Workshop Report

Assessment Methods for Undefined Species

Sevaly Sen
Oceanomics P/L

5 May 2017

FRDC Project No 2016–063

ISBN 978-0-6480476-0-5

Workshop Report: Assessment Methods for Undefined Species

FRDC 2016–063

2017

Ownership of Intellectual property rights

Creative Commons licence

Disclaimer

The authors do not warrant that the information in this document is free from errors or omissions. The authors do not accept any form of liability, be it contractual, tortious, or otherwise, for the contents of this document or for any consequences arising from its use or any reliance placed upon it. The information, opinions and advice contained in this document may not relate, or be relevant, to a readers particular circumstances. Opinions expressed by the authors are the individual opinions expressed by those persons and are not necessarily those of the publisher, research provider or the FRDC.

The Fisheries Research and Development Corporation plans, invests in and manages fisheries research and development throughout Australia. It is a statutory authority within the portfolio of the federal Minister for Agriculture, Fisheries and Forestry, jointly funded by the Australian Government and the fishing industry.

Researcher Contact Details

Name: Sevaly Sen

Address: Oceanomics P/L
87 The Bulwark
Castlecrag, NSW 2068
Phone: 0414344593
Email: Sevaly.sen@gmail.com

FRDC Contact Details

Address: 25 Geils Court
Deakin ACT 2600
Phone: 02 6285 0400
Fax: 02 6285 0499
Email: frdc@frdc.com.au
Web: www.frdc.com.au

In submitting this report, the researcher has agreed to FRDC publishing this material in its edited form.

Contents

Tables

Figures

Executive Summary

This is a report of a Fisheries Research and Development organised workshop on Assessment Methods for Undefined Species. The workshop was held in Sydney 7–8 February 2017. The workshop was attended by stock assessment scientists from Australia and New Zealand with expertise in data-limited assessment methods.

Background

A target under National Priority 1 of the FRDC Research, Development and Extension Plan 2015–20 is that, by 2020, community attitudes to fishing and aquaculture are more positive as a result of an increased awareness of Australian seafood's sustainability performance and the value it provides to local communities. The Status of Australian Fish Stocks (SAFS) Reports are a key component to the achievement of this objective by increasing the number of species assessed in SAFS and reducing the percentage of species classified as 'undefined.' This requires the use of methods specifically developed for data-limited stocks.

Objective

The objective of this project was to progress the development of assessment methods for undefined species in the Status of Australian Fish Stocks report and for other data-limited species/fisheries.

Workshop participants were asked to:

1. Discuss assessment methods for 'undefined' species.
2. Categorise 'undefined' species and scope suitable tools that could be used to assess these different categories.
3. Identify next steps (action plan) to reduce the percentage of species classified as 'undefined' in the national Status of Australian Fish Stocks Reports.

Results/Discussion

There has been an increased research in data-limited assessment methods in recent years with a wide range of tools now developed depending on data and resources available. Some of these methods were presented at this workshop. Making tools accessible to researchers as well as providing support on their application could enable more data-limited stocks to be assessed.

For categorisation and assessment of currently undefined species, participants considered that developing criteria as well as a transparent, defensible and documented risk process were required to determine which stocks could be assessed for status. Using a risk assessment process, currently undefined stocks could first be identified as at risk of being overfished, subject to overfishing, subject to other risks such community concerns or reputational risk or of low/negligible risk. These stocks could be assessed using existing data-limited methods based on what risk category they fell into, their characteristics and the data and resources available. A case study approach trialling different assessment methods was considered valuable. Participants emphasised that, irrespective of whether stocks could be assessed for the purposes of status reporting, it was important to have an associated

harvest strategy. Finally, participants voiced concern about the workload and additional resources required to reach the 200 species target for SAFS by 2020.

Recommendations

1. A risk assessment process be undertaken to identify which undefined species should be assessed using the data-limited methods.

2. A toolkit of available data-limited assessment methods is made available on the FRDC website.

3. Where species were identified as requiring assessment, FRDC could consider funding case studies which trial different data-limited assessment methods as well as supporting innovative ways to build capacity within jurisdictions to undertake assessments.

4. Participants suggested that the SAFS Working Group reconsider the use of internationally recognised status classifications rather than those currently used in SAFS.

Keywords

Undefined species; data-limited fisheries; catch only assessment methods; Status of Australian Fish Stocks

Introduction

The Status of Australian fish stocks (SAFS) report provides national assessments of the status of Australian wild capture fish stocks, incorporating information from all eight fisheries management jurisdictions into a single set of reports. The 2016 edition included 83 wild-caught species/species complexes, comprised of 294 separate stocks. These stocks contributed around 90 per cent by volume and around 80 per cent by value of total annual Australian wild capture fish catches.

Information in the SAFS reports has been valuable as a performance reporting tool for government and has helped to inform purchasing decisions of seafood retailers, food service companies and consumers. It is also a respected source of information used by the broader Australian community, including third party certification schemes, researchers and environmental NGOs.

In the 2016 SAFS report, stock status classifications could be determined for 232 of the stocks assessed. The remaining 62 stocks were classified as undefined stocks (49) or negligible (13). Under the agreed national reporting framework for SAFS, an ‘undefined stock’ is defined as one where there is not enough information to determine stock status.

A target under National Priority 1 of the FRDC Research, Development and Extension Plan 2015–20 is that, by 2020, community attitudes to fishing and aquaculture are more positive as a result of an increased awareness of Australian seafood’s sustainability performance and the value it provides to local communities. SAFS reporting is a key component to the achievement of this objective by increasing the number of commercial species assessed in SAFS and reducing the percentage of species classified as ‘undefined.’

Reducing the number of undefined species will require the use of methods specifically developed for data-limited stocks. There are a number of cost-effective methods which have been developed over the last 10 years which may be applicable to different sub-categories of stocks classified as undefined.

Objective

The objective of this project was to hold a workshop to discuss existing assessment methods for data-limited species in order to progress the development of assessment methods for undefined species in both the Status of Australian Fish Stocks report as well as other data limited species/fisheries.

Method

FRDC invited stock assessment specialists with experience in data-limited stock assessment methods to attend a workshop in Sydney on 7–8 February 2017. The participants were:

	Name		Title	Organisation
Dr	Malcolm	Haddon	Principal Research Scientist	CSIRO Oceans and Atmosphere
Dr	Cathy	Dichmont	Consultant	CDC; Adjunct Associate Professor, James Cook University
Dr	Brent	Wise	Stock Assessment and Data Analysis	Department of Fisheries Western Australia
Dr	Richard	McGarvey	Sub-program leader (fisheries Modelling)	SARDI
Dr	Shijie	Zhou	Principal Research Scientist	CSIRO Oceans and Atmosphere
Dr	Nokome	Bentley	Consultant	Trophia Ltd.
Dr	Michael	Lowry	Principal Research Scientist: Research Leader (Fisheries Resource Assessment)	NSW Department of Industry
Dr	Simon	Nichol	Scientist	ABARES
Dr	Carolyn	Stewardson	Projects Manager - Research	FRDC
Dr	Natalie	Dowling	Senior Research Scientist	CSIRO Oceans and Atmosphere
Dr	Jeremy	Helson	Chief Executive	Fisheries Inshore New Zealand
Dr	Crispian	Ashby	Programs Manager	FRDC
Dr	James	Scandol	Senior Statistical Systems Officer	NSW Ministry of Health
Ms	Sevaly	Sen	Facilitator	Oceanomics P/L

The agenda is attached as Appendix 1.

Results

This section summarises the key points of each presentation. All presentations are attached as Appendix 2.

Introduction and Aim of Workshop – Dr Carolyn Stewardson, FRDC

The FRDC provided an overview of targets and deliverables relevant to the delivery of the Status of Australian Fish Stock reports as outlined under of National Priority 1 of RD&E Plan 2015–20.[1] Of relevance to this workshop, were the following:

Deliverables:

- An increased number of commercial species assessed in the national Status of Australian Fish Stocks Reports.
- A reduction in the percentage of species classified as 'undefined' in the national Status of Australian Fish Stocks Reports.

Targets:

- Increase the number of species to 200 in the national Status of Key Australian Fish Stocks Reports.
- Reduce the number of species classified as 'undefined' from the current figure of approximately 30 per cent to less than 10 per cent.

In SAFS 2014 there were 68 undefined stocks; in 2016, there were 49 undefined stocks (Table 1). By 2020, SAFS species/species complexes will increase from 83 to around 200. However, as the majority of high GVP species with formal assessments are already included in SAFS, the number of species in the undefined category will increase unless suitable assessment methods are agreed to and employed.

Table 1: Status of Australian fish stocks reports 2014 and 2016

Stock status	Year	Number of stocks			Total stocks	Catch ('000 t)	% of total catch of species
		Biological stock	Management unit	Jurisdiction			
Undefined	2014	21	17	30	68	6.4	4.6
	2016	12	17	20	49	5.87	4.36
Total	**2014** **2016**	**102** **108**	**89** **105**	**47** **71**	**238** **294**	**139.7** **133.22**	**100** **100**

[1] http://frdc.com.au/research/RDEPlanningandPriorities/RDandE_Plan_2015-2020/ (pages 25-27)

Based on a preliminary draft scope to reduce the number of undefined species/species complexes agreed to by the SAFS Advisory Group, workshop participants were asked to:

1. Discuss assessment methods for 'undefined' species.
2. Categorise 'undefined' species and scope suitable tools that could be used to assess these different categories.
3. Identify next steps (action plan) to reduce the percentage of species classified as 'undefined' in the national Status of Australian Fish Stocks Reports.

The workshop report will be presented to the SAFS Advisory Group for consideration at their next meeting in May 2017.

Operational Strategies for Managing Data-Poor Species or Fisheries – Dr Malcom Haddon, CSIRO

Undefined species currently are categorised as such primarily because there is no assessment (of any kind) or an assessment exists but there are no reference points. To determine a status in SAFS other than undefined, as a minimum, there is a need to set a Limit Reference Point, or an implied LRP, along the axis of possible values for each proxy. Whilst there are many data-poor methods available, all require at least some data. It is suggested that for some undefined species, it would be possible to use an empirical proxy or a model-assisted method.

Performance measures which could be used as empirical proxies need to exhibit contrast across different stock levels; be consistent through time in how it responds to stock changes, and; exhibit a strong relationship between the performance measure and stock status.

The current undefined species in the SAFS could be broken down into three categories based on landed tonnage: do nothing (no reliable catch data), maybe able to do an assessment (>10mt <100mt) and should do an assessment (>100mt).

Generating stock status does not constitute management advice but has value in terms of performance reporting and as an incentive to improve management. At least two assessments would be required to consider what SAFS status category it falls within. For minor species which are "undefined, the value of their inclusion in SAFS should be questioned as they are likely to be a low priority for management and may be a minor influence on stock dynamics. It also begs the question as to whether these species should be managed at all.

Overall, there is a need for better guidelines on the use of proxies and data-limited assessment methods.

Operational Strategies for Assessing the Current Status of Data-Poor Species or Fisheries – Dr Simon Nicol, ABARES

There is a need to separate stock assessment from the process of status determination. A weight of evidence approach can be used but ABARES experience has found that it is critical that there is documentation (evidence used and weighting) to ensure repeatability, credibility, transparency and consistency. It is important to be explicit about uncertainties in the determination process.

Our experience of splitting status into two categories, Biomass (i.e. is the population depleted to such an extent it can be defined as overfished) and Fishing Mortality (is the population currently experiencing a fishing mortality that would deplete the population to unsustainable levels, i.e. is it experiencing overfishing), makes the determination process more explicit.

Stock assessment when catches are also given in number landed: qR model - Dr Richard McGarvey, SARDI

Three previous studies examined the potential of adding catch in numbers to improving the quality of the assessment. The first showed that for a steady-state fishery, total catches in weight and in number could permit estimates of absolute abundance provided there was information on growth (as mean weights-at-age) and natural mortality. No 'contrast' or surplus production relationship was required. The second study was extended to a dynamic estimation of (yearly) recruitment, and found close agreement with recruitment and exploitation rate in simulation. The third study extended these results to two different stock assessment models, confirming that the full catch-log data set of catch in weight, catch in numbers, and fishing effort, can provide absolute abundance assessment indicators when length selectivity is not variable and weights-at-age can be estimated.

This research has shown that recording the number of fish in the catch can greatly improve the quality of the assessment. Adding catch by numbers gives a highly reliable estimate of mean weight in the catch which, combined with growth, permits estimation of total mortality rate.

Adding catch in numbers can be achieved with relatively modest additional cost and may be a feasible method for some undefined or by-catch species such as sharks.

Catch-only methods – Dr Shijie Zhou, CSIRO

Until now there have been few applications to use catch data alone for fisheries stock assessment and management. As most fisheries have catch data or have catch data only, including some currently in SAFS and categorised as undefined, there is an opportunity to apply catch only assessment methods.

There has been an increasing research in developing catch-only methods in recent years. Two tools have been developed in Australia, one for estimating stock status and the other one for stock assessment. In the first study we develop a Boosted Regression Tree (BRT) model to correlate stock depletion level with a range of predictors calculated from catch data, making the model usable for many fisheries worldwide. The most important predictors were found to be catch trends obtained from linear regressions of scaled catch on time, including regression coefficients for the whole catch time series, the sub-series before and after the maximum catch, and in recent years. Eight predictors explain about 80 per cent of variation in depletion. There is a correlation of 0.5 between measured levels of depletion and the predictions of the BRT model. Predictions are less biased when the stock is fished down below half of the carrying capacity. The BRT model could be used to provide priors for depletion for data-poor stock assessment methods, or used more directly to provide estimates of the probability that depletion is below a given threshold value.

In the second study, we develop an Optimised Catch-Only method (OCOM) for stock assessment of data-poor fisheries. It uses time series of catches and two priors, one for the intrinsic population growth rate derived from natural mortality, and another for stock depletion based on catch trends. The method is based on a biomass dynamics model, along with an algorithm to search the possible parameter space. The utility of this method is demonstrated by applying it to 13 stocks in Australia that are assessed using Stock Synthesis—an assessment package that can make use of a variety of data sources. The estimated parameters, including carrying capacity, intrinsic population growth rate, maximum sustainable yield and depletion from the catch-only method are broadly comparable with those from the full assessments. As preparing and running the model is quick, OCOM is low cost. There are circumstances in which the method can perform poorly, such as longer-term changes in productivity (regime shift) and episodic recruitment.

Risk-based Weight of Evidence approach and how it is applied to data-limited species in WA – Dr Brent Wise, Department of Fisheries, WA

The risk-based weight of evidence approach is suitable for conducting all stock assessments including data-limited assessments because it makes use of all available lines of evidence within a structured and transparent risk framework. The key benefit is the need to provide a clear narrative associated with the evidence including where tensions exist between lines of evidence. This leads to more robust and defensible outcomes and is therefore a pragmatic and repeatable way of going forward for data-limited species.

Data moderate and limited assessments: a global perspective – Dr Cathy Dichmont, CDC

There has been an international drive to address assessment approaches for data moderate and data-limited fisheries with increasing focus on data-limited harvest strategies which do not require stock assessments. The gradient for assessment approaches range from the weight of evidence approach used in Western Australia to catch/age/size only to ensemble methods. The pros and cons of the range of methods within this gradient were discussed. Some of these methods would not be SAFS-classification compliant, such as SAFE and PSA because they only identify fishing mortality status “overfishing” (not the stock status “overfished”) using international classifications: overfished or overfishing occurring.

What is needed is a toolbox of methods for people to choose tools suitable according to the data that they have available. NOAA used to do this but have stopped supporting their toolbox although most are still available directly from the authors. Methods developed in Australia, such as SAFE are not being sold well – there is an opportunity for FRDC to support this.

Management procedures for data-poor fisheries: case studies from New Zealand – Dr Nokome Bentley

Of around 600 fish stocks in New Zealand, a significant proportion of the lower value/volume stocks are not assessed.

Industry has supported the development of management procedures for some of these stocks as a pragmatic approach to their management. Case studies on bluenose, jack mackerel and red cod were presented. For these, data-limited fisheries, management procedures have been evaluated using simple Management Strategy Evaluation (MSE) in which parameter values and associated uncertainty were based on the available prior knowledge and values from similar species. Management procedures are a valuable and cost effective tool to manage data–limited fisheries but are not used for defining stock status.

Overview of changes to NSW Assessment Methodology and Species Case Study – Dr Mick Lowry, NSW DPI

NSW fisheries are currently undergoing a major structural reform which includes setting TACs for species which are going to quota. An independent review of the current NSW resource assessment framework and the performance of the arrangements have recently been completed by Drs John Mckoy and Kevin Stokes. It provided recommendations designed to facilitate the transition of the resource assessment framework to incorporate a larger number of species managed by output controls. Recommendations encouraged the development of harvest strategies as a means of providing greater transparency between the formal assessment and fishery management outcomes. The report also outlined the need for more effective consultation with stakeholders within this process. The review has be invaluable in assisting NSW DPI explore how to address these issues and meet the demands of the reform program.

Importance of assessments and issues stemming from not doing so – Dr Jeremy Helson, Fisheries Inshore New Zealand

Of around 600 fish stocks in New Zealand, there are 292 stocks removed from status reporting as they are considered nominal stocks (TACC or catch less than about 10 t, or other indications of no proven development potential).

Fisheries Inshore New Zealand represents 237 stocks which are not nominal but are of relatively smaller volumes and/or of lower value when compared to many other New Zealand fisheries. As a consequence, for many inshore stocks there is limited fisheries-independent data. Economic rents generated limit the funding available for research under current research funding model which acts as constraint on information acquisition. There is also a lack of pragmatism/managerial courage within government to deal with data-limited stocks. Within this context, management and monitoring plans are fundamental and are a simple, but not simplistic, solution to managing these stocks.

Data-limited Assessment methods and Pragmatic Ways Forward – Dr Natalie Dowling, CSIRO

The reasons why stocks/fisheries may be data-limited are many, including: new fisheries with limited observations and no time series of information; fisheries where research and management have lagged exploitation; low-value species for which comprehensive data collection is considered uneconomic or unjustified; multi-gear, multi-species fisheries with many small operators and landing sites; fisheries where data quality is poor or variable and difficult to verify) or; fisheries that retain by-catch species but do not adequately monitor by-catch.

Cost-effective methods for analysing and managing data-limited fisheries exist, but they are challenging to navigate due to the myriad options, different data requirements, unique outputs and a lack of understanding of the relative costs and advantages of each approach. Additionally, there remains a disconnect between the development of assessment approaches and decision rule options, and their on-the-ground implementation in a management context. FishPath was developed to fill this gap: it is a decision support system that allows users to characterise their fishery with respect to i) available data; ii) biological/life history attributes of relevant species; iii) fishery operational characteristics; iv) socio-economic characteristics; and, v) governance context. FishPath navigates among these to identify a subset of feasible harvest strategy (monitoring, assessment (from among ~45 methods), and harvest control rule) options appropriate for their fishery based on this characterisation.

A key question is whether it is better to have a highly uncertain, yet designated, stock status or an honest "uncertain" classification. While more empirical data-limited assessments may not defensibly resolve stock status, it can be argued that it is preferable to do something than to maintain management paralysis in the absence of a "gold standard" quantitative stock assessment. A lack of any form of assessment increases the risk of fishery collapse and may result in lost opportunity. Additionally, empirical assessments can serve as a starting point for grooming capacity, managers and industry, for increasing buy-in to, and support of, formal management, and to empower stakeholders.

It is strongly encouraged that data-limited assessments are embedded within a harvest strategy, with control rules that can be used to sustainably manage a fishery, over assessments in isolation to resolve stock status. Control rules within a harvest strategy can compensate (to some extent) for bias or imprecision in status assessment. Assessments linked to precautionary harvest control rules can perform well in avoiding overfishing (although less well in maximising yield), even though the assessment method may poorly measure stock status.

Analysis and Reporting of Complex Data: What I've Learnt Post Fisheries – James Scandol

Based on experiences from NSW Health and general project management methods (such as PRINCE2), SAFS could be interpreted as a "project", which requires consideration of the requirements, the customer, as well as governance and change management processes. Stock assessment is, quite understandably, focused on the technical aspects of the science (what). Within a project management context, however, reporting stock assessments also requires consideration on people (who) and processes (how). Projects also inevitably involve change, and processes to manage that change. Large changes should be addressed early within a project, otherwise these changes will be more expensive to implement, and may not achieve the planned result.

The agency-based assessment processes behind SAFS reporting are necessarily very technical, but it is also important to ensure these processes are well documented, reproducible and transparent so that other experts or incoming teams can understand what has been done and why. This approach will also minimise key person risk within assessment teams.

Risk Assessment for Sourcing Seafood – A B2B tool for Australia and New Zealand – Sevaly Sen, FRDC National Priority 1 Coordinator

Seafish UK has developed a business to business tool to enable evidence based purchasing known as the Risk Assessment for Sourcing Seafood (RASS). Under FRDC National Priority 1 and in collaboration with Seafood New Zealand, a similar tool for Australia and New Zealand is planned. The tool will use a risk assessment methodology (already developed) that scores units of assessments (species /gear/area) for four criteria: stock status, management, bycatch and habitat impact. Risk scores are provided but there no recommendations are made about what to buy so that seafood business can make their own purchasing decisions according to their company's appetite for risk. SAFS will inform these risk assessments. There is still work to be done on refining methodology, gaining a better understanding of what Australian businesses want, explaining how to use the tool and preparing guidance documents regarding the methodology, assessment review and use of the assessments.

Discussion

There were robust discussions both during and after the presentations. A number of key points were raised:

- There has been an increasing research in developing data-limited assessment methods in recent years and diverse and wide range of tools is now available. Making them easily available and providing guidance as to which ones are most suitable for a particular stock/fishery needs further work.
- Some undefined species currently in SAFS should be moved to the negligible classification. Within this classification, the challenge may be that the impact of the fishery on population status could be important (even if negligible quantities).
- A risk assessment process could be applied to undefined species in order to identify which stocks require assessment using data-limited methods.
- It is important to have a definition of what is an "acceptable" assessment in terms of resolving stock status, against SAFS criteria.
- If changing status from undefined to another status, there needs to be a transparent, defensible and well documented process which enables repeatability.

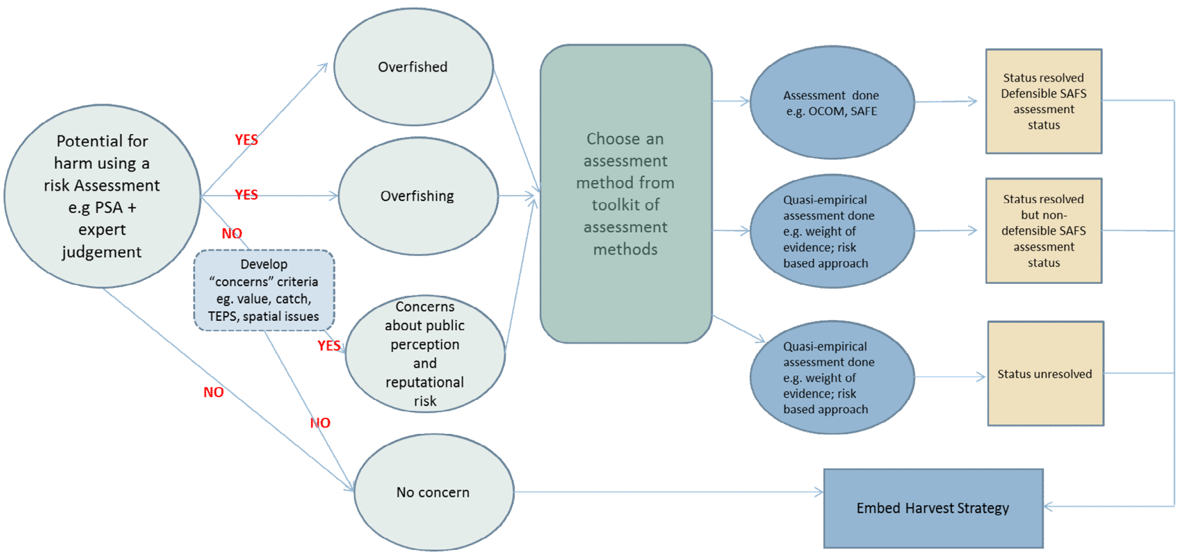
- SAFS has stimulated a move to improve management but reporting on status is not sufficient for good fisheries management. An associated harvest strategy is required.
- There is concern about the workload and additional resources required to reach the 200 species target for SAFS by 2020.

Recommendations

The workshop participants made the following recommendations:

1. A risk assessment process be undertaken to identify which undefined species should be assessed using the data-limited/limited methods. The schematic for this process was sketched out (Figure 1) with acknowledgement that further elaboration is required.

Figure 1: Proposed Risk Assessment Process for Assessment of Undefined Species category



2. A toolkit of available data-limited assessment methods is made available on the FRDC website.
3. Where species were identified as requiring assessment, FRDC could consider funding case studies which trial different data-limited assessment methods as well as supporting innovative ways to build capacity within jurisdictions to undertake assessments.
4. Participants suggested that the SAFS Working Group reconsider the use of internationally recognised status classifications rather than those currently used in SAFS.

Appendix 1 Agenda

WORKSHOP ON ASSESSMENT METHODS FOR UNDEFINED AND/OR DATA DEFICIENT SPECIES

Agenda

Sydney February 7 -8 2017

Venue: H C Coombs Centre, Sydney Conference Centre

122A Kirribilli Avenue

KIRRIBILLI NSW 2061

Function Room (Level 5)

http://www.hccoombscentre.gov.au/

Tuesday 7 February 2017	
0930–0945	Introduction and aim of the workshop (Carolyn Stewardson, FRDC)
0945–1045	Operational Strategies for Assessing the Current Status of Data-Poor Species or Fisheries. (Malcolm Haddon, CSIRO and Simon Nicol, ABARES)
1045–1100	Tea/coffee break
1100–1200	Stock assessment of medium data availability, namely, (1) regular annual catch and effort logbook totals, (2) a measure of annual mean weight in the landed catch, and (3) a vector of mean weights at age. (Rick McGarvey, SARDI)
1200–1300	Assessment methods using catch data only. (Shijie Zhou, CSIRO)
1300–1330	Lunch
1330–1430	Risk-based Weight of Evidence approach and how it is applied to data-limited species in WA (Brent Wise, Department of Fisheries, WA)
1430–1530	Range of assessment methods and resources used overseas.(Cathy Dichmont, CDC)

1530–1545	Tea/coffee break
1545–1645	Management procedures for data-poor fisheries: case studies from New Zealand. (Nokome Bentley,NZ)
1645–1745	Overview of changes to NSW Assessment Methodology and Species Case Study. Mick Lowry, NSW DPI
1815	Drinks and dinner (Garfish Restaurant, Kiribilli)
Wednesday 8 February 2017	
0815–0915	Importance of assessments and issues stemming from not doing so (Jeremy Helson, Fisheries Inshore NZ)
0915–1015	Data-limited Assessment methods and Pragmatic Ways Forward (Natalie Dowling, CSIRO)
1015–1030	Coffee break
1030–1130	Analysis and Reporting of Complex Data: What I've Learnt Post Fisheries; (James Scandol)
1130–1200	Risk Assessment for Sourcing Seafood – A B2B tool for Australia and New Zealand (Sevaly Sen, FRDC National Priority 1 Coordinator)
1200–1230	Wrap up discussions
1230–1330	Lunch

Appendix 2: Presentations

WORKSHOP ON ASSESSMENT METHODS FOR UNDEFINED SPECIES: INTRODUCTION AND AIM OF WORKSHOP

Carolyn Stewardson and Crispian Ashby (FRDC)

FRDC NATIONAL PRIORITY 1

Deliverables:

- Increased knowledge about how community values align with the values of Australian fishing and aquaculture sectors, with the aim of improving community perceptions.
- An Australian fisheries management and/or technical standard that addresses all fisheries and can be adopted by any management agency in Australia.
- A scheme for responsible fisheries management that can specifically be applied to small-scale, data-poor Australian fisheries.
- Bycatch performance metrics.
- Community net benefit metrics.
- An increased number of commercial species assessed in the national *Status of Australian Fish Stocks Reports*.
- **A reduction in the percentage of species classified as 'undefined' in the national *Status of Australian Fish Stocks Reports*.**
- Expanded capacity to connect with seafood consumers and markets in Australia and abroad, and use of these channels to understand community perceptions to tell the Australian fishing and aquaculture story across the sectors.

