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VOLUME 1, Suppl. 2 -

Second Meeting of the Ad hoc Working Group on Methods

Report of Third Annual Scientific Meeting -
Kingstown, St. Vincent & the Grenadines
17-26 July 2007

CRFM Secretariat,
Belize & St. Vincent and the Grenadines
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Foreword

The 2007 CRFM Annual Scientific Meeting took place during 17-26 July 2007. During this Meeting, CRFM Resource Working Groups examined data from eleven fisheries: the Nassau grouper (*Epinephelus striatus*) fishery of Belize; the queen conch (*Strombus gigas*) fisheries of St. Lucia and the Turks and Caicos Islands; the spiny lobster (*Panulirus argus*) fisheries of Jamaica and the Turks and Caicos Islands; the shrimp (*Farfantepenaeus subtilis* and *Farfantepenaeus brasiliensis*) fishery of Suriname; the Atlantic Seabob (*Xiphopenaeus kroyeri*) fishery of Guyana; the bangamary (*Macrodon ancylodon*) fishery of Guyana; the seatrout (*Cynoscion virescens*) fishery of Guyana; the king mackerel (*Scomberomorus cavalla*) fishery of Trinidad and Tobago; the wahoo (*Acanthocybium solandri*) fishery of the Eastern Caribbean. The Meeting also reviewed and adopted the Report of the Second Meeting of CRFM's Ad Hoc Working Group on Methods. A working draft of a CRFM Data Policy Outline was also reviewed and discussed during the Meeting.

The Report of the 2007 CRFM Annual Scientific Meeting is published in two Volumes: Volume 1 contains the proceedings of the plenary sessions and the full reports of the CRFM Resource Working Groups for 2007. National reports, submitted for consideration by the Meeting, are published as Supplement 1 to Volume 1, while the Report of the Second Meeting of the Ad Hoc Working Group on Methods is published as Supplement 2 to Volume 1. Volume 2 contains the fishery management advisory summaries, which are the same as the first 7 sections (sections 1 to 1.7) of each of the fishery reports that are provided in full (sections 1 to 1.8) in Volume 1.

Volume 1 is intended to serve as the primary reference for fishery assessment scientists, while Volume 2 is intended to serve as the main reference for managers and stakeholders.

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Acronyms and Abbreviations

AFMA	Australian Fisheries Management Authority
BWI	British West Indies
CARIFIS	Caribbean Fisheries Information System
CARICOM	Caribbean Community
CEMARE	Centre for the Economics and Management of Aquatic Resources
CRFM	Caribbean Regional Fisheries Mechanism
CSIRO	Commonwealth Scientific and Industrial Research Organization
DWF	Distant Water Fleets
ECOST	Ecosystems, Societies, Consilience, Precautionary principle
ERAEF	Ecological Risk Assessment for Effects of Fishing
FAO	Food and Agriculture Organization of the United Nations
FMSP	Fisheries Management Science Programme
JPoI	Johannesburg Plan of Implementation
LRS	License and Registration System
MPA	Marine Protected Areas
MRAG	Marine Resources Assessment Group
MSEY	Maximum Sustainable Economic Yield
NEFSC	Northeast Fisheries Science Center
PSA	Productivity Susceptibility Analysis
SARC	Stock Assessment Review Committee
SAW	Stock Assessment Workshop
SICA	Scale, Intensity, Consequence Analysis
T&T	Trinidad and Tobago
TEP	Threatened, Endangered and Protected
TIP	Trip Interview Programme
UK	United Kingdom
UNEP	United Nations Environmental Program
USA	United States of America
USDA	United States Department of Agriculture
WTO	World Trade Organization

1. Opening of Meeting

The meeting was opened by Mr. Justin Rennie, Chief Fisheries Officer for the Fisheries Division, Grenada. Mr. Rennie welcomed participants and conveyed the Minister's apologies for not being able to be present at the workshop.

Dr. Susan Singh-Renton, CRFM's Programme Manager for Research and Resource Assessment, was then invited to address participants on behalf of the Chairperson of the Caribbean Fisheries Forum. She took the opportunity to educate participants and members of the press and public about the history of the CRFM, its mission, structure and mandate, as well as to highlight the key achievements of the Caribbean Fisheries Forum since it commenced functioning formally in March 2003. Dr. Singh-Renton pointed out the important role of the annual scientific meetings and their outputs.

Mr. Crafton Isaac, Fisheries Officer in the Fisheries Division, Grenada, delivered the feature address on behalf of his Minister. Mr. Isaac noted the recent shift in emphasis from Artisanal to industrial-type fishing activities in Grenada. Given the current fragile state of the economy in Grenada, Mr. Isaac emphasized the need for establishing sound statistical and monitoring systems to ensure sustainability of the fishing industry. The limited resources available for data collection continued to inhibit progress in these areas. Bearing this in mind, Mr. Isaac urged the Working Group to pay closer attention to developing assessment methods that did not require huge amounts of data. In closing, Mr. Isaac reminded participants that the work of the Ad Hoc Methods Working Group, as well as the annual Scientific Meeting, was crucial for informing the development of fisheries management plans within the region.

Dr. Susan Singh-Renton then delivered the vote of thanks.

2. Election of Meeting Chair

Mrs. June Masters was elected to serve as the Chairperson for the meeting.

3. Introduction of Participants

Mrs. Masters introduced herself, and then invited others to introduce themselves. The Meeting was attended by those fisheries officer who had agreed to serve as chairpersons and/or species rapporteurs for the five CRFM Resource Working Groups for the period 2006-07. Three consultants had been engaged to provide expertise during the Meeting. A list of participants is given in Appendix 1.

4. Adoption of Meeting Agenda

The draft agenda was modified to reflect more accurately all the presentations expected of the consultants. Following these corrections, the meeting agenda was adopted (Appendix 2). In respect of the meetings noted under agenda items 10 and 11, the meeting agreed that all participants would contribute to the meetings of the working groups on data and communications.

5. Review of additional information provided by fisheries managers and national fisheries administrations since the First Meeting

The CRFM Secretariat informed the meeting that to date, 12 countries had completed their fishery manager questionnaires and submitted this to the Secretariat. Only eight countries had completed the data availability questionnaires. Compilation and summaries of the results of both questionnaire studies have been prepared by the Secretariat (Headley and Singh-Renton, 2007a, b) Samples of the two types of questionnaires are provided in Appendix 3. It was agreed to review and discuss the completed data availability questionnaires in more detail during the meeting of the Data Working Group.

6. Review of the Ecological Risk Assessment for Effect of Fishing (ERAEF) Method, and evaluation of the options for its application to fisheries assessment and management activities within the region

The ERAEF method was presented by Dr. Alistair Hobday. A summary of the method is given in Appendix 4, Addendum 1.

A clarification was sought regarding the 'H' (high), 'M' (medium), and 'L' (low) risk scores. It was explained that attributes have a range of values, and that this range is simply (and hence arbitrarily) divided into three sections (lower third, middle third and upper third) for allocation of the scores. There was also a query whether different attribute value ranges were applied to temperate and tropical systems. It was noted that the same values were sometimes applied, because of lack of knowledge. Despite the use of group consultations, there was concern that the subjectivity of the preliminary level analyses could still suffer inaccuracies as a result of one or more individuals dominating the consensus building processes with unintentionally biased opinions (i.e. self-delusion). It was suggested that this could be checked by splitting the group involved into two or more smaller groups that conduct the analysis independently of each other. An alternative or additional check could be done by subjecting the analysis to an external peer review.

Following the preliminary general discussion session, participants began exploring the method for several fisheries within the region. Dr. Hobday's report, given in Appendix 4, provides details of: (i) the trials conducted during the meeting, (ii) proposed inter-sessional activities and schedule for continuing to test the method on CRFM country data, and (iii) a suggested framework for developing a toolbox of methods to address the various types of management objectives listed for CRFM countries.

7. Review of the available options for improving resource assessment analyses and the formulation of management advice, through the collection/compilation and analyses of socio-economic data

This agenda item was presented by Mr. Pierre Failler. A summary of the presentation is given in Appendix 5.

There was some discussion on the need for trade-off analysis in risk assessments, in order to obtain an acceptable balance among agreed social, economic and ecological concerns and goals. The meeting was reminded that the ECOST project was undertaking some trade-off analyses; the results would be available soon, and some of the ideas developed could be incorporated into the efforts of CRFM Resource Working Groups.

Following the preliminary general discussion session, participants engaged in smaller group discussions with Mr. Failler. The smaller group discussions considered in greater depth the social and economic issues affecting fisheries in CRFM States, and sought to identify the next steps needed to improve understanding of the social and economic aspects of the fishing industry within the context of fisheries governance (see Appendix 5 for further details).

8. A simple method for estimating survival rates from catch rates

This agenda item was presented by Dr. Hoenig. A paper describing the method is given in Appendix 6, Addendum 2.

In response to a query, Dr. Hoenig confirmed that some age data were required for applying the method. It was pointed out that the method might be useful for examining trends in mortality over time, and not for estimating absolute mortality.

Following the preliminary general discussion session, participants attempted to apply the method to various datasets. The report of these trials is given in Appendix 6.

9. Method tests

The consultants' full written reports of the method tests conducted during the meeting are given in Appendices 4-6.

Following Dr. Hobday's verbal update on the tests conducted on the ERAEF method, there was some discussion about the schedule for completing tests during the inter-sessional period. Dr. Hobday highlighted the importance of testing the method within a 3-month period, and the need to correspond with him during the testing period.

Following a verbal update by Mr. Failler on the discussions held with various participants in respect of possible approaches to accounting for social and economic issues in fishery assessment work, there was some discussion about identification of problems within the framework outlined. Mr. Failler noted the importance of building a picture of the fishing industry/management chain, and relating this to management objectives. A query was raised in respect of linking the economic issues to the biological issues, and Mr. Failler pointed out that recent efforts in West Africa demonstrated how this could be achieved. There was also a brief discussion about the need for legislation to protect the local market, given its valuable contribution to food security and quality.

Following a verbal update by Dr. Hoenig on the tests conducted so far on his survival estimation method, there was a general discussion about the various approaches and how they fit into an overall management framework. Although the CRFM Secretariat had been attempting to broaden the assessment methodologies applied in order to address a range of fisheries management objectives, i.e. biological, social, economic, ecological/ environmental, no specific agreed framework was in place for tracking the progress of work on methodology at different levels. It was recommended that such a framework be developed to ensure orderly progress of the work of the Methods Working Group. Considering the work completed by the Methods Working Group so far, Dr. Hobday prepared and presented a basic framework for consideration by the meeting. This basic framework highlighted the potential usefulness of the RAPFISH method for identifying those management components (i.e. social, economic and ecological) that would require further attention in respect of quantitative analyses. Methods being evaluated could then be placed within the context of this basic framework (see Appendix 4, Addendum 2).

10. Meeting of the Working Group on Data

All participants were present for this item.

This agenda item commenced with a powerpoint presentation titled 'Data Quality Control Procedures', delivered by Dr. John Hoenig (see Appendix 6, Addendum 1).

The meeting was reminded that several persons were usually involved in maintaining national fisheries databases, and so a query was raised regarding the procedure for ensuring quality in this situation. The importance of identifying potentially false data values was emphasized. The ability of Excel to generate zero values in response to certain data manipulations was also highlighted and demonstrated. Following identification of these questionable data values, there would have to be some investigation of possible explanations, e.g. unusual fishing conditions, and the paper records should also be examined in the event that the data values were copied incorrectly.

In the instance when the paper record could not be retrieved, there was a question about the feasibility of omitting the uncertain data value. It was explained that if the data value is clearly incorrect, then it should be omitted. However, if the value is only suspected of being false, it was suggested that two sets of analyses should probably be undertaken, including and excluding the data value in question to determine its influence on the results. Based on this, a judgment could be made to retain the point for analysis. Alternatively, the analysis could be undertaken without the uncertain value, but then graphical illustrations with all data values included could be presented to allow others to appreciate the possible uncertainty in the overall results of the analysis. Participants were reminded of the importance of being clear and honest about the exclusion of data values from an analysis and uncertainties in their datasets.

Following the presentation and discussion of data quality control procedures, the Working Group on Data held a general discussion about the information provided in the data availability questionnaires completed by seven countries. The meeting agreed that each questionnaire provided valuable information about the extent of a country's fleets, and that this would greatly facilitate identification of data gaps for assessment purposes. It was suggested that the completed data questionnaires should be placed on the CRFM website to enable greater access to the information. The meeting was informed that the ECOST project also conducted a questionnaire survey on data in participating countries, and that this information could be shared with the CRFM Secretariat. It was also suggested that countries should contribute data to FISHBASE.

There was a concern that the questionnaire had not captured information about data that had not been computerized by countries. Several participants noted cases in which countries had considerable amounts of historical data that, due to lack of resources, had not been computerized, and hence was not currently available for use in assessments. The meeting agreed that it was important to gather further information about the extent of the problem within CRFM Member States. Since Trinidad and Tobago had supplied good information about the extent of their non-computerised data, it was suggested staff of that Fisheries Division could help with developing a template for completion by other countries. The template could be further reviewed during the next Scientific Meeting. Certainly, countries had to provide a complete list of the amount of historical data they have. This was also necessary to aid development of a proposal that would facilitate computerization of historical data. However, it was also pointed out that there needed to be agreement on the types of historical data for which information was required.

The meeting was informed that several countries in West Africa had just completed such a project and some documentation was available on a CD. It was not clear whether the CD gave details of the procedures, but the meeting was informed that it was a 4-year project involving 6 countries. In the absence of imminent funding, it was recommended that records at risk be identified, scanned and stored on CDs.

In closing, the Working Group on Data made the following recommendations.

(i) All countries should be requested to list what historical data are available. Staff of the Trinidad and Tobago Fisheries Division are to draft a template for collection of the information on historical data, and this template should be reviewed and finalized during the next Scientific meeting.

(ii) Questionnaire data should be reviewed, and feedback provided to the countries, in order to encourage other countries to submit their completed questionnaires.

(iii) Countries should make an effort to contribute data to FISHBASE and CEPHBASE and other similar databases. Furthermore, the Secretariat should collaborate with FISHBASE staff to explore the possibility of providing FISHBASE search results at a regional level.

(iv) The RAPFISH method should be explored for application during the initial stages of fisheries evaluation work.

(v) It was agreed to accept the criteria for evaluating methods, as noted in the Working Group's Terms of Reference, and as applied for the test of the re-scaled age-structured production model (Addendum 7 to Appendix 4 of the Report of the Second CRFM Annual Scientific Meeting (CRFM, 2006).

(vi) The Secretariat should investigate effective ways of facilitating training of fisheries officers in data analysis.

11. Meeting of the Working Group on Communications

All participants were present for this item.

To facilitate completion of its work, the Working Group referred to several documents: (i) the report of its first meeting; (ii) a paper submitted by S. Willoughby, Chief Fisheries Officer of the Fisheries Division in Barbados and titled 'Guidelines to a common understanding and writing project's goals and objectives' (see Appendix 7 of the present report); and (iii) two FMSP guidebooks produced by the FMSP Project R8468. The FMSP guidebooks were titled: 'How to Manage A Fishery. A simple guide to writing a Fishery Management Plan' (Hindson *et al*., 2005); and 'A Guide to Fisheries Stock Assessment using the FMSP Tools' (Hoggarth *et al*., 2005).

