Integrating economic and social objectives in marine resource management: Australian experiences

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Overview

The evolution of fisheries objectives in Australia
MSY ⇒ MEY ⇒ MOOY?
(Multi-objective optimal yields)

So what really are the management objectives?

Evaluating management strategies with multiple objectives
- two examples
Objectives of fisheries management

1900s
- Protection of stocks key focus
  - concepts of MSY and MEY developed

1950s
- Development of surplus production and age structured models
  - MSY and MEY identifiable targets
  - Dominance of MSY
  - Some concerns about trade-offs between catch and employment

2000s
- Ecosystem based fisheries management
  - Ecologically sustainable development
  - Environmental, social and economic objectives
The era of “fuzzy” objectives

Economic

Social

Environmental

Thank you for being my friend!
So what is happening down under?

Brief overview of Australian fisheries management jurisdictions

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Pre-2007
- Focus on resource sustainability
- Consideration of economic implications

2007
- Ensure sustainable resources
- Maximise net economic returns (“MEY”)
- Minimise bycatch

2017
- Maximise net (sustainable) economic returns
- Minimise bycatch
- Consider recreational and indigenous fisheries
- Consider social implications
State high level objectives (some examples)

Queensland (2017)

- Economic target reference points ($B_{MEY}$ proxy)
- Sustainable, profitable industry
- Social “considerations”

New South Wales

- Resource sustainability
- Social and economic “considerations”
- No target reference points (just limits)
In most cases high level objectives in policy or management plans are vague (e.g. “consider”)
• Social and economic objectives are also usually poorly defined
  • What are they trying to achieve?
• Fisheries are starting to develop fishery-specific operational objectives
  • Particularly Queensland fisheries with the new fisheries reforms
  • Operational objectives linked to indicators that are measurable (and in some cases modellable)
<table>
<thead>
<tr>
<th>Broad Objectives</th>
<th>Sub-objectives (Level 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ensure ecological sustainability</td>
<td>1.1 Ensure resource biomass sustainability</td>
</tr>
<tr>
<td>1.2 Ensure ecosystem resilience</td>
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</tr>
<tr>
<td>1.3 Minimize risk of localized depletion</td>
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</tr>
<tr>
<td>2. Enhance fishery economic performance</td>
<td>2.1 Maximize commercial economic benefits, as combined totals for each of the following sectors</td>
</tr>
<tr>
<td>2.2 Maximize value of recreational fishers and charter experience</td>
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<tr>
<td>2.3 Maximize flow-on economic benefits to local communities from all sectors</td>
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</tr>
<tr>
<td>2.4 Minimize short term (inter-annual) economic risk</td>
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<tr>
<td>2.5 Minimize costs of management associated with the harvest strategy: monitoring, undertaking assessments, adjusting management controls</td>
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<tr>
<td>3. Enhance management performance</td>
<td>3.1 Maximize willingness to comply with the harvest strategy</td>
</tr>
<tr>
<td>4. Maximize social outcomes</td>
<td>4.1 Maximize equity between recreational, charter, indigenous and commercial fishing</td>
</tr>
<tr>
<td>4.2 Improve social perceptions of the fishery (social license to operate) (recreational, commercial, charter, indigenous)</td>
<td>4.2 Maximize social perceptions of the fishery (social license to operate) (recreational, commercial, charter, indigenous)</td>
</tr>
<tr>
<td>4.3 Enhance the net social value to the local community from use of the resource</td>
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**Specific Operational Objectives (Level 3)**

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<tr>
<td>1.1 Achieve $B_{MAX}$ (biomass at maximum economic yield) (~60% unfished biomass or defensible proxy)</td>
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<td>1.1.2 Minimize risk to Other Species in the fishery which are not included in 1.1.1.</td>
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<td>1.2 Minimize risk to bycatch species</td>
<td>1.2.1 Minimize risk to bycatch species</td>
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<td>1.2 Minimize discard mortality of target species (e.g. high grading)</td>
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<td>1.2 Minimize broader ecological risks</td>
<td>1.2.3 Minimize broader ecological risks</td>
</tr>
<tr>
<td>1.2 Minimize risk to protected species</td>
<td>1.2.4 Minimize risk to protected species</td>
</tr>
<tr>
<td>1.3 Minimize risk of localized depletion due to fishing</td>
<td>1.3.1 Minimize risk of localized depletion due to fishing</td>
</tr>
<tr>
<td>1.3 Minimize risk of localized depletion in response to environmental events</td>
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</tr>
<tr>
<td>2.1 Commercial fishing industry profits</td>
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</tr>
<tr>
<td>2.1 Charter sector profits</td>
<td>2.1.2 Charter sector profits</td>
</tr>
<tr>
<td>2.1 Indigenous commercial benefits</td>
<td>2.1.3 Indigenous commercial benefits</td>
</tr>
<tr>
<td>2.2 Maximize value of recreational fishers and charter experience (direct to participant)</td>
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<td>2.3 Maximize flow-on economic benefits to local communities (from all sectors)</td>
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<td>4.1 Increase equitable access to the resource</td>
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<td>4.2 Minimize adverse public perception around discard mortality (compliance with size limits, environmental sustainability, and waste)</td>
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<td>4.2 Maximize utilization of the retained catch of target species</td>
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<td>4.2 Maximize the potential for fishing to be perceived as a positive activity with benefits to the community (commercial, rec, and charter)</td>
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<td>4.3 Increase access to local seafood (all species)</td>
<td>4.3.1 Increase access to local seafood (all species)</td>
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<tr>
<td>4.3 Maximize spatial equity between regions or local communities</td>
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Two example fisheries

- **NORTHERN PRAWN FISHERY (NPF)**
  - Commonwealth managed fishery
  - Very commercially focused
    - no recreational or indigenous component
  - Remote
    - No “local” communities
  - One main operation objective
    - Maximise net economic returns
      - Discounted fishery profits over time

- **QUEENSLAND CORAL REEF FINFISH FISHERY (CRFFF)**
  - State fishery
  - Multi-species
  - Multi-sector
    - Commercial, charter, recreational
  - Local employer
    - East coast of Queensland
  - Operates within the GBRMP
    - Conservation issues!
  - Lots of operational objectives!
NPF

• Three sub-fisheries spatially and temporally separated
  • Common banana prawn
    – first season
  • Tiger prawn plus other spp
    – second season
  • Red-leg banana prawn
    – Both seasons, but geographically separated

• Established harvest strategy
• Effort controls (ITEs)

• Banana prawn
  • “depletion” fishery
  • Trigger catch rate set equating marginal revenue with marginal cost (for an average boat).

• Tiger prawn fishery
  • Multispecies bioeconomic model
    – Four species
  • Total allowable effort
    – Dynamic measure: TAE this year that is part of an optimal trajectory to maximise the NPV over time given current prices and costs
• Quota (ITQ) managed