From: FRDC's RD&E Plan 2015–20

FRDC NATIONAL PRIORITY 1

Ensuring that Australian fishing and aquaculture products are sustainable and acknowledged to be so

Aim: By 2020, the community has effective access to, and understanding of, RD&E that supports fishing and aquaculture sustainability and improves perceptions of Australian seafood.

Strategy: Build understanding of the drivers of social licence to operate and respond to community concerns and needs for information with science-based evidence.

Continue to prioritise investment in RD&E that contributes to the sustainability of fishing and aquaculture, including consideration of target species; bycatch species; threatened, endangered and protected species; and the broader marine environment.

Priority Identified by:
- Minister's meeting
- AFMF – Statement of Intent
- NSIA – Priority
- Recfish Australia - Priority

From: FRDC's RD&E Plan 2015–20

FRDC NATIONAL PRIORITY 1

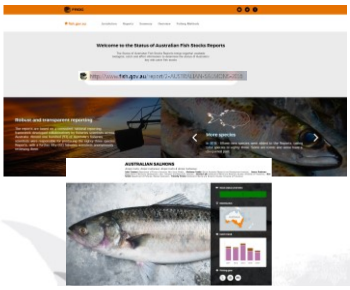
Targets: Community attitudes to fishing and aquaculture are more positive based on an awareness of Australian seafood's sustainability performance and the value it provides to local communities.

- Ensure information on the performance and value of Australia's fisheries is readily available.
- Increase the number of species to 200 in the national *Status of Key Australian Fish Stocks Reports.*
- **Reduce the number of species classified as 'undefined' from the current figure of approximately 30 per cent to less than 10 per cent.**
- Increase positive perceptions of the commercial fishing industry from 28 per cent to 40 per cent by 2020 as measured through independently commissioned FRDC stakeholder surveys.

From: FRDC's RD&E Plan 2015–20

Status of Australian Fish Stocks Reports

FRDC



Status assessment summary for all SAFS 2016 species and species complexes: undefined species extracted

SPECIES	STOCK	JURISDICTION	STOCK STATUS
BALMAIN BUGS	South Australia (J)	South Australia	Negligible
	Victoria (J)	Victoria	Negligible
	Western Australia (J)	Western Australia	Negligible
Banded Morwong	Victorian Banded Morwong Fishery (M)	Victoria	1. Undefined
Barramundi	South-East Coast (B)	Queensland	Negligible
Black Jewfish	Gulf of Carpentaria (M)	Queensland	2. Undefined
	Queensland East Coast (M)	Queensland	3. Undefined
Blacklip Abalone	Western Australia (J)	Western Australia	Negligible
BLACKTIP SHARKS	Gulf of Carpentaria (B)	Northern Territory	4. Undefined
		Queensland	
Blue Swimmer Crab	West Coast (B)	South Australia	5. Undefined
Commercial Scallop	Bass Strait Central Zone Scallop Fishery (M)	Commonwealth	6. Undefined
	Ocean Scallop Fishery (M)	Victoria	7. Undefined
	Tasmanian Scallop Fishery (M)	Tasmania	8. Undefined
CORAL TROUTS	Gulf of Carpentaria (M)	Queensland	9. Undefined
Crimson Snapper	East Coast Queensland (B)	Queensland	10. Undefined
Dusky Flathead	New South Wales (J)	New South Wales	11. Undefined
Dusky Whaler	Eastern Australia (B)	Commonwealth	12. Undefined
		New South Wales	
Eastern School Prawn	Victoria (J)	Victoria	13. Undefined
ENDEAVOUR PRAWNS	Northern Prawn Fishery (Red Endeavour Prawn) (M)	Commonwealth	14. Undefined
Giant Crab	Giant Crab Fishery (Victoria) (M)	Victoria	15. Undefined
	South Australia (J)	South Australia	16. Undefined

Stock status classification summary of the stocks in the *Status of Australian fish stocks reports* 2014 and 2016, and the proportion of the catch of all species considered in the reports

Stock status	Number of stocks			Total stocks	Catch ('000 t)	% of total catch of species
	Biological stock	Management unit	Jurisdiction			
Sustainable stock	**85 (2016)** 68 (2014)	**56 (2016)** 48 (2014)	**34 (2016)** 13 (2014)	**175 (2016)** 129 (2014)	**114.84 (2016)** 122.3 (2014)	**85.41 (2016)** 87.5(2014)
Transitional-recovering	**5 (2016)** 4 (2014)	**4 (2016)** 3 (2014)	**0 (2016)** 0 (2014)	**9 (2016)** 7 (2014)	**1.29 (2016)** 1.2 (2014)	**0.96 (2016)** 0.9 (2014)
Transitional-depleting	**7 (2016)** 5 (2014)	**15 (2016)** 13 (2014)	**4 (2016)** 1 (2014)	**26 (2016)** 19 (2014)	**3.91 (2016)** 3.0 (2014)	**2.90 (2016)** 2.1 (2014)
Overfished	**7 (2016)** 4 (2014)	**7 (2016)** 4 (2014)	**3 (2016)** 3 (2014)	**17 (2016)** 11 (2014)	**8.51 (2016)** 6.9 (2014)	**6.33 (2016)** 4.9 (2014)
Environmentally limited	**0 (2016)** 0 (2014)	**4 (2016)** 4 (2014)	**1 (2016)** 0 (2014)	**5 (2016)** 4 (2014)	**0.03 (2016)** 0 (2014)	**0.02 (2016)** 0 (2014)
Undefined*	**12 (2016)** **21 (2014)**	**17 (2016)** **17 (2014)**	**20 (2016)** **30 (2014)**	**49 (2016)** **68 (2014)**	**5.87 (2016)** **6.4 (2014)**	**4.36 (2016)** **4.6 (2014)**
Negligible	**2 (2016)**	**2 (2016)**	**9 (2016)**	**13 (2016)**	**0.01 (2016)**	**0.01 (2016)**
Total	**118 (2016)** 102 (2014)	**105 (2016)** 89 (2014)	**71 (2016)** 47 (2014)	**294 (2016)** 238 (2014)	**133.22 (2016)** 139.7 (2014)	**100 (2016)** 100 (2014)

* The agreed national reporting framework for the Status of Australian fish stocks reports defines the term 'undefined stock' as follows: Not enough information exists to determine stock status

Status assessment summary for all SAFS 2016 species and species complexes: undefined species extracted *cont..*

SPECIES	STOCK	JURISDICTION	STOCK STATUS
Goldband Snapper	East Coast Queensland (M)	Queensland	17. Undefined
Golden Snapper	East Coast (M)	Queensland	18. Undefined
Greenlip Abalone	South Australian Southern Zone Fishery (M)	South Australia	19. Undefined
Gummy Shark	Eastern Australia (B)	New South Wales	20. Undefined
MUD CRABS	Estuary General Fishery (M)	New South Wales	21. Undefined
Mulloway	Queensland (J)	Queensland	22. Undefined
Murray Cod	Australian Capital Territory (J)	Australian Capital Territory	23. Undefined
	New South Wales (J)	New South Wales	24. Undefined
	Queensland (J)	Queensland	25. Undefined
	South Australia (J)	South Australia	26. Undefined
	Victoria (J)	Victoria	27. Undefined
Orange Roughy	Great Australian Bight (M)	Commonwealth	28. Undefined
Ornate Rock Lobster	Western Australia (J)	Western Australia	Negligible
Pale Octopus	South Australia (J)	South Australia	Negligible
	Victoria (J)	Victoria	29. Undefined
Pipi	New South Wales (J)	New South Wales	30. Undefined
	Victoria (J)	Victoria	31. Undefined
Red Emperor	East Coast Queensland (M)	Queensland	32. Undefined
	Gulf of Carpentaria (M)	Queensland	33. Undefined
	Northern Territory (J)	Northern Territory	34. Undefined
Saddletail Snapper	East Coast Queensland (B)	Queensland	35. Undefined

Status assessment summary for all SAFS 2016 species and species complexes: undefined species extracted *cont..*

SPECIES	STOCK	JURISDICTION	STOCK STATUS
Sandbar Shark	Eastern Australia (B)	New South Wales	36. Undefined
		Queensland	
Silver Trevally	Queensland (J)	Queensland	37. Undefined
	Tasmania (J)	Tasmania	38. Undefined
	Victoria (J)	Victoria	39. Undefined
Silverlip Pearl Oyster	Northern Territory (J)	Northern Territory	40. Undefined
Snapper	East Coast (B)	New South Wales	41. Undefined
		Queensland	
		Victoria	
Snook	New South Wales (J)	New South Wales	Negligible
	Tasmania (J)	Tasmania	42. Undefined
	Victoria (J)	Victoria	43. Undefined
Southern Calamari	Commonwealth (J)	Commonwealth	44. Undefined
Southern Garfish	South Coast (Western Australia) (B)	Western Australia	45. Undefined
	South-East (B)	South Australia	46. Undefined
	West Coast (South Australia) (B)	South Australia	47. Undefined
Southern Sand Flathead	South Australia (J)	South Australia	Negligible
	Western Australia (J)		Negligible
Spotted Mackerel	Western Australia (B)	Western Australia	Negligible
Swordfish	South-West Pacific Ocean (M)	Commonwealth	48. Undefined
TIGER PRAWNS	New South Wales (J)	New South Wales	Negligible
VONGOLES	Western Australian Vongole Fishery (M)	Western Australia	Negligible
Yellowtail Kingfish	Eastern Australia (B)	Commonwealth	49. Undefined

The SAFS Advisory Group agreed to the following draft work scope

- List of undefined species to be provided to the SAFS Advisory Group.
- Define the different ‘categories’ that undefined species can be subdivided into
- Allocate undefined species to the agreed ‘categories’.
- Prioritise which ‘categories’ are to be assessed. Importantly, clearly identify which ‘category’ does not require assessment and agree on how best to represent this in SAFS
- Conduct an audit of methods used to address undefined species (and work that is in progress with estimated completion date).

What are the attributes of the current Undefined species

Example: Banded Morwong (Undefined in the Victorian Banded Morwong Fishery)

- Insufficient information available to confidently classify the status of this stock:
  - Most recent stock assessment was in 2012 which examined catch data from 2002 to 2012.
  - Catch and CPUE used as indicators.
  - Clear downward trend in biomass since the mid-2000s.
  - Data from only two operators contributes to high levels of uncertainty.
  - The total catch is currently less than 2.5 tonnes per year (catches are now limited to 625 fish per operator).

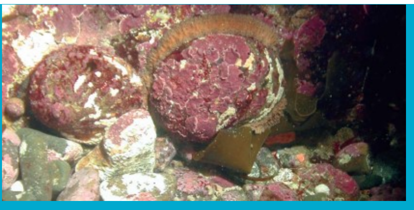
The SAFS Advisory Group agreed to the following draft work scope *cont*:

- Where appropriate, list suitable tools that could be used to assess each ‘categories’ (can these species avoid being undefined).
- Consider including case studies to test the assessment tools against relevant ‘categories’.
- Document minimum specification of assessments.
- Agree on an approach for appropriate consultation with the Advisory Group out of session, and a timeframe to implement change where agreed.
- Agree timeframe to be incorporated into the SAFS timeline.

Outputs of this workshop

FRDC

- Discuss assessment methods for ‘undefined’ species.
- Categorise ‘undefined’ species and scope suitable tools that could be used to assess these different categories.
- Identify next steps (action plan) to reduce the percentage of species classified as ‘undefined’ in the national *Status of Australian Fish Stocks Reports.*



Operational Strategies for Managing Data-Poor Species or Fisheries

Malcolm Haddon

Feb 2017

OCEANS AND ATMOSPHERE RESEARCH FLAGSHIP
www.csiro.au

To Start with Specific Undefined species:

- No data, not even accurate catch, means we know there is a fishery but we do not know if there are problems

Banded Morwong VIC	?
Murray Cod ACT	?
Murray Cod SA	?
Murray Cod VIC	?
Murray Cod NSW	?
Murray Cod QLD	?
Pale Octopus VIC	?
Silver Trevally QLD	?
Silverlip Pearl Oyster NT	?
Snook VIC	?

Why are they (we) here; are these KEY?

Species	Catch
Orange Roughy GAB	0.000
Gummy Shark East Australia	0.004
Black Jewfish GOC	0.043
Southern Garfish South-east	0.275
Dusky Whaler East Aust	1.530
Red Emperor GOC	1.600
Sandbar Shark East Australia	1.670
Southern Calamari CWTH	1.690
Black Jewfish QLD	1.920
Southern Garfish SA	3.820
Greenlip Abalone SA Southern Zone	4.970
Snook TAS	6.480
Silver Trevally TAS	6.600
Golden Snapper East Coast	7.150
Southern Garfish WA	7.230
Commercial Scallop Ocean Scallop Fishery	7.300
Mulloway QLD	8.820

Might be able/need to do something:

Crimson Snapper QLD	14.52
Giant Crab SA	16.98
Silver Trevally VIC	28.73
Blue Swimmer Crab WA	41.7
Red Emperor QLD	43.51
Goldband Snapper QLD	53.33
Saddletail Snapper QLD	63.49
Red Emperor NT	64.76
Eastern School Prawn VIC	75.77
Pipi VIC	83.96

Should do something, but even then…

Dusky Flathead NSW	110.70
Pipi NSW	111.35
Blacktip sharks	129.28
Yellowtail Kingfish East Australia	156.89
Mud Crabs Estuary General Fishery	188.64
Red Endeavour Prawns NPF	206.00
Snapper East Coast	213.31
Commercial Scallop TAS	781.70
Coral Trouts GOC	797.50
Bass Strait Scallop	2260.00
Swordfish SWPO	20090.00

SAFS should lead to better Management

- It could be claimed that the management of many fisheries in Australia is minimal or ineffective.
- A harsh judgement, but if accepted things can improve.
- The Status of key Australian Fish Stocks (SAFS) has the potential to drive improvement – already evidence of this as 'status' reports stimulate actual management.
- But unfortunately I have also heard SAFS described as a 'low bar', which risks reducing its credibility.
- A discussion of the implications of 'stock status' should also throw light on how to treat currently 'undefined' fisheries.

Definition of Undefined

- Undefined - indicates that insufficient information exists to determine stock status

http://www.fish.gov.au/Summary/National-framework-for-status-reporting

- So, either a very short workshop or we are talking about different aspects of the process.

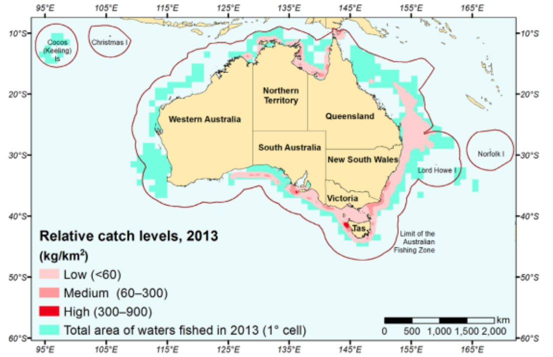
Reasons to be undefined in SAFS:

- A lack of any accepted (reliable) data – (make a decision)
- Lack of an assessment (of any kind)
  - assessment of some measure of a fisheries performance is required; many data-poor methods now exist (best compare the outcomes of a few; but all require at least some data)
  - Could use an empirical proxy or a model-assisted method.
- An assessment exists but no reference points.
  - Assess a measure of a fishery's performance (*proxy* for *F* &/or *B*)
  - As a minimum, need a Limit Reference Point, or an implied LRP, along the axis of possible values for each *proxy.*
- This would be the minimum required to set a status in SAFS (what is the objective of the assessment?)

How is 'Status' being Used?

- I used to believe the main reason to assess a stock is to generate management advice for a fishery.
- But this assumes that a management framework is already in place.
- Perhaps naïve to think that generating stock status is not the <u>current</u> main aim of a stock assessment.
- Knowing a Stock's Status has value because:
  - Public Perception/Licence to Operate
  - Encouragement (nice word) to introduce effective management
  - But it does not, in itself, constitute management advice.
  - And need at least 2 assessments to consider all status categories.

Character of Australian Fisheries

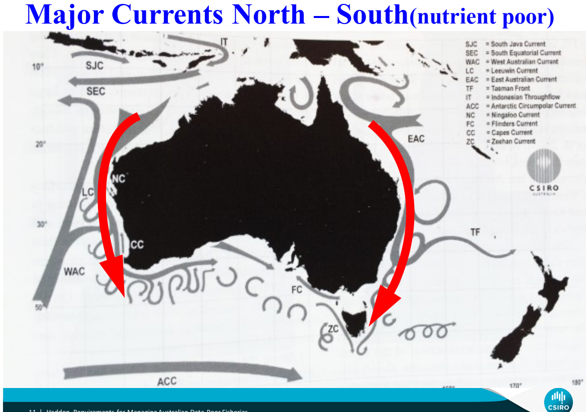


Commonwealth Fisheries Only

ABARES (2014) Fishery Status Report

Excluding the Heard and McDonald Islands; and Macquarie Island

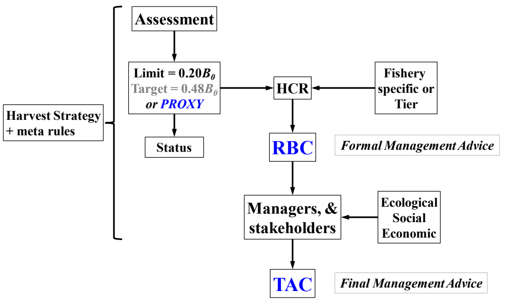
Major Currents North – South(nutrient poor)



Character of Australian Fisheries

- 100's of species and dozens of fisheries
- A few have real value:
  - Northern prawn fishery (*Penaeus* or *Fenneropenaeus*)
  - State abalone fisheries (*Haliotis)*
  - State rock lobster fisheries (*Jasus* and *Panulirus*)
  - Gummy shark fishery (*Mustelus antarcticus*)
  - Flathead fishery (*Platycephalus richardsoni*)
  - Patagonian Toothfish (*Dissostichus eleginoides*)
- Many highly mixed species fisheries
- And <u>many</u> low to very low value fisheries in both Commonwealth and States = limited or poor data.

The Basic System

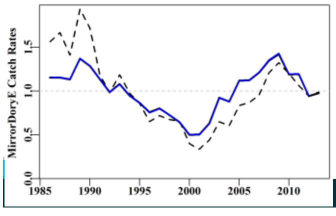


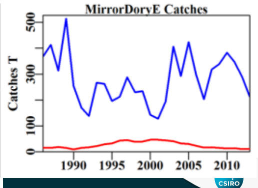
A Potential Jurisdictional Problem for SAFS?

- **If a Limit Reference Point is defined and implies a cessation of targeted fishing if below LRP:**
- **Is this an Implicit Fishery Policy?**
- **BUT, whether it really is policy depends on what management actions follow from a stock being:**
  - **a) above or below the Limit,**
  - **b) between the Limit and Target, and**
  - **c) being above the Target.**
- **A Full Harvest Strategy requires the LRP, TRP, as well as an HCR that defines the management advice.**
- **But a (LRP OR TRP) & HCR is sufficient to obtain status and management advice, but may not fit SAFS.**

Some Issues for Consideration:

- **Need Stock Status through time to determine if management succeeding or failing (>1 assessment).**
- **BUT:**
- **What if the catches are only a minor influence on the dynamics?**
- **What if we are catch-takers rather than catch-setters?**





Science meets Policy

- **Some BIG questions for Management/Policy.**
  - **Stock Status: relative to what?**
  - **How do we handle information-poor fisheries?**
  - **Should we even try to manage all species? (Key Australian Species)**
- **Some Possible Answers:**
  - **Status relative to unfished spawning biomass.**
  - **A Tier system of Assessment and Decision Rules**
  - **BUT inappropriate for data-poor (undefined) species**

Australian Harvest Strategy Policy (Distilled)

- Maintain primary stocks, on average, at $B_{TARG} = B_{MEY}$
- Maintain secondary stocks, on average, at B_{MSY}
- Ensure all stocks remain above B_{LIM} (or proxy), at least 90% of the time.
- $B_{TARG} = 48\%B_0$ $B_{LIM} = 20\%B_0$ (or proxies).
- B_{LIM} (or proxy) ≥ ½ B_{MSY} (or proxy).
- $B_{TARG} \sim 1.2B_{MSY} \sim 1.2B_{40\%}$
- In meeting all objectives HSs also required to consider ecosystem interactions.
- For highly variable species (naturally breach B_{LIM}), HS must be consistent with Policy intent (same for data-poor?)

Management Frameworks and Policy

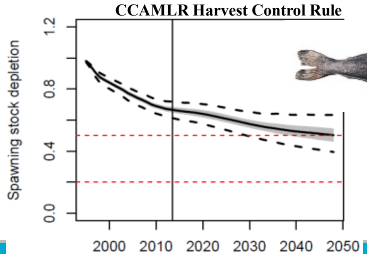
- Most policy designed for the ideal of having sufficient representative information to enable integrated-model based stock assessments.
- This is origin of ideas of B_0, B_{MSY}, and B_{MEY}
- At Least 2 Classes of Harvest Control Rule:

1. Given current status, how to get to the Target? (potentially but not necessarily a long time frame; *and a target*)
2. With current status, what is ***immediate*** next step? (1 – 3 year time frame)

At Least 2 Classes of Harvest Control Rule

1. Given current status, how to get to the Target?
   - Reliant on projections, explicit risk assessment
   - Needs a formal model; Any value to data-poor species?

CCAMLR Harvest Control Rule



Macquarie Island Patagonian Toothfish – *Dissostichus eleginoides*

At Least 2 Classes of Harvest Control Rule

2. With current status, what is ***immediate*** next step?
   - Deterministic HCR, 1 – 3 year time frame
   - But needs MSE testing to define risk.
   - Relevant to Data-rich and some Data-Poor situations

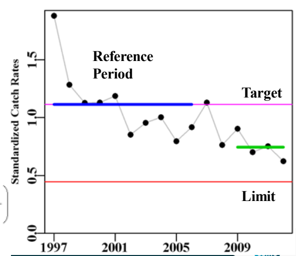
Development and evaluation of a cpue-based harvest control rule for the southern and eastern scalefish and shark fishery of Australia

L. Richard Little, Sally E. Wayte, Geoffrey N. Tuck, Anthony D. M. Smith, Neil Klaer, Malcolm Haddon, André E. Punt, Robin Thomson, Jemery Day, and Mike Fuller

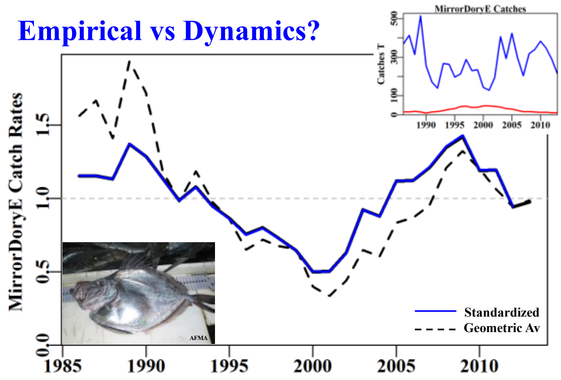
SESSF Tier 4 HCR

$$\text{Scaling Factor } = SF_t = \max\left(0, \frac{\overline{CPUE} - CPUE_{lim}}{CPUE_{targ} - CPUE_{lim}}\right)$$

$$RBC = C_{targ} \times SF_t$$



Empirical vs Dynamics?

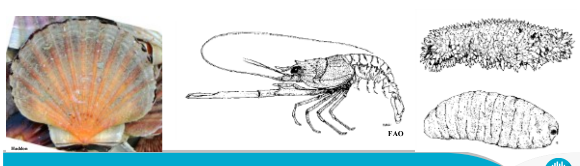


Intent of Commonwealth Policy

- **Avoid unsustainable fishing**
  - Avoid over-fishing – manage *F*
  - Avoid stocks being over-fished – often defined as where recruitment <u>may</u> be compromised - manage *B*.
- **Optimize Yield or Profits**
  - *More rarely: Ensure reproduction (e.g. scallops, squid)*
- **Rebuild depleted or over-fished stocks**
  - When status = 'unacceptable'
  - HCR should reduce *F* as *B* declines

Reducing Uncertainty in Stock Status

- **Dept Ag & Fish reports annually on stock status of Commonwealth Fisheries.**
- **Too many species had an "Uncertain" status**
- **Funded a project to determine whether the HSs applied met the Harvest Strategy Policy intent.**



Reducing Uncertainty in Stock Status

Management Strategy Evaluation testing of the Management Strategies used with South-Eastern Scallop Fisheries

Malcolm Haddon
Wealth from Oceans Flagship,
CSIRO.

Climatic Change (2013) 119:181–197
DOI 10.1007/s10584-012-0596-0

Risk management tools for sustainable fisheries management under changing climate: a sea cucumber example

Éva E. Plagányi · Timothy D. Skewes · Natalie A. Dowling · Malcolm Haddon

Contents lists available at SciVerse ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

An evaluation of the performance of a harvest strategy that uses an average-length-based assessment method

Neil L. Klaer, Sally E. Wayte, Gavin Fay

Management Strategy Evaluation testing of the Management Strategies used with North West Slope Trawl Fisheries

Natalie Dowling
CSIRO, Wealth from Oceans Flagship, GPO Box 1538, Hobart, TAS 7001, Australia

MSE Testing of Specific Cases = Trouble

- Species biological properties used to condition models.
- Some species so data-poor that a simulation framework wasn't plausible – tropical Turbo.
- The many idiosyncrasies of each fishery meant each simulation framework and each harvest strategy had to be specific to each separate fishery.
- The operating models enabled determination of how each stock responded to application of the HS used.

Conclusions of RUSS Project

- The Annual Reports only report on sustainability status, not profitability (limits not targets).
- Current HSs for some species with uncertain status, can meet intent of HSP (avoid limit).
- The proxies devised to represent the HSP limit reference point tend to be fishery specific in these more complex fisheries.
- Fully conditioned MSE of each data-poor fishery is impractical (too expensive; takes too long).

Catch Levels for Secondary and Byproduct Species

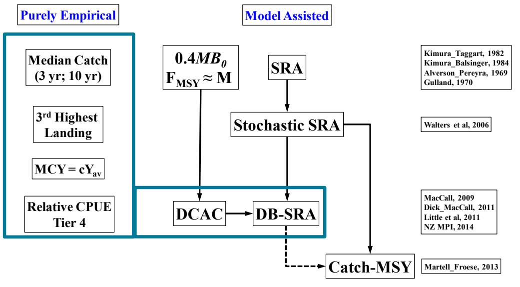
- Where higher Tiers are inappropriate (data-poor), upper catches and/or triggers for action = management.
- Usually insufficient data or people resources to conduct anything other than a simple method using available fishery dependent data.
- Considering a range of data-poor methods: from catch triggers, to purely empirical, to hypothetical model-assisted catch data.
- All use proxies to represent reference points; <u>only the Limit Reference Point useful for data-poor situations</u>.