There was some discussion about the process currently being used by countries to develop their fisheries management plans. It was confirmed that a national consultation usually took place after the fisheries management plan had been drafted with inputs by national fisheries staff. Having noted this, it was pointed out that there were different methods of consultation and that the techniques should be agreed even before decisions are taken about what to include in a fisheries management plan. Several participants confirmed that the level of involvement of scientists in the process was variable but generally low. In referring to the report of the first meeting of the Working Group on Communications, and the paper submitted by S. Willoughby, a query was raised regarding the scientist-manager-stakeholder communications task being addressed, and the identification of persons serving the role of managers and scientists within the region. As these persons were unaware that a specific process should be followed, it was pointed out that the work of the Communications Group had indeed been very helpful, as it served to outline the process and clarify what was required. The meeting agreed that the format proposed by the Working Group on Communications during its first meeting and described in the report of that meeting should be considered by the managers within countries who had the responsibility for testing the suggested approaches and determining which format would be most suitable for each situation. In addition, the guidelines noted in S. Willoughby's paper should be tested by managers within countries.

Regarding the FMSP guidebooks, the meeting noted that these guidebooks were reader-friendly with respect to the presentation of the material; in addition, their compact size and glossy appearance made them appealing as interesting and readily portable reference books. There were strong similarities between the formats developed by the Working Group on Communications and the approaches outlined in the FMSP guidebooks.

Having reviewed and endorsed various options for aiding the development of operational management objectives, the Working Group decided that its work was concluded. In closing, the Working Group on Communications made the following recommendations.

(i) Scientists and Managers within CRFM countries should examine the following documents that provide guidance regarding the process for formulating operational management objectives:
   (a) The format presented in the first report of the Working Group on Communications (Addendum 5 to Appendix 4 in the Report of the Second Annual CRFM Scientific Meeting (CRFM 2006);
   (b) The two FMSP guidebooks produced by FMSP Project R8468 (Hindson *et al*., 2005 and Hoggarth *et al*., 2005); and
   (c) The guidelines outlined in the paper prepared by S. Willoughby (Appendix 7).

(ii) Having undertaken the first recommendation, scientists and managers within countries should then proceed to test and customise the approach most suited to each fishery situation.

(iii) Reports on the tests performed in countries, as well as reports on the scientific assessments conducted should be considered to determine whether further guidance is needed from the scientists.

12. Recommendations for application of approved methods to CRFM fisheries situations

The meeting agreed that recommendations for application of approved methods were still being developed, and so a complete list could not be compiled at this time. It was also suggested that the Secretariat seek an update from those who were expected to continue tests during the last inter-sessional period.

13. Finalize inter-sessional work plan and assignments

Participants noted their interest to continue exploring and testing the ERAEF method inter-sessionally, and an inter-sessional schedule was proposed (Appendix 4).

14. Any other business

A query was raised on the use of CARIFIS by countries, particularly whether countries were still using CARIFIS. There was some discussion about the present efforts to transfer historical data from TIP and LRS to CARIFIS.

15. Review and adoption of meeting report

Given that the rapporteurs were directly involved in the meeting discussions and had not prepared a complete draft of the report, it was agreed to review and adopt the report by e-mail.

16. Adjournment

In closing, the Chairperson thanked the government of Grenada for hosting the meeting and for arranging a very enjoyable field trip. She also thanked all participants and consultants for their valuable contributions to the discussions.

17. References

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Appendices

APPENDIX 1

List of Participants

The Bahamas

Mr. Lester Gittens
Assistant Fisheries Officer
Department of Fisheries
P. O. Box N-3028, Nassau
THE BAHAMAS
Tel: (242) 393 1777
Fax: (242) 393-0238
Email: lestergittens@bahamas.gov

Barbados

Mr. Christopher Parker
Fisheries Biologist
Fisheries Division
Princess Alice Highway
Bridgetown
BARBADOS
Tel: (246) 426 3745
Fax: (246) 436 9068
Email: fishbarbados.fb@caribsurf.com

Belize

Mr. Ramon Carcamo
Fisheries Officer
Fisheries Department
Princess Margaret Drive
P. O. Box 148, Belize City
BELIZE
Tel: (501) 223-2623
Fax: (501) 223-2983
Email: species@btl.net

Grenada

Mr. Crafton Isaac
Fisheries Officer II, Assist. Biologist
Fisheries Division
Ministerial Complex
Botanical Gardens, Tanteen,
St. George's
GRENADA
Tel: (473) 440-3831
Fax: (473) 440 6613
Email: fisheries@gov.gd
spicecraf@hotmail.com

Guyana

Ms. Colletta N. Derrell
Fisheries Officer
Department of Fisheries
Ministry of Fisheries, Crops and Livestock
18 Brickdam, Strabroek,
Georgetown
GUYANA
Tel: (592) 225-5052/225 9559
Fax: (592) 225 9558
Email: guyfish@solutions2000.net

Ms. Pamila B. Ramotar
Fisheries Officer
Department of Fisheries
Ministry of Fisheries, Crops and Livestock
18 Brickdam, Strabroek,
Georgetown
GUAYANA
Tel: (592) 225-5052/225 9559
Fax: (592) 225 9558
Email: guyfish@solutions2000.net

Jamaica

Mrs. June Masters
Data Manager Analyst
Fisheries Division
Ministry of Agriculture
P. O. Box 470, Marcus Garvey Drive
Kingston 13, JAMAICA, W.I.
Tel: (876) 923-8811/3 & 923-7571
Fax: (876) 759-1239
E-mail fisheries@cwjamaica.com
Dof_Jamaica@yahoo.com

St. Lucia

Ms. Patricia Hubert-Medar
Fisheries Assistant
Department of Fisheries
Ministry of Agriculture, Forestry & Fisheries
Pointe Seraphine, Castries
ST. LUCIA
Tel: (758) 468-4140
Fax: (758) 452-3853
E-mail: deptfish@slumaffe.org

Trinidad & Tobago

Ms. Louanna Martin
Fisheries Officer
Fisheries Division
Ministry of Agriculture, Land & Marine Resources
St. Clair Circle, St. Clair
Port-of-Spain
TRINIDAD AND TOBAGO
Tel: (868) 624-4504/5
Fax: (868) 634-4488
Email: mfau@tstt.net.tt

Ms. Elizabeth Mohammed
Fisheries Officer
Fisheries Division
Ministry of Agriculture, Land & Marine Resources
St. Clair Circle, St. Clair
Port-of-Spain
TRINIDAD AND TOBAGO
Tel: (868) 624-4504/5
Fax: (868) 634-4488
Email: mfau@tstt.net.tt

Consultants & Resource Persons

Mr. Pierre Failler
Senior Research Fellow
University of Portsmouth
CEMARE
Boathouse n º6, College Road,
H. M.Naval Base
Portsmouth, UK
Tel: (44) 239 –284 –4085
Fax: (44) 239-284-4614
Email: Pierre.faille@port.ac.uk

Dr. Alistair Hobday
Senior Research Scientist
CSIRO – Australia
Castram Esplanade
Hobart
AUSTRALIA
Tel: (61) 362-325310
Email: Alistair.hobday@csiro.au

Dr. John M. Hoenig
Consultant
Virginia Inst. Of Marine Science
P. O. Box 1346
Gloucester Pt., VA 23062
U.S.A
Tel: (804) 684-7125
Fax: (804) 684-7327
Email: hoeing@vims.edu

CRFM Secretariat

Dr. Susan Singh-Renton
Programme Manager Research and Resource Assessment
CRFM Secretariat
3rd Floor Corea's Floor
Halifax Street, Kingstown
ST. VINCENT AND THE GRENADINES
Tel: (784) 457-3474
Fax: (784) 457-3475
E-mail: ssinghrenton@vincysurf.com

Ms. Maren Headley
CRFM Secretariat
3rd Floor Corea's Floor
Halifax Street, Kingstown
ST. VINCENT AND THE GRENADINES
Tel: (784) 457-3474
Fax: (784) 457-3475.
Email: marenheadley@vincysurf.com

APPENDIX 2

Second Meeting of the CRFM Ad Hoc Working Group on Methods (St. George's, Grenada, 27-30 June 2006)

MEETING AGENDA

27 June 2006
(i) Registration (0830-0900h)

27-30 June 2006
1. Opening of Meeting.
2. Election of Meeting Chair.
3. Introduction of Participants.
4. Adoption of Meeting Agenda.
5. Review of additional information provided by fisheries managers and national fisheries administrations since the First Meeting.
6. Review of the Ecological Risk Assessment for Effects of Fishing (ERAEF) Method, and evaluation the options for its application to fisheries assessment and management activities within the region.
7. Review of the available options for improving resource assessment analyses and the formulation of management advice, through the collection/ compilation and analyses of socio-economic data.
8. A simple method for estimating survival rates from catch rates.
9. Method tests.
10. Meeting of the Working Group on Data
11. Meeting of the Working Group on Communications
12. Recommendations for application of approved methods to CRFM fisheries situations.
13. Finalize inter-sessional work plan and assignments.
14. Any other business.
15. Review and adoption of meeting report.
16. Adjournment.

APPENDIX 3

I - FISHERY MANAGER'S QUESTIONNAIRE

Note to Fishery Managers: This questionnaire has been designed to gather information useful for re-evaluating current management advice needs and existing constraints to the provision of this within CRFM countries. The information provided will be used to optimize, as well as customize, the development and application of assessment tools in respect of the management process.

Instructions for completion: *Please tick or encircle your answer choices. In the case of multiple choice questions, you may tick or encircle all the choices that apply. Please print all responses.*

1. Fishery Manager's Name (Director or CFO) ………………………………………..

2. What sources of information are currently used for establishing management objectives for your fisheries?
   (a) National consultations
   (b) Social and economic data available from national statistics authority
   (c) Stakeholder interview survey data
   (d) Local/Traditional ecological knowledge (ethno-scientific information)
   (e) Adopt objectives used by other countries with similar fisheries situations.
   (f) International fisheries instruments
   (g) Other (specify) ………………………………………………………………..

3. Do you actively measure/monitor the achievement of management objectives?
   (a) No (*please go to question 4*) (b) Yes (*please go to question 5*).

4. If you answered negatively in (3), please indicate the constraints to monitoring management objectives.
   (a) Insufficient data collected to allow evaluation.
   (b) Officers do not have sufficient time to analyse available data and hence prepare management advice
   (c) Officers do not have sufficient skills and experience to analyse available data and hence prepare management advice
   (d) Assessment tools being used by officers are not appropriate, as these tools do not provide answers to the management questions of direct concern.
   (e) Defined objectives are too broad, and so officers do not provide specific management guidance on specific issues of concern, e.g. providing advice on suitable gear restrictions and acceptance of this as an effective management tool.
   (f) Other, specify ………………………………………………………………………

5. In table I that follows, list the management objectives for each fishery/ stock, allocate a priority rank to each of the objectives by fishery (using a scale of 1 to 5, with 1 used to indicate highest priority), then list the data collected to facilitate monitoring/measuring of the achievement of the listed objectives, and finally indicate the software tools currently used to analyse the available data (the first data input row shows an example).

Table I. Management objectives by fishery / stock

Fishery (identify specific species or stock)	Management objectives	Priority of objective	Data collected to measure achievement of objective	Sampling coverage (% total)	Analysis tools used [FISAT, prepared FAO Excel spreadsheets, SPSS, Other, specify]	Decision-making rules / reference points used, if any	Current management measures in place for each fishery / stock. Indicate if decision rule was used to establish measure
EXAMPLE. Large pelagic fishery – Spanish mackerel	1) Maximize employment opportunities 2) Maximize biological yield 3) Protect juvenile stock	1) 1 2) 2 3) 3	1) Social and economic data, catch and effort data 2) Catch & effort data 3) Catch, effort, age/size and maturity data	1) 20% 2) 30% 2) 30%, 15%	1) Excel 2) Surplus Production (ASPIC) 3) Excel spreadsheet for yield per recruit, VPA	1) Minimum net profit = 5% of costs 2) Lower limit of estimated MSY range 3) $F_{0.1}$	Mesh size limit for gill nets ($F_{0.1}$ value used).
Reef fishery -							
Conch fishery -							
Lobster fishery -							
Shrimp fishery -							
Ground fish -							
Small coastal pelagic fish -							
Large pelagic fish -							

6. How much work time is currently allocated for data review and analysis tasks and hence also development of assessment skills by the fisheries officers so involved? (Answer is assumed to represent time for a single individual)

(a) < 5% of work time
(b) 10-15% of work time
(c) 15-20% of work time
(d) 20-30% of work time
(e) > 30% of work time

7. In table II that follows, please provide information the qualifications of your officers involved in stock assessment work, and list the data analysis and assessment tools with which they are familiar (the first data input row shows an example.

Table II. Qualifications and experience of staff conducting assessments

Officer (names can be omitted)	Qualifications (include training courses)	Experience with analysis and assessment tools
Example: officer 1	B.Sc., M. Phil, 1995 FAO-Danida training course in assessment	Excel, S-Plus, FISAT, ECOPATH
Officer 1		
Officer 2		
Officer 3		
Officer 4		

8. In table III that follows, note the top specific management questions, by fishery or stock, which currently concern management groups in your country (the first data input row shows an example).

Table III. Current management questions of highest priority.

Fishery	Question
Example: queen conch fishery	1) How effective are marine reserves in enhancing the spawning stock biomass?
1)	
2)	
3)	
4)	
5)	

NB: The CRFM is grateful for your time and attention in completing this questionnaire

II - QUESTIONNAIRE TO OBTAIN DETAILS ON DATA AVAILABILITY

Note to Fishery Data Managers: At the request of the CRFM Ad Hoc Working Group on Methods, this questionnaire has been designed to gather information on the nature and extent of data currently available within CRFM countries. The information provided will be reviewed during the Second Meeting of the Working Group, scheduled to take place within the next few weeks.

Instructions for completion: ***Please print all responses.***

1. (a) Country……………………… (b) Fishery Data Manager's Name ………………………………..

2. Please provide a complete list of all major species/ fishery resources harvested by your fishing industry.

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____

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____.

3. In the table below, please list all types of fisheries statistics collected by your Fisheries Division/Department, and please indicate the periodicity and methods of collecting these statistics. Examples are shown in the grey cells and extra rows are provided for adding your own national information.

Fishery type (list by species or resource type, whichever is more suitable)	Fishery Statistics	Periodicity of Collection (mark the applicable columns with 'X')					Method of Collection (mark the applicable columns with 'X')						Comments (additional information can be included here)
		once	daily	monthly	annually	Ad-hoc (needs basis)	Direct sampling during vessel offloading operations	Direct sampling during vending operations	Observer programmes	Fisher interview surveys	Fishery independent surveys	Other (specify)	
•	landings		X				X						
	effort		X				X						
	size		X				X						
•*EXAMPLES*	age			X			X						
	sex		X				X						
	maturity		X				X						
Wahoo & dolphinfish	ex-vessel price			X			X						
	Area fished	X								X			
Other offshore pelagic species	landings		X				X					Processing plant records examined regularly	
	effort		X				X						
Queen conch	catch							X		X			
	effort									X			
	Area fished									X			
	meat weight							X					
	size										X		
	sex										X		
	maturity										X		
	Area of occurrence										X		
	Habitat type										X		
	depth										X		

4. List data that are collected by other agencies or entities that are potentially useful for providing additional data on fishers and other stakeholders, markets, resources, and the health of the aquatic environment (also indicate agencies/entities involved), e.g. employment data; customs export data.

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____.

5. Please complete the tables on the following pages to provide further details on the data that are collected by your Division/Department as part of your routine fisheries statistical monitoring programme – see the two examples provided (rows with grey fill) to guide completion of the table. If the details are the same for more than one species, simply list all the species in the 'Species' column, for which the same details are applicable, e.g. in the first example, the details are the same for wahoo and dolphinfish, while in the second example, the details are the same for Caribbean spiny lobster and queen conch. Seven additional tables are provided for insertion of your national fisheries information.

