: Essential

Economy air fares, TA and car hire are required for workshop leaders to attend the workshops in Darwin. Note that Dr. Sainsbury, as a Section Leader, is entitled to the higher TA rate included.

Relative priority: Essential

Computer and projection panel hire: It is anticipated that the workshop will be computer based. To maximise the benefit of the workshop, it is desirable that there be a maximum of 2 workshop participants per computer. A projection panel will be sought from within the NT Public Service, but if one is not available the quoted hire charge is applicable. Funds for software are included to avoid breaches of copyright if proprietary packages are used.

Relative priority: High

(iii) **FIRDTF First Payment**

The workshop is to be conducted in April or May 1992 and thus all costs will be incurred around this date. The **full amount requested, $22,230**, should therefore be included in a single payment in early 1992.

(iv) **Commercial Assessment**

This section is not pertinent to this application.