Guidelines for Selecting Proxies

- Proxies:
  - Data-rich include $B_{40} \sim B_{MSY}$, $B_{20} \sim B_{MSY/2}$, & $B_{48} \sim B_{MEY}$
  - With data-poor species <u>can be many other things</u>
  - <u>No guarantee</u> these even approximate B_{20}, B_{40}, or B_{48}.
  - But do aim to capture policy "intent"
- Australian HSP – Alternative HS acceptable as long as they achieve the "intent" of the HSP.
- "The objective of this Policy is the sustainable and profitable utilisation of … fisheries …"

  (Avoid overfishing, be profitable, rebuild depleted stocks)
- Any proxy needs explicit inclusion within a formal Harvest Control Rule, which implies an HS.

Some Data-Poor Method Relationships



What Performance Measures to use as Proxies

- Can develop criteria for acceptance of empirical PMs:
  1. The PM needs to exhibit contrast across different stock levels
  2. The PM needs to be consistent through time in how it responds to stock changes.
  3. Need a strong relationship between PM and stock status.
- Whatever gets selected still implies the fishery concerned needs focussed attention.
- The assumption is that only KEY species within each jurisdiction will receive attention.

Conclusions (an ambitious word)

- The assumption that we can manage/control every species is likely wrong in some cases!
- Should minor species (which are 'undefined') even be included in SAFS.
- Both empirical and model-assisted methods use proxies.
- Better guidelines on the use of proxies and related data-poor methods are needed

CSIRO Oceans and Atmosphere
Malcolm Haddon
tel. 61 3 6232 5097
email. Malcolm.Haddon@csiro.au
web. www.csiro.au

Thank you

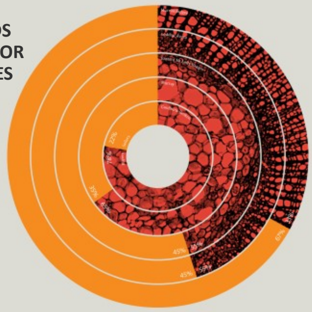
Operational Objectives (Practice)

- **Biological Reference Points!**
  - Fishing Mortality: $F_{x\%}$, $F_{SPR\%}$, F_{MSY}
  - Spawning Biomass: B_{MSY}, $B_{40\%}$, $B_{48\%}$, $SPR_{x\%}$, $B_{x\%}$, $B_{MSY/2}$
- **Policy or Operational Questions Raised:**
  - What *F* constitutes over-fishing?
  - What $B_{x\%}$ = depletion = being over-fished?
  - At what $B_{x\%}$ is recruitment compromised?
  - What is an optimum yield or profit?
  - Are *F* and *B* based reference points sufficient?
- **OR THEIR PROXIES**

[redacted]

ASSESSMENT METHODS FOR UNDEFINED AND/OR DATA DEFICIENT SPECIES

Operational Strategies for Assessing the Current Status of Data-Poor Species or Fisheries.



Dr Simon Nicol
February 2017

Research by the Australian Bureau of Agricultural and Resource Economics and Sciences

Status Assessment in SAFS

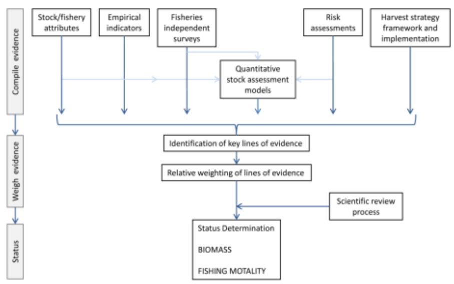
- •Repeatability
- •Adaptive to new information and methods
- •Consistent across species
- •Interpretable by all users
- •Credible
- •Transparent

	Measure	Indicator
FSR	Overfishing	Fcurrent < Flim = no overfishing Fcurrent >Flim = subject to overfishing **Fcurrent = ? = uncertain**
	Overfished	Bcurrent > Blim = not overfished Bcurrent < Blim = overfished **Bcurrent = ? = uncertain**
SAFS	Sustainable	Bcurrent > Blim | Fcurrent < Flim = Sustainable, Envt limited, Negligible
		Bcurrent > Blim | Fcurrent > Flim = Transitonal - depleting
		Bcurrent < Blim | Fcurrent < Flim = Transitonal - recovering
		Bcurrent < Blim | Fcurrent > Flim = Overfished
		Bcurrent = ? | Fcurrent = ? = Undefined

Reducing Uncertainty in Status Assessment - FSR

- •Weight of evidence criteria
- •Prioritise stocks where quantitative assessment is feasible
- •MSE testing of harvest strategies

Weight of Evidence



Stock/fishery Attributes

- Biological (productivity, M estimates, distribution, mobility, behaviour, etc)
- Fishery (targeting, distribution, sources of F, IUU, etc)

Indicators

Empirical ⟷ Model Based

- catch trends
- size structure of the catch
- age structure of the catch
- effort trends
- spatial distribution of the fishery
- catch rates (standardised)

- Stock Assessments
- Harvest strategies

Age structure implications

Age structure	biomass status	fishing mortality status
Stable mean age	Bcurrent > Blim	Fcurrent < Flim
↓ mean age	Bcurrent < Btarg Bcurrent < Blim	Fcurrent > Flim
Age(catch) < Age(maturity)	Bcurrent < Btarg Bcurrent < Blim	Fcurrent > Flim
Age(catch) > Age(maturity)	Bcurrent > Blim	Fcurrent < Flim

Weighting Evidence

•Inconsistencies in evidence

•Uncertainties in estimates

•Documentation

Indicator	Document •Representiveness •Inconsistencies •Uncertainties	Interpretation of evidence for status (B)	Interpretation of evidence for status (F)	Relative weighting

Documentation (evidence and weighting)

•critical for repeatability

•credibility

•Transparency

•Generates consistency

ABARES experience

•Robust Status Determination Framework is critical

•Toolbox of indicators and assessment techniques

•Capture and be explicit on uncertainty

SAFS 2018

•Linguistic uncertainties and constraints

•Toolbox of indicators and assessment techniques

•Author support

- Resourcing analyses to allow determination of status

Stock assessment when catches are also given in number landed – qR model

Richard McGarvey
SARDI Aquatic Sciences

Presentation for the workshop on assessment methods for undefined and/or data deficient species
Sydney
February 7-8 2017

SOUTH AUSTRALIAN RESEARCH & DEVELOPMENT INSTITUTE
PIRSA

PREMIUM FOOD AND WINE FROM OUR CLEAN ENVIRONMENT

Question: Can collecting catch in numbers improve the quality of stock assessment?

- Most fishery log books report catch totals by weight and fishing.
- For large species (sharks) or high-valued species (lobsters), a count of the catch is sometimes feasible.
- Adding catch in numbers can be achieved with relatively modest additional cost.
- In the southern rock lobster fisheries, catches are reported in both weight (Cw) and number (Cn) of lobsters landed.

SARDI

Notation: Cw and Cn

Cw == total yearly catch in weight (t or kg)
Cn == total yearly catch in number of animals landed.

SARDI

Basis of this method: Cw/Cn

- Cw/Cn provides a measure of mean body size in the catch.
- Cw/Cn is nearly perfect information about mean landed weight, since
  - It is based on a 100% sample (all yearly catch logs).
  - It requires no conversion from sample-measured lengths to weight—avoiding additional error in fitting weight to length.
  - Length samples can be notoriously variable, nearly always exceeding the multinomial variances we often assume to fit length frequencies.
  - It is relatively inexpensive data to obtain.

SARDI

How can adding Cn permit estimates of absolute abundance?

- Adding catch by numbers permits a highly reliable estimate of *mean weight* in the catch, as Cw/Cn.
- Combined with growth, this permits estimation of total mortality, Z.
  - Much like Beverton-Holt's mean-length method.
- Exploitation rate U = Z – M.
- Absolute biomass is B=Cw/U.

SARDI

First attempt: Steady State

- OBJECTIVE 1: The first goal was to determine, using simulated data, what can be estimated using only time series of Cn and Cw (no effort data, and so no CPUE).

McGarvey, R., Matthews, J. M., & Prescott, J. H. (1997). Estimating lobster recruitment and exploitation rate from landings by weight and numbers and age-specific weights. *Marine and Freshwater Research* 48(8): 1001-1008.

SARDI

Model assumptions: first paper

- Steady-state catches
- Steady-state age structure
- Assume no length length selectivity.
  - Numbers caught are proportional to numbers present in fishable stock
- Effort data are not used.

SARDI

Inputs

- Catch by weight (C^w)
- Catch by number (C^n)
- Mean weights-at-age in the catch (w_1, w_2, etc)
- Natural mortality (as annual discrete fraction, M_d)

SARDI

Estimated Outputs: Yearly exploitation rate Yearly recruitment

- Average exploitation rate (fraction of fishable population harvested annually, *U*)
- Recruitment (as absolute numbers entering yearly)
- From these, average age-specific population numbers in exploited stock (N_1, N_2, etc) are also inferred.

SARDI

Steady-state catch equations

$$R = N_1$$

$N_a = N_{a-1} \cdot e^{-M} - U N_{a-1}$, for all ages a = 2, . . . , 20.

And model-predicted quantities fitted to data are:

$$\hat{C}^n = \sum_{a=1}^{20} U N_a .$$

$$\hat{C}^w = \sum_{a=1}^{20} U N_a w_a .$$

SARDI

Simulated yearly catch data

- An individual-based model was constructed to output simulated yearly catch time series for Cw and Cn.
- For this steady state case we tested the ability to reliably estimate recruitment and exploitation rate.

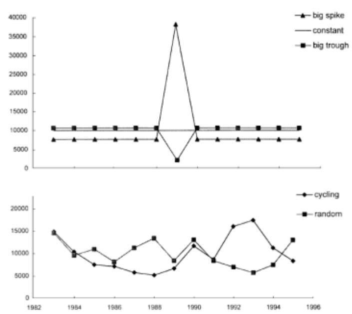
SARDI

Other performance measures

- We also ran bootstraps to estimate confidence intervals, and so estimate precision.
- We also ran standard sensitivity analysis.

SARDI

Simulated settlement time series data



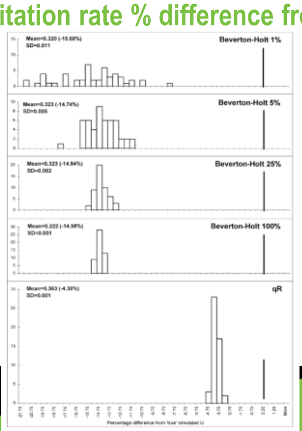
SARDI

Overall outcome

- Time-average (absolute) recruitment number was (unexpectedly) reliably estimated.
- Exploitation rate was slightly biased (about -4.5%).

SARDI

Exploitation rate % difference from true



SARDI

Sensitivity analysis

Table 2. Sensitivity analysis of qR estimates and Beverton–Holt estimates of exploitation rate, *U*, and recruitment, *R*, for *(a)* simulated and *(b)* Northern Zone data

Parameters tested were varied by factors of 1·1 and 0·9. All values are percentages and show percent changes in the estimate of exploitation and recruitment for given ± 10% changes in the parameter indicated. *M*, natural mortality; v_1, vulnerability of recruit age; f_1, fraction at legal size; *K* and L_∞, von Bertalanffy constants; m_r, release mortality; $\{w_a\}$, weight vector

Parameter	qR				Beverton – Holt	
	U		*R*		*U*	
	−10%	10%	−10%	10%	−10%	10%
(a)						
M	1·75	−1·76	−1·72	1·80	2·42	−2·42
v_1	4·75		-0·07		0·00	
f_1	4·75		-0·07		0·00	
K	−20·83	28·71	5·93	−5·01	−10·33	9·83
L_∞	−39·71	62·86	14·94	−8·68	−29·14	25·44
m_r		0·00		0·00		0·00
Catch no.	−15·67	17·40	−6·23	6·33	0·00	0·00
Catch weight	19·46	−14·30	−3·67	3·76	0·00	0·00
$\{w_a\}$	−15·67	17·40	4·19	−3·33	0·00	0·00
(b)						
M	2·84	−2·87	−3·08	3·29		
v_1	2·94		−0·44			
f_1	2·84	−2·70	−0·04	0·05		
m_r	0·05	−0·05	−0·20	0·20		
Catch no.	−24·53	26·20	−2·06	4·03		
Catch weight	29·24	−22·35	−5·90	7·80		
$\{w_a\}$	−24·53	26·20	8·83	−5·42		

SARDI

Advantages

- Recruitment, and exploitation rate and so also numbers at age are estimated with relative ease.
- Can provide higher precision than fully length-based methods (if no length selectivity).
- Requires no assumption of multinomial distribution which nearly always underestimates the sampling variances of length frequencies.
- Can provide a cost effective method to greatly enhance the usefulness of stock assessment outputs.

SARDI

Disadvantages

- Length selectivity cannot be estimated.
- No proper likelihood formulation is possible with equal numbers of data points (Cw and Cn) and estimated unknowns (exploitation rate, U and recruitment, R). .
- Not using effort data.

SARDI

Principal surprising outcome

- Take-home message: Adding Cn permits the ability to estimate absolute population size.
- If the assumptions are met, this method can give accurate estimates of yearly recruitment.
  - That is, even with no effort, and so no CPUE series or other index of relative abundance.
- Exploitation rate is also estimated, but less precisely, and with some bias, and higher sensitivity to error in inputs.

SARDI

Paper 2:

McGarvey, R., & Matthews, J. M. (2001). Incorporating numbers harvested in dynamic estimation of yearly recruitment: onshore wind in interannual variation of South Australian rock lobster (*Jasus edwardsii*). *ICES Journal of Marine Science* 58(5): 1092-1099.

SARDI

Better dynamic model using effort

- The qR model was improved to
  - Incorporate effort data, and so also, implicitly, CPUE,
  - Construct a proper likelihood formulation,
  - Including an appropriate error structure on fits to Cw and Cn.
- Assessment model is effort-conditioned.
- Baranov exponential survival and catches are computed (avoiding error),
- Still assumes a priori:
  - M = 0.1
  - Mean weights-at-age.

SARDI

Model variables and parameters

Table 1. Listing of model variables and parameters.

$N_{a,t}$	Number of lobsters of age a, at the start of year t
R_t	Number of recruits at start of year t
F_t	Fishing mortality in year t
$\hat{C}_t^n$	Model catch by numbers in year t
$\hat{C}_t^w$	Model catch by weight in year t
N_t	Total population number start of year t
B_t	Biomass of lobsters at start of year t
a	1, . . ., 20+ (the last one representing ages 20 years and older)
t	1978, . . ., 1998

SARDI

Predicted catches by number and weight

Yearly cohort losses due to natural mortality and harvesting are written:

$$N_{a+1,t+1} = N_{a,t} \cdot \exp(-Z_t) \qquad (1)$$

where total mortality $Z_t = F_t + M$. Deaths due to harvesting were summed to yield predicted catches by number ($\hat{C}_t^N$) and weight ($\hat{C}_t^W$) in each year of the data time series:

$$\hat{C}_t^N = \frac{F_t}{Z_t} \cdot \{1 - \exp(-Z_t)\} \cdot \sum_{a=1}^{20+} N_{a,t} \qquad (2a)$$

$$\hat{C}_t^W = \frac{F_t}{Z_t} \cdot \{1 - \exp(-Z_t)\} \cdot \sum_{a=1}^{20+} w_a N_{a,t} \qquad (2b)$$

SARDI

Use effort to scale model predicted fishing mortality

- Assume fishing mortality varies in proportion to yearly effort.
- This is an 'effort-conditioned' stock assessment method:

$$F_t = q \cdot E_t$$

SARDI

Likelihood function

The negative log likelihood was written:

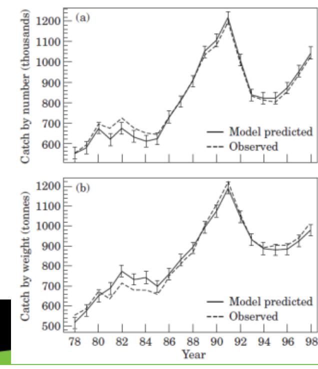
$$-\log L = n_t \log \sigma_N + \frac{1}{2\cdot\sigma_N^{\,2}} \sum_{t=1983}^{1983+n_t} \left(C_t^N - \hat{C}_t^N\right)^2 + n_t \log \sigma_W + \frac{1}{2\cdot\sigma_W^{\,2}} \sum_{t=1983}^{1983+n_t} \left(C_t^W - \hat{C}_t^W\right)^2 .$$

Variances of these two normal likelihood components (for catches in numbers and in weight) were written in terms of a single estimated coefficient-of-variation parameter (σ_C) and the respective data time series means:

$$\sigma_N = \sigma_C \cdot \bar{C}^N \qquad (5a)$$

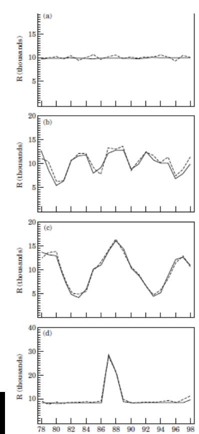
$$\sigma_W = \sigma_C \cdot \bar{C}^W . \qquad (5b)$$

Model fit to catch by number and weight for SA rock lobster



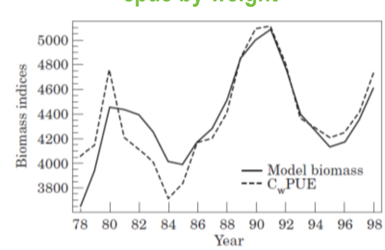
Simulation outcomes:

qR model output agreement with simulated recruitment



Four patterns of recruitment:
(a) Constant
(b) Random
(c) Cyclical
(d) spike

Model-estimated fishable biomass compared with cpue by weight



The model used yearly effort to scale yearly F, therefore cpue (in weight) is not independent

Paper 3:

McGarvey, R., Punt, A. E., & Matthews, J. M. (2005). Assessing the information content of catch-in-numbers: a simulation comparison of catch and effort data sets. *Fisheries Assessment and Management in Data-Limited Situations* (Eds. GH Kruse, VF Gallucci, DE Hay, RI Perry, RM Peterman, TC Shirley, PD Spencer, B Wilson & D Woodby) University of Alaska Sea Grant, AK-SG-05-02, Fairbanks, pp. 635-53.

Objective

- To evaluate the information content of adding catch in numbers to logbooks.
- Assumed data and parameter inputs:
  - Yearly logbook catch and effort totals:
    - Catch by weight ('Cw')
    - Catch by number ('Cn')
    - Effort ('E').
  - Growth as weights-at-age.
  - Natural mortality (M).
- No length or age samples.
- No independent surveys of abundance.

Approach

- We evaluated the information content of added catch-in-numbers totals by comparing three data sets from logbooks:
  - Traditional catch and effort data: Cw & E.
  - Catches-only (no effort): Cw & Cn.
  - 'Full' Cn-augmented data set: Cw, Cn & E.

Methods

- Simulated logbook data sets (Cw, Cn, E for 17 years) were generated using an individual-based fishery model.
  - Simulated data also included mean weights-at-age.
- Two delay-difference stock assessment estimation models were used.
- Output quantities of management interest were yearly estimates of :
  - Recruitment (R)
  - Biomass (B)
  - Population numbers (N)
  - Exploitation rate (U)

Why two stock assessment estimation models?

- Using more than one model makes it more likely that any improvement in the stock assessment estimates resulting from the addition of Cn information, and not from arbitrary model structural choices.
- Thus, any outcomes that result from both model estimators we can more reliably accept as 'robust', and ascribe to the information to the underlying data and not merely to a given model.

Two stock assessment estimation models

- Both were delay-difference models.
- The two models ('DD1' & 'DD2') differed:
  - First- or second-order weight-difference relationship assume and thus
  - first- or second-order in yearly time for biomass and number dynamics.
  - Effort- or catch-conditioned.
  - Normal or lognormal likelihoods.
- A fully age-structured model can be used if prior knowledge exists about varying catchability with age.
  - No such inference can be drawn from catch totals alone.

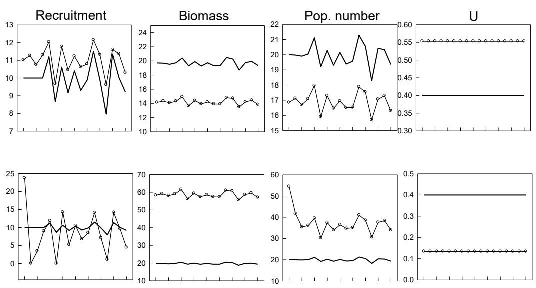
Performance statistics

- 100 simulated data sets and estimations (x 2 models) were run for each case.
- To quantify the levels of agreement between model estimates and 'true' simulated values, we used the 'relative error'.
- Relative error = (Estimated – True) / True.
  - i.e., the percentage deviation of estimated from true.
- For the estimation performance graphs to follow, we plot the median and quartiles of relative error over the 100 runs.
- We also present an overall relative error mean (denoted 'OREM') for each case and data set to be tested, relative

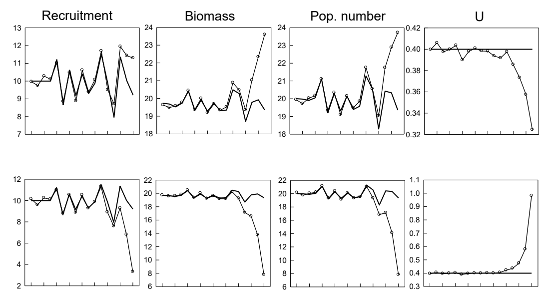
Perfect knowledge case

- First we constructed a case of perfect agreement in the inputs to the simulator and delay-difference estimators.
- True values of M, growth, etc. were assumed by the two model estimators.
- This generated a baseline case of 'perfect knowledge'.

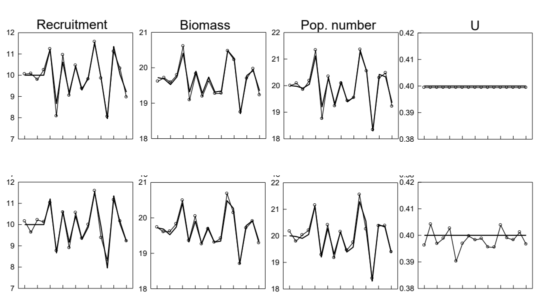
Sample realization (1 run) with Perfect Knowledge
Cw & E only; Cn omitted



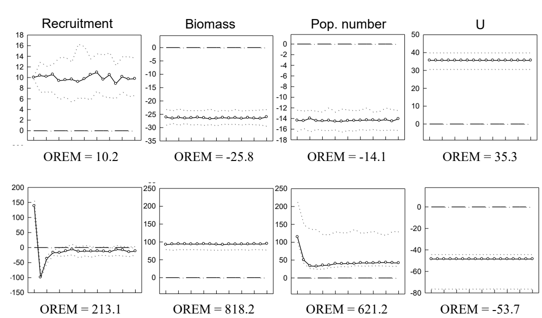
Sample realization (1 run) with Perfect Knowledge
Data set: Cw & Cn only



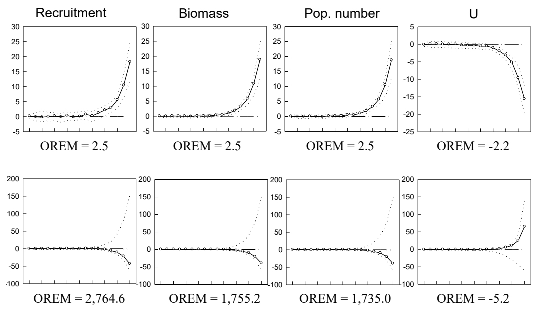
Sample realization (1 run) with Perfect Knowledge
Fitting to 'full data set': Cw, Cn & E



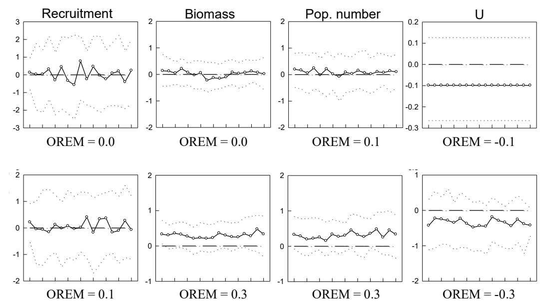
Case: Perfect Knowledge
Data set: Cw & E



Case: Perfect Knowledge
Data set: Cw & Cn



Case: Perfect Knowledge
Data set: Cw, Cn & E



Perfect knowledge case: Summary

- These yielded nearly perfect agreement of model estimates with simulation true values for R, B, N & U.
- Thus it appears both models, with their input data, display effectively zero bias, and produced reliable stock assessment estimates for standard management performance indicators.
- This provided a zero-bias origin for stock assessment performance comparison.

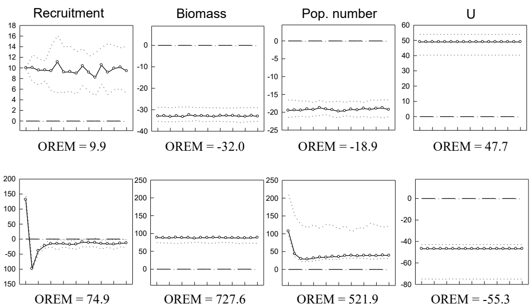
SARDI

Sensitivity to common sources of error in fishery data

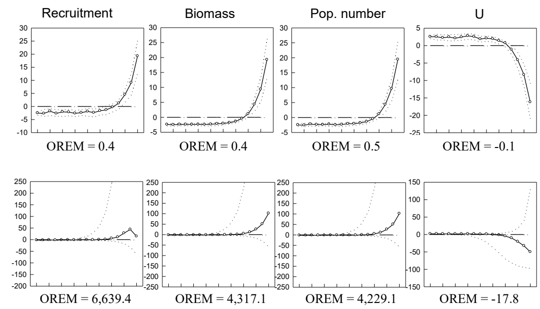
- To test more realistic situations, where some input error is inherent, the simulator was successively altered to include a range of common errors such as:
  - A true natural mortality (M) that was 10% higher than assumed by the estimations.
  - Underreporting of catch and effort totals by 10%.
  - True mean weights-at-age all 10% higher than assumed.
  - Lognormal yearly variation in effort as a measure of exploitation rate (CV = 10%).