Explanatory notes for completing tables for question 5:

1. If the same fishery and sampling details are relevant to more than one species please list the names of all the relevant species here.
2. Give details on the number of markets, processing plants, landing sites, fleet and gear types relevant to the respective species. *This information will be used to understand the full nature and distribution of various activities related to the fishing operations, and if and how these feature in the currently implemented statistical monitoring programme.*
3. Types of data may include landings, fishing effort, area fished, size data, age data, sex data, maturity data (*indicate whether macroscopic examination or collection of gonad weight for estimation of gonado-somatic indices*), ex-vessel price, and other data such as habitat type, depth data, water salinity, etc.. Please give the unit of measurement in brackets. *List each data type on a separate line as specific details are required in the following columns*.
4. Based on the specified fishery details, indicate the extent of statistical coverage e.g., number of each type of market, plant, landing site, fleet, and gear, for which data are collected.
5. Based on the already specified extent of statistical coverage (in numbers of markets, plants, sites, fleets, and gears), indicate further details on whether a census or sample is/was taken. *Kindly be reminded that a census, in relation to a particular landing site, implies that data are collected on every vessel and gear type operated each day at the site. In comparison, a sample, in relation to a landing site, implies that data are collected on a subset of the total number of vessels of each fleet and each gear type at the site and for a subset of the total number of fishing days of the season*.
6. In cases where samples are taken, briefly describe how the species data are raised to obtain total estimates for the entire industry. If the raising procedures have been formally documented, this documentation should be submitted along with the completed questionnaire.
7. Include any other additional information that may assist in estimation of totals.

Table providing further details on the data that are collected by your Division/Department as part of your routine fisheries statistical monitoring programme

<table>
<tr><td colspan="2" rowspan="3"><u>EXAMPLE 1</u>

SPECIES[1]: Wahoo and dolphinfish________</td><td colspan="4">FISHERY DETAILS[2]</td></tr>
<tr><td colspan="2">No. markets: ____2 main____
No. processing plants: ____5 main___
No. landing sites: ___5_primary; 10 secondary; 22 tertiary______</td><td colspan="2">No. fleet types: ___4 major & 2 fleets that harvest as bycatch_______
No. gear types: ___2 major gears plus 3 other gears (bycatch)</td></tr>
<tr></tr>
<tr><td>Types of data available[3] – give measurement unit</td><td>Time periods for which data are available</td><td>Extent of data collection activities in relation to fishery details[4]</td><td>Statistical coverage details[5]</td><td>Where sample data collected, how are sample data to provide totals for entire industry[6]</td><td>Comments[7]</td></tr>
<tr><td>(i) landings by individual species (lbs)</td><td>1970-1994 (primary sites only); 1995-present (expanded to other sites)</td><td>(a) <u>Markets and processing plants</u>: 2 main markets & 5 processing plants
(b) <u>Landing sites</u>: 5 primary, 2 secondary, 0 tertiary.
(c) <u>Fleet types</u>: 4 major fleet types, plus 1 of the minor fleet types.

(d) <u>Gear types</u>: 2 major gears plus 2 gears that also catch wahoo in small amounts</td><td>(a) Census at markets and plants

(b) Census at primary sites; 30% coverage at secondary sites

(c) Census of 4 major fleets at primary sites; 30% coverage of fleets at secondary sites (1 minor fleet operating at tertiary sites and not sampled)
(d) Census of major gears at primary sites; 30% coverage of gears at secondary sites (1 minor gear used by minor fleet at tertiary site not sampled)</td><td>For b, c, & d, use number of sampling days and sample-day totals of vessels by fleet type out fishing at secondary sites to determine total number of fishing days and hence overall landing totals by gear type, fleet type, and hence landing site</td><td></td></tr>
<tr><td>(ii) effort, lumped for both species (hours fished)</td><td>1970-1994 (primary sites only); 1995-present (expanded to other sites)</td><td>(a) <u>Landing sites</u>: 5 primary, 2 secondary, 0 tertiary.
(b) <u>Fleet types</u>: 4 major fleet types, plus 1 of the minor fleet types.

(c) <u>Gear types</u>: 2 major gears plus 2 gears that also catch wahoo in small amounts</td><td>(a) Census at primary sites; 30% coverage at secondary sites

(b) Census of 4 major fleets at primary sites; 30% coverage of fleets at secondary sites (1 minor fleet operating at tertiary sites and not sampled)
(c) Census of major gears at primary sites; 30% coverage of gears at secondary sites (1 minor gear used by minor fleet at tertiary site not sampled)</td><td>For a, b, & c, use number of sampling days and sample-day totals of vessels by fleet type out fishing at secondary sites to determine overall effort totals gear type, fleet type, and hence also landing site</td><td></td></tr>
<tr><td>(iii) size data – fork length (cm)</td><td>1996-1998; 2002-2003</td><td>Markets and processing plants, and 2 primary sites only</td><td>30% in 1996-1998; 15% in 2002-2003</td><td>Use ratio of sample size to total landings estimated, taking into account the numbers and types of sampling strata covered.</td><td></td></tr>
<tr><td>(iv) age data</td><td>Not available</td><td></td><td>NA</td><td>NA</td><td></td></tr>
<tr><td>(v) sex data</td><td>1996-1998; 2002-2003</td><td>Markets and processing plants, and 2 primary sites only</td><td>30% in 1996-1998; 15% in 2002-03</td><td>Use ratio of sample size to total landings estimated, taking into account the numbers and types of sampling strata covered.</td><td></td></tr>
<tr><td>(vi) maturity data – macroscopic exam</td><td>1996-1998; 2002-2003</td><td>Markets and processing plants, and 2 primary sites only</td><td>30% in 1996-1998; 15% in 2002-03</td><td>Use ratio of sample size to total landings estimated, taking into account the numbers and types of sampling strata covered.</td><td></td></tr>
<tr><td>(vii) ex-vessel price data
(EC$ per lb)</td><td>1970-1994 (main sites only); 1995-present (expanded to other sites)</td><td></td><td>30% before 1995; 40% from 1995</td><td>(vii) Use ratio of sample to total landings</td><td></td></tr>
</table>

EXAMPLE 2 **SPECIES[1]:** queen conch and spiny lobster_________		**FISHERY DETAILS[2]**			
		No. markets: ____3 main____ **No. processing plants:** ____5 main___ **No. landing sites:** ___3_primary; 15 secondary; 15 tertiary______		**No. fleet types:** ___2 major fleets_______ **No. gear types:** ___2 major gears______	
Types of data available[3] – give measurement unit	**Time periods for which data are available**	**Extent of data collection activities in relation to fishery details[4]**	**Statistical coverage details[5]**	**Where sample data collected, how are sample data to provide totals for entire industry[6]**	**Comments[7]**
(i) landings by individual species – meat weight (ozs)	1950-1994 (processing plants only); 1995-present (expanded to actual landing sites)	(a) Processing plants: 5 processing plants (b) Landing sites: 2 primary, 5 secondary, 5 tertiary. (c) Fleet types: 2 major fleet types (d) Gear types: 2 major gears	(a) Census at plants during open fishing season (b) 30% coverage at primary sites; 15% coverage at secondary sites; 15% coverage at tertiary sites (c) 30% coverage at primary sites; 15% coverage at secondary sites; 15% coverage at tertiary sites (d) 30% coverage at primary sites; 15% coverage at secondary sites; 15% coverage at tertiary sites	For b, c, & d, use number of sampling days and sample-day totals of vessels by fleet type out fishing at each site type to determine total number of fishing days and hence overall landing totals by gear type, fleet type, and hence landing site	
(ii) effort, indistinguishable for both species (hours fished)	1995-present (primary, secondary, and tertiary sites)	(a) Landing sites: 2 primary, 5 secondary, 5 tertiary. (b) Fleet types: 2 major fleet types (c) Gear types: 2 major gears	(a) 30% coverage at primary sites; 15% coverage at secondary sites; 15% coverage at tertiary sites (b) 30% coverage at primary sites; 15% coverage at secondary sites; 15% coverage at tertiary sites (c) 30% coverage at primary sites; 15% coverage at secondary sites; 15% coverage at tertiary sites	For b, c, & d, use number of sampling days and sample-day totals of vessels by fleet type out fishing at each site type to determine total number of fishing days and hence overall landing totals by gear type, fleet type, and hence landing site	
(iii) size data – shell length (mm) for conch & carapace length (mm) for lobster	1996-1998	Visual surveys (conch only) and primary sites only for lobster	20% of grounds in 1996-1998 for conch; 40% coverage for lobster	Use ratio of sample size to total landings estimated, taking into account the numbers and types of sampling strata covered.	
(iv) age data	Not available		NA	NA	
(v) sex data	1996-1998	Visual surveys (conch only)	20% of grounds in annual surveys during 1996-1998	Use ratio of sample size to total landings estimated, taking into account the numbers and types of sampling strata covered.	
(vi) maturity data – macroscopic exam	1996-1998	Visual surveys (conch only)	20% of grounds in annual surveys during 1996-1998	Use ratio of sample size to total landings estimated, taking into account the numbers and types of sampling strata covered.	
(vii) ex-vessel price data (EC$ per lb)	1950-1994 (processing plant records); 1995-present (expanded to other sites)	Processing plants, 2 primary, 5 secondary, 5 tertiary	From 1995, 30% coverage at primary sites, and 15% at secondary and tertiary sites	Use ratio of sample size to total landings estimated, taking into account the numbers and types of sampling strata covered.	
(viii) Other (specify) habitat type and depth data (ft), area of occurrence		Visual surveys (conch only)	20% of grounds in annual surveys during 1996-1998	Extrapolate to entire area of likely resource distribution	

SPECIES[1]: ________________________		FISHERY DETAILS[2]			
		No. markets: ____________ No. processing plants: ____________ No. landing sites: __________________		No. fleet types: ________________ No. gear types: ________________	
Types of data available[3] – give measurement unit	**Time periods for which data are available**	**Extent of data collection activities in relation to fishery details[4]**	**Statistical coverage details[5]**	**Where sample data collected, how are sample data to provide totals for entire industry[6]**	**Comments[7]**

THANK YOU FOR YOUR TIME AND ATTENTION IN PROVIDING THE REQUESTED INFORMATION

APPENDIX 4

SECOND MEETING OF THE CRFM AD HOC WORKING GROUP ON METHODS
St. George's, Grenada, 27-30 June 2006

Consultant Report

Ecological Risk Assessment for the Effects of Fishing (ERAEF): test for CRFM fisheries

Dr. Alistair Hobday
CSIRO Marine and Atmospheric Research
Australia
Alistair.Hobday@csiro.au

Submitted 8 July 2006

Risk assessment method for sustainable fisheries

The Australian Ecological Risk Assessment for the Effects of Fishing (ERAEF) method was presented to the working group during the Grenada meeting then tested on a range of CRFM fisheries over a 3-day period. The ERAEF method is appropriate for a variety of Caribbean fisheries as it works on fisheries, which are small-scale or data-limited (see Addendum 1 for a summary of the method). The ERAEF method has been applied recently to all of the fisheries currently managed by the Australian Fisheries Management Authority (AFMA), amounting to over 30 sub-fisheries (gear types). This has demonstrated the utility and flexibility of the method, while the consistency of the approach is leading to improved selection of research priorities, both within and between fisheries.

Test of the ERAEF on Caribbean fisheries

Following an introduction to risk assessment processes, and the ERAEF in particular, the consultant worked with the CRFM country-representatives to test the ERAEF method for their fisheries (Addendum 1). Participants had brought data with which to test the method, including information on species captured, their biological characteristics and information about the scope of fishing operations. The meeting participants were provided with materials to allow testing of the ERAEF method for a variety of Caribbean fisheries:

ERAEF: Methodology (100 pages)
Level 1: excel spreadsheet
Level 2: excel spreadsheet

Each of the ERAEF stages was tested at the meeting (Table 1**)**

- Scoping (5 fishery tests)
- Level 1 (4 fishery tests)
- Level 2 (5 fishery tests, 2 - 185 species)

Table 1. Fisheries tested using the ERAEF stages at the CRFM workshop.

ERAEF stage	Fisheries testing that stage
Scoping Elements of scoping were tested for the following fisheries:	St Lucia lobster pot fishery (Patricia) St Lucia conch fishery (Patricia) Trinidad gillnet fishery (Elizabeth, Louanna) Belize trap fishery (Ramon)
Level 1 Draft Level 1 for target species were completed for the following fisheries:	St Lucia conch fishery (Patricia) Trinidad gillnet fishery (Elizabeth, Louanna) Belize trap fishery (Ramon) Guyana Trap, Gillnet nylon (Pamila)
Level 2 Draft Level 2 assessments were undertaken for the target and bycatch components of the following fisheries:	St Lucia lobster pot fishery (Patricia, Lester, June, Maren) Barbados longline fishery (Chris), n=2 species Trinidad gillnet fishery (Elizabeth, Louanna ~ 185 species) Belize finfish (Ramon, ~ 12 sp). Guyana Trap, Gillnet nylon (Pamila, ~12, 3 species). Selectivity data

Conclusion – risk assessment method

I contend that the ERAEF method will work for CRFM countries, the skills and experience of the participants at the meeting were sufficient to draft ERAEF analyses using the excel spreadsheets used for assessments. The ERAEF method also performs well against the criteria developed by the working group (Table 2). At the stage, the focus should be on the target and bycatch species components, rather than the other three ERAEF components (protected species, habitats or communities). These remaining three components that support an ecosystem-based fishery management approach should be contemplated by CRFM in the next five years.

Recommendation: inter-sessional work – next 3 months
The working group agreed to continue to refine the tests back in the home countries and try the method with a greater range of species and components. In particular,

- Level 1; complete SICA with bycatch component
- Level 2; complete PSA with a full species list

Following these tests, country participants will advise (via Dr Susan Singh-Renton) whether the ERAEF method

1) would work for their fishery and would be useful.
2) would work for their fishery, however, would not be useful.
3) would not work for their fishery.

A short report describing the tests and copies of the spreadsheets and results should be submitted to Dr Susan Singh-Renton who will send on to the consultant. This will allow the consultant to also validate the tests, and identify improvements to the method for use by the CRFM participant.

If the answer is (1), then the action by the consultant should include:

- refinement of the ERAEF guidance document for the CRFM to be supplied back to Dr Susan Singh-Renton for distribution
- a full test of the ERAEF on a selected sub-set of fisheries, undertaken in-country by nominated participants. This will generate a priority list of components, activities, and species for the selected fisheries. Results of this full test could then be presented at the scientific meeting. It is expected that one of the test fisheries would be selected, and the full test would refine the draft tests.

If the answer is (2) or (3), then the methods group will advise the consultant, and thank him for his contribution.

Immediate Action

- Participants to continue to test ERAEF method and advise Dr Susan Singh-Renton by 30 October 2006 as to the interest in the method, together with submission of spreadsheets and short report on the test.
- Dr Singh-Renton to advise consultant as to the outcome by 10-Nov-2006.
- Consultant to advise next course of action following that report.

Long-term suggestion for CRFM

- Move towards eco-system-based fishery management in the region, using a tool such as ERAEF. This means considering ecological components such as habitats and ecological communities, a well as target and bycatch species.
- Develop an overall framework for sustainable fisheries, as outlined in this report (**Addendum 2**).

Table 2. Summary of ERAEF method presented and discussed at the CRFM ad-hoc methods working group 2nd meeting (June 2006), in accordance with proposed selection criteria noted by the working group in previous meetings.