SARDI

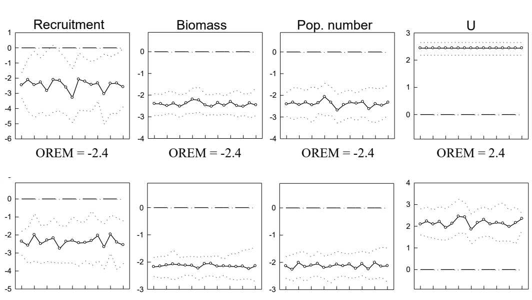
Case: Sensitivity to +10% error in M (true M=0.11)
Data set: Cw & E



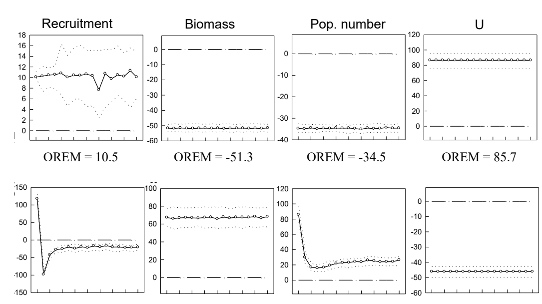
Case: Sensitivity to +10% error in M (M=0.11)
Data set: Cw & Cn



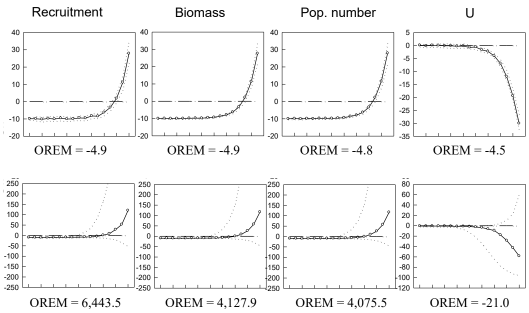
Case: Sensitivity to +10% error in M (M=0.11)
Data set: Cw, Cn & E



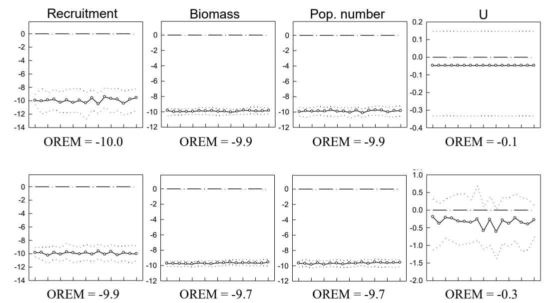
Case: 10% Underreporting of catch log data
Data set: Cw & E



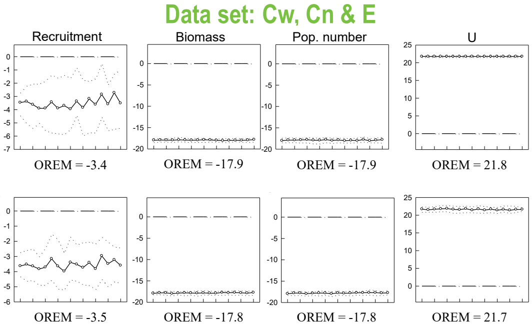
Case: 10% Underreporting of catch log data
Data set: Cw & Cn



Case: 10% Underreporting of catch log data
Data set: Cw, Cn & E



Case: 10% Growth bias (true wts-at-age all 10% higher than assumed)
Data set: Cw, Cn & E

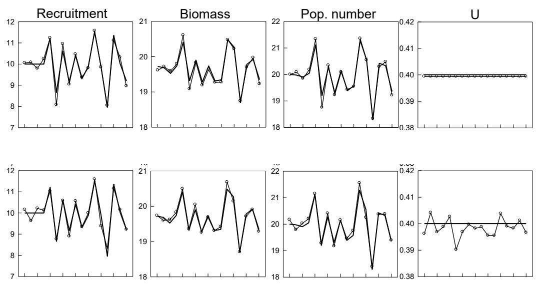


How can Cw and Cn track changes through time?

- A decrease in mean weight can have two causes, either:
  - A pulse of recruits brings younger, thus lighter fish.
  - Or, rising levels of exploitation, can shorten the age and thus size-frequency spectrum, again lighter fish on average.
- How can Cw and Cn alone differentiate these two possibilities? ANS: By the expected time scale of change:
  - Recruitment pulses happen over a year, and then mean weight rises.
  - Higher exploitation happens over longer times with no subsequent reversal in expected mean weight trend.

SARDI

Sample realization (1 run) with Perfect Knowledge Fitting to ‘full data set’: Cw, Cn & E



Conclusion

- Adding catch in numbers to the usual {Cw, E} improved stock assessment accuracy and precision substantially.
- About 3 orders of magnitude improvement in accuracy for absolute biomass with perfect knowledge.
- Thus, for data-limited situations, when feasible, we recommend that catch by numbers be added to logbooks.
- Even when length samples are available, the additional information of mean size as Cw/Cn is worthwhile.
- If the catch cannot be feasibly counted (net fisheries), mean weight from bin samples (every 10 or 100 bins) at weigh-in can probably yield large improvements in stock assessments.

SARDI

Title

- Text

SARDI

History

- Developed to obtain parameters for the South Australian rock lobster spatial model
- Catchability, q, and average recruit numbers, R

SARDI

Using catch by weight and numbers

- Numbers sometimes available in reported catch statistics
- More typical for high value species (lobsters) or large animals (eg sharks)
- (catch-by-weight) / (catch-by-number) = average weight of individuals in catch
- Average weight gives information about size structure
- This allows estimation of exploitation rate, *U*

SARDI

Optional Inputs

- Partial recruitment of first (or all) age classes (v_1)
- Release mortality of first age class (m_r)
- Fraction of first age class reaching harvestable size (f_R)

SARDI

Weights-at-age

- Derived from von Bertalanffy tag-recapture estimates
- Von Bertalanffy lengths converted to weights
- Males and females combined in proportion to commercial catch sex ratios

SARDI

Notes to Rick

- 3 papers and their acronyms
  - McGarvey et al. (1997) Mar. Freshw. Res. -- "qRSS"
  - McGarvey & Matthews (2001) ICES -- "qRDYN"
  - McGarvey et al. (2005) Alaska conf. – "Alaska"
- Have included provenance for each paper, & slides if used, in the comment section
- Looking through the Alaska ppt there are some slides which might make better sense higher up in the talk
  - For now I will keep our chosen tables/figs/eqns from qRSS & qRDYN papers separate from slides of Alaska ppt & you can move around as required.
- Haven't included figure captions in the snipped figures, but have typed them into the comments.

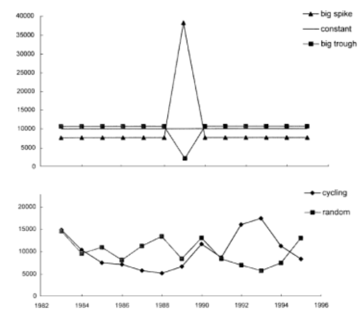
SARDI

Title

- Text

SARDI

Simulated settlement time series data



SARDI

Variance of the normal likelihood components

- The likelihood standard deviations for the fitted normal likelihood function are written in terms of
  - a single freely estimated coefficient of variation parameter (σ_0), and
  - the respective data time series means for Cw and Cn respectively:

$$\sigma_n=\sigma_0\cdot\overline{C}^n \qquad (5)$$
$$\sigma_w=\sigma_0\cdot\overline{C}^w$$

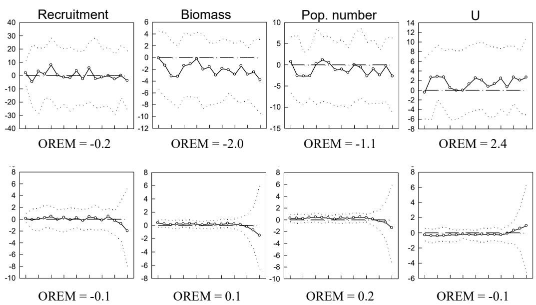
SARDI

What is known so far?

- Two previous studies have examined the potential values of added catch in numbers.
- The first showed for a steady-state fishery that total catches in weight (‘Cw’) and in number (‘Cn’) could permit estimates of absolute abundance:
  - Growth (as mean weights-at-age) and natural mortality were needed.
  - No ‘contrast’ or surplus production relationship required.
- The second study extended to dynamic estimation of (yearly) recruitment, and found close agreement with recruitment and exploitation rate in simulation

SARDI

Case: Lognormal yearly error in U versus E (CV=10%)
Data set: Cw, Cn & E



Catch-only methods

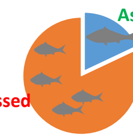
Shijie Zhou

OCEANS AND ATMOSPHERE

7 Feb 2017

Why catch-only methods

- Majority of stocks (> 80% of global catch) have no formal stock assessment.
- Classical assessment requires various data.
- Most fisheries have catch data.
- Most fisheries have catch data only.
- Catch data are easier to collect than other types of data.
- Until now there has been few application to use catch data alone for fisheries assessment and management.
- It is very cheap!



Existing catch-only methods

- Depletion-corrected average catch (DCAC)
- Depletion-Based Stock Reduction Analysis (DB-SRA)
- Catch-MSY
- Catch-based method for classifying stock status

Additional methods: requires additional data

- XDB-SRA—Depletion-Based Stock Reduction Analysis extended using survey index data.
- SS-CL—Stock Synthesis uses catch and a time series of length composition data.
- SS-CI—Stock Synthesis uses catch and a time series of survey indices.
- Catch curve stock-reduction analysis: catch data + age-composition data in a catch curve analysis to estimate fishing mortality.
- Feasible stock trajectories.

Reviews on catch-only methods

- NMFS 2011 (May): Calculating acceptable biological catch for stocks that have reliable catch data only (only reliable catch stocks – ORCS).
- NMFS 2011 (June). Assessment Methods for Data-Poor Stocks Report of the Review Panel Meeting.
- ICES WKLIFE REPORT 2012. Report of the Workshop on the Development of Assessments based on LIFE history traits and Exploitation Characteristics (WKLIFE).
- FAO Technical Paper 2014: A review of data-poor assessment methods and their application to management.
- Several papers/reports on comparison and evaluation of these methods

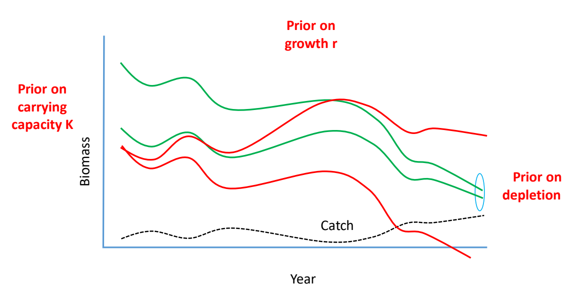
Data requirement for existing methods

- Time series of catch over a reasonably period (>10 years)
- Priors:
  - natural mortality *M*
  - F_{MSY}/M
  - B_{MSY}/B_0
  - age-at-maturity T_{mat}
  - carrying capacity *K*
  - steepness *h*
  - Resilience parameter
  - **growth rate *r***
  - **depletion level *d*** (= 1 - B_{cur}/K)

General procedure

1. Specify priors (K, r, d) and a population model.
2. Randomly drawn initial biomass in year 1 from assumed distribution and range.
3. Draw a parameter set from the prior distributions (r, K, M, F_{msy}/M, B_{msy}/B_0, etc).
4. Apply all these values into a population model and subtract the know annual catch.
5. If the biomass trajectory ends within specified range of the depletion, keep the iteration and all the parameters. Otherwise, discard the iteration.
6. Repeat these steps many times.
7. Use the retained iterations for parameter inference.

Stochastic stock reduction



General comments for existing methods

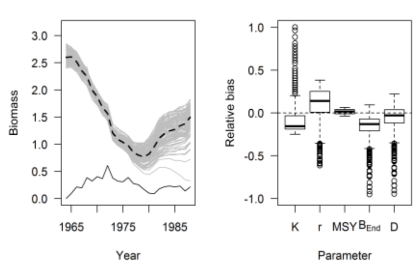
- Priors, particularly the assumed depletion, can have substantial effect on the results.
- Requires more than catch data. Prior information may be difficult to get.
- Low efficiency of stochastic method (difficult in "thread the needle").

OCOM—optimized catch-only method

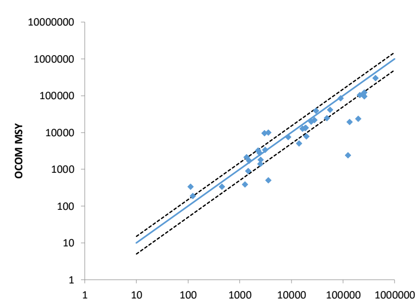
Early development

- Use a Schaefer production model (two parameters ***K*** and ***r***).
- Define a series (large range) of ***K***.
- Define a series of depletion ***d***, including all possible values.
- Use optimization algorithm to search for ***r*** that corresponds to each pair of ***K*** and ***d***.
- Determine the linear section of the log(***r***)~log(***K***) plot for each ***d***.
- Select a narrow range of ***d*** from **MSY~*d*** plot with stable MSY.
- Derive basic parameters: ***K***, ***r***, **MSY**.
- Rerun the model using these parameters.
- Obtain biomass trajectories, ending biomass, and depletion.

Testing and comparing OCOM with data-rich methods



RAM legacy data



Robustness

- The purely catch-only method is robust for MSY and *K*.
- It is also robust for *r* and *d* when the stock has a modest population growth rate and depletion.
- Catch patterns and the initial depletion have little impact.
- Errors in catch data cause similar bias in the estimated ***K***, and ***MSY***, but have little impact on ***r*** and ***d***.

- This early method performs poorly for *r* and *d* when the true values are very low or very high

Improvement of OCOM

- Informative prior for growth rate r.
- Informative prior for depletion d.

Prior on r:
Borrowing information from the rich for data-poor species

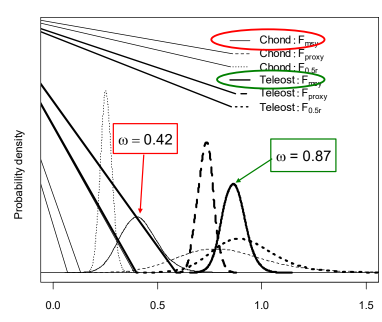
$$F_{MSY} = f(\text{LHP})$$

- Data from 245 data-rich species
- LHP: natural mortality, growth rate, asymptotic length, maximum age, etc.
- Two taxonomic levels: Class and Order
- Bayesian hierarchical measurement error models

$$r = 2F_{MSY} = 2\omega M$$

Zhou, S., Yin, S., Thorson, J.T., Smith, A.D.M., Fuller, M. 2012. Linking fishing mortality reference points to life history traits: an empirical study. Canadian Journal of Fisheries and Aquatic Science 69: 1292–130

Probability distribution of F_{BRP} / M



Prior on depletion *d* = 1- *S*

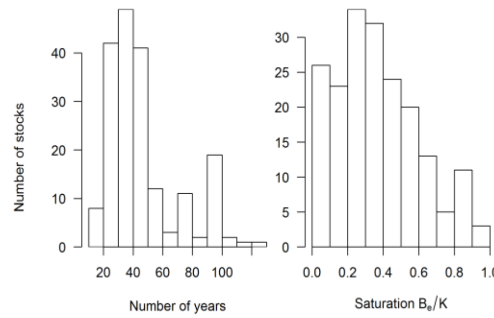
Also borrowing information from data-rich species

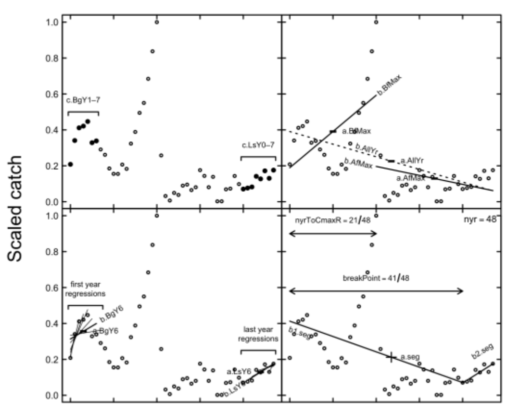
d = *f*(catch history)

- Data from 191 data-rich species in RAM Legacy database.
- Predictors: scaled catch, various linear regressions of catch, number of years, mean catch, etc.
- Boosted Regression Trees (BRT).

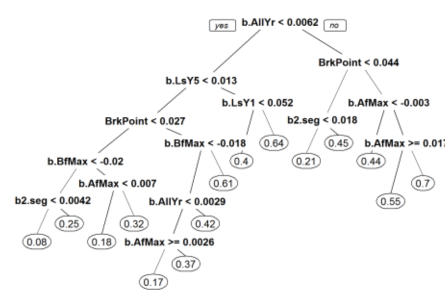
Zhou, S., Punt, A.E., Ye, Y., Ellis, N., Dichmont, C.M., Haddon, M., Smith, D.C., Smith, A.D.M. 2017. Estimating stock depletion level from patterns of catch history. Fish and Fisheries..

Data: RAM database

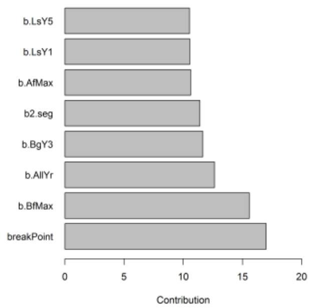




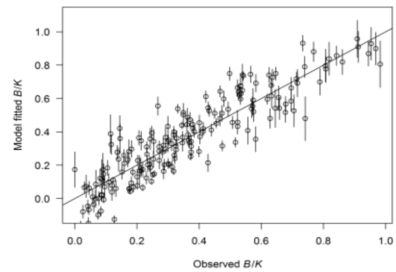
Boosted regression tree



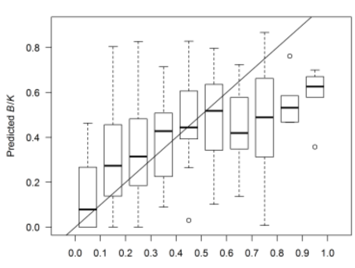
Result: Key predictors



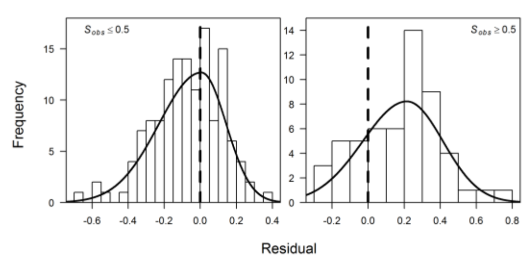
Model fit



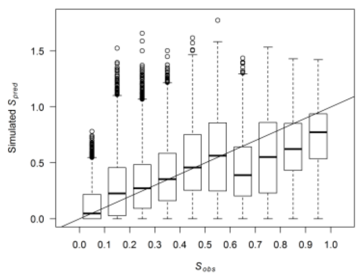
LOOCV Prediction



Prior distributions



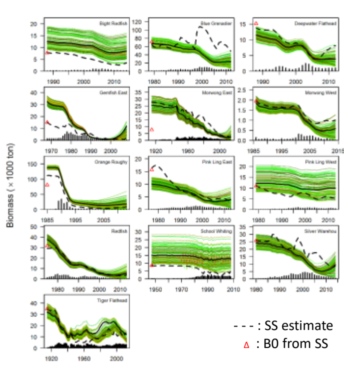
S prior for OCOM



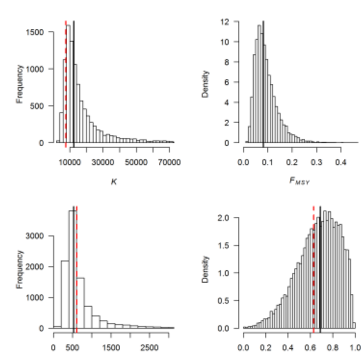
OCOM

1. Based on Schaefer surplus production model.
2. Priors:
   1. *r* ~ *M*
   2. *s* ~ catch history
3. Generate a large number of *r* and *s*;
4. Estimate *K*s using R function "optimize";
5. Exclude pairs with large computation errors;
6. Derive summary statistics from the remaining samples.

Biomass trajectories for SESSF Tier 1 species

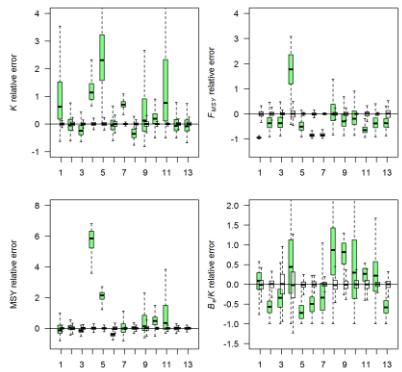


Distribution of key parameters: Bight Redfish

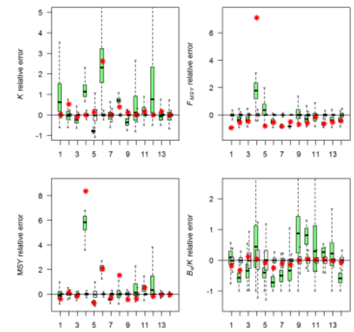


Red: SS estimate

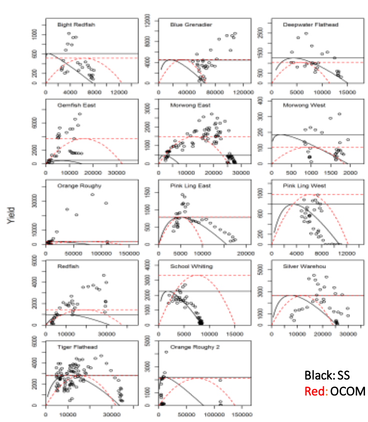
Comparison with Stock Synthesis for SESSF stocks



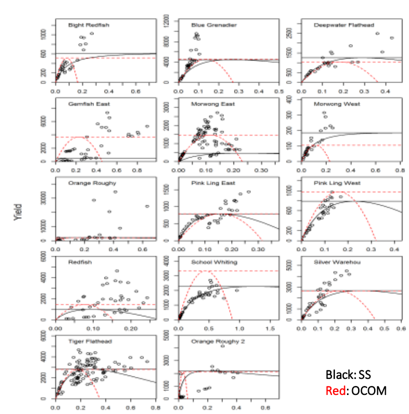
Comparison with Stock Synthesis for SESSF stocks



Green box: OCOM
Red star: production model fitted to biomass from SS

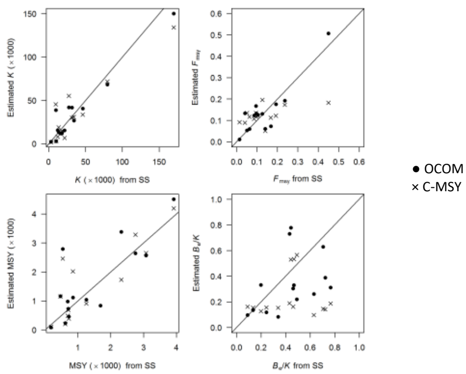


Black: SS
Red: OCOM



Black: SS
Red: OCOM

Comparison with Catch-MSY

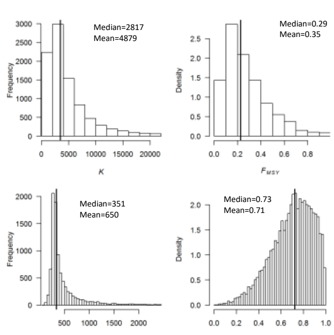


Application to NT Spanish mackerel

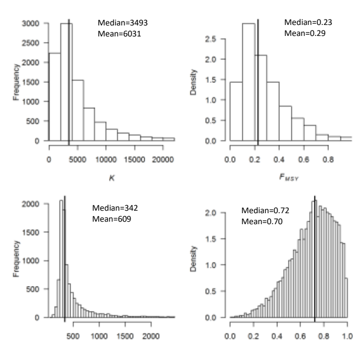
Data required

- 34 years of catch history
- Natural mortality:
  - Scenario 1: M = 0.48
  - Scenario 2: M = 0.39

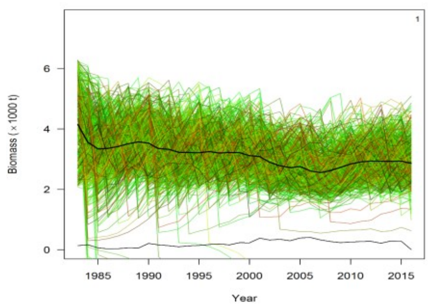
Spanish Mackerel: assume M = 0.48



Spanish Mackerel: assume M = 0.39



Spanish Mackerel: biomass trajectory



Spanish mackerel: NT recent assessment

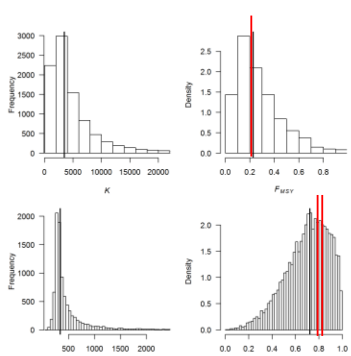
Data required

- Time series of catch
- Time series of fishing effort (CPUE)
- Life history parameters:
  - Unfished natural recruitment rate;
  - Maximum theoretical body length;
  - Survival rate;
  - Length weight relationship;
  - Recruitment compensation ratio;
  - Hypothetical age at fish length 0;
  - von Bertalanffy K growth coefficient;
  - Weight at maturity.

Grubert, M. A., Saunders, T. M., Martin, J. M., Lee, H. S. and Walters, C. J. (2013). Stock Assessments of Selected Northern Territory Fishes. Northern Territory Government, Australia. Fishery Report No. 110.

Spanish mackerel: NT recent assessment with OCOM

- Deterministic SRA:
  - Fmsy = 0.21
  - B/K = 0.79
- Stochastic SRA:
  - Fmsy = 0.20
  - B/K = 0.85



Discussion

- OCOM is very low-cost.
- Preparing and running the model is quick.
- It is reasonably accurate for most stocks.
- Error in catch data causes similar error in *K* and MSY.
- *r* and *d* largely depend on priors.
- Cannot detect change in productivity (regime shift).

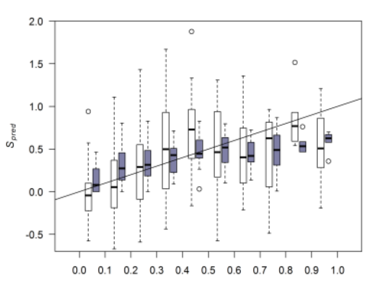
Thank you

Shijie Zhou, Ph.D.
Oceans and Atmosphere
Commonwealth Scientific and Industrial Research Organization
Brisbane, Australia
Phone: +61 7 38335968
Email: shijie.zhou@csiro.au

Comparison between SS and OCOM

	SS3					OCOM			
Stock	B0	Fmsy	MSY	S		K	Fmsy	MSY	S
Bight Redfish	16,426	0.06	545	0.62		15,443	0.08	591	0.64
Blue Grenadier	79,738	0.1	3,914	0.77		66,747	0.14	4,558	0.28
Deepwater Flathead	17,928	0.19	1,257	0.46		11,876	0.17	1,019	0.27
Gemfish East	27,422	0.04	540	0.13		38,132	0.16	2,994	0.13
Gemfish West	10,208	0.1	616	0.72		2,875	0.17	238	0.37
Morwong East	9,704	0.14	468	0.34		30,158	0.09	1,347	0.07
Morwong West	3,284	0.17	185	0.63		2,107	0.09	94	0.25
Orange Roughy	169,697	0.01	1,687	0.24		139,172	0.03	2,127	0.12
Pink Ling East	16,308	0.09	708	0.2		9,973	0.16	792	0.31
Pink Ling West	12,180	0.1	693	0.43		14,525	0.16	1,170	0.74
Redfish	31,759	0.05	849	0.09		36,848	0.08	1,409	0.09
School Whiting	13,566	0.45	2,320	0.44		18,257	0.45	4,109	0.79
Silver Warehou	34,220	0.24	3,072	0.47		27,127	0.19	2,520	0.3
Tiger Flathead	46,203	0.13	2,751	0.49		36,440	0.15	2,709	0.18

Compare mPRM (blank) and BRT (grey)



Government of Western Australia
Department of Fisheries
Fish for the future

Risk-based WoE approach and how it is applied to data limited species in WA

Contents

Why?

Historical approaches

Current approaches

Data limited approaches

Fisheries WA approach –
Inclusive, not exclusive

Weight of Evidence

Been around since from late 1880s

Purist view of the world

Building blocks of evidence

- all qual+quant information
- all analyses/assessment methods
- better understood
- greater transparency, repeatability
- more robust outputs (narratives)

Weight of Evidence approach

Category	Lines of evidence (Consequence/Status)
L1 Catch	Summary **Status**
Catch distribution	Summary **Status**
L2 Catch rates	Summary **Status**
Vulnerability	Summary **Status**
Length and/or age composition	Summary **Status**
L3 biological sampling of catch	Summary – average size of fish in the catch, fishing mortality, spawning potential ratio **Status**
L4 relative abundance based models	Summary – fishery-independent surveys of relative abundance, exploitation rate, recruitment or standardised fishery-dependent relative abundance data. **Status**
L5 integrated models	Summary – All above data **Status**

Precautionary Approach

UN Convention on Law of the Sea (1982) :

The coastal State, taking into account the **best scientific evidence available** to it, shall ensure through proper conservation and management measures that the maintenance of the living resources in the exclusive economic zone is not endangered by over-exploitation.

Principle #15 from the Rio Conference or "Earth Summit" (1992) :

In order to protect the environment, the precautionary approach shall be widely applied by States according to their **capabilities**.

Where there are threats of serious or irreversible damage, **lack of full scientific certainty** shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

FAO Code of Conduct for Responsible Fisheries (1992) – Voluntary based on above :

States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment.

The **absence of adequate scientific information** should not be used as a reason for postponing or failing to take conservation and management measures.

Risk-based

Risk Level	Description	Monitoring & Reporting Requirements	Management Actions
1 Negligible	**Acceptable**; Not an issue	Brief justification – no monitoring	Nil
2 Low	**Acceptable**; No specific control measures needed	Full justification needed – periodic monitoring	None specific
3 Medium	**Acceptable**; With current risk control measures in place (no new management required)	Full Performance Report – regular monitoring	Specific management and/or monitoring required
4 High	**Not desirable**; Continue strong management actions OR new / further risk control measures to be introduced in the near future	Full Performance Report – regular monitoring	Increased management activities needed
5 Severe	**Unacceptable**; Major changes required to management in immediate future	Recovery strategy and detailed monitoring	Increased management activities needed urgently

Risk-based approach

Risk = Consequence X Likelihood

	Likelihood Levels			
Consequence Levels	**Remote**	**Unlikely**	**Possible**	**Likely**
Minor				
Moderate				
High				
Major				

(DR, CB, PS, …)

Risk-based approach

Consequence Levels

Minor – Impacts either not detectable against background variability for this population; or if detectable, minimal impact on population size and none on dynamics

Moderate – Impacts at maximum acceptable level of depletion

High – Level of depletion unacceptable but still not affecting recruitment levels of stock

Major – Level of depletion is already affecting (or will definitely affect) future recruitment potential/ levels of the stock

Likelihood Levels

Defined as the likelihood of a particular consequence level occurring within a defined time period

Remote – The consequence has never been heard of in these circumstances, but it is not impossible within the time frame (<5%)

Unlikely – The consequence is not expected to occur in the timeframe but it has been known to occur elsewhere under special circumstances (5-20%)

Possible – Evidence to suggest this consequence level is possible and may occur in some circumstances within the timeframe. (20-50%)

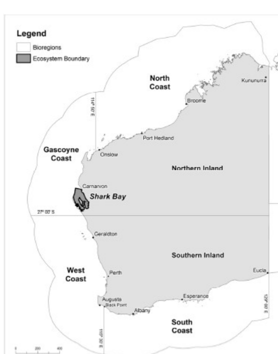
Likely – A particular consequence level is expected to occur in the timeframe (≥50%)

Risk-based approach

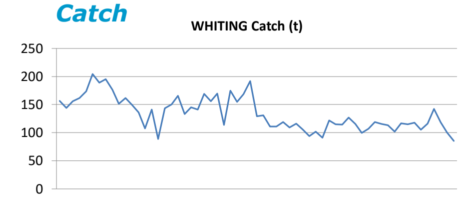
Objective: Stock Sustainable [redacted]

Consequence [redacted] ood
Minor [redacted] e
Moderate [redacted] ly
Major [redacted] le
Extreme [redacted]

CASE STUDY - Yellowfin Whiting in Shark Bay Beach Seine and Mesh Net Managed Fishery



Catch



Catch	Between 1956 and 1985, catches of yellowfin whiting in Shark Bay have fluctuated around 150 t. Since 1985 catches have fluctuated around 100 t resulting primarily from changes to management arrangements (e.g. limited entry). The catch in 2016 was 85t. **The catch time series provides no evidence of unsustainable stock depletion i.e. ongoing lightly fished OR the catch time series provides evidence of continued stock depletion i.e. ongoing collapsed state**

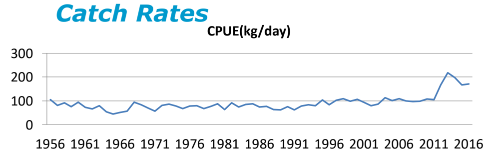
"Catch only" methods

"Catch only" methods	"Catch only" methods (DCAC, DB-SRA & Catch-MSY) Catch time series with estimates/assumptions for key biological parameters, including **depletion** (i.e. proportion of the unfished spawning stock that remains). Assuming **60% depletion** for 2013, estimates of MSY range from 77-110 t using DCAC; 55-1281 t using DB-SRA; and 110-150 t using Catch-MSY. These analyses indicate that recent catches were around MSY. **The "catch only" methods (using 60% depletion) provides no evidence of unsustainable stock depletion.** **Of concern is that the results from these "catch only" methods strongly reflect the assumed level of depletion.**

Catch distribution

Catch distribution	Yellowfin whiting is distributed widely throughout WA (Exmouth – Albany) and considered to constitute a single genetic stock. The majority of the total catch is taken by the Shark Bay Beach Seine and Mesh Net Managed Fishery commercial fishery (90-95%). Commercial licenses restricted to 12, with 10 actively fishing. The commercial fishery operates within the confines of the shoreline of the embayment of Shark Bay with no expansion to areas outside the embayment. **The catch distribution provides no evidence of unsustainable stock depletion.**

Catch Rates



Catch rates	The nominal catch rates remained relatively steady until the mid 1990s with an upward slight increasing trend until 2011, after which they increased dramatically from ~100 kg/day to 166-218 kg/day in 2012-16. There is anecdotal evidence from fishers that the abundance of yellowfin whiting has increased markedly in recent years, possibly reflecting a recruitment spike. **The catch rate time series provides no evidence of unsustainable stock depletion OR stock is recovering from depleted state.** It is questionable whether the nominal commercial catch rate data for this fishery represents a reliable abundance index due to the multi-species nature of the fishery, and unknown changes in fishing efficiency.

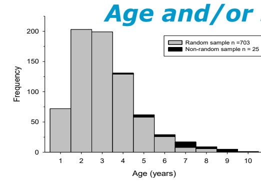
Vulnerability

Vulnerability (MSC-PSA)	Yellowfin whiting has a low maximum age (12 years), young age at maturity (2 years) and high fecundity i.e. very productive. This was reflective is a MSC-PSA score of 1.14 for productivity. The MSC-PSA susceptibility score is very sensitive to the estimate of spatial overlap (between the fishery and stock), with a value of 2 resulting in a score of 2.33 and a value of 3 yielding a susceptibility score of 3. **Biological parameters indicate a low inherent vulnerability.** **Depending on the value for spatial overlap, the MSC-PSA score is categorised as either low or high "risk".** **The MSC-PSA analysis indicates that unacceptable stock depletion could occur if the stock was not well managed.**

Risk Scores

Consequence Levels	Likelihood Levels L1 Remote (<5%)	L2 Unlikely (5-20%)	L3 Possible (20-50%)	L4 Likely (>50%)	Risk Score
C1 Minor > Target			X		3
C2 Moderate Target <Threshold				X	8
C3 High Threshold<Limit		X			6
C4 Major <Limit			X		12

Age and/or size composition



2014 age sample

Grey bars are 'random sample' obtained at the factory

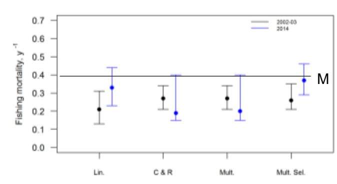
Black bars are 'non-random sample' of large fish retained by commercial fishers for private use or sale

Age and/or size composition	The maximum recorded age for the yellowfin whiting stock in the subtropical environmental of Shark Bay is 10.7 years from samples collected in 2001-03 and 2014. This is less than the value for maximum age of 12 years recorded for yellowfin whiting in a temperate environment. The 2014 age sample is dominated by fish between 2-4 years with reasonable representation of fish caught between 5-8 years. **The age composition data provide no evidence of unacceptable stock depletion.**

Dynamic models with catch and age data ("Catch only" method + age data)

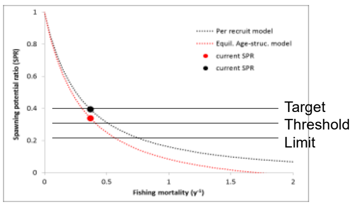
Dynamic models with catch and age data	Simulation analyses employed a dynamic age-structured model with known biological parameters, a Beverton-Holt stock-recruitment relationship (*h*=0.75) and M=0.39 y^{-1}. The current method does not provide estimates from a stock assessment model fitted to the data, but explores the range of parameters consistent with data. Observed catches were removed from a simulated population and estimates of age composition compared with observed age data. MCMC analysis was used to select feasible values of key population parameters (e.g. virgin recruitment) consistent with the age composition, producing estimates of current depletion and MSY. Results using age data for 2002-03 indicate that MSY is 110-150t and a depletion of 0.9 in 2013. Result using age data for 2002-03 and 2014 indicate a similar range for MSY and a depletion of ~0.8 in 2014. **The estimates of depletion and MSY provide no evidence of unacceptable stock depletion.**

Fishing Mortality (F)



Fishing mortality (F)	M = 0.39 y^{-1} based on Hoenig's (1983) equation using a max age of 10.7 years The point estimates for *F* for the 2002-2003 data were 0.21-0.26 y^{-1} were all below *M.* The point estimates of F for the 2014 data were 0.19-0.37 y^{-1} were all below *M.* As yellowfin whiting is relatively short-lived, despite the equilibrium assumptions, the *F* estimates probably reflect the fishing mortality experienced by the stock in recent years. **The estimates of *F* indicate that the current level of exploitation of the stock is acceptable.**

Spawning Potential Ratio (SPR)



Equilibrium models without catch	Estimates female SPR from per-recruit analysis and a simple equilibrium age-structured model incorporating a Beverton and Holt stock-recruitment relationship (using *h* = 0.75). The analyses assumed values for M=0.39 y^{-1} and highest F point estimate from multiple catch curve analyses; F = 0.37 y^{-1}. Results were SPRs were 0.34-0.39. Therefore SPR values lie between the target (0.4) and threshold (0.3). **The estimates of SPR indicate that the current level of exploitation of the stock is acceptable.**

Risk Scores

Consequence Levels	Likelihood Levels				Risk Score
	L1 Remote (<5%)	L2 Unlikely (5-20%)	L3 Possible (20-50%)	L4 Likely (>50%)	
C1 Minor > Target			X		3
C2 Moderate Target <Threshold				X	8
C3 High Threshold<Limit	X				3
C4 Major <Limit					

Summary

C1 (Minor Depletion >target): L3 (Possible) - Based on the lines of evidence, it is possible that the level of current stock depletion is still only minimal.

C2 (Moderate Depletion target<threshold): L4 (Likely) - All of the lines of evidence are consistent with the stock level of yellowfin whiting likely to be at an acceptable level. The age structure, F and SPR lines of evidence are consistent with the level of depletion currently being close to the maximum level of acceptable depletion. These lines of evidence also suggest that if the current total levels of annual capture are maintained, the stock level is likely to remain within this band during the next five years.

C3 (High Depletion threshold<limit): L1 (Remote) – Based on the lines of evidence it is remote that at the current levels of fishing that the stock depletion has or will become unacceptably high within the next five years.

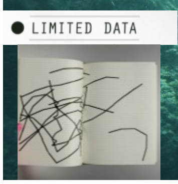
C4 (Major Depletion <limit): NA

Overall Risk

Risk Level	Description	Monitoring & Reporting Requirements	Management Actions
1 Negligible	**Acceptable**; Not an issue	Brief justification – no monitoring	Nil
2 Low	**Acceptable**; No specific control measures needed	Full justification needed – periodic monitoring	None specific
3 Medium	**Acceptable**; With current risk control measures in place (no new management required)	Full Performance Report – regular monitoring	Specific management and/or monitoring required
4 High	**Not desirable**; Continue strong management actions OR new / further risk control measures to be introduced in the near future	Full Performance Report – regular monitoring	Increased management activities needed
5 Severe	**Unacceptable**; Major changes required to management in immediate future	Recovery strategy and detailed monitoring	Increased management activities needed urgently

Conclusions

- includes all data, analyses and models (i.e. don’t ignore anything)
- better understood, greater transparency, repeatability
- “forced” to explain inconsistencies
- allows inclusion of other data (stakeholder) and consideration of its value
- quickly adopt new methods and compare with other lines of evidence
- collection of 1 – 2 age samples did reduce the uncertainty in “catch only” methods NB cost-benefit of collecting age samples
- use of risk-based methods means undefined stocks don’t exist…



Data moderate and limited assessments: a global perspective

Dr Cathy Dichmont

Data moderate and limited

- International drive to address stock assessment methodologies for data limited fisheries
  - ICES WKLIFE – data rich to data limited assessment testing
  - ICES - SISAM
  - EU: DRuMFish – data limited methods in mixed species fisheries
  - a4a (data moderate)
  - NOAA tools
  - Data limited workshops and Conferences
  - BUT USA and EU rich in survey data (i.e. their view of data limited does not always link with ours!)
  - BUT many approaches now aiming at data limited harvest strategies, not always stock status

Apologies

- Very USA and Australian centric presentation thanks to various USA Centre for Independent Expert (CIE) reviews, recent FRDC stock assessment project
  - see Dichmont et al., 2016a (for USA tools) and Dichmont et al., (2016 Marine Policy) for Australia tool review
- EU developed approaches not as easily comparable as used to have different policy drivers (not any more though)

Overfishing (F) versus overfished (SSB)

- Most common stock status system

USA

2014	2015
26 (8%) on overfishing list	28 (9%) on overfishing list
37 (16%) on overfished list	38 (16%) on overfished list
37 stocks on rebuilt list	39 stocks on rebuilt list

EU

Australian C'Wealth

National status report

- Biomass centric system
- High bar, although does accept weight of evidence approaches

175 SUSTAINABLE STOCK Biomass above limit reference point and fishing pressure is adequately controlled	**17** OVERFISHED STOCK Biomass too low and fishing pressure too high or recovery not yet detected
9 TRANSITIONAL-RECOVERING STOCK Biomass too low but fishing restricted and stock is recovering	**26** TRANSITIONAL-DEPLETING STOCK Biomass above limit reference point but fishing pressure too high
5 ENVIRONMENTALLY LIMITED STOCK Biomass too low as a result of substantial environmental changes/impacts or disease outbreaks and appropriate management is in place	**49** UNDEFINED STOCK Not enough information available to make a definitive assessment

Gradient of approaches from data limited to data moderate

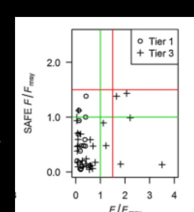
1. Expert judgement (e.g. weight of evidence) – WA example talk
2. Risk analyses
3. Biological parameters
4. Catch only – this and Shijie's talk
5. Size only (and with biology for some)
6. Age only (and with biology for some)
7. Index only
8. Catch and index
9. Simple assessments
10. Ensemble methods

Biological parameters

- Yield and SSB per recruit – but doesn't help with stock status or really relative F on its own
  - YPR in NOAA toolkit (not supported anymore) – easy to code!
  - FishBase support for biology

Risk assessment

- *SAFE (e.g. Zhou et al., 2016)
  - overfishing only
- PSA (Hobday et al.,)
  - relative risk only
- Rapfish (Rapid appraisal for Fisheries – relative risk only



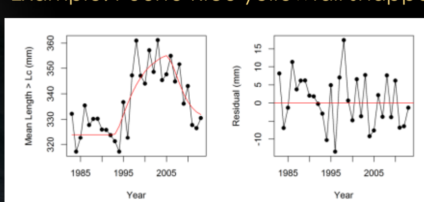
Catch length frequency approaches

- Mean length and Beverton-Holt (Hoenig) – overfishing only
- Non-equilibrium extensions of above (Gedamke and Hoenig, 2006) – overfishing only
- SPR extension of above
- Length-based SPR (Hordyk et al., 2015)
- Length-based empirical metrics (Cope and Punt, 2009)

Gedamke and Hoenig (2006)

- Non-equilibrium extension of the Beverton-Holt mean length mortality estimator
  - transitional behaviour of population mean length following a change in Z
  - Needs mean length above full selection, M, von Bertalanffy parameters
  - Assumes:
    - 1. Recruitment is constant over time.
    - 2. Growth is deterministic following a von Bertalanffy growth equation and is time invariant.
    - 3. Selectivity is knife-edge above the length of full selectivity Lc and is time-invariant.
    - BUT used in USA on large recreational fisheries i.e. no total catch

Example: Puerto Rico yellowtail snapper



Length-based SPR (Hordyk et al., 2015)

- Calculates relative fishing mortality (F/M) and selectivity-at-length using length composition of the catch data, and calculates the resulting SPR
- Not good for highly variable recruitment species

Cope and Punt, 2009

- builds on Froese (2004) to develop length based reference points but didn't link well with stock status
- Four metrics based on catch length frequency
  - Pmat -take of mature individuals, Pmat
  - Popt - fish of optimal size, the size at which the highest yield from a cohort occurs, and that demonstrate the conservation of large, mature individuals,
  - Pmega - can be used to monitor population status of large, mature individuals
  - Pobj - the sum of Pmat, Popt, and Pmega
  - Compared with unfished population to get relative SSB

Catch only methods

- OCOM – Shijie's talk
- Depletion-Based Stock Reduction Analysis (DB-SRA) (Dick and MacCall, 2011)
- Simplified stock synthesis (SSS) e.g. Cope (2015), WCPC and RFMOs
  - NB Strength of SS flexibility is its ability to start DL and move to DR
- Catch MSY

Catch + Index methods

- Biomass dynamic models
  - Haddon (2011): Includes Excel sheets with different shapes
  - A Stock Production Model Incorporating Covariates (ASPIC) (Prager (1992, 1994, 2002)
  - Bayesian Surplus Production Model-1 (BSP1) (Brodziak and
  - Ishimura, 2011); Brodziak et al., 2014)
  - Bayesian Surplus Production Model-2 (BSP2) (McAllister, 2014)
- Extended Simple Stock Synthesis (XSSS) (Cope et al. 2015; Wetzel and Punt, 2016)
- Extended Depletion-Based Stock Reduction Analysis (XDB-SRA) Cope et al. (2015a);
- Wetzel and Punt (2016)

Package Name	Data for use (in addition to catch)
Age/Age-size Models	
Assessment Method for Alaska (AMAK)	Age, Index
Age Structured Assessment Procedure (ASAP)	Age, Index
Beaufort Assessment Model (BAM)	Age, Size, Index, Discards
MULTIFAN-CL	Age, Length, Tagging, Index
Statistical Catch-At-Length (SCALE)	Age, Size, Index
Stock Synthesis (SS)	Age, Length, Conditional age-at-length, Index, Discards, Tagging
Simple Stock Synthesis (SSS)	None+
Extended Simple Stock Synthesis (XSSS)	Index
Virtual Population Analysis (VPA)	Age, Index
VPA-2Box	Age, Index, Tagging
A Stock Production Model Incorporating Covariates (ASPIC)	Index
Bayesian Surplus Production Model-1 (BSP1)	Index
Bayesian Surplus Production Model-2 (BSP2)	Index
Depletion-Based Stock Reduction Analysis (DB-SRA)	None+
Extended Depletion-Based Stock Reduction Analysis (XDB-SRA)	Index
Delay difference model	
Collie-Sissenwine Analysis (CSA)	Index

Ensemble methods (and super ensembles)

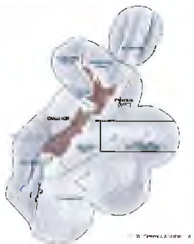
- Robin hood approach – stealing from the rich to give to the poor (Punt et al., 2011)
- Super ensemble models (Anderson et al., 2016)
  - Used in climate and weather specie
  - Uses predictions from multiple models as covariates in an additional super ensemble model fitted to known data

DLMTool

- **Over 85 Data-Limited Methods**
  - **MSE testing and real world application of data**
  - **Most of these methods are harvest strategies (but some very relevant here)**
- **FishPath – Natalie Dowling's talk**
- **NOAA packages (NOAA toolbox sadly not supported but software are)**

Toolbox rather than a tool

Management procedures for data-poor fisheries: case studies from New Zealand



Nokome Bentley, Trophia Ltd

Workshop on assessment methods for undefined and/or data-deficient species

Sydney, Australia, 7-8 February 2017

NZ's quota management system

10 quota management areas

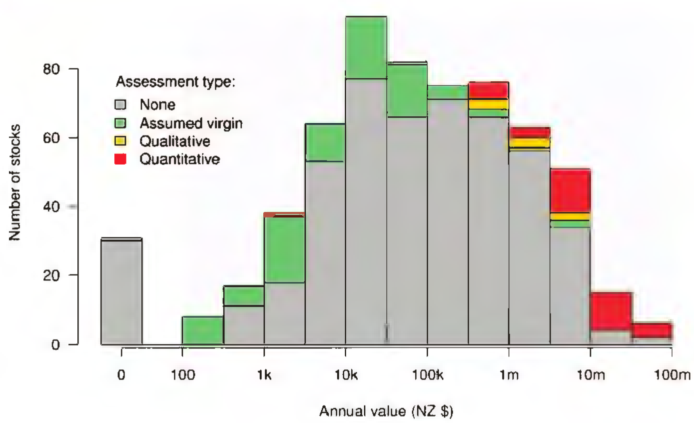
> 90 species

x

...

~ 600 "Fishstocks"

NZ "Fishstocks" : assessment status



Bentley & Stokes (2009) Marine and Coastal Fisheries 1:391–401

Management decision making: assessment paradigm

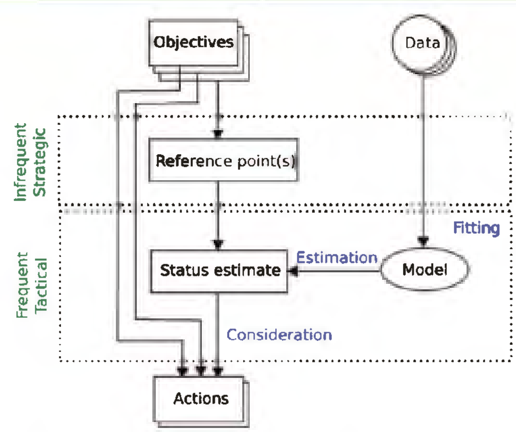


FIGURE 1.—Decision-making elements and processes under the assessment paradigm.

Bentley & Stokes (2009) Marine and Coastal Fisheries 1:391–401

Management decision making: procedural paradigm

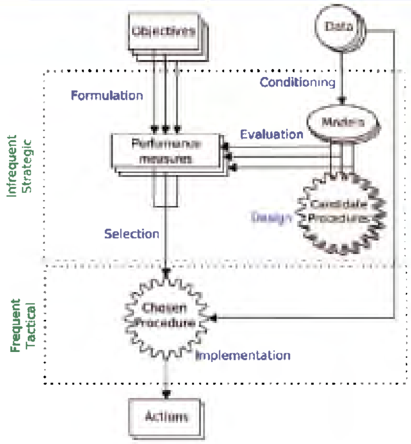


FIGURE 3.—Decision-making elements and processes under the procedural paradigm.

Bentley & Stokes (2009) Marine and Coastal Fisheries 1:391–401

Fisheries estimation : strategic versus tactical

Table 1. A comparison of the characteristics and roles of strategic and tactical fisheries estimation.

Strategic estimation	Tactical estimation
Comparatively. . .	
More complicated	Less complicated
More integrated	Less integrated
More statistical	More empirical
Focus on estimating. . .	
Stock status (e.g. B_t/B_0)	Current biomass (e.g. B_t)
Reference points (e.g. B_{msy})	Current exploitation rate (e.g. F_t)
Parameter uncertainty (e.g. posterior for M)	Forecast biomass (e.g. B_{t+1})
Within the management procedure approach provides. . .	
Distributions of operating model parameters and current state to define a plausible range of states of nature	A component of a management procedure for inferring current fishery indicators from monitoring data

Bentley (2014) ICES Journal of Marine Science; doi:10.1093/icesjms/fsu023

Fisheries estimation : roles of strategic and tactical

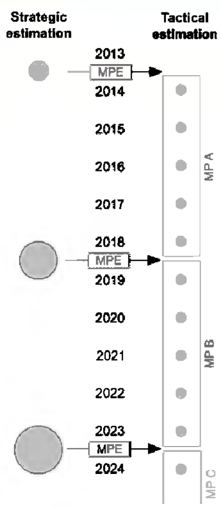


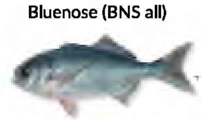
Figure 2. The roles, relationship, and timing of strategic and tactical estimation in fisheries management. Each circle represents an estimation exercise. In this example, strategic estimation is performed every 5 years and is used as the basis for the evaluation of alterative management procedures (MPs). The circles for strategic estimation grow larger over time representing improved knowledge and the accumulation of data. The chosen MP is operated annually and includes alternative forms of tactical estimation which fall into different tiers of data-richness (Figure 1).

Bentley (2014) ICES Journal of Marine Science; doi:10.1093/icesjms/fsu023

Case studies

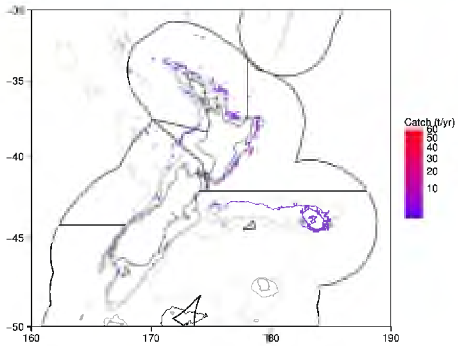
Jack mackerel (JMA 1)

Bluenose (BNS all)



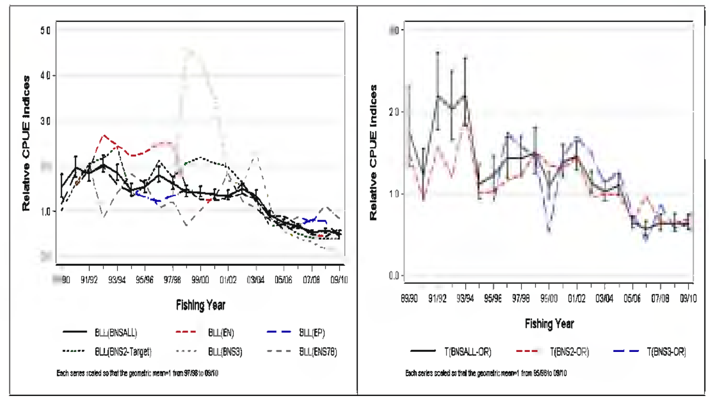
Red cod (RCO 2 & 3)

BNS: Bluenose



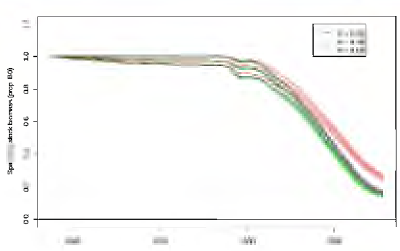
BNS: simultaneous decline in CPUE

By "chance" a similar fall in CPUE in several was observed...