Method	Data requirements	Mgmt advice produced?	Mgmt measures	Level of skills required	Costs and risks/ benefits	Type of stock/fishery	Working group
ERAEF	Increase with each level, but generally: 1) Species lists 2) Knowledge of biological characteristics of each species (e.g. from fishbase). 3) Estimates of range and gear selectivity.	Yes, used to guide the research or data gathering priorities	Identified at each level. For example, can be suggested by the scoring of the management axis at Level 2.	Excel data manipulation. Relatively minimal quantitative skills, but good qualitative understanding of fishery.	**Overall** <u>Risks</u> Time to complete the assessment. Is fishery-focused, and not a regional assessment tool. Once individual assessments are completed cumulative impacts can be considered. <u>Benefits</u> As described in the overview: hierarchical and efficient. Lack of data still allows prioritization. **Level 1** <u>Risks</u>: Qualitative assessment can be limited by experience of participants. Wide stakeholder consultation would offset this risk. <u>Benefits</u> Works in data-deficient situations **Level 2** <u>Risks</u>: Species-specific information not available. Use fish-base for fish and sharks, but invertebrate data may be missing. Can use genera or family averages if needed. Distribution effort not available for the fishery…precautionary approach will increase risk scores. <u>Benefits</u> Quickly screen up to hundreds of species	Any – tested on over 30 fisheries to date.	Tested on 4-5 CRFM fisheries, see Table 1.

Addendum 1 to Appendix 4 - Summary of ERAEF method

The Ecological Risk Assessment for the Effects of Fishing (ERAEF) has been developed by CSIRO Marine Research in Australia. The ERAEF framework involves a hierarchical approach that moves from a comprehensive but largely qualitative analysis of risk at Level 1, through a more focused and semi-quantitative approach at Level 2, to a highly focused and fully quantitative "model-based" approach at Level 3 (Figure 1). This approach is efficient because many potential risks are screened out at Level 1, so that the more intensive and quantitative analyses at Level 2 (and ultimately at Level 3) are limited to a subset of the higher risk activities associated with fishing. It also leads to rapid identification of high-risk activities, which in turn can lead to immediate remedial action (risk management response). The ERAEF approach is also precautionary, in the sense that risks will be scored high in the absence of information, evidence or logical argument to the contrary.

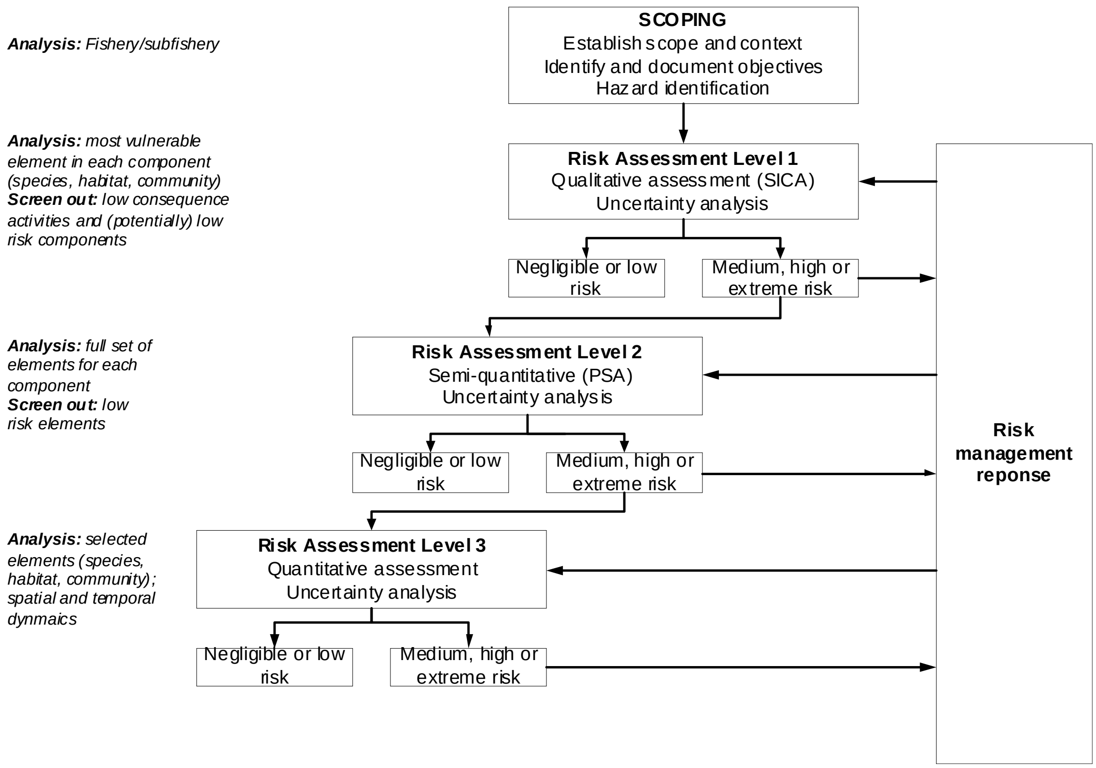


Figure 1: Overview of ERAEF showing focus of analysis for each level at the left in italics.

The scoping stage includes four aspects: fishery description, details of objectives, list of activities (hazards), and identification of units of analysis. The fishery description includes identification of sub-fisheries (mainly designated by fishing method), history and current status, including current management arrangements. This step identifies information to support assessment at the subsequent levels. The particular activities are identified from a general list of 26 activities[1] associated with fishing, as well as six activities outside the fishery that could also impacts on the ecological system. Thus, the scoping stage identifies those activities that are relevant to the sub-fishery under assessment. In ERAEF, impacts can be assessed against five ecological components that comprise the ecosystem: target species; by-product and by-catch species; threatened, endangered and protected (TEP) species; habitats; and communities. At the scoping stage, the

[1] The description of these activities might need to be expanded or modified for use by the CRFM counties.

relevant units of analysis are identified for each component, comprising either a list of species, habitats or communities. Benthic habitats are classified based on geomorphology, sediment, and faunal cover, most often using photographic images. Communities are classified using nationally agreed bioregions and biotic provinces, combined with a depth classification scheme. Depending on the nature and scale of the fishery under assessment, the units of analysis may comprise hundreds of species and habitat types, and tens of community types.

The Level 1 assessment uses a SICA (scale, intensity, consequence analysis) method that involves assessing the impact of each activity on each component using expert judgment and a 6-point scale of impact from negligible to catastrophic. The potential amount of analysis required at this qualitative level is limited by taking a "plausible worst case" approach (credible scenario analysis) that selects the unit of analysis identified by stakeholders to be most vulnerable to each activity. The maximum number of scenarios required is 160 (32 activities by five components). Each scenario is carefully documented, and only activity/component combinations (hazards) for which the risk score is greater than 2 (moderate or above, precautionary approach) are assessed at the next level. In practice, most hazards are eliminated at Level 1. In some cases, entire components are assessed to be a low risk (e.g. habitats for pelagic longline fisheries), and excluded from further assessment at higher, more costly levels.

Level 2 assessments are based on a PSA (productivity susceptibility analysis). At Level 2, all units of analysis are assessed for any component not screened out at Level 1. Given that there may be hundreds of units of analysis (e.g. up to 500 by-catch species in a tropical prawn fishery), this requires an efficient screening process. This is achieved by compiling for each unit of analysis a list of attributes that bear either on productivity (ability of the unit to recover from impact) or susceptibility (exposure of the unit to impact). There are no new methods developed for Level 3 analyses in the ERAEF, as existing methods were suitable: these include quantitative stock assessment for target and by-product species, population viability analysis for TEP species, and potentially methods such as Ecopath/Ecosim for Level 3 community analyses.

Several other features of ERAEF are worth describing briefly. First, there is a common underlying theoretical basis to the method that formally links the three levels of analysis. This is loosely based around a commonly used "impact model" described by the equation

$$dB/dt = rB(1-B/K) - qEB$$

where B is biomass or numbers (or other appropriate measure of the unit of interest), r is intrinsic rate of increase, K is carrying capacity, q is "catchability" and E is fishing effort. The Level 1 analysis attempts to assess the impacts qualitatively (ie, estimate dB/dt), while Level 2 provides proxies for r (productivity) and q (susceptibility). Level 3 solves the full equation (or its equivalent).

ERAEF also has an explicit and formal treatment of uncertainty. As already noted, the Level 1 analysis is based on a "plausible worst case" treatment of impact, while there are a number of aspects of the Level 2 analyses whereby the default scoring (in the absence of better information) leads to an assessment of high risk. This means that application of the method provides the correct incentive to acquire better information in order to reduce risk. Overall, the hierarchical approach leads to a very cost-effective means of screening hazards, as Level 1 allows for rapid assessment with minimal information requirements, while successive levels require more time, resources and information, but are only called upon where needed (Figure 1).

Addendum 2 to Appendix 4 - A framework for sustainability

The CRFM methods group should consider how the tools they are investigating are complimentary or will build a toolbox for supporting sustainable fisheries (Figure 2). For example, a tool such as Rapfish (Pitcher and Preikshot 2001) can provide an overview of the relative sustainability of fisheries, and also indicate the segments that are of concern. There are three main segments in a sustainable fishery: economic, social and environmental/ecological. The tools that have been investigated to date have mostly been ecological; although at the second meeting, the economic segment was considered. Once a particular segment is shown to be of concern, a one or more segment tools, such as ERAEF, might be selected. Once particular issues are identified with these tools, even greater resolution can be provided by sub-segment tools, such as survival analyses (presented by John Hoenig at this meeting). The working group might consider revising this suggested framework, or develop an alternative, but should have an overall plan for selecting the tools to support sustainable fisheries.

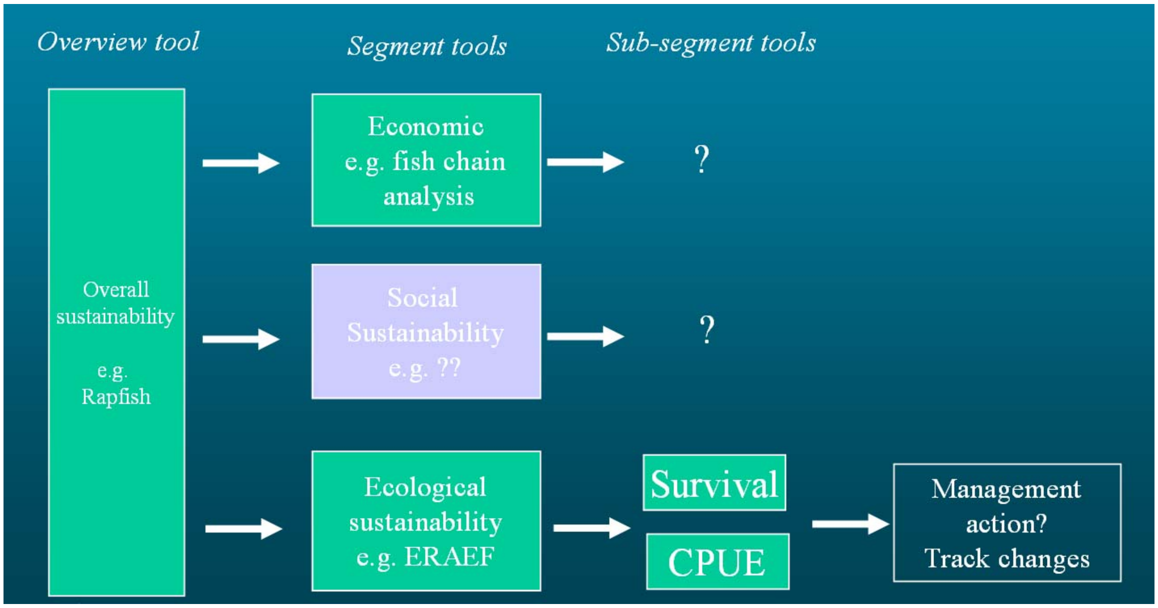


Figure 2: Example of an overall framework for assessing the sustainability of fisheries. No present identification of segment or sub-segment tools by the working group is shown by a "?". In future these may be added to the framework as needed.

References

Pitcher, T. J. and Preikshot, D. (2001). RAPFISH: a rapid appraisal technique to evaluate the sustainability status of fisheries. *Fisheries Research* **49**(3): 255-270.

APPENDIX 5

Report on economic and social considerations for fishery management
Second meeting of the CRFM ad HOC working group on methods
St Georges, Grenada, 27-30 June 2006

By: Pierre Failler,
CEMARE
Pierre.failler@port.ac.uk

1. Workshop presentation

Past considerations — In the past, economic considerations consisted mainly of the evaluation of fishermen's revenues and fishery rent; and social considerations meant number of jobs in the fishery sector. Economists used (and still!) to play with bio-economic models to define optimal capital investment and fishing effort based on MSEY but their impact in the fishery management was limited as these tools were not able to reflect changes in the fisheries.
Current considerations — Nowadays, economics is more and more present in fishery management, fishery policies and national development policies through:

- The evaluation of the fishery contribution to regional or island development (fishery is one component of the development process…like tourism). Sophisticated methods to assess the contribution of fishery to local, national development have been developed (EU-AXES project) and fishery sector and regional development is now linked with marine ecology and biology of fish stocks (EU-PECHDEV and EU-ECOST projects)
- The recognition that management is not only fish stock management but also fishery development in a context of island development with many other options… The fact also that management is dedicated to high commercial value species
- The fact that the market is the main driving force in many fisheries and that has management implications. The attractiveness of international markets (prices, growing demand) compared to local or national ones lead to :
    - Some shifts of fishing efforts;
    - The lack of supply of local and national markets with imports of white meat to compensate;
- The analysis of the effect of the propensity of fishery sectors to be more and more opened-up (export orientated) with knowing side effects on other fishery components (highly selective = by-catches; sophisticated = push others to adapt; quality orientated = standards for other fisheries … with costs). Globally that leads to a progressive degradation of both fishery sector and ecosystem and a pervasive system where fishermen develop all the time new strategies to adapt to the market (See: UNEP work, CARICOM 2004 Trade liberalisation and related policies impacts, etc.)

West African fisheries are a good example of opened-up fisheries with a contribution to the national economies and well-being of population in significant decline. Overall, the current operating system is contributing both to the collapse of ecosystem and production system. Figure 1 is the first step to the evaluation of the economic and social contribution of the fishery sector to countries or a region. It presents main producers and main trade flows of the most important fishery both in terms of quantities and source of animal proteins in West Africa. Such a simple graph presents an idea of the economic and social contribution of the fishery sector (including processing and marketing) as soon as you put employment and revenues at each level of the fish chain. It helps also to identify where are the main constraints to the implementation of a new management measure that tends to reduce the catches level.