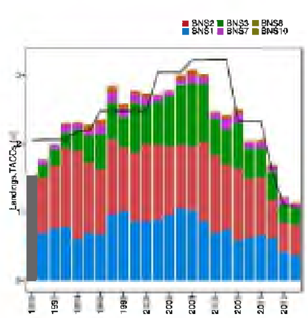


Starr (2012)

BNS: stock assessment and TAC reductions



Cordue & Pomarede (2012)

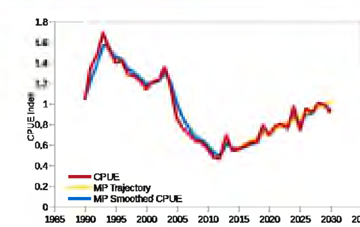


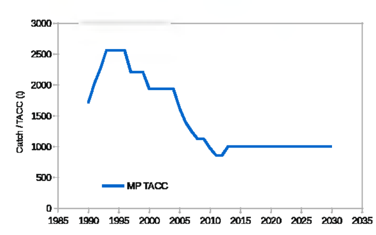
fonz.tridentsystems.co.nz

BNS: rebuild management procedure design

Trajectory based – adjust TACC if go above or below a rebuild trajectory

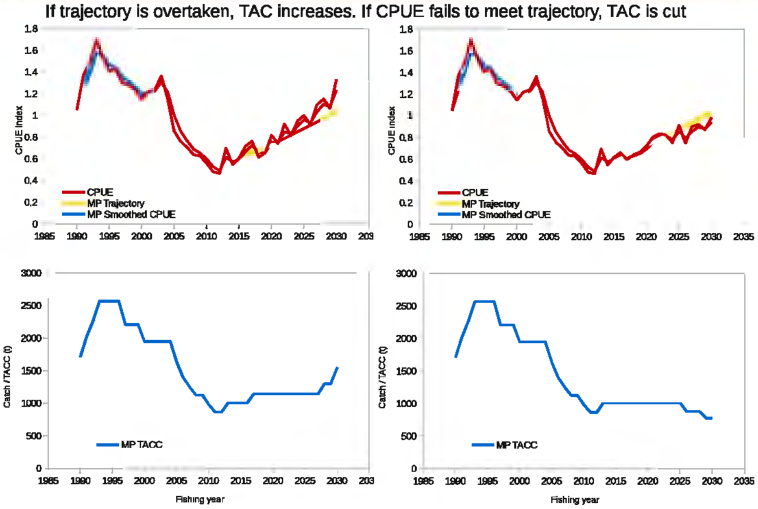
1. **Define a CPUE trajectory** ~ rate of rebuild
2. Calculate **standardised CPUE** index
3. Calculate **smoothed CPUE** index (to reduce effect of CPUE fluctuations)
4. Calculate **status** = ratio between smoothed CPUE and trajectory e.g. 1.15 = 15% above trajectory
5. Calculate **TACC** = status x starting TACC x asymmetry factor
6. **Restrict TACC changes.** e.g.
   - No change if <10%
   - Max. change 40%
7. **Restrict absolute TACC.** e.g.
   - Min. TACC 400t
   - Max. TACC 2000t



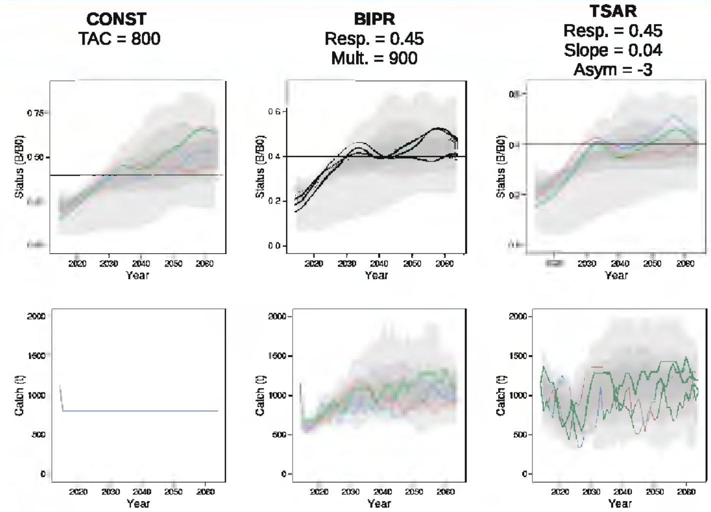


BNS: TSAR class of management procedure

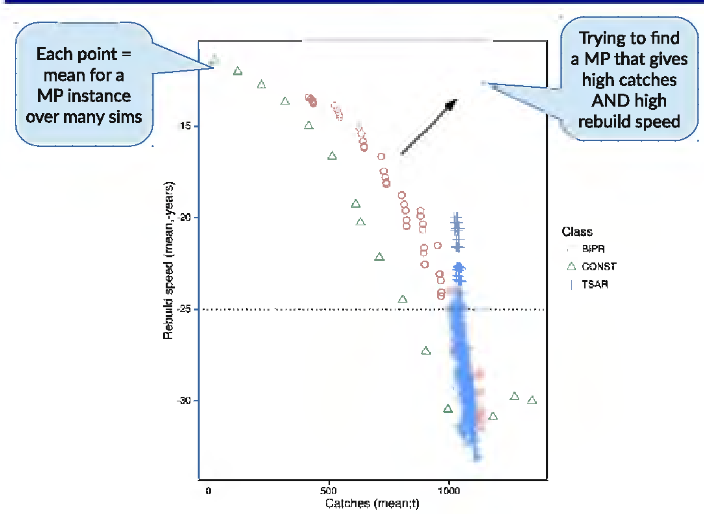
If trajectory is overtaken, TAC increases. If CPUE fails to meet trajectory, TAC is cut



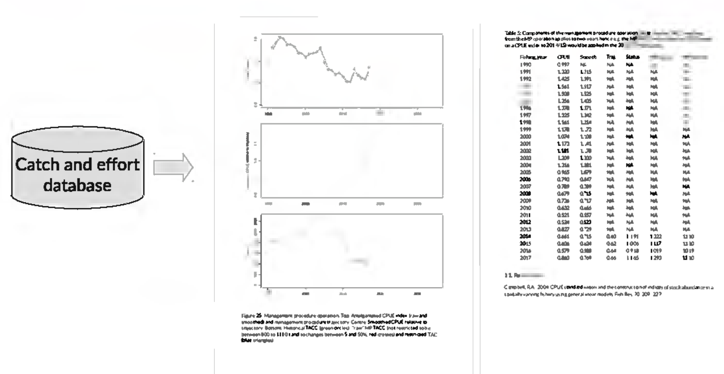
BNS: alternative classes of management procedure



BNS: catch v rebuild speed trade off



BNS: annual CPUE update and MP operation



BNS: annual monitoring of CPUE by zone

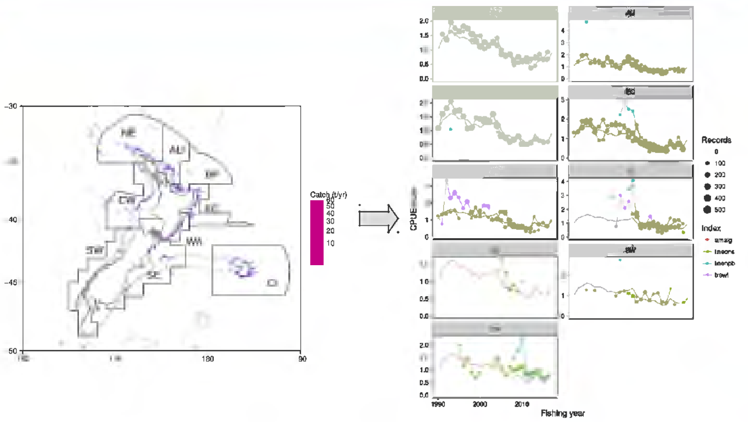


Figure 14. CPUE indices by zone and analysis. Points are only shown where there are greater than or equal to, thirty records in a fishing year/zone combination for the analysis. The amalgamated national index is shown in each panel for reference.

BNS: annual monitorng of CPUE by feature

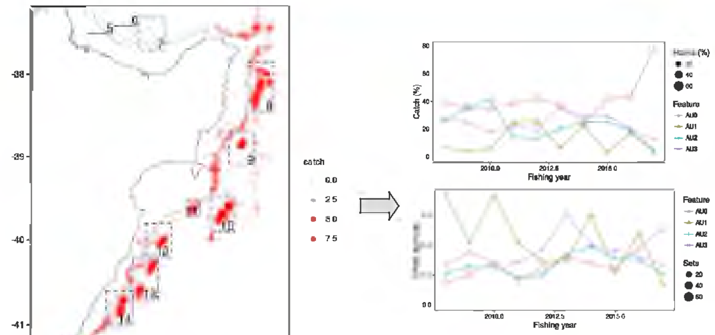
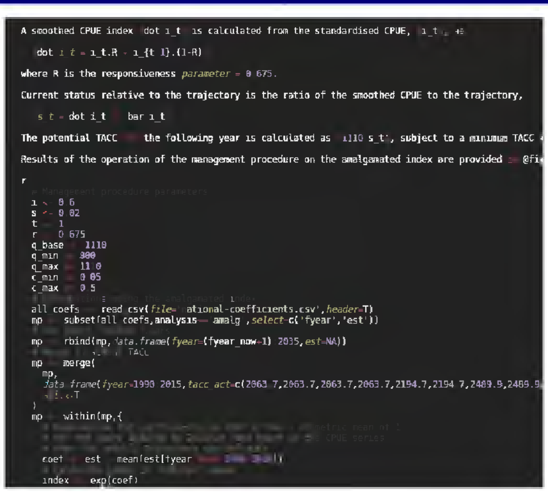
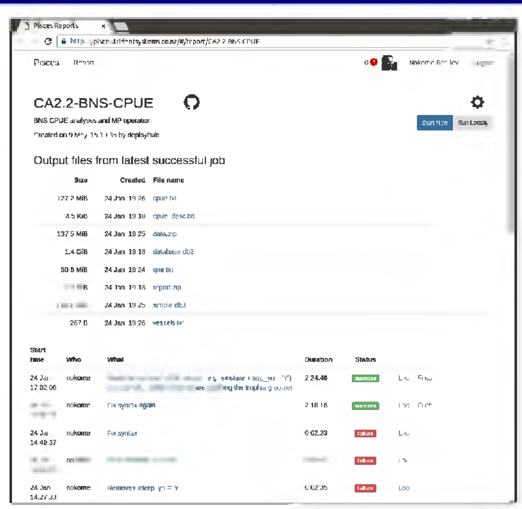


Figure 17: The percentage of effort and catch (top) and unstandardised CPUE (bottom) for each feature within zone AU.

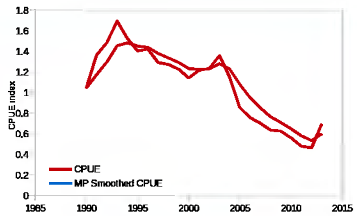
BNS: MP operation : annual reports are code

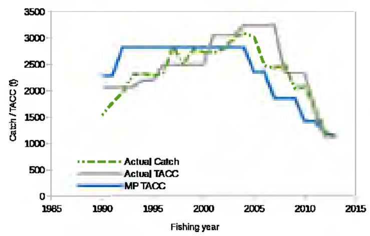


BNS: MP operation : “continous delivery”



BNS:

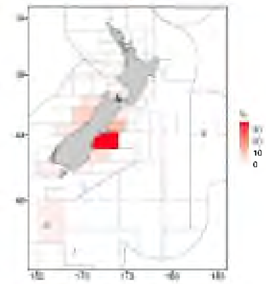


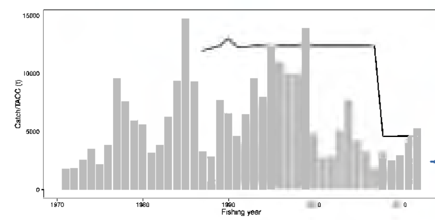


RCO : Red cod

Very short lived
Fishery on 2 year olds

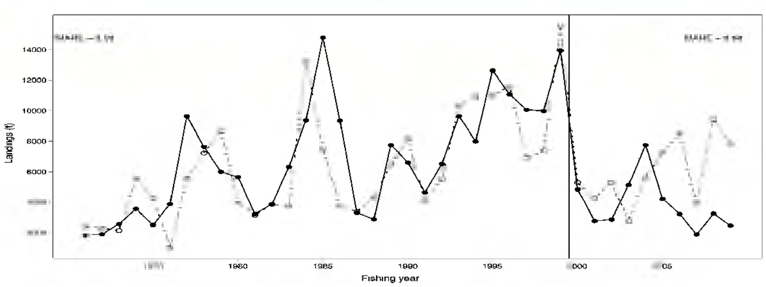
Trawl fishery
mainly FMA 3

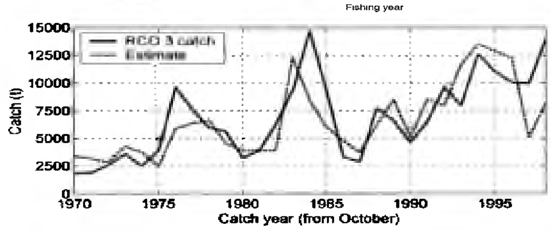




Highly variable catches
Recent TAC reduction

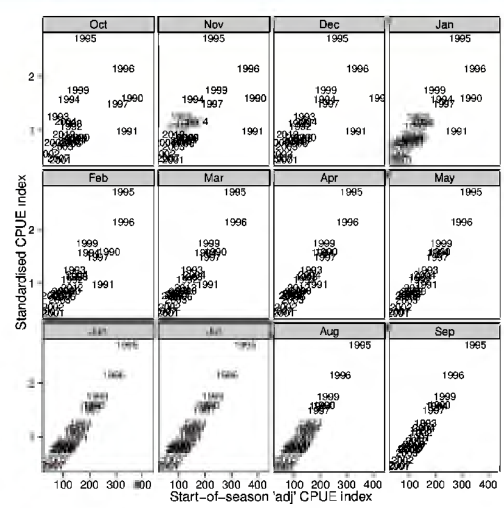
RCO 3 : predicting landings from SST



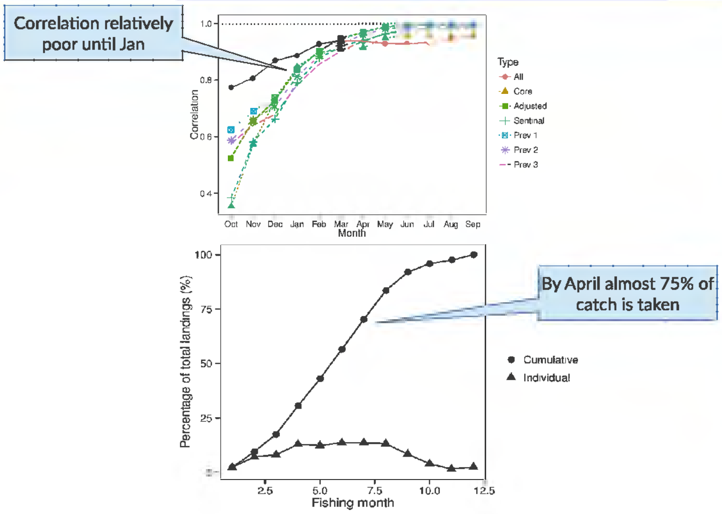


Beentjes & Renwick (2001)

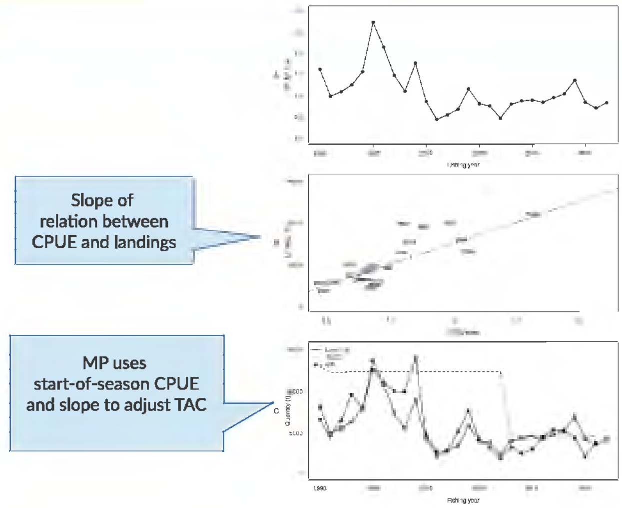
RCO 3: predicting CPUE from start-of-year CPUE



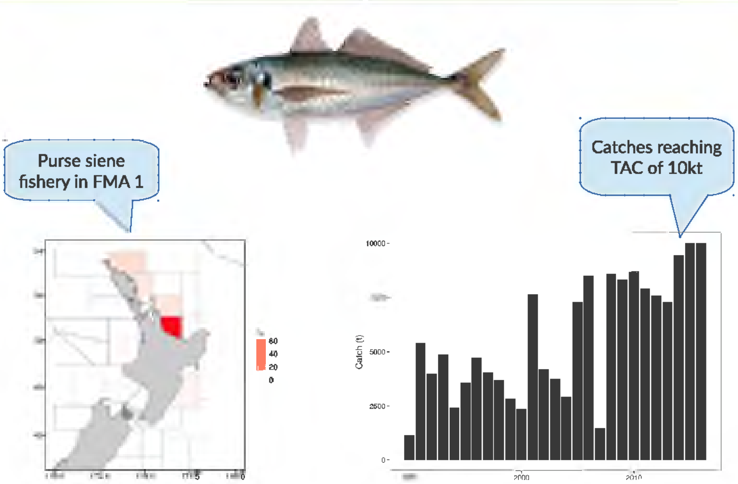
RCO 3: predicting CPUE from start-of-year CPUE



RCO: annual CPUE update and MP operation

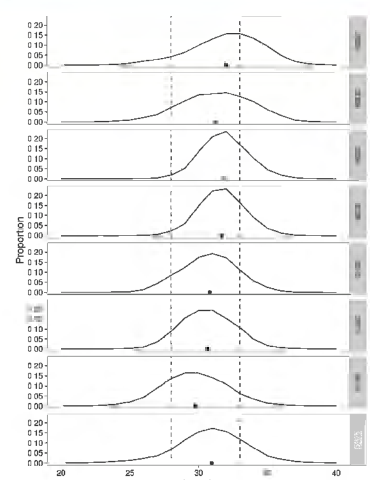


JMA : Jack mackerel

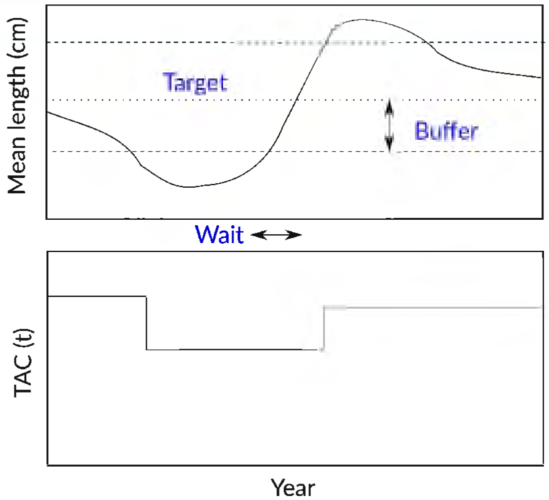


JMA: available data

- **CPUE** - not considered reliable
- **Aerial sightings data** - not considered reliable
- **Length frequency data** – collected consistently for last decade
- **Preliminary MSE work** using mean length



JMA: a MP based on a target range for mean length

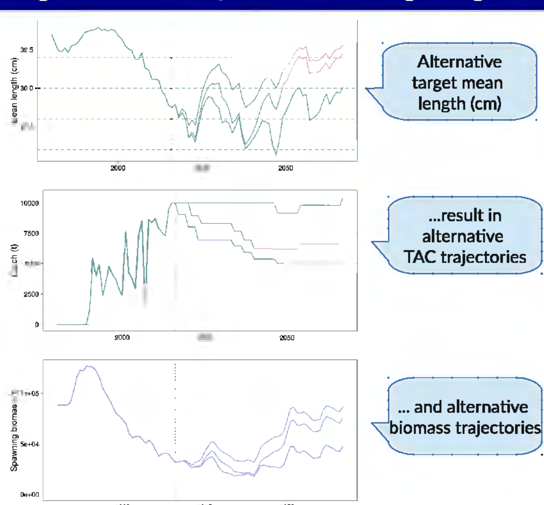


JMA: MP control parameters

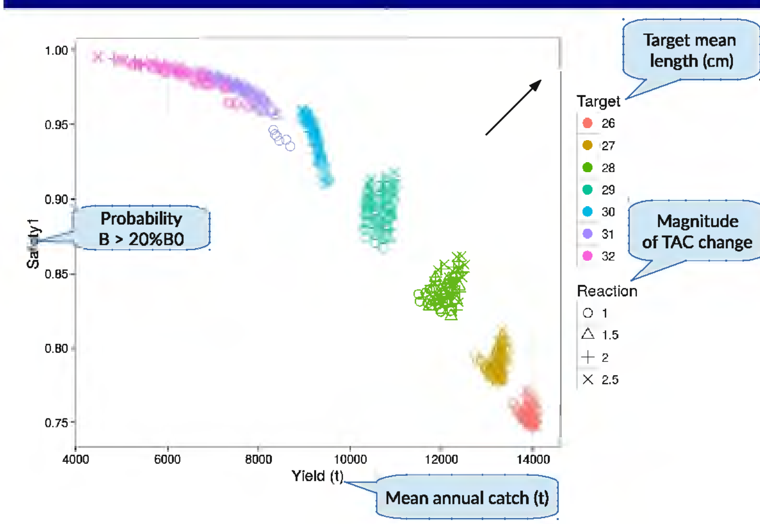
Table X. Reference and alternative values for control parameters of the LMAR managment procedure

Parameter	Value	Alternatives
Responsiveness	1	-
Target (cm)	30	28, 32
Buffer (cm)	2	1, 3
Reaction	1	2, 3
Wait (yrs)	3	1, 5
Maximum TACC (t)	15000	-

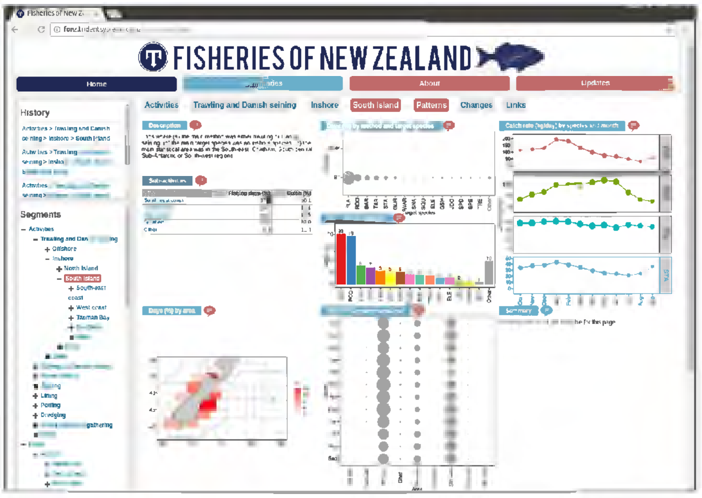
JMA: tuning MP control parameters e.g. target length



JMA: MP selection tradeoff between safety and yield



http://fonz.tridentsystems.co.nz

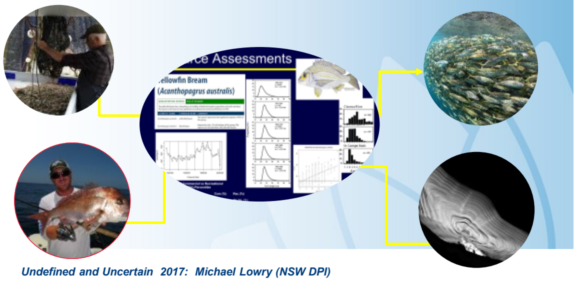


Thank yous and acknowledgments

- Sevaly Sen and AFMA
- David Middleton, Trident Systems
- Fisheries Inshore NZ
- Members of NZ Fisheries Assessment Working Groups

The new state of business

Overview of NSW Assessment / Case Study



Undefined and Uncertain 2017: Michael Lowry (NSW DPI)

Outline

Background (NSW DPI systems)

Review and changes to the assessment framework

Response to recommendations

Future directions

Case study

Summary

Background

Priority Programs within Fisheries Research

Research Unit	Fisheries Resear… Threats to fishery resources	Ecosystem assessment	Aquatic biodiversity	Sustainable aquaculture	Fish habitat improvement
[redacted]	Minor involvement				Minor involvement
Marine Ecosystems	Significant involvement	Significant involvement	Minor involvement		Minor involvement
Freshwater Ecosystems	Minor involvement	Minor involvement	Significant involvement		Significant involvement
Aquaculture	Minor involvement			Significant involvement	
Stakeholders					
Recreational fishers	X	X			X
Commercial fishers	X	X			X
Indigenous and cultural users	X	X	X		X
Aquaculture businesses	X			X	
Conservation NGOs	X	X	X		X

Sustainable Fish Harvest

- Assessment - Quota
- Monitoring commercial - rec
- Data collection quality control
- Determine exploitation status
- Inform management decisions

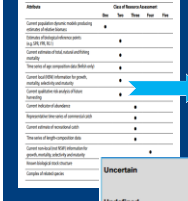
Fisheries Enhancement

- Review of Resource Assessment Framework
- Other projects – PFAS - Sharks

Review of Resource Assessment

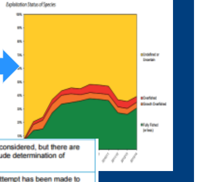
- Current framework: Exploitation Status (traffic light)

(RAC)
Data - assessment class



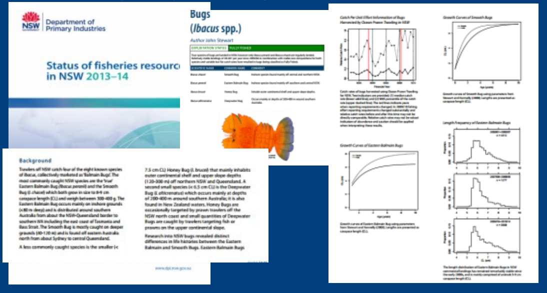
Exploitation Status

Summary



Uncertain	• A significant amount of evidence has been collected and considered, but there are inconsistent or contradictory signals in the data that preclude determination of exploitation status
Undefined	• Commercial catch data are available but no reasonable attempt has been made to determine exploitation status • Recreational species - some data are available but no reasonable attempt has been made to determine exploitation status

Status Report (Biennial)

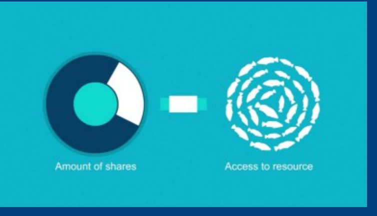


Implemented 2004 - A lot has changed since then.

Factors driving change

Business Adjustment Program

Linkage of shares with catch → Quota species



Quota

- Whiting
- Bluespot flathead
- Tiger flathead
- Silver trevally
- Blueswimmer crab
- Mudcrab
- Eel
- Pipi
- Cockle ……………..