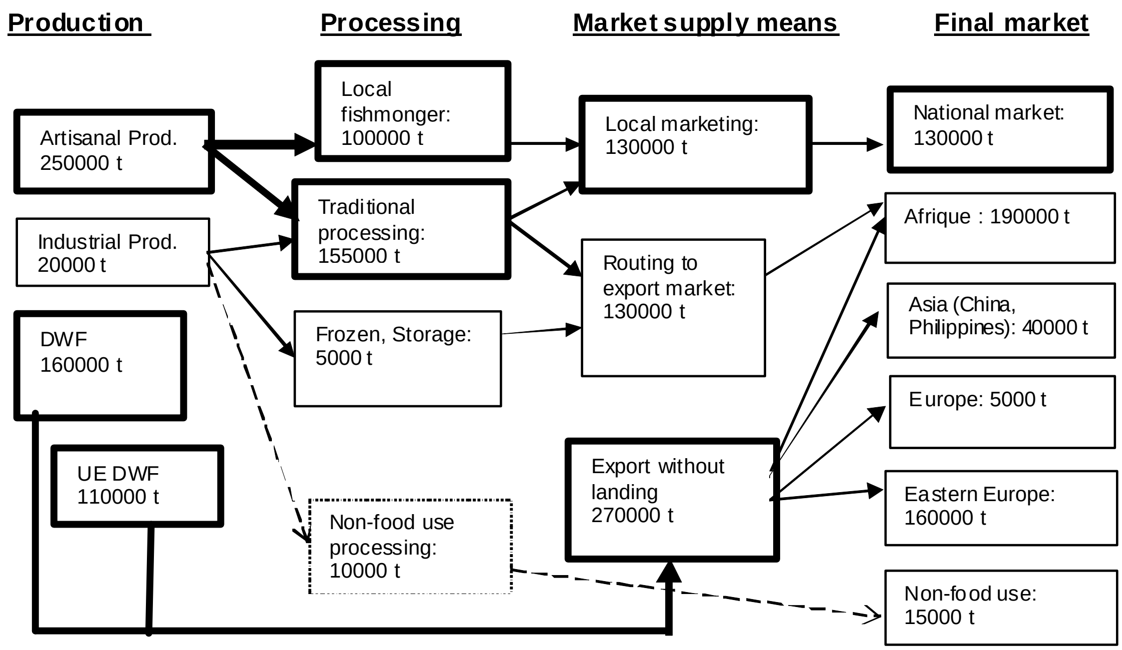


Figure 1: Average yearly (1996-2000) sardinella production, processing and distribution (note: DWF:`Distant water fleets; all figures are in live weight equivalent)

The evaluation of management effectiveness is another new area where economists can bring elements for thought. What are the economics and social effects of management measures? This question is rarely asked and never answered in most of the fisheries in the world. Why? Simply because managers assume that the new measure will sort out all the problems (that the previous measure failed to solve!)…so effects of a new management measure are positive on the whole system. For instance, measures such as biological rests, closure seasons, MPA, etc. can be monitored and evaluated if set up on time.

Social considerations — Social considerations are of course jobs but not only as they relate to fishing but also:

- Fishing communities livelihoods and well-being
- Fishing communities culture and role of conservation of marine resources and ecosystems
- National level: Poverty, equity, food security and nutrition issues
- Management to be regarded as a process of reconnection between people and the sea
- Use people knowledge, social process of control
- Involvement of stakeholders in the management process

For instance, nutrition concerns are great in most of the African and Asian Fisheries. The table below presents some of nutritional characteristic of fish species and chicken for comparison. This table helps to identify if a species shift on the national market supply will affect the population heath.

Table 1: Nutritional values of some fish species and chicken

Species	FAO Code	Species Group	Energy(Kcal)	Protein(g)	Lipid(g)
Octopus nei	OCT	Cephalopods	82	14,91	1,04
Lesser African threadfin	GAL	Demersal	87	19,2	0,6
Flatfishes nei	FLX	Marine fish, demersal	91	18,84	1,19
Cuttlefishes/bobtail/squids	CTL	Cephalopods	92	15,58	1,38
Pargo breams nei	SBP	Demersal	92	18,4	1,5
Congo dentex	DNC	Demersal	92	18,8	1,3
Groupers nei	GPX	Demersal	92	19,38	1,02
Goatfishes, red mullet nei	MUM	Demersal	96	20,4	1
Skipjack tuna	SKJ	Pelagic/Tunas	100	20,51	1,34
Snappers nei	SNA	Demersal	100	20,51	1,34
Sardinellas nei	SIX	Pelagic	101	21	1,9
Shrimp	CNZ	Crustaceans	102	17,9	0,6
Common shrimp	CSH	Crustaceans	120	23,08	1,96
Shark	SKH	Demersal	130	20,98	4,51
Chiken			139	19	12
Hakes nei	HKX	Demersal	142	21,8	5,4
European pilchard(=Sardine)	PIL	Pelagic	143	17,6	7,5
Jack and horse mackerels nei	JAX	Pelagic, small	143	25	4
Plain bonito	BOP	Pelagic	151	22,6	6
Yellowfin tuna	YFT	Pelagic/Tunas	170	24	7,5
Atlantic mackerel	MAC	Marine fish, pelagic	205	18,6	13,89

Source: Platt B.S., 1962. Tables of Representative values of foods commonly used in tropical countries; USDA Table of nutrient www.nal.usda.gov/fnic/cgi-bin/; FAO and US Department of Health, Education and Welfare, 1968. Food Composition Table for use in Africa; "McCance and Widdowson's, 1992. The Composition of Foods. The Royal Society of Chemistry, Cambridge; CNRST and University of Oslo, 1995. The Composition of Malian Foods.

Governance considerations — Economists have extended their area of expertise recently by looking at the governance of fishery systems and the coherence of fishery and national development policies. The tendency is to move from the management approaches, characterised by a sectoral approach, mechanistic and reductionism approaches, centralised processes, non-participatory approach despite some attempts, science based management and at last reactive approach. On the opposite, the governance approach is based on some institutional and decisional processes that allow the whole system to meet the objectives of the sustainable development (i.e. economic growth, social equity and environment protection). The governance can thus be evaluated.

The coherence analysis is based on this move from management to governance with the basic idea that fishery is not a stand alone sector but is integrated into a broader picture and contributes (as well as other economic sectors) to the process of national development through the creation of value added, exports, taxes, job creation, food security, poverty reduction, etc. At the fishery level, the objective of this approach is to evaluate the level of coherence of fishery policies and management measures (for instance the coherence of the different objectives/achievement of the fishery policy: market supply, employment, exports, maximisation of the value of fish stocks). At the national level, the coherence approach consists of the analysis of the consistency of all policies that affect the fishery sector: poverty reduction and growth facility policy (structural adjustment program), food security, economic growth, etc. At the international level, the coherence approach looks at the international policies (WTO, Cotonou agreement, JPoI, for instance, for the Caribbean countries).

Caribbean fishery considerations — A brief overview of the Caribbean fish production and export/import main trends reveal that fish production seems to have reached its maximum production level in 2000 with 200,000 t (as shown in the Figure2 below), and since then, has shown a declining trend. In terms of tonnage, the main players in 2004 were Guyana, with nearly 60,000 t and, to a much lesser extent, The Bahamas, Jamaica, Trinidad and Tobago, St Vincent and the Grenadines and Haiti (Figure 3).

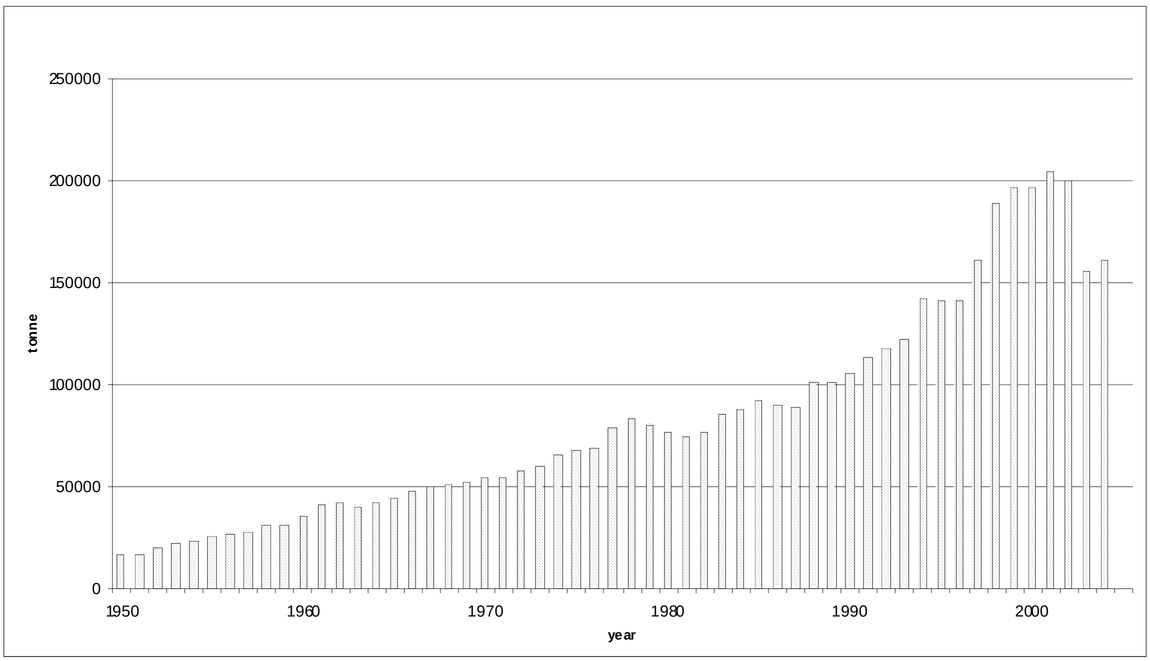


Figure 2: Total captures of the CRFM countries 1950-2004 (FAO, fishstat)

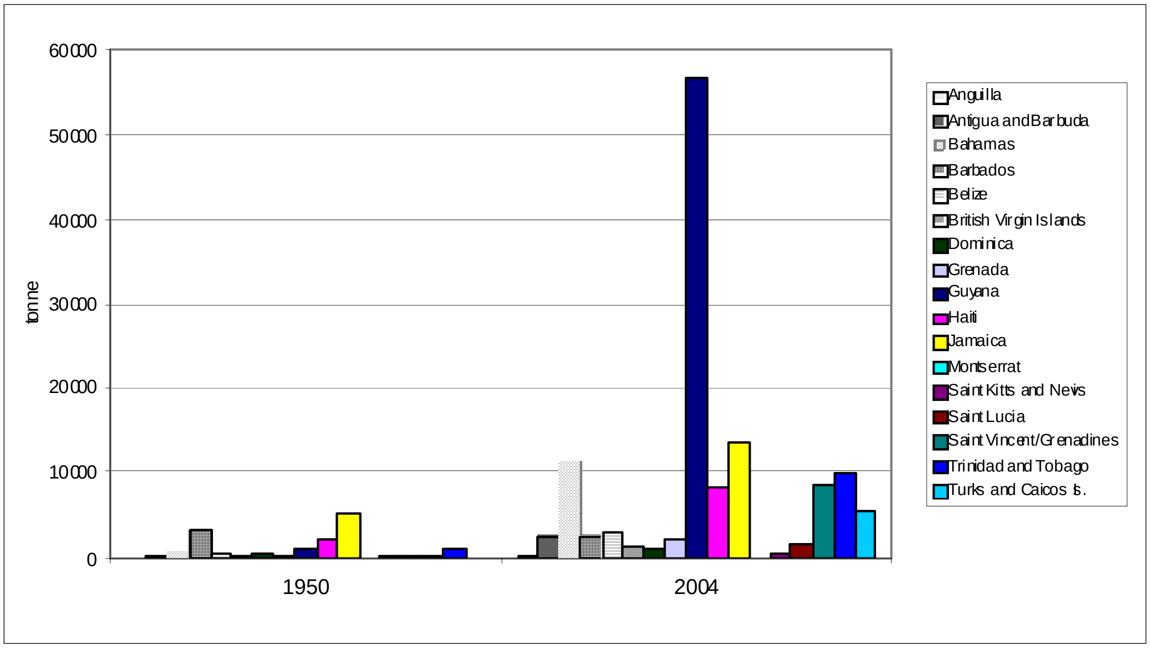


Figure 3: Captures of the CRFM countries in 1950 and 2004 (FAO fishstat)

The import and export structure reveal the propensity of the CRFM countries to export high value species and import low value ones. Figure 4 shows the price multiply factor of export price (per tonne). It indicates that exports of all CRFM countries are more valuable than imports. For some countries that are exporting red lobster, for instance, and importing low value fish from South America for instance, the multiply factor can be up to 110. A deeper analysis can be done, using the fish chain analysis (both for imports and exports) to present the main driving forces of the fish trade in each country and define public policy options and governance proposals.

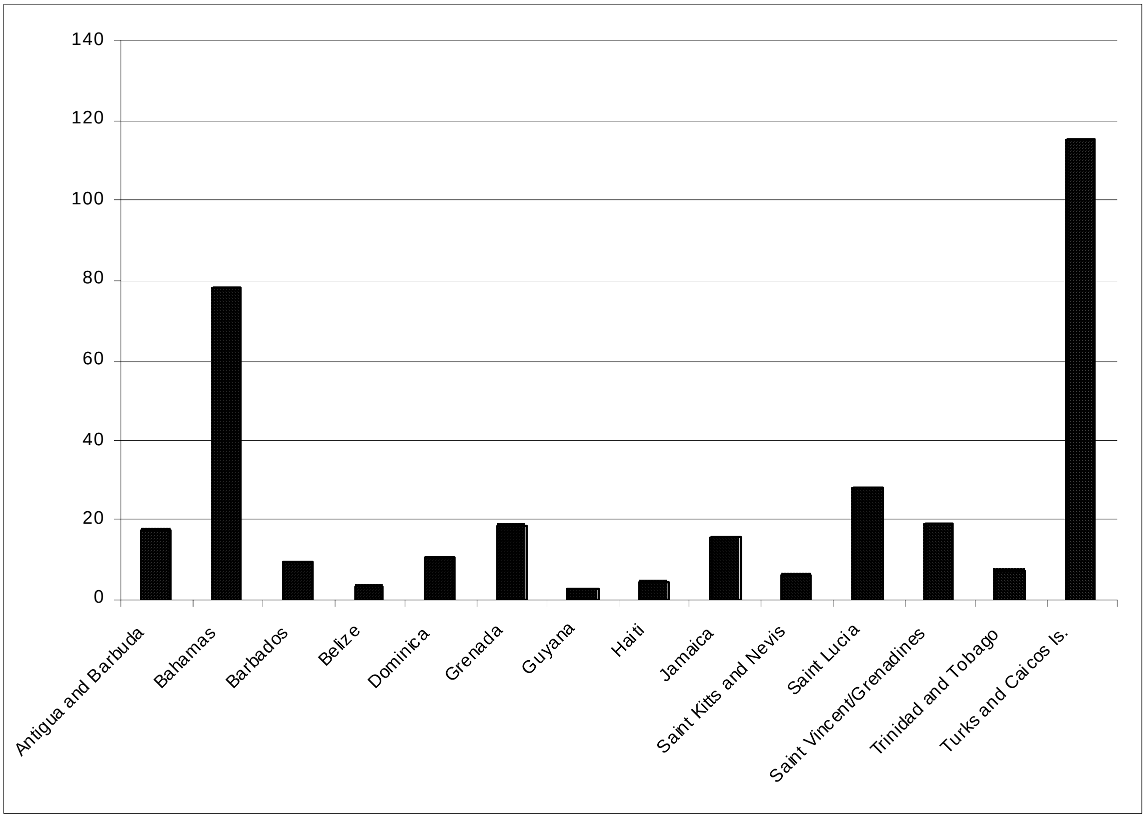


Figure 4: Price multiply factor (export price per tonne over import price per tonne)

Current workshop working steps — The main steps of the current workshop are:
1- Define what countries want and need knowing the fact that some data are already available in some countries (BVI, Guyana, Nevis, St Lucia, St Vincent, T&T) and economic and trade analysis already done (2004 survey on Economics data (T&T, Dominica, etc.).

2- Make an overview of economic and social aspects of fishery sector in each country:
a) Characterize the fishery sector in each country (production, processing, marketing, consumption). Flows of quantities and values of products; Key factors affecting each component of the fishery sector (exports, imports, DWF, etc.)
b) Determine the main economics and social driving forces (how much the market (internal and external) is driving the fishing effort, for instance).
c) Define issues for the consideration of economic and social aspects into fishery management (coherence, trade, etc.) and main aspects to be covered at both national and regional levels.

3- Propose agenda for some economic and social work with countries and CRFM

2. Workshop findings and recommendations

The purpose of the discussion with CRFM country representatives was mainly to discuss economic and social aspects of their fisheries and try to find key points to work on further on.