- **22 additional**

Non Quota

- Australian Anchovy
- Australian Bonito
- Australian Salmon
- Banded Rockcod
- Blue Swimmer Crab
- Dart
- Eastern King Prawn
- Fiddler/Shovelnose Shark
- General Sharks
- Mud Crab
- Octopus
- Pilchard
- Pipi
- Rubberlip Morwong
- Sand/Bluespotted Flathead
- School Whiting
- Southern Calamari
- iting
- Balmain Bug
- Bass Groper
- Beachworm
- Blue Mackerel
- Blue-eye
- Boarfish
- Catfish
- Cockle
- Common Dolphinfish
- Common Jack Mackerel
- Cuttlefish
- Diamondfish
- Dusky Flathead
- Flattail/Fantail mullet
- Flounder
- Frigate Mackerel
- Gummy Shark
- Hapuku
- Jackass Morwong
- John Dory
- Latchet/Gurnard
- Leatherjackets
- Luderick
- Mirror Dory
- Ocean Perch
- Pearl Perch
- Pigfish
- Pink Tilefish
- Red Mullet
- Redfish
- River Eel
- River Garfish
- Royal Red Prawn
- Sand Whiting
- Sandy Sprat (Whitebait and Glassfish)
- Silver Biddy
- Silver Trevally
- Snapper
- Sole
- Spanish Mackerel
- Spotted Mackerel
- Squid
- Sweep
- Tarwhine
- Tiger Prawn
- Trumpeter
- Wobbegong Sharks
- Yellowfin Tuna
- Yellowfin/Black Bream
- Yellowtail Kingfish
- Yellowtail Scad
- Bigeye Tuna
- Mackerel Tuna
- Mantis Shrimp
- Mulloway
- Longtail Tuna
- Red Bullseye
- School Prawn
- Sea Garfish
- Sea Mullet
- Spanner Crab

Factors driving change

Consolidation of commercial fishing (business adjustment program)

Ability of the process to incorporate sectors (recreational)

Recreational and Indigenous customary fishing activity is at best sporadically monitored and impacts on stock sustainability largely uncounted in fishery management regimes.

This is despite the fact that recreational fishing is a popular pastime for millions of Australians, and that recreational catch rivals commercial catch for some species, placing pressure on some key stocks.

Development of alternative / complementary models (SAFS)

Relevancy to management / reporting metrics – action plans

Ability of frame to integrate with other processes TAC, MEMA, MSC

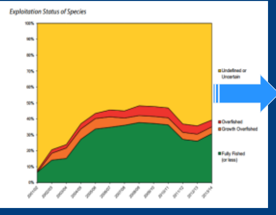
FRA Review – Terms of Reference

- Initiated *Review of the current NSW resource assessment framework and the performance of the arrangements employed to assess NSW fisheries* of the NSW resource assessment framework completed May 2016.
- Potential transition from the existing assessment framework to the National Status of Fish Stocks (SAFS) model,
- The capacity of the existing framework to meet responsibilities that will be driven by coming changes to the management of commercial fisheries in NSW,
- Arrangements for consulting, engaging, and communicating with stakeholders, and
- Prioritisation and planning of research.

NSW Department of Primary Industries

Review of Resource Assessment

Response to (McKoy Stokes review) completed Oct 2016
Accepted all 13 recommendations



What was the process set up to achieve – reporting metrics the need for meaningful performance measures

Framework did not deliver on management needs / outcomes

Not effective at engagement with stakeholders.

Data quality.
Did not provide for relative assessment of the quality of data.

Response to recommendations - consideration of alternative model

Uncertain – Undefined 2017 - Michael Lowry

NSW Department of Primary Industries

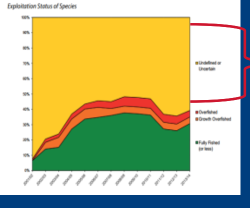
Development of harvest strategies

Review indicated that the transitioning status frameworks was the first step and more fundamental changes needed to be addressed to meet commercial consolidation. – Harvest Strategies

NSW Department of Primary Industries

Undefined and Uncertain

Identified that the purpose of current reporting of status is unclear. It does not obviously meet management needs, but neither does it meet stakeholder or public communication needs (Stokes & McKoy 2016).



Poor understanding of the difference between undefined and uncertain

Lacks transparency in pre assessment of the status of low $ value, low risk, species

Provides an expectation that undefined status may change

Lack of confidence in the process

Poor performance indicator

Uncertain – Undefined 2017 - Michael Lowry

NSW Department of Primary Industries

FRA Review – Outcomes

A good research planning system should ensure that all projects have a clear statement as to i) what are the management or policy needs, ii) what are the specific scientific objectives, and iii) how will meeting those objectives contribute to the management or policy needs. (included in SSG process)

- **Provided direction for the development of frame to meet change (commercial consolidation)**
- **Provided opportunities to better align resources with assessment needs (biennial assessments?)**
- **Greater flexibility in the implementation of PIs (rec fishing)**

Culture of review and DPI

Parliamentary Inquiry

Standing Committee inquire into and report on commercial fishing in New South Wales, and in particular:

(c) the scientific research underpinning fisheries management,

(d) current arrangements for the assessment of fisheries by the NSW

Report due April 2017 ?

Focus on the quality of information needed to drive linkage and allocation of catch

Highlights the importance of high quality information in the delivery of resource sharing arrangements

Specific reference to issues relating to undefined / uncertain status

Case study - Pipi Fishery

Similar attributes / problems to many other fisheries

Case study - Pipi Fishery

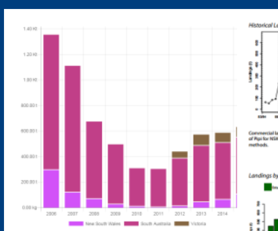
Relatively low value ~ 1.5 million
low catch

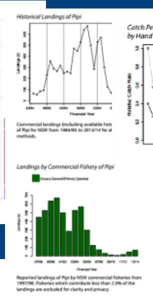
Rec harvest (20t - 50t)
commercial harvest (500t – 65t)
Relatively low participation ~ 20-30

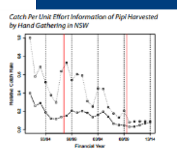
Biological characteristics –
High degree of variation at all spatial scales
Variable recruitment
Sensitive to overharvesting / mass mortality events
Biohazard
Size at maturity 45mm age 1-2 years

Case study - Pipi Fishery

Rapid decline in commercial catch 560 tonnes (t) in the 2004–05 financial year to less than 10 t in 2010–11, despite a significant increase in price over this period factors contributing to the decline ?? Multi jurisdictional ??

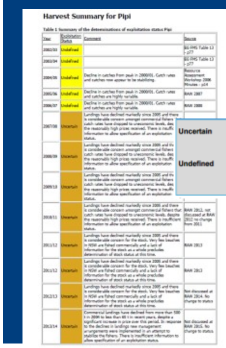


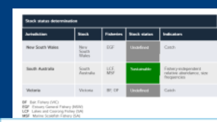




NSW Department of Primary Industries

Case study - Pipi Fishery





Uncertain	• A significant amount of evidence has been collected and considered, but there are inconsistent or contradictory signals in the data that preclude determination of exploitation status
Undefined	• Commercial catch data are available but no reasonable attempt has been made to determine exploitation status • Recreational species - some data are available but no reasonable attempt has been made to determine exploitation status

Transition in status Undefined – Uncertain result of reduction in catch in NSW and other jurisdictions

NSW Department of Primary Industries

Case study - Pipi Fishery

In 2011, a six-month closure output controls limiting catch to 40 kg per fisher per day were implemented in an attempt to stabilise the fishery. A minimum legal length of 45 mm is in place to allow spawning to occur before recruitment to the fishery. Spatial closures

Review of biology of species

- Determination of age / growth structure of population
- Reproductive ecology
- Understanding spatial distribution
- Port monitoring of size structure
- Observer based survey
- **Remains uncertain**

NSW Department of Primary Industries

Case study - Pipi Fishery

Why uncertain

Uncertainty exists around commercial catch rates as an index of relative abundance due to aggregation of Pipi, catches being limited to 40 kg per fisher per day (hyperstable catch rates).

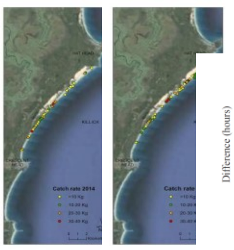
Inability to accurate reflect effort – poor understanding of catch rates

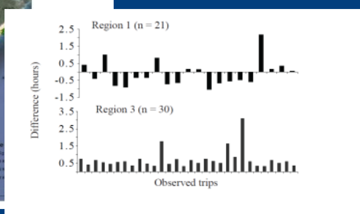
Inaccurate and inconsistent reporting

Fishers agree that there is inaccurate reporting – but not aware of the link between assessment and data quality (reflected in many fisheries)

NSW Department of Primary Industries

Case Study - Pipi Fishery





•Common problem – reporting changes –interpretation of time series

Department of Primary Industries

Case study - Pipi Fishery

Uncertainty does not reside with a lack of detailed biological information understanding of fishery dynamics (complex patterns of distribution of catch and effort)

Primarily driven by accurate (lack of) information around fisher behavior (observer study)

Lack of understanding of the importance of this information in development of output controls and resource sharing

Transition to quota = development of the relationship between **data quality, uncertainty and allocation**

Department of Primary Industries

Case study - Pipi Fishery

What information would result in transition to status

- **Transitioning to TAC no trip limit (Management Action)**
- **Reliable understanding of effort and catch at spatial scale consistent with harvest activity (GPS) (Fishery Dependent)**
- **Reporting of the undersized component at the same scale - recruitment (Fishery Dependent)**
- **Supported by independent assessment of reference beaches (DPI Research)**
- **Transitional recovering**

Department of Primary Industries

Summary

- **Resource assessment allocation of exploitation status and the integration into other processes is high profile.**
- **Current definitional protocols (undefined / uncertain) are not clearly understood.**
- **Often undefined is (mis) interpreted as a measure of abundance**
- **Often (Uncertain and Undefined) used interchangeably or grouped together i.e. the "uncertain and undefined"**
- **Transition from undefined - uncertain will require greater link between quality of information , uncertainty and allocation of catch and data from all sectors**

Department of Primary Industries

Summary

- Risks associated with perceptions / efficacy of programs that have a large proportion of undefined / uncertain
- Unintended risks associated with classification used in processes that are not directly aligned (MEMA TARA)
- Pre assessment mechanisms that provide transparent pathway for allocating undefined / uncertain (risk assessment)

NSW Department of Primary Industries

Questions

NSW Department of Primary Industries

The unfortunate reality of data-poor fisheries

Jeremy Helson
Fisheries Inshore New Zealand

FISHERIES INSHORE NEW ZEALAND
COMMITTED TO HEALTHY OCEANS; SUSTAINABLE FISHERIES

Context

- FINZ represents 237 stocks, most small
- A wide variety of methods
- Research funding model acts as constraint
- Limited fisheries-independent data
- Lack of pragmatism / leadership

Legislation / Policy / Politics

- Relatively simple legislation. Set TAC at a level that maintains the stock at or above B_{MSY}
- Some policy guidance, not binding
- 628 stocks
- Almost unfettered discretion regarding allocation
- More recent emphasis of “noise reduction”
- Little emphasis on status

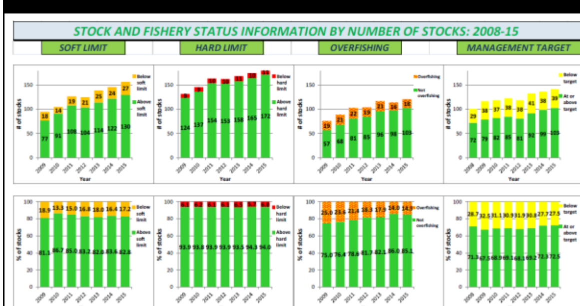
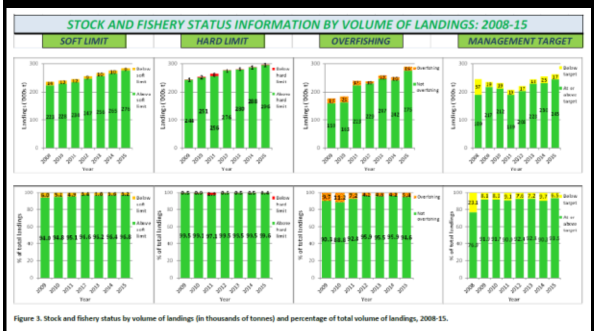
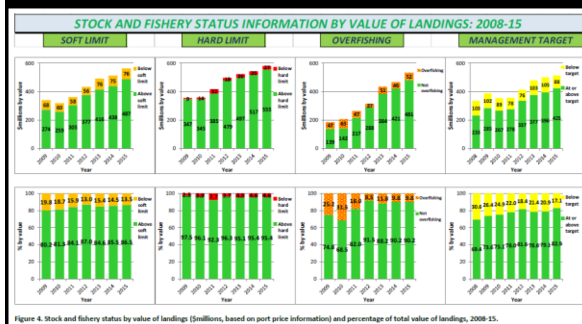


Figure 2. Stock and fishery status by number of stocks and percentage of stocks, 2008-15.





The Usual Caveats

*292 stocks removed from this as nominal stocks (TACC or catch less than about 10 t, or other indications of no proven development potential)

However, these are not the real problem children

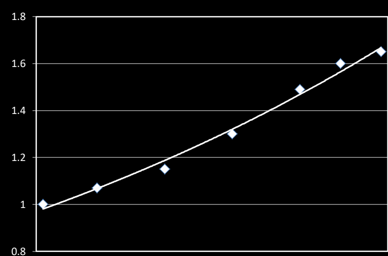
A range of problems

Research spend
Lack of pragmatism / managerial courage
Politics
Leadership
Governance
Principle replaced by populism

Data can't solve all these, but it sure helps

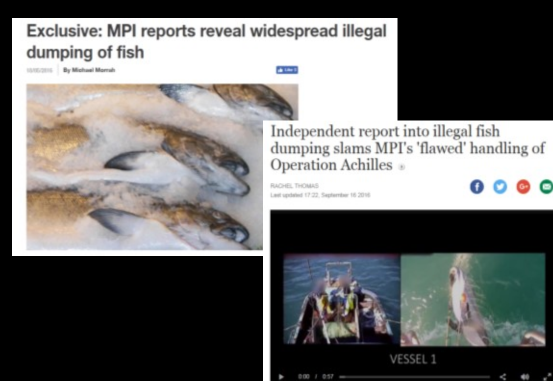
The value of a dollar

Revenue hasn't kept pace, more fisheries in QMS…



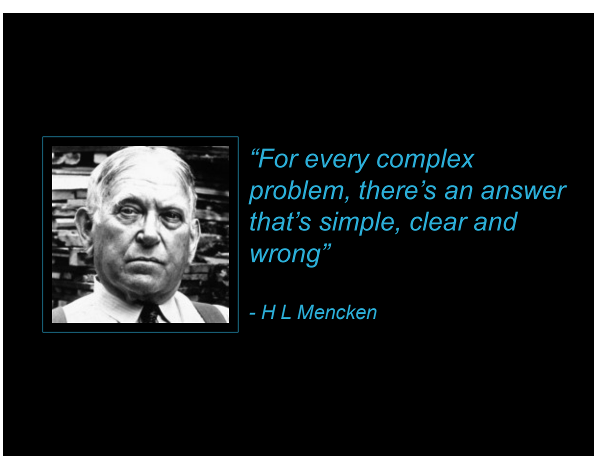
So, …

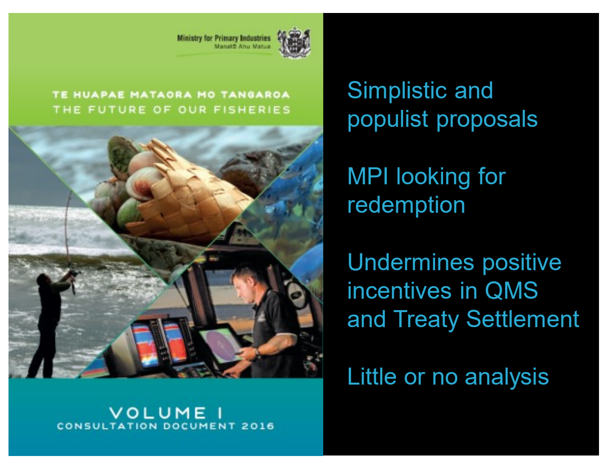
- More stocks in QMS, most by-catch
- Little funding for research
- Too few TACC adjustments (86%, 62%)
- TACCs out of sync with biomass
- Incentives to discard (no ACE, high deemed values)
- Non-compliance, enforcement, community concern …
- Complete chaos, blood-bath




NEW ZEALAND / ENVIRONMENT
NZ fish catch under-reported for decades - study
6:26 pm on 16 May 2016
Share this
The number of fish caught in New Zealand waters has been under-reported for six decades, with the true catch nearly three times official figures, according to a new report.


Minister moves to fast-track fisheries monitoring after fish dumping
ROSANNA PRICE
Last updated 15:19, May 24 2016
GRANT MATTHEW / FAIRFAX NZ
Nathan Guy, Minister for Primary Industries, says campaigners wanting McDonald's to drop hoki from their menu are just "scaremongering".

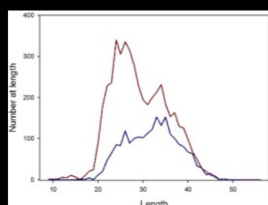

"For every complex problem, there's an answer that's simple, clear and wrong"
- H L Mencken

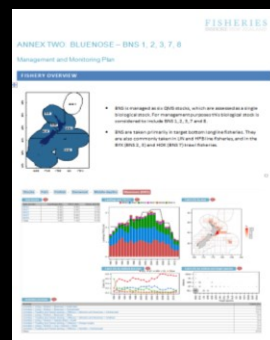

Ministry for Primary Industries
TE HUAPAE MATAORA MO TANGAROA
THE FUTURE OF OUR FISHERIES
VOLUME I
CONSULTATION DOCUMENT 2016
Simplistic and populist proposals
MPI looking for redemption
Undermines positive incentives in QMS and Treaty Settlement
Little or no analysis

Our solution

Multi-faceted:

- Management and Monitoring Plans
- Better catch information
- Electronic monitoring
- Penalty regime
- Gear trials
- Re-balancing

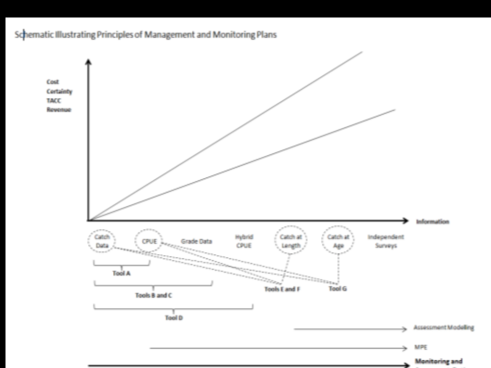




Management and Monitoring Plans are fundamental

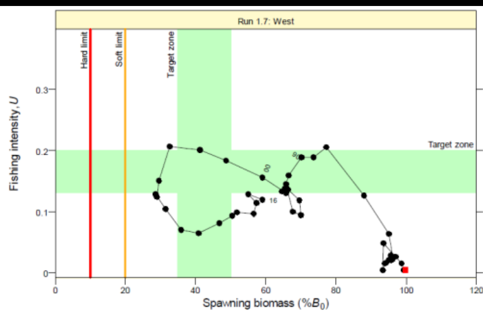
Key requirement is pragmatism and creativity regarding monitoring

Some progress, but more scope; on the water and desktop



FISHERIES
INSHORE NEW ZEALAND

COMMITTED TO HEALTHY OCEANS SUSTAINABLE FISHERIES



Trajectory over time of fishing intensity (U) and spawning biomass (% B_0), for the western hoki stock from the start of the assessment period in 1972 (represented by a red square), to 2016 (15). The red vertical line at 10% B_0 represents the hard limit, that the yellow line at 20% B_0 is the soft limit, and the shaded area represents the management target ranges in biomass and fishing intensity. Biomass estimates are based on MCMC results, while fishing intensity is based on corresponding MPD results.

Data-limited assessments and pragmatic ways forward

Natalie Dowling, CSIRO

Workshop on assessment methods for undefined and/or data deficient species

Sydney, February 7 -8 2017

OCEANS AND ATMOSPHERE
www.csiro.au

"Data-limited/data-poor fisheries"

- Relative term; can cover a range of conditions, e.g:

1. Classic (quantitative) stock assessment models unable to be used
   - Lack of data availability, data quality and/ or analytical capacity;
2. Large uncertainty in the status and dynamics of the stock due to poor data;
3. Uncertainty in the nature of fishing (e.g. in terms of fleet dynamics and targeting practices); or
4. Low GVP

"Data-limited/data-poor fisheries"

Can include, but not necessarily limited to:

a. new fisheries with limited observations and no time series of information

b. those where fisheries research and management have lagged exploitation

c. low-value fisheries or species for which comprehensive data collection is considered uneconomic or unjustified

d. multi-gear, multi-species fisheries with many small operators and landing sites for which comprehensive monitoring is complex and resource demanding

e. fisheries where data quality is poor or variable and difficult to verify (e.g., high levels of misreporting or non-reporting)

f. spatially-structured fisheries where data collected may not be representative of the whole stock

g. fisheries that retain by-catch species but do not adequately monitor by-catch

Data-limited assessments vs. harvest strategies

- Encourage embedding data-limited assessments within a harvest strategy with control rules that can be used to sustainably manage a fishery, over assessments in isolation to resolve stock status.
- Control rules within a harvest strategy can compensate (to some extent) for bias or imprecision in status assessment.
- Assessments linked to precautionary harvest control rules can perform well in avoiding overfishing (although less well in maximizing yield), even though the assessment method may poorly measure stock status.
- Consider context and consequence: the same reasons that resulted in the fishery being data-limited may also cause restrictions on assessment and management options.

"One size fits all" mentality should be strongly discouraged

- While their application may be simple, data-limited assessment methods are context specific and each has its own assumptions and caveats, requiring expert guidance and/or local knowledge. As such, automated or generic packages may often be inappropriate or misapplied
- Care needs to be exercised to ensure that the methods used and the estimates produced are robust (to some level), and much more thought is required to adequately represent the (range of) uncertainties in all status determinations

"Quick and dirty fixes" mentality should be strongly discouraged

- (Empirical assessments) perceived to be technically simple BUT non-trivial to implement and to simulation test
- Can be difficult to define proxy reference points for "empirical assessments": subjective judgement within the assessment's architecture
- Many data-limited assessments do not provide direct estimates of biomass or fishing mortality. They also have some minimum level of data requirement/can be labour intensive/costly
- *Is a highly uncertain, yet designated, stock status preferable over an honest "uncertain" classification?*

Potential challenges and pitfalls

- Cost
- The extent of infrastructure/agency support for a formal, open and comprehensive process
- Typically information- and resource-poor
  - formal model-based stock assessments may be unable to be undertaken
  - Limited resources to implement a harvest strategy
- Lack of formal data collection protocols

Potential challenges and pitfalls

- Multiple sectors/user groups
  - identifying and obtaining adequate representation
  - Intersectorial conflict
- Social licence: need to acknowledge
  - the relative strength of this within the fishery
  - the influence it may have
- Lack of a clear leader or representative from a sector(s), and/or the need for the process to be bounded by expertise

We're obliged to get stock statuses resolved

- Management paralysis in face of inability to undertake "gold standard" model-based assessment
- Big space of options in between

- Tiers provide a context for getting on the formal management ladder
  - Risk equivalency via higher buffers around less "robust" assessments (though NB robustness is highly situation-specific)
  - Provides incentive to move up the Tiers
  - Meanwhile gets people on board with the process of formal management
  - Some notion of where things are at is better than flying blind.

- **But HOW to proceed?**
- **And how to defend choices in the data/capacity-limited space?**

- ***Process-based guidance required***

FishPath

- Harvest strategy selection tool
  - An organisational tool to empower a formal guided process.
  - Grew out of experiences of harvest strategy development in Australian Commonwealth (playing "Twister")

- Automates the process of filtering harvest strategy options
  - Five information categories
  - Navigates all available possibilities to reveal those most appropriate, with relevant caveats – will eliminate or caution against inappropriate options (data availability is only ONE information considered)

- A participatory process for identifying appropriate and feasible harvest strategy options given any fishery's context.

- Mitigates against decision paralysis, and/or using the wrong assessment, or inappropriate control rules or monitoring, all of which create risks for fishery collapse.

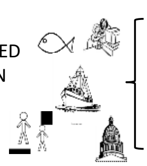
FishPath: confronting options with fishery context

- Starting the process of developing a management strategy by <u>efficient and transparent identification of feasible options</u>, tailored to fishery context.

- User-friendly; provides or re-evaluate options for

- Monitoring
- Assessment
- Decision/Control Rules, Management Measures

→ BASED ON



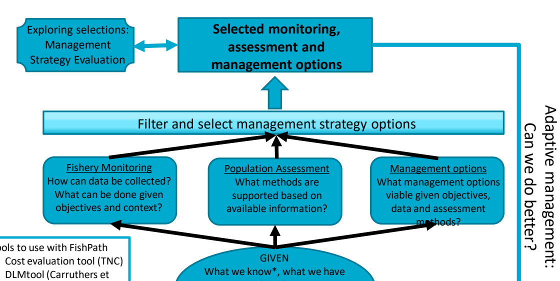
1. available data
2. biological/life history attributes
3. fishery operational characteristics
4. socio-economics
5. governance attributes

- Single or multispecies fisheries

- *Given a set of circumstances, here is a subset of options*

NOT "AT ARM'S LENGTH"/ TOP-DOWN

FishPath: a roadmap to managing fisheries



Tools to use with FishPath
- Cost evaluation tool (TNC)
- DLMtool (Carruthers et al.)
- Stock Synthesis (NOAA)
- Capacity building via stock assessment training

*Life history info, fishery operations, socio-economics, & governance

FISHPATH DOES

- Provide a platform for engagement and informed discussion
- Provide a broader perspective into management strategy development (as opposed to recommending and undertaking an assessment).
- Allow for more thoughtful consideration of management strategy selection process

FISHPATH IS

- Efficient, transparent, objective process to formalize engagement and empower decision making
- Comprehensive with a considered list of options
- Identifies what can be done if specific caveats or limitations can be overcome

FISHPATH is NOT

- An assessment toolkit or software tool that identifies a single assessment options and undertakes the associated analysis
- Top-down recommendation of methods or approaches without considering specifics of fishery

FISHPATH DOESN'T

- Recommend any single option
- Provide reference points or assessments
- Tell you how to overcome sticking points and constraints (future work?)
- Tell how hard to pull harvest control rule levers
- Evaluate options in context of objectives (MSE)

Assessment: definition in the data-limited space

- "Assessment" here can embrace
  - "is there any sense of where things are at?"
  - harm/no harm
  - changes worthy of management response
  - proxy indices of abundance
  - indirect notion of stock status across multiple indicators
  - loose assumptions that trigger levels correspond to some status
  - estimates of (for e.g.) F, MSY, SPR

FishPath Assessment component

- 44 possible "assessment" approaches
  - "no" reference points (harm/no harm)
  - proxy reference points
  - stock-status-based reference points
- for fisheries lacking sufficient data to inform a model-based assessment
  - Production model, DB-SRA most "data-rich"
  - Exploratory analysis most "data-poor"
  - explanation of each assessment
    (what it does, what is estimated within each)

"Assessments" by "family" (more than one way to assign)

"Family"	Assessment
Expert judgment	Move directly to decision rules
Expert judgment	Discourse/expert judgement
Expert judgment	Changes in spatial distribution of effort
Expert judgment	Changes in spatial distribution of catch
Expert judgment	Changes in gear type or manner of deployment
Expert judgment	Corral/explore data via descriptive statistics
Risk analysis/Vulnerability	PSA to estimate risk of overfishing
Risk analysis/Vulnerability	Ecosystem risk assessment for the effects of fishing
Risk analysis/Vulnerability	Comprehensive assessment of risk to ecosystems (CARE)
Risk analysis/Vulnerability	Ecosystem threshold analysis (coral reefs only)
Risk analysis/Vulnerability	RAPFISH (Multi-dimensional scaling)
Risk analysis/Vulnerability	SAFE (Zhou)
Empirical reference points	Sequential effort triggers
Empirical reference points	Sequential catch triggers
Empirical reference points	Size-based sequential trigger system
"Family"	Assessment
Multiple Indicators	CUSUM Control Charts
Multiple Indicators	Traffic lights
Multiple Indicators	Sequential trigger framework involving catch and/or effort, CPUE, size, sex ratio etc.
Multiple Indicators	Hierachical decision trees

"Family"	Assessment
Life history-based RPs	Modal analysis to estimate growth rates
Life history-based RPs	YPR
Life history-based RPs	Samples of catch; ensure 30% have spawned (per squid fishery in California)
Size/age-based	Catch curves
Size/age-based	Sustainability indicators (per Cope and Punt (2009) based on Froese's size-based indicators)
Size/age-based	Catch, CPUE by size indicators (per Froese)
Size/age-based	Changes in mean length/weight or length/weight percentiles
Size/age-based	Size relative to size at maturity
Size/age-based	Mortality estimates from length data in nonequilibrium situations (Gedamke and Hoenig 2006)
Size/age-based	Size-specific catch rate indicators for fish sampled inside and outside of MPAs, and per-recuit (per Wilson)
Size/age-based	Length-based SPR assessment (Prince and Hordyk)
Size/age-based	Estimate lifetime egg production per O'Farrell & Botsford

"Family"	Assessment
Catch only	Feasible stock trajectories (Bentley and Langley 2012)
Catch only	Zhou's catch-only method (estimates MSY)
Catch only	ORCS (Only Reliable Catch Series)
Catch only	DCAC (MacCall)
Catch only	DB-SRA
Catch only	Simple Stock Synthesis (SSS) using only a time series of catch (Cope 2013)
Catch only	Stochastic SRA (User Guide Lombardi and Walters)
Catch only	Catch-MSY (Martel and Froese 2013)
Abundance indicators	Standardised CPUE
Abundance indicators	Use of biomass surveys to inform spatial management
Abundance indicators	Ratio of density inside:outside MPAs (per Babcack and MacCall; McGilliard et al.)
Abundance indicators	Change of dominant species
Abundance indicators	Change in species composition ratios
Abundance indicators	Linear regression to recent time series of CPUE
Population dynamics model	Depletion analysis
Population dynamics model	Production model
Population dynamics model	SCA

FishPath Assessment component

- Unambiguously score each "assessment": unique minimum requirements against
  - Indices (catch, effort, size, sex, abundance, species composition)
  - Biology
  - Expert judgement
- Compare the resulting vector of scores to the fishery's unique vector for minimum data requirement matching
- Traffic light warnings/restrictions against ~30 secondary caveats/additional requirements (post vector-matching)

SNAP Science for Nature and People

Assessment

	Assessment method 1	Assessment method 2	Assessment method 3	Assessment method 4	Assessment method 5
Biology/life history attributes					
a	0	1	2	3	3
b	1	1	1	2	1
c	2	1	2	2	2
Indices					
a	0	1	1	2	3
b	1	1	2	2	2
Types of expert judgement					
a	1	1	2	1	2
b	1	1	1	2	2

Extent of matching between
- vectors for each assessment approach
- the vector for the fishery of interest

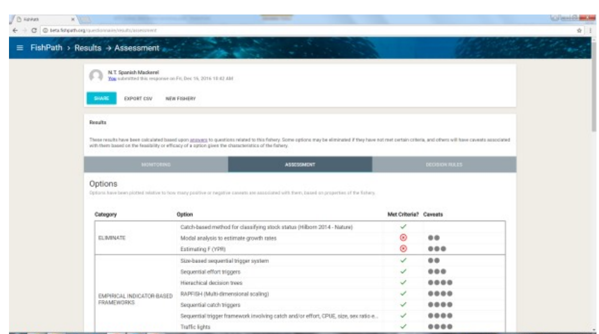
SNAP Science for Nature and People

Assessment: BC Rougheye Rockfish example

ASSESSMENT OPTIONS	Rougheye Rockfish: Meets minimum criteria	Rougheye Rockfish: Caveat
Move directly to decision rules	X	
Discourse/expert judgement	X	
Corral/explore data via descriptive statistics	X	
Ecosystem risk assessment for the effects of fishing	Expert judgement	
Comprehensive assessment of risk to ecosystems (CARE)	Expert judgement	
Ecosystem threshold analysis (coral reefs only)	X	
PSA to estimate risk of overfishing	X	
Sustainability indicators (per Cope and Punt (2009) based on Froese's size-based indicators)	X	Multiple fleet selectivities
Change of dominant species	X	Temporal changes in fishery; operational changes in fishery
Change in species composition ratios	X	Temporal changes in fishery; operational changes in fishery
Changes in spatial distribution of effort	X	Temporal changes in fishery
Changes in spatial distribution of catch	X	Temporal changes in fishery
Changes in gear type or manner of deployment	X	Temporal changes in fishery
Standardised CPUE	X	Active targeting required
Catch, CPUE by size indicators (per Froese)	X	Selectivity unknown; multiple fleet selecitvities; active targeting required; temporal changes in fishery
Changes in mean length/weight or length/weight percentiles	X	Multiple fleet selecitvities
Linear regression to recent time series of CPUE	X	Active targeting required; temporal changes in fishery
Depletion analysis	X	Active targeting required
Size relative to size at maturity	X	Multiple fleet selectivities
Ratio of density inside:outside MPAs (per Babcack and MacCall; McGilliard et al.)	Expert judgement	Requires mature MPA, well enforced, similar habitat.
Use of biomass surveys to inform spatial management	X	Multiple fleet selectivities
Size-specific catch rate indicators for fish sampled inside and outside of MPAs, and per-recuit (per Wilson)	X	Requires mature MPA, well enforced, similar habitat.
CUSUM Control Charts	X	Multiple fleet selectivities; active targeting required
Traffic lights	X	Multiple fleet selectivities
RAPFISH (Multi-dimensional scaling)	Expert judgement	Multiple fleet selectivities
Hierachical decision trees	X	Multiple fleet selectivities
Size-based sequential trigger system	X	Multiple fleet selectivities
Sequential effort triggers	X	
Sequential catch triggers	X	
Sequential trigger framework involving catch and/or effort, CPUE, size, sex ratio etc.	X	Multiple fleet selectivities (IF USING SIZE DATA); active targeting required
Catch curves	X	Multiple fleet selectivities; equilibrium dynamics assumed; highly migratory (fishery does not embrace spatial extent of stock)
Estimate lifetime egg production per O'Farrell & Botsford	X	Multiple fleet selectivities; equilibrium dynamics assumed
SAFE (Zhou)	X	Highly migratory (fishery does not embrace spatial extent of stock)
Zhou's catch-only method (estimates MSY)	X	Active targeting required; highly migratory (fishery does not embrace spatial extent of stock)
ORCS (Only Reliable Catch Series)	X	Active targeting required; highly migratory (fishery does not embrace spatial extent of stock); requires a broad categorical classification of stock abundance; requires a perceived level of stock "risk".
DCAC (MacCall)	Expert judgement	Active targeting required; highly migratory (fishery does not embrace spatial extent of stock); requires some concept of B0; can be indirect via back-extrapolation of catch series; requires depletion estimate (can be crude)
DB-SRA	X	Multiple fleet selectivities; active targeting required; highly migratory (fishery does not embrace spatial extent of stock); requires an estimate of depletion (may be crude)
Length-based SPR assessment (Prince and Hordyk)	X	Multiple fleet selectvities; highly migratory (fishery does not embrace spatial extent of stock)
Production model	X	Multiple fleet selectivities; active targeting required; highly migratory (fishery does not embrace spatial extent of stock)
Stock synthesis using only a time series of catch SS-CO (Cope 2013)	X	Selectivity unknown; multiple fleet selectivities; active targeting required; highly migratory (fishery does not embrace spatial extent of stock); Requires some concept of B0; can be indirect via back-extrapolation of catch series; Requires depletion estimate (can be crude)
Stochastic SRA (User Guide Lombardi and Walters)	X	Selectivity unknown; multiple fleet selectivities; active targeting required; highly migratory (fishery does not embrace spatial extent of stock); Requires depletion estimate (can be crude)
Catch-MSY (Martel and Froese 2013)	X	Selectivity unknown; multiple fleet selectivities; active targeting required; highly migratory (fishery does not embrace spatial extent of stock); requires possible ranges of relative stock sizes in the first and final years of the time series
Feasible stock trajectories (Bentley and Langley 2012; Can J.)	Recruitment deviations	Selectivity unknown; multiple fleet selectivities; active targeting required; requires some estimate of virgin recruitment
Mortality estimates from length data in nonequilibrium situations (Gedamke and Hoenig 2006) -see	X	Selectivity unknown; multiple fleet selectivities; active targeting required; highly migratory (fishery does not embrace spatial extent of stock);
Escapement: Samples of catch; ensure 30% have spawned (per squid fishery in California)	X	

Assessment:
FishPath example: Rougheye Rockfish

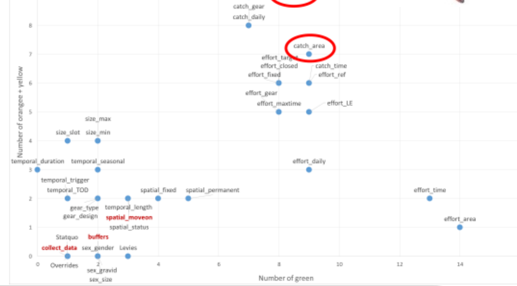
- Few identified options
- Main limiters
  - Level of expert judgement
  - Multiple fleets with differing selectivities
  - Species not actively targeted
  - Temporal and operational changes in fishery
  - Fishery does not embrace spatial extent of the stock
  - (BUT most of these are specific to fishery-dependent data – independent surveys, if regular and representative, could overcome these and open up options) (though stock structure issue difficult to overcome)
- Multiple indicator trigger systems
- ?? SPR?
- Close-kin mark-recapture (at least to help resolve stock structure)
  - (not yet in FishPath)



Decision Rule Types

- Any form of decision rule can be applied to the outcome of any assessment
  - Often these are conceptually bolted together: e.g. a "management procedure" that provides a TAC adjustment directly from an assessment outcome
- Decision rules, can and often SHOULD be applied in combination.
- Need to consider DURATION of the measure and timeframe for review
  - research capacity and willingness of community to tolerate flexible management will be important here

FishPath: Rougheye Rockfish



			1 Catch limits		5 Spatial restrictions (can be invoked or modified by HCRs)	9 Invoke data collection	10 Apply additional (precautionary) buffers/adjustments to chosen measure
			according to assessment outcomes (feedback): ii) target based with F- or biomass-based reference point	Catch restrictions by area (whether informed by formal assessment or not)	move-on provisions	This does not confer the necessity to immediately analyse the collected data. Data may be archived against a time when required and/or the GVP/capability exists to analyse it.	These measures can be applied to the existing control rules AND/OR applied as a separate measure
Biology/life history	Largely sedentary/sessile?	yes		YES	YES		
	"Periodic strategist" species? (slow-growing, long-lived, steady state population, but with variable recruitment)	yes			YES		
	Spawning seasons?	yes	Consider augmenting with spatial-temporal measures	Consider augmenting with temporal measures			
	Is species susceptible to barotrauma, and/or has low survivorship on release?	yes	Caution re: discarding when limit exceeded	Caution re: discarding when limit exceeded			
	High level of uncertainty?	yes	Caution re: interpretation and use of data	Caution re: interpretation and use of data			YES
	No immediate concerns re: stock status	yes				YES - to build more defensible estimate of stock status and to avoid complacency	
	Previous linear regression on CPUE time series	yes	YES				
Operational	Multiple fleets?	yes	NO - difficult to reconcile catch quotas across the fleets without allocation disputes, while aiming for sustainable management	NO - difficult to reconcile catch quotas across the fleets without allocation disputes, while aiming for sustainable management			
	Multispecies fishery?	yes	Non-catch quota may be easier; unless by key/high-risk or aggregate of species	Non-catch quota may be easier; unless by key/high-risk or aggregate of species	YES		
	Latent effort?	yes	NO - effectiveness may be compromised by activation of latent effort	NO unless this is a secondary control rule - effectiveness may be compromised by activation of latent effort	Does not directly address latent effort - augment		YES
	Effort creep likely?	yes			Does not directly address latent effort - augment		
	Spatial concentrations of effort?	yes	Consider impact of fishing in concentrated area	YES			
	Seasonal concentrations of effort?	yes	Consider impact of fishing in concentrated area				
	Additional species/habitat threatened by gear?	yes	Consider augmenting with controls that account for threatened/highly vulnerable species/habitat, and/or downweighting catch accordingly	Consider augmenting with controls that account for threatened/highly vulnerable species/habitat, and/or downweighting catch accordingly			
Socio-economic	Subsistence-recreational-Artisinal (subsistance and local markets only)-Artisinal (commerical)	commercial	YES	YES			
	Level of fisher cooperation (includes cultural preferences)	high	YES	YES			
	Level of community cooperation	high	YES	YES			
Governance	Open access - limited entry	ITQ fishery	YES	YES			
	Enforcement capability	high	YES	YES			
	Strength of governance	high	YES	YES			
	Research capacity	high	YES	YES			

[redacted] these details w[redacted]

[redacted]ons (ma[redacted]

[redacted]olour)

[redacted]

discussion

[redacted]ves efficiency

[redacted]sible basis for d[redacted]

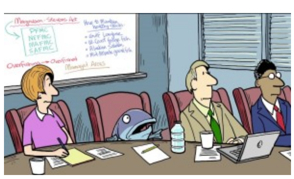
Cautions re: scoring

- Colour designations intended to be helpful guidance, but no broad-brush summary can replace careful consideration of each caveat and expert discussion in this context
  - Zero scores are not a "bad" thing.
  - TOTAL NUMBER ORANGE = caution for option under certain circumstances as detailed
  - TOTAL NUMBER GREEN = option particular recommended given caveat
- Weigh # greens against # oranges - and ito WHY oranges are triggered and whether these can be readily overcome (or will be overcome in the future)
- **Tool is intended to EMPOWER decision making, NOT replace it**

Recommendations

- Still can get a long way in a data-limited context
  - Embed assessments within a formal harvest strategy
  - Use a tool such as FishPath as a defensible process via which to justify harvest strategy choice
  - Tier systems of precautionary buffers to directly acknowledge uncertainty
  - Ensure harvest strategy is adaptive (aim to move up the Tiers to the extent possible
    - Commit to "data banking"
  - Formally evaluate harvest strategy (MSE)

Bottom line



- Big space between doing nothing and "gold standard" assessments, in which there are defensible assessment options
- Will these give status? Likely not.
  - But must be pragmatic given context
- Doing something is preferable to nothing
  - High risk of crashing (also = maximum precautionary buffers per risk equivalency)
  - Lost opportunity
  - "Management paralysis" – can't go from zero to hero
- Need a starting point
  - Adaptive with intent of moving up Tiers (incentive = decreasing buffers)
  - Groom capacity
  - Groom managers
  - Groom industry re: buy-in to formal management
  - Empower stakeholders

Bottom line

- FishPath is a tool for considering a comprehensive inventory of options for an informed and defensible was forward.
  - Considers not only
    - Data, life history and fishery operational characteristics
    - but also socio-economic and governance constraints
- Currently preparing Guidelines that embrace the entire management regime for data-limited, low-value fisheries
  - Ultimate aim is that this will underpin an expanded FishPath tool

Thank you

CSIRO Oceans and Atmosphere
Natalie Dowling
Senior Research Scientist

t +61 3 6232 5148
e natalie.dowling@csiro.au
w www.csiro.au/lorem

OCEANS AND ATMOSPHERE
www.csiro.au

CSIRO

Analysis and Reporting of Complex Data: What I've Learnt Post Fisheries

JAMES SCANDOL

Overview

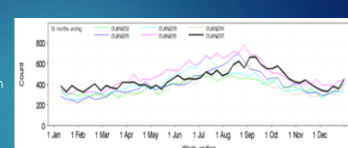
- Systems
- Jargon disclaimer
- Projects versus BAU
- People, processes and technology
- ~~Metadata~~
- ~~Open data~~
- ~~Privacy issues~~

Health Statistics NSW

- Publicly facing
- Hundreds of indicators
- Thousands of views
- ~ 50 Topics
- Updated every two weeks
- Public reporting not surveillance

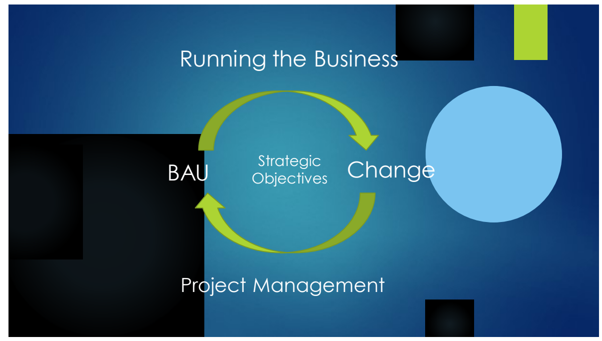
PHREDSS

- NSW emergency department and ambulance public health surveillance system
- Intranet access only (across NSW)
- Syndromic surveillance
- Time series signals
- Frequently updated reports across NSW



Total weekly counts of ED presentations for pneumonia, from January – December 2016 (black line), compared with each of the 5 previous years (coloured lines), for 59 NSW hospitals.


SAPHaRI
Population health data warehouse
Analysis-ready datasets for demography, admitted patient, emergency department, perinatal, notifiable conditions and the NSW health survey
NSW Health staff access only
Requires SAS or SQL skills to use
Secure analytics for population health research and intelligence.


Running the Business
BAU
Strategic Objectives
Change
Project Management


Project Management
Project management is the discipline of initiating, planning, executing, controlling, and closing the work of a team to achieve specific goals and meet specific success criteria
Scope
Quality
Time
Cost

SAFS as "a project"

- Include more species in SAFS
- Have fewer "undefined" stocks

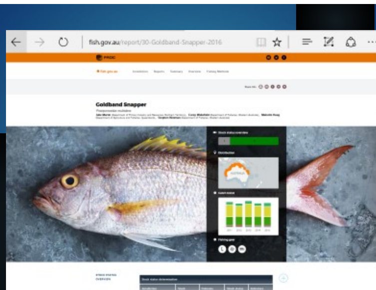
- Who is the "customer"?
- What are the requirements

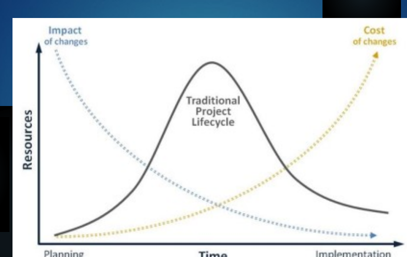
- Project sponsor
- Project governance

- Managing changes within the project

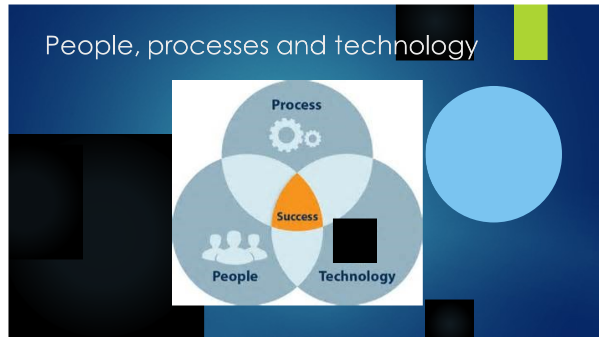
If you don't like the answer…

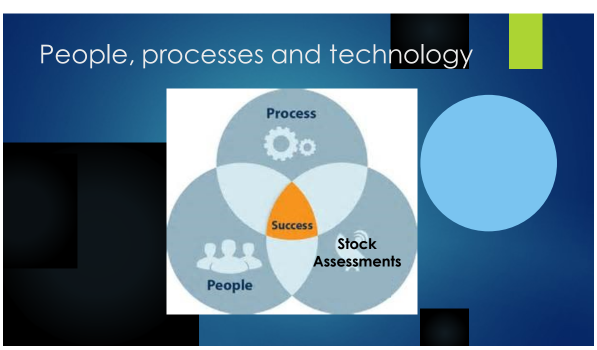
Ask a (slightly) different question.

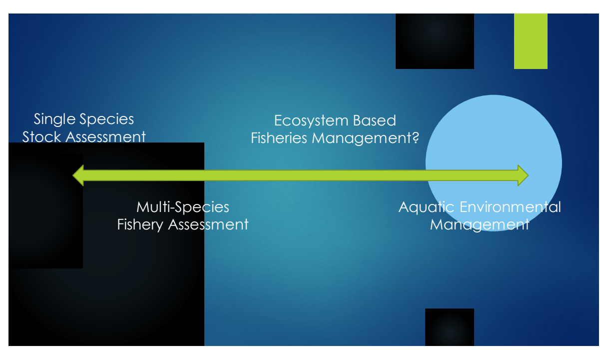


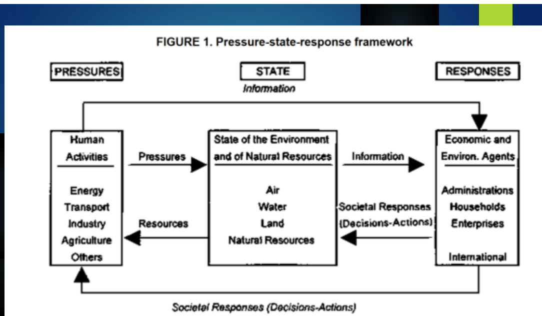



Principles of PRINCE2
Continued Business Justification
Learn from Experience
Defined Roles and Responsibilities
Manage by Stages
Manage by Exception
Focus on Products
Tailor to Suit the Project Environment
PRINCE2


People, processes and technology
Process
Success
People
Technology


People, processes and technology
Process
Success
Stock Assessments
People


Single Species
Stock Assessment
Ecosystem Based
Fisheries Management?
Multi-Species
Fishery Assessment
Aquatic Environmental
Management



Perspectives

Joe Average

Agency Manager

Joe Average - Is there a problem?

- **Yes**
  - What are you doing about it?
  - What will success look like
- **No**
  - Keep an eye on it thanks mate!
- **Dunno**
  - What are you doing to find out?
  - **OR**
  - Why shouldn't I worry that you don't know?

Agency Manager

- Confidence that approaches are defensible and reproducible (from both a qualitative and quantitative perspective)
- Documentation and peer review
- Transparency - can I, the public, another expert, understand what has been done and why
- Accountable - have the appropriate level of resources been allocated and tracked
- Support innovative ideas, but they must be able to be operationalized
- Minimise key person risk

Comments?

Metadata

Technical
- Servers
- Databases
- Tables
- Fields
- Indexes
- etc

Business
- Descriptions
- Labels
- Data dictionaries
- Common names
- Reference data
- Master data

Process
- System status
- Logfiles
- Hardware utilisation
- etc

Open Data

NSW Government Open Data Policy

- Improving government
- Empowering citizens
- Creating opportunity
- Solving problems

- Open Data Principles
  - Open by default, protected where required
  - Prioritised, discoverable and usable
  - Primary and timely
  - Well managed, trusted and authoritative
  - Free where appropriate
  - Subject to public input


Privacy issues
HealthStats
Privacy issues and the reporting of small numbers
NSW Health
Strategies for privacy
Justification of the indicator presented
System architecture designs
Consideration of high-risk attributes
Table design
Statistical smoothing
Privacy assurance processes
Responsiveness to privacy concerns

A B2B Risk Assessment Tool for Sourcing Seafood in Australia and New Zealand

FRDC National Priority 1 and New Zealand Open Seas

Sevaly Sen
Coordinator, FRDC National Priority 1
Workshop on Assessment Methods for Undefined Species
7-8 February 2017
Sydney

Need

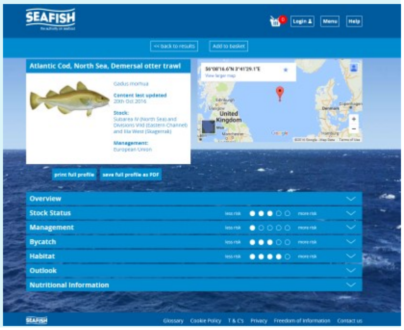
1. Increasing numbers of seafood businesses are want to/under pressure to source responsibly
2. They need data to inform their sourcing decisions
3. They do not have time/resources to research extensively
4. They want a trusted and credible source of information
5. They want to make their own decisions according to their appetite for risk

Do not want to reinvent the wheel

RASS

Seafish UK has developed an online tool

http://www.seafish.org/rass/



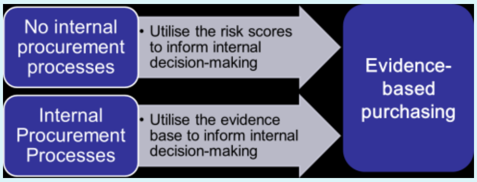
What do the UK RASS metrics measure?

Risk score for each one of four fishery 'factors'

- Stock status
- Stock management
- Bycatch
- Habitat Impact

Very Low → Low → Medium → High → Very High

RASS is used in two ways...



RASS does not tell you what to do...

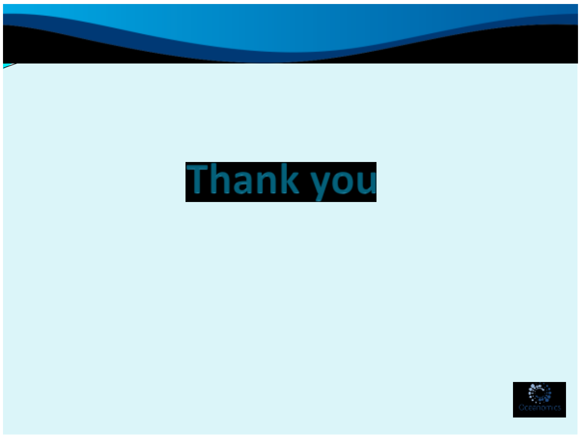
- No amalgamation of risk scores
- No instruction of “buy” / “don’t buy”
- No determination of sustainable/responsible
- It’s up to business to purchase based on their risk appetite

Risk scores are based on a risk assessment methodology

- MRAG had already developed for Coles a cost effective way of rapidly screening large numbers of non-certified source fisheries for major sustainability risks (RSS)
- Applied consistently across all fisheries (domestic and foreign)
- Modelled on the MSC Fishery Standard v2.0, but streamlined 28 PIs collapsed into 9: MSC scoring guideposts (SGs) become proxies for risk
- The Precautionary High Risk Score was introduced to the differentiate between fisheries **undefined** species (and there is no info to indicate a problem),from fisheries in which we know there’s a problem
- Intention is to use the RSS methodology will be used for Australian and New Zealand RASS (with some tweaking) as more aligned with GSSI.

Next steps

- Fine tune the methodology
- Sort out governance
- Separate bycatch risk scores (bycatch, TEPS, discards)
- 220 species assessments have already been undertaken by Coles by species/stock, gear type, management system – upload at least 20 by July 2017


Thank you