Current situation — In many CRFM countries the current context can be summarised as :
- High dependency on sea and its living resources

- Similarity of production sector profiles
- Heterogeneity of fishery chain profiles
- Consumption from 10 to 45 kg/y/c (contribution to food proteins from 4% to 20%) with some self-sufficient, exports, imports countries

Fish chain — Discussion on the fish chain has been done in order to define its major components:

- From production to consumption (and trend)
- Key players identification
- Key problems along the claim
- Define problems in economics terms
- See how much market can solve them instead (or with) technical measures

As representatives from countries were biologists or ecologists, discussions have been limited to the production and management options using market incentives instead of state control. Further investigations need to be done in order to draw a consistent presentation of the fish chain.

Contribution of fishery — The assessment of the contribution of fisheries has been done with representatives, focusing mainly on the following aspects:

- Food security
- Poverty alleviation
- Tourism
- Local economy, development and well-being
- Culture and identity of the country

All five aspects have been ranked as main economic and social concerns outside of the fishery sector itself. If the lack of data on the relationship between the fishery sector and the rest of the economy has limited the discussion to a qualitative assessment, it clearly shows the lack of knowledge on the economic and social importance of the fishery sector and somehow the under-estimation of its role in the national economy.

Next steps – Further investigation on the economic and social considerations have to be done through the CRFM, based on the willingness of countries to have a knowledge and understanding of economic and social aspects of their fisheries that can lead to a governance process.

APPENDIX 6

Report to the Caribbean Regional Fisheries Mechanism on the First Component of the Assignment as Specified in the Terms of Reference

Activities of Consultant John M. Hoenig in Furtherance of the Work of the Ad Hoc Methods Working Group at its Meeting in Grenada, June, 2006

John M. Hoenig, Ph.D.
Virginia Institute of Marine Science*
Gloucester Point, VA 23062, USA

Submitted 10 August 2006

Abstract

Guidelines were developed for data quality control evaluation (Addendum 1). A simple method for estimating survival rate from catch rate information was presented (Addendum 2). The method requires that only one age class needs to be identified in the catch which makes it attractive in a wide variety of situations where age determination is difficult. In cases where age determination is subject to systematic error, the method can provide an index of survival rather than absolute survival. Thus, the method may be useful in detecting trends in survival rate over time even when there is error in the determination of age categories. Trials began to evaluate the use of this method on five species: spiny lobster in the Bahamas, conch in St. Lucia, seabob in Guyana, bangamary in Guyana, and crevalle jack in Trinidad and Tobago. Results for spiny lobster appeared reasonable in the sense that estimates from catch rate data from two commercial gear types were largely in agreement, and showed little change in survival over the years examined. Results for the other trials are pending.

Data Quality Control Procedures.

Errors in data can arise in myriad ways, and at any stage in the collection, transference, processing and interpretation of the data. Thus, a port sampling agent may misunderstand or mishear information given to him or her; may record the information incorrectly or in the wrong place, may be inconsistent in units of measurement, and so forth. The data entry person may misread the data, or enter it incorrectly into the computer, or mislabel what has been entered. Errors can be introduced by data users, or by the software, when data is processed, especially when data is transferred from one format to another. For these reasons, it is essential that data be proofread at least once before they are considered "final", and that quality control checks be performed whenever data is analyzed.

A number of suggestions are given in Addendum 1 on how to ensure the quality of data is high. A key point is that checks for "unusual" or "suspicious" values be made.

Estimation of Survival Rate from Catch Rates.

A simple method for estimating survival rate from a series of observations on catch rate was examined by the working group. This method is described in detail in Addendum 2. The method is attractive because it requires minimal aging of the catch. One must be able to identify at least approximately how much of a sample falls in one age class. If the information for defining the age group is rough, then the method can provide an index of survival but the results may be subject to considerable bias if interpreted as an actual survival rate.

In order to use the method, three key pieces of information are necessary.

1) Catch rate measured each year over a restricted period of time (say, a month or two) for a minimum of two years.

2) Size frequency information for the catch used to determine catch rates.

3) Growth information, used to define one age category.

The data are processed as follows.

1) Length frequency graphs are prepared for each year and examined for evidence of modes (peaks) that might represent age classes.

2) Based on the available growth information and length frequency distributions, three groups are defined: a) sizes that are not well sampled by the fishing gear and are thus ignored; b) the first fully represented age class in the catch; and c) everything older than the first fully represented age class.

3) The proportion of the catch in each of the three defined groups is determined from the length frequency distributions. Thus, we might determine that 30% of the catch is in the first fully represented age class, 55% is older than the first fully represented age class, and 15% is small and not well sampled (note: 30 + 55 + 15 = 100).

4) The catch rate for a given year is multiplied by the proportions determined in step 3 to determine the catch rate of each group in that year.

Trials of this method were attempted for five species as follows.

species	country	available data
spiny lobster	Bahamas	catch rates, size frequencies by market category, growth
seabob	Guyana	catch rates, size frequencies by market category
banga	Guyana	catch rates, size frequencies
crevalle jack	Trin.-Tob.	catch rates, size frequencies, growth
conch	St. Lucia	catch rates, size frequencies

The size frequencies for spiny lobster and seabob are by market weight category and thus are rather rough. Growth information is currently available for two of the trial species. For conch, we will try applying growth information from Jamaica to the St. Lucia population. For banga and seabob we will try to extract growth information from the size frequency samples.

To date, results have been generated for one species, the spiny lobster in the Bahamas. Data were available for the years 2001, 2002, 2003 and 2004. It was assumed that lobsters with 5 oz tails would become lobsters with 6 oz. or heavier tails the next year. Catch rates were available for lobster hooks and lobster spears. Survival estimates were calculated using pairs of years and using the new method that simultaneously uses all years of data. The results were as follows.

	survival estimate	
years	lobster hook	spear
2001-2	0.69	0.63
2002-3	0.71	0.69
2003-4	1.09	0.42
all years	0.83	0.58

The results based on 2001-2002 data match those based on 2002-2003 data for both types of commercial gear. The data for 2003-2004 give different results for the two gear types. Note, however, that the average of 1.09 and 0.42 is close to all four estimates based on the previous data. The estimates based on all of the data for a particular gear type are influenced quite strongly by the 2003-2004 results. If those results are anomalous, then as a few more years of data are added the results for the two gear types should become closer. It may be possible to extract historical data from some earlier years to further test the method.

Data Quality Control Procedures

John M. Hoenig

Prepared for the 2nd CRFM

Methods Working Group Meeting

St. George's, Grenada

June 2006

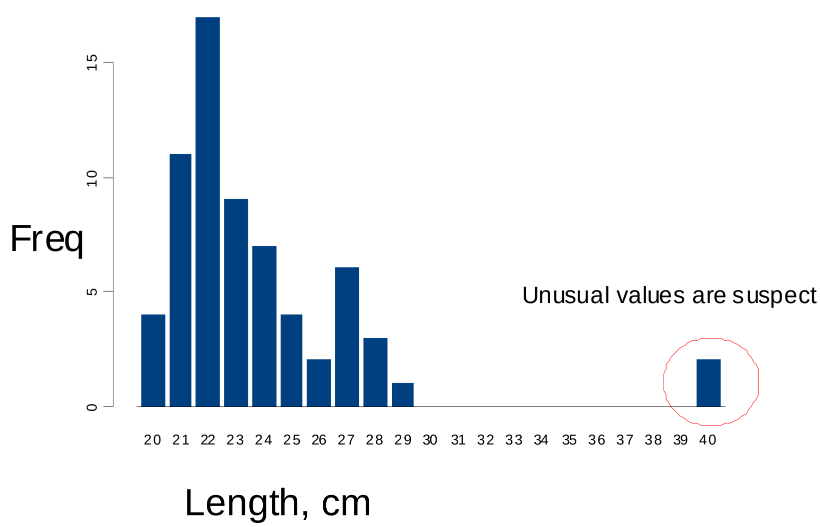
1) Every time you make a change to a database, enter your name, the date, and a description & justification of the change
2) Data must be proofread at least once. Enter name of person doing checking and date the data were checked
3) Every database should have embedded in it an explanation of every column heading, every symbol used, etc.
4) A person examining a database should be able to understand it without having to look elsewhere for explanations.

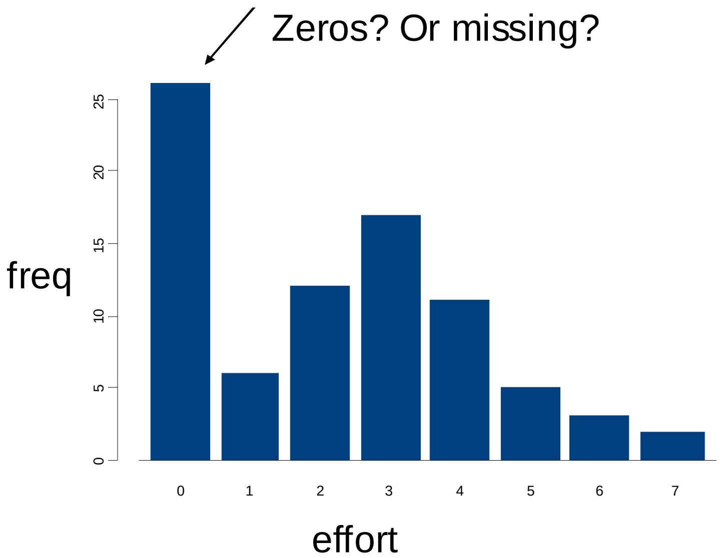
LOOK at the data.

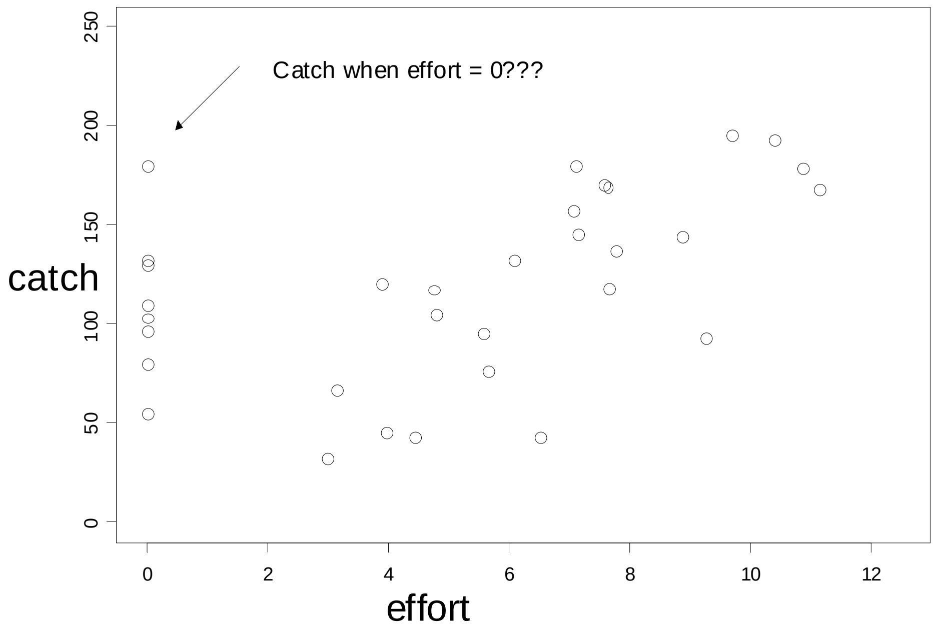
• are there impossible values, e.g., length = 47g.2 cm

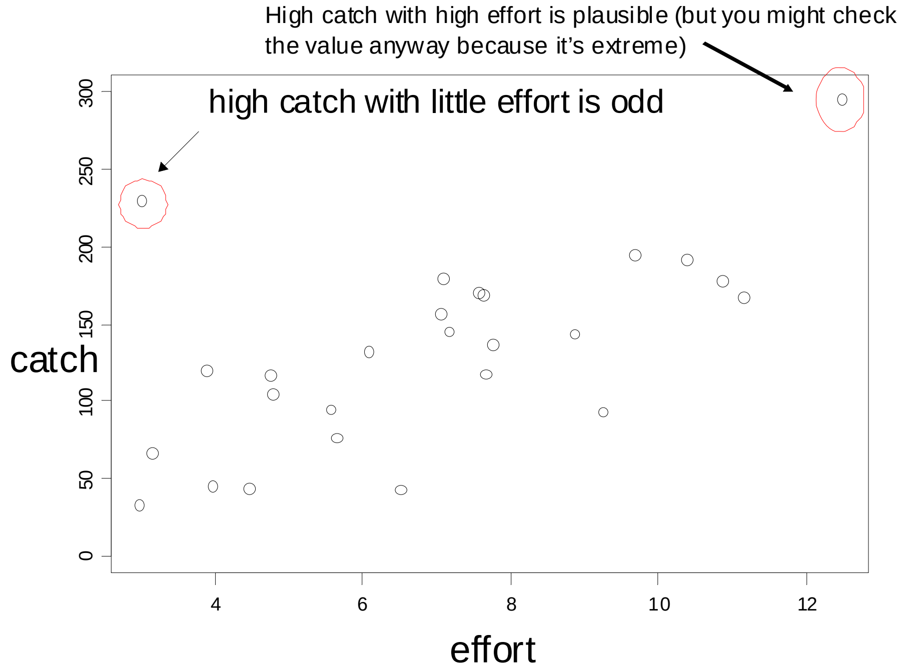
• have missing values accidentally been converted to zeros? (see end of this presentation for an example of how this can occur.)

Histograms




Zeros? Or missing?
freq
25
20
15
10
5
0
0
1
2
3
4
5
6
7
effort


Catch when effort = 0???
catch
250
200
150
100
50
0
0
2
4
6
8
10
12
effort



Example: how missing values can be converted into zeros

In Excel, enter a column of numbers but leave a couple of cells blank. Use the average function to compute the sample average. (for example, =average(b3:b10)

Now highlight this column of numbers and copy it to a new page. Notice that the blank cells now have zeros. Use the average command to find the average. Note that it's different from what you got in the previous sheet. The reason is that Excel now thinks the missing cells are real data that should be included in the average.

The point is that errors can creep into databases in a variety of ways and sometimes it's not even a case of typing errors. So, you need to check your data. Also, the wise data analyst does not trust Excel completely.

Addendum 2 - Simple Methods for Estimating Survival Rate from Catch Rates from Multiple Years

John M. Hoenig and Todd Gedamke
Virginia Institute of Marine Science, P.O. Box 1346, Gloucester Point, VA 23062, USA

Abstract

Survival rates can be estimated from annual surveys by tracking the abundance of one or more cohorts, as measured by catch per unit of sampling effort, from one year to the next. It can be difficult to attain reasonable precision unless sampling effort is extensive. Indeed, estimates of survival exceeding 100% are not infrequently obtained. We show that data from several years can be analyzed simultaneously to obtain a single estimate of survival under the assumption that survival is constant over the period analyzed. The method requires that only a single age group need be identifiable and thus has minimal data requirements. Estimates of goosefish (*Lophius americanus*) survival obtained by this method compare favorably with estimates obtained by analyzing changes in mean length over time.

Introduction

Annual survival rate, S, can be estimated from annual surveys using a longitudinal catch curve to follow a cohort over time. This is based on the relationships that

$$N_{a+1,t+1} = S\, N_{a,t}$$

and

$$I_{at} = qN_{at}$$

where $N_{a,t}$ is the number of animals of age a alive at the time of the survey in year t, I_{at} is an index of abundance of the animals of age a in year t, and q is the catchability coefficient. The survival rate can thus be estimated by linear regression of the index on the previous year's value for the same cohort. The assumptions are that survival and catchability are both constant over time and age, and that the ages of the animals observed in the survey can be determined.

Sometimes, it is difficult to determine ages for older animals. If one age group can be identified and separated from the others, and two years of data are considered, then the survival rate can be estimated by

$$\hat{S}_t = \frac{N_{\geq a+1,t+1}}{N_{\geq a,t}} = \frac{I_{\geq a+1,t+1}}{I_{\geq a,t}} \qquad (1)$$

where the ^ indicates an estimate and the notation $\geq a$ means all ages greater than or equal to a. That is, age groups are pooled and the abundance of a group of cohorts is followed from one year (when they are age a and above) to the next (when they are age $a+1$ and above). Heincke (1913, cited in Ricker 1975) was apparently the first to suggest pooling data over ages although he formulated the estimation procedure in terms of a cross-sectional catch curve (age composition observed in one year) rather than as a longitudinal catch curve (changes in abundance of specified cohorts monitored over time). A generalization of this to include more than two years of data has not been given previously and is developed below.

Development of multi-year estimators

We consider just two age groups in the population – recruits and previously recruited animals. Recruits are defined to be those animals that will join the previously recruited animals the next year (if they survive the year). The relationship between the number of previously recruited animals in year $t+1$, N_{t+1}, and the number of recruits R_t and previously recruited animals N_t in year t is:

$$N_{t+1} = S\,N_t + \phi^*\,R_t\ , \qquad t = 1, \ldots, T\text{-}1$$

where ϕ^* and S are the survival rates of the recruits and previously recruited animals, respectively, and T is the number of years of survey data. In terms of indices of abundance, we have

$$I_{t+1} = S\,I_t + \phi\,r_t\ , \qquad t = 1, \ldots, T\text{-}1 \qquad (2)$$

where r_t is the index of recruits in year t and ϕ subsumes the survival of recruits and the selectivity of the survey gear for recruits. If the indices I_t are independent then equation (2) is in the form of a multiple linear regression with no intercept. Parameter estimates can be found easily by minimizing the sum of squared deviations between observed indices and predictions obtained from the previous year's index:

$$\sum_{t=1}^{T-1} (I_{t+1} - S\,I_t - \phi\,r_t)^2\ .$$

Estimates of S and ϕ may be highly negatively correlated and unstable unless appreciable contrast is observed in the recruitment over time. When recruitment is not highly variable, an alternative is to ignore the recruitment altogether and replace equation (2) with

$$I_{t+1} = S\,I_t + \beta\ , \qquad t = 1, \ldots, T\text{-}1 \qquad (3)$$

where β is the intercept in a linear regression.

Another alternative is based on the idea that the parameter ϕ likely is close to the value of S. Recruits may have a higher natural mortality than previously recruited animals but likely have a lower fishing mortality and a lower catchability so that, on balance, it may be reasonable to set ϕ equal to S to obtain an estimate of survival. Thus, equation (2) would be replaced by

$$I_{t+1} = S\,(\,I_t + r_t)\ , \qquad t = 1, \ldots, T\text{-}1. \qquad (4).$$

Example: Goosefish

Goosefish (*Lophius americanus*) are captured in the annual groundfish trawl survey conducted by the National Marine Fisheries Service Woods Hole Laboratory in the fall of each year. However, the survey was not designed to sample this species and the catches are always low, ranging from 14 to 196 animals per survey. Despite this, the mean length data from the survey have proved useful for estimating mortality rates even though the mean lengths vary greatly from year to year (see Gedamke and Hoenig 2006). Estimates were made for two regions: the northern management area, comprising the Gulf of Maine, southern New England and Georges Bank, and the southern management area, comprising waters from Rhode Island to North Carolina. It is of interest to see how well those values are reproduced when mortality is estimated from catch rates (Table 1) instead of mean lengths.

Goosefish are believed to be fully vulnerable to the survey trawl when they reach 30 cm in total length (NEFSC 2002). We determined the first fully vulnerable age class using the von Bertalanffy growth models developed by the National Marine Fisheries Service. Growth parameters for the northern region are: L_∞ infinity = 126.0 cm, K = 0.1080 yr^{-1}; for the southern region the values are L_∞ = 129.2 cm, K = 0.1198 yr^{-1} (NEFSC 2002). No values were given for the parameter t_o so a value of 0.0 yr was assumed for both regions. It is seen that fish from age 2.5 to 3.5 have predicted lengths of 29.8 to 39.7 cm in the northern region. Consequently, fish in the size range 30 to 40 cm are taken to be the recruits, and all fish above the size 40 cm are considered the previously recruited animals. For the southern region, the recruits are 33 to 44 cm.

We apply equation (1) to the catch rate data in Table 1 to obtain annual estimates of survival rate and then convert these to estimates of instantaneous rates of total mortality, $\hat{Z}$, according to the formula $\hat{Z}$ = - ln($\hat{S}$) (Figures 1 and 2). Data from the 1963 and 1964 surveys give rise to an estimate of survival between the surveys, i.e., between fall 1963 and fall 1964. We refer to this as the survival in 1964 because most of the time interval is in 1964. Not unexpectedly, the results are highly variable and often infeasible (i.e., estimates of mortality rate are negative). We computed the arithmetic mean of the results from (1) over the periods of years of stable mortality identified by Gedamke and Hoenig from their analysis of mean sizes (2006) (Table 2, Figures 1 and 2). Averaging the annual estimates gives results roughly similar to those obtained by Gedamke and Hoenig but the agreement is strong only in one comparison. We apply the estimators in (2), (3) and (4) to those same ranges of years. Results from equations (2) and (3) were poor and are not shown here.

The results of applying equation (4) are extremely close to the results of Gedamke and Hoenig (2006) for four of the five comparisons. Only for the period 1963 to 1976 for the southern region was there a large discrepancy ($\hat{Z}$ = 0.33 yr^{-1} based on mean lengths and = 0.55 yr^{-1} based on (4)).

Sensitivity Analysis

Assumption that $\phi = S$

A key assumption in applying equation (4) is that the parameter ϕ is equal to S. We specify departures from this assumption by specifying $\gamma S = \phi$. Then (2) can be written

$$I_{t+1} = S\, I_t + \gamma S\, r_t \;, \qquad t = 1, \ldots, T\text{-}1.$$

The effect of assuming $\gamma = 1$, when it is really some other value, can be determined by multiplying all the recruitment index values by the other value and then re-estimating the survival rate. We did this for the northern management region data from 1963 to 1977 and converted the results to instantaneous rates of total mortality, *Z* (Figure 4). The computed *Z* is an increasing function of the value of γ used and is described by: computed $Z = 0.0554\,\gamma + 0.123$ such that when $\gamma = 1$ the computed *Z* is 0.1784, as reported in Table 2. If ϕ is really 90% of S (i.e., $\gamma = 0.9$), the estimate of Z should be 0.17286 and the percent difference in results is

$$\% \text{ difference} = 100(.1784 - .17286)/.17286 = 3\% .$$

Thus, a 10% error in the specification of γ results in a 3% error in the estimate of *Z*. In this case, at least, the estimator is insensitive to model misspecification.

Effects of systematic errors in age composition

There are two effects of systematic errors in the specification of age composition. First, if only a portion of the animals in age group 1 is included in the analysis the result will be a positive bias in the survival estimator. This is easily seen from equation (1) where the denominator is made smaller by the exclusion of some recruits. Similarly, including some animals in the new recruits category that will not reach the size of the second age group in one year results in a negative bias.

The second consequence of systematic misspecification of age composition is that the estimator is no longer unaffected by recruitment variability. Suppose the fraction α of age group 1 included in the analysis is constant. Then, as recruitment approaches zero, the estimator approaches the survival rate, *S*. As recruitment increases without bound, the estimator tends to $S/(1 - \alpha)$. If recruitment is overestimated (some animals are included in age group 1 that will not grow into age category 2 in one year) but recruitment approaches zero then the estimator tends to the true survival rate *S*. If recruitment is overestimated and recruitment approaches infinity, the estimator is too low and tends to $S/(1 + \alpha)$. These conclusions are justified in Attachment A.

Discussion

We have presented a new approach to estimating survival rate from multiple years of survey data. The big advantages of this approach are that one does not need to know the magnitude of the landings and one does not have to be able to age the catch beyond identifying the recruits.

For the goosefish example, it appears that the survey catch rates are more variable than the mean lengths and, consequently, that the precision of the estimates from the new approach may be less than those based on the Gedamke and Hoenig (2006) approach based on mean lengths. However, it should be noted that both methods can be applied to the same data. For goosefish, it is reassuring that the two approaches gave very similar results for five of the six time-area comparisons. Estimates obtained by averaging two-year estimates obtained by equation (1) appeared reasonable in most cases. However, averaging a set of numbers that contain nonsensical values (survivals greater than 1.0) may be troubling and hard to justify.

We relied on the model described by equation (4) because the survey catches of goosefish were low and the catch rates highly variable. In cases where a species is better sampled, it may be worthwhile to use the models in (2) and (3).

Our example involved survey catch rate data. It is also possible to apply the method to commercial catch rate data provided these represent relatively short periods of time. For example, catch rate in the first two months of year $t+1$ can be compared to catch rates in the same period in year t. The restricted period of time within a year is necessary for two reasons. First, catch rate in a time interval is proportional to average abundance in that interval. Thus, over an extended period of time the effort may be large and the commercial catch rate reflects both the initial abundance and the depletion of the population. The second reason for using a restricted period of time is that catchability, recruitment and other factors may change seasonally so that catch rate is harder to interpret.

In Attachment A, we investigate the impact of errors in determining the fraction of the survey catch that will recruit in the next year and place bounds on these errors. In cases where errors in determining the catch composition may be appreciable, the survival estimators are more properly thought of as providing an index of survival rather than absolute survival. That is, the estimators can be used to monitor trends in survival rate over time rather than to quantify the level of survival.

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Attachment A - effects of systematic errors in age composition on survival estimates

The survival estimator in equation (1) can be written

$$\hat{S} = \frac{b_2}{a_1 + b_1} \qquad \text{(A1)}$$

where a_1 represents the abundance of recruits in year 1 and b_1 and b_2 are the abundances of previously recruited animals in years 1 and 2, respectively. If a portion of the animals that will recruit in year 2, say, αa_1, is excluded from the recruitment, then the estimate of survival will be biased high. Similarly, if some animals are included in the recruitment that will not, in fact, recruit in year 2 (a_1 is specified to be too large), the estimate will be biased low.

We now consider how the magnitude of the recruitment affects this result. We note that

$$b_2 = S(\, a_1 + b_1). \qquad \text{(A2)}$$

If a portion of the recruitment, say, αa_1, is excluded from the calculation of survival, then (A1) becomes an erroneous estimate of survival, $\hat{S}_{err}$, given by

$$\hat{S}_{err} = \frac{b_2}{a_1 + b_1 - \alpha a_1} = \frac{S(a_1 + b_1)}{a_1 + b_1 - \alpha a_1}.$$

Suppose the recruitment a_1 approaches zero. This implies that the amount of recruitment not included in the calculation, αa_1, also approaches zero. Then, $\hat{S}_{err}$ approaches $S(b_1/b_1) = S$. On the other hand, suppose $a_1 \rightarrow \infty$ while α remains constant. Then,

$$\hat{S}_{err} \rightarrow S\left(\frac{a_1}{a_1 - a_1\alpha}\right) = \frac{S}{1-\alpha}.$$

Similarly, it can be shown that if recruitment is overstated by an amount α, but recruitment approaches zero, then the erroneous estimator approaches the true survival rate, S.

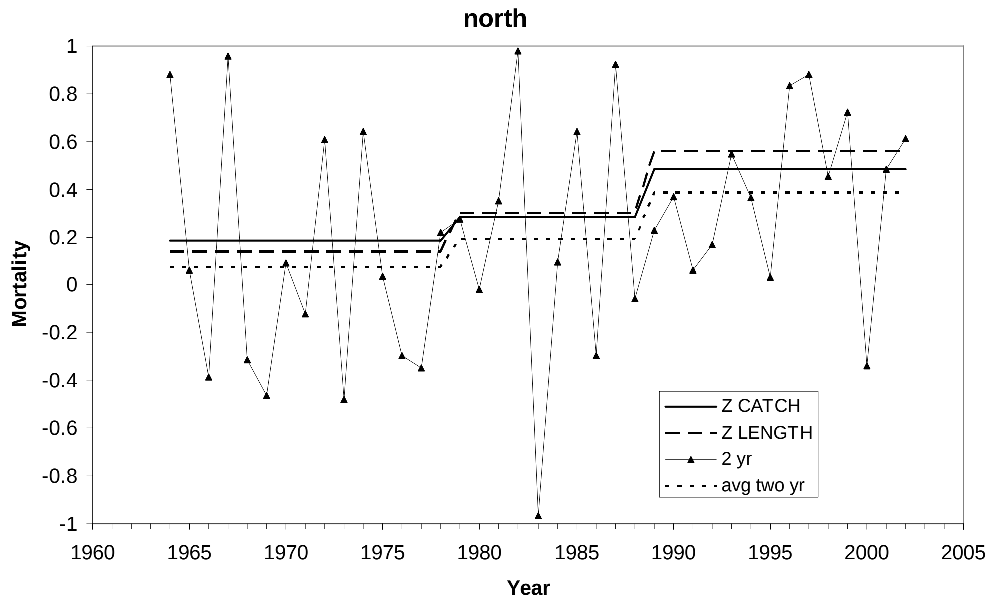

Figure 1: Estimates of total instantaneous mortality rate Z (= - ln(S)) for the northern management zone in three time periods, obtained by Gedamke and Hoenig (2006) from the length frequencies of the survey catches (heavy dashed lines). Also shown are annual estimates of Z obtained using two years of data and applying equation (1) (triangles) along with their averages over the three time periods (dotted lines) and the results of applying equation (4) to the catch rate data (solid lines).

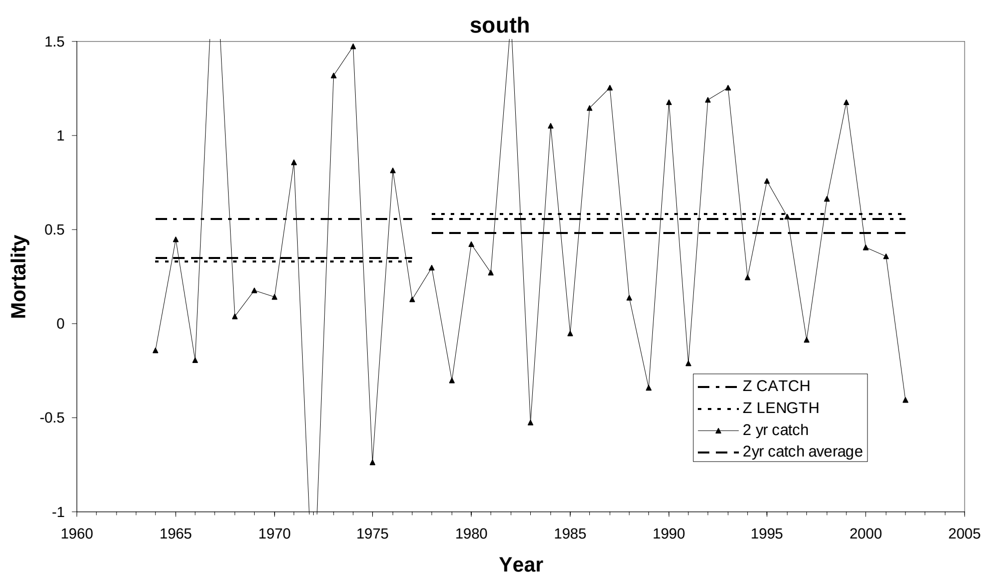

Figure 2: Estimates of total instantaneous mortality rate Z (= - ln(S)) for the southern management zone in three time periods, obtained by Gedamke and Hoenig (2006) from the length frequencies of the survey catches (heavy dashed lines). Also shown are annual estimates of Z obtained using two years of data and applying equation (1) (triangles) along with their averages over the three time periods (dotted lines) and the results of applying equation (4) to the catch rate data (solid lines).

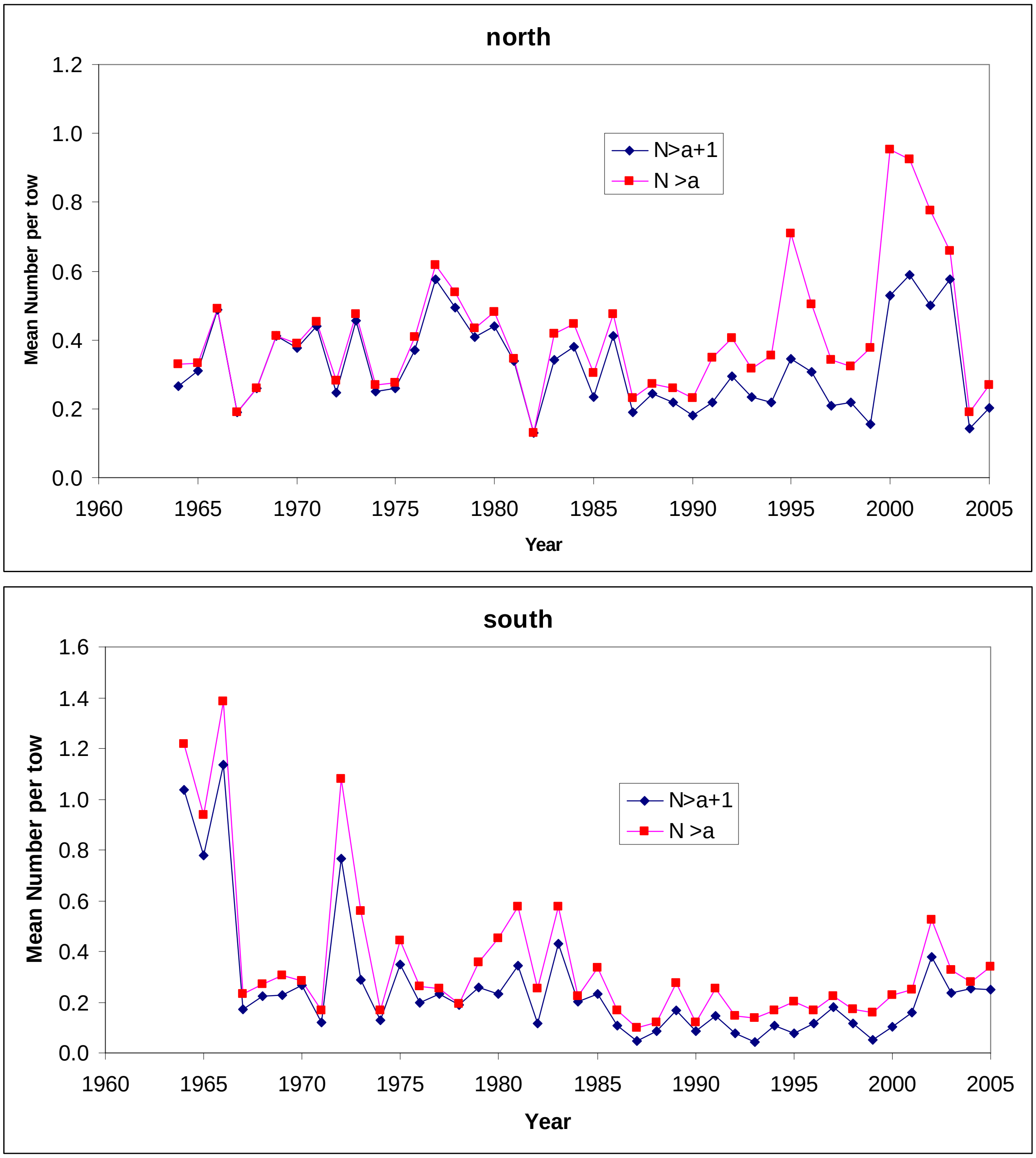

Figure 3: Catch rates (mean number per tow) of goosefish in National Marine Fisheries Service groundfish surveys in two management regions off the northeast coast of the United States. Diamonds denote catch rates of previously recruited fish; squares denote catch rates of recruiting and previously recruited fish combined.

Table 1. Survey stratified mean number per tow for goosefish off northeastern United States. The surveys were conducted in the fall of each year.

	northern region catch per tow of size		southern region catch per tow of size	
survey year	> 30 cm	> 40 cm	> 33 cm	> 44 cm
1963	1.035	1.218	0.266	0.330
1964	0.777	0.938	0.311	0.333
1965	1.137	1.384	0.489	0.492
1966	0.172	0.234	0.189	0.189
1967	0.225	0.272	0.259	0.259
1968	0.228	0.307	0.411	0.411
1969	0.266	0.282	0.375	0.389
1970	0.120	0.168	0.439	0.451
1971	0.764	1.081	0.246	0.282
1972	0.289	0.558	0.455	0.476
1973	0.128	0.167	0.250	0.270
1974	0.349	0.442	0.260	0.276
1975	0.196	0.263	0.370	0.409
1976	0.231	0.253	0.577	0.616
1977	0.188	0.192	0.495	0.539
1978	0.258	0.357	0.408	0.432
1979	0.234	0.451	0.440	0.481
1980	0.344	0.577	0.338	0.346
1981	0.115	0.254	0.130	0.130
1982	0.430	0.577	0.341	0.418
1983	0.201	0.222	0.379	0.445
1984	0.234	0.336	0.234	0.305
1985	0.107	0.168	0.411	0.475
1986	0.048	0.099	0.189	0.232
1987	0.086	0.120	0.245	0.274
1988	0.168	0.274	0.217	0.260
1989	0.084	0.120	0.180	0.232
1990	0.148	0.254	0.219	0.349
1991	0.077	0.147	0.294	0.406
1992	0.042	0.139	0.234	0.315
1993	0.109	0.168	0.219	0.356
1994	0.079	0.204	0.344	0.709
1995	0.115	0.168	0.308	0.502
1996	0.182	0.224	0.208	0.342
1997	0.116	0.172	0.217	0.323
1998	0.053	0.157	0.157	0.376
1999	0.105	0.227	0.528	0.954
2000	0.159	0.251	0.588	0.924
2001	0.377	0.523	0.501	0.776
2002	0.238	0.325	0.575	0.660

Table 2: Estimates, $\hat{Z}$, of total mortality rate for goosefish in two management areas. The $\hat{Z}$ from lengths were taken from Gedamke and Hoenig (2006).

Northern management zone.

Period	$\hat{Z}$ from lengths	$\hat{Z}$ from (4)	average of $\hat{Z}$ from (1)
1963-1977	0.14	0.18	0.07
1978-1988	0.29	0.28	0.19
1989-2002	0.55	0.48	0.39

Southern management zone

Period	$\hat{Z}$ from lengths	$\hat{Z}$ from (4)	average of $\hat{Z}$ from (1)
1963-1976	0.33	0.55	0.37
1977-2002	0.58	0.56	0.47

APPENDIX 7

Guidelines to a Common Understanding and Writing Project's Goals and Objectives

By Stephen Willoughby

Introduction

Goals, general objectives, specific objectives, operational objectives, functional objectives are commonly used in project proposals and planning documents to describe accomplishments. However there appears to be no consistency or agreed standards in the use and interpretations of these terms.

A review of many CRFM's and Member States' documents shows that goals and objectives are used interchangeably both within the same document and among different documents. This has created tremendous confusion and misinterpretation of projects and Fisheries Management Plans, among those charged with interpreting, managing, implementing, monitoring and evaluating regional projects.

To eliminate this ambiguity it is necessary to have agreed definitions and guidelines for the formation of project goals, objectives and activities.

It is necessary to emphasize that these guidelines do not propose a project format. It is recognised that project formats may vary from agency to agency. However, despite the format required by the agency or purpose of the project, a project will contain goals, objectives, activities, budgets, schedules and must be evaluated.

The purpose of this paper is therefore to provide a common understanding and guidelines for conceptualising projects, formulating goals objectives and evaluating project outcomes. The guidelines also show the links among project, goals, objectives and activities.

Project

Definition of project

A project is simply a proposal to change a behaviour, situation or condition. To effect any change, a project must have a beginning and an end. The beginning and the end are connected by a link that describes the project. The difference between where we are (beginning/present status) and where we want to be (end/goal) is what we do (link/objectives) to achieve the desired outcome.

Guideline to formulating a project

To conceptualise a project, answer the following questions.

- What present behaviour, situation or condition will be changed?

  ____

- How will the behaviour, situation or condition be different at the end of the project?

  ____

- How will the change be achieved?

- How will the success be determined?

<u>Objectives</u>

Defining an objective

An objective forms the basis for the activities of the project by breaking down the broader goal into smaller Specific, Measurable, Attainable, Realistic and Time-specific (SMART) actions. The objective is a tool for effectively communicating, monitoring and evaluating the progress and outcome of a project. It describes the results needed to reach the goal.

Guideline to writing objectives

Use the following ABCD steps to write an objective:

Step 1**. Action Verb**

Start with an action verb – a verb that is measurable.

[**Example**: *increase*].

Step 2. **Who or what will change or be affected?**

<u>A</u>udience (target): State the target population or situation for which the desired outcome or change is intended.

[**Example**: *lobster fishermen in Reef Bay*]

Step 3. **What change is expected?**

<u>B</u>ehaviour change: State the observable/measurable result or change (in knowledge, attitude, behaviour, process, in the target group) expected. You must be able to see it, hear it, touch it, taste it or smell it for it to be observable or measurable.

[**Example**: *increase the annual earning*]

Step 4. **How?**

<u>C</u>ondition: The conditions under which the change will occur. Usually introduced by the words “given”, “by”, “after”, “provided”, “allowed”, “using” or by some restriction eg ”without”.

[**Example**: *by improved handling practices, marketing strategies and management of the fisheries……*]

Step 5. **How much?**

<u>D</u>egree: State the specific set of criteria to meet (specific outcome) by how much or how many will the situation or behaviour change?

[**Example**: *over 20% in the next two years*]

<u>**Step 6**. Combine the who, what, how and how much (steps 1-5)</u>

The combination of who, what, how and how much gives the **OBJECTIVES**

OBJECTIVE: *Increase the annual earning of lobster fishermen in Reef Bay to over 2% in the next two years by improved handling practices, marketing strategies and management of the fisheries.*

Goals

Defining the goal

A goal is a broad generalized statement:

- about what the project or programme is expected to accomplish, or
- how the behaviour, situation, or condition will change because of the project, or
- what you want to achieve at the end of the project or
- for solving of the problem that has been identified.

Goals are nor measurable since they are not specific, finite, concrete or verifiable.

Guidelines to writing the goal

To write the goal state:

- the present behaviour, situation or condition to be changed?

[**Example**: *low earning of lobster fishermen at Reef Bay*]

- how the behaviour, situation or condition will be different?

[**Example**: *increase the earning*….]

- combine the above to give the goal

[**Example**: *increase the earning of lobster fishermen at Reef Bay* – GOAL]

Assessing the Objective

Once the objective is written using the above **ABCD** technique, it is necessary to assess the content to ensure that it is **SMART.**

S*pecific*:
The Objective:

- uses action verbs
- identifies the problem being addressed – what kind of, or which problem is being addressed
- specifies results, not activities
- is precise about what you are going to achieve
- is clear about what, where, when and how the situation will be changed

M*easurable*
The Objective:

- states an indicator for measuring the achievement – how much, how many, or how well the problem/need will be resolved?
- measures outputs or results (not activities)
- quantifies the change in targets and benefits

Attainable (Achievable)
The Objective:

- is it feasible with the budget (money) and human resources (people), equipment (machines, materials) within the given time-frame?

***R**ealistic*
The Objective:

- is related to what you want to accomplish or achieve
- related to problem (areas of weaknesses) you want to improve
- able to obtain the level of change reflected in the objective

***T**ime-specific*
The Objective:

- identifies a time-frame for success, or
- states the time period in which success will be accomplished, or
- states when you will achieve the objective (within hours, months, years)

<u>Work Sheet for Writing Objectives</u>

Building your Objective

Step 1: [action verb – measurable] ____

Step 2: [**a**udience – target of change] ____

Step 3: [**b**ehaviour – change in target] ____

Step 4: [**c**ondition – condition under which the behaviour will occur – introduced by words such as given, by after, provided, allowed, using] ____________________

____

Step 5: [**d**egree – how well must the behaviour be performed] ______________________

Step 6: [combine 1 to 5 to give the objective] ____________________________________

____

____

- **Assessing the Objective**

Check your objective for the following. If you objective is properly written, you will be able to find all five of the following components in your objective.

- **Specific**: [does it state the problem that is being addressed? [ ]
- **Measurable**: [can it really be measured? Or shows how to assess?] [ ]

- **Attainable**: [is it feasible within the budget, human resources and time-frame?] [ ]
- **Realistic**: [are the expected results related to the problem (weakness) you want to improve?] [ ]
- **Time-specific**: [does it identify a time-frame for success?] [ ]

If any one of the above components is missing in your objective, you need to revisit your objective and add that component.

- **Unpacking the objectives**

The objective is the source of activities. Once the objective e is determined, the next step is to identify the activities that will lead to achieving the objective e, attain the goal and consequently contribute to the success of the project. The process of identifying these activities is called "unpacking".

- **Unpacking**

To unpack the objective complete the following steps

Step 1. Identify the barriers
Start by asking, "what are possible barriers that prevent the achievement of the objective?"

Step 2. List activities
List the activities required to remove (or deal with) the barrier. Implementing these activities will clear the path to achieving the objective.

Step 3. Prioritise the activities
Determine the priority of the activities.

Step 4. Identify the resources
For each activity identify the resources and timeframe for completion.

Example of Unpacking

- **Objective**

Increase the annual earning of lobster fishermen in Reef Bay to over 2% in the next two years by improved fish handling practices, marketing strategies and management of the fisheries.

Barriers	Activities
Fishermen not aware of project	• Meet with Reef Bay lobster stakeholders to discuss the project • Involve stakeholders in implementing, monitoring and evaluating the project
Potential catch not known	• Collect and analyse catch and effort data – historical and present to determine potential catch • Review and improve present data collection
Poor handling practices	• Review and improve existing handing practices.
No marketing strategy	• Review and improve existing marketing and distribution strategies • Identify new lobster markets and develop marketing strategies
No management in place	• Develop and enforce appropriate management measures
Only anecdotal economic information	• Collect and analyse information on lobster earnings
	• Evaluate project outcomes

<u>Evaluating the Project Outcomes</u>

The evaluation of the project should be based on the achievement or outcomes stated in the objectives. The evaluation should include the following:

a) outcome indicators
b) method for collecting data on the indicators

- **Outcome Indicators**

When you develop your indicators, ask yourself:

- What does the outcome look like when it occurs?
- How will I know if it has happened?
- What will I be able to see?

An indicator should be:

- Direct: measure the essential components of the outcome to enable you to determine whether it has been achieved.
- Meaningful: The indicator should provide information that is important to key stakeholders of the project.
- Useful: The information provided by the indicator should be useful for understanding and talking about the achievements of the project.
- Realistic to Collect: The data for the indicator shouldn't be a burden to collect and can be collected in a timely manner and at a reasonable cost.

- **Data Collection method**

The data collection method answers the question – How will you collect the data on the outcome indicators?

The most common data collection strategies fall into the following broad categories:

- Examining records
- Conduct surveys, interviews
- Observation
- Measurement
- Document review
- Focus Groups

Data collection should be cost effective, realistic and time-specific.

Conclusion

The above guidelines provide a simple approach to writing projects, goals and objectives that allows common understanding of the project intent. The guidelines also provide an easy way for implementing, monitoring and evaluating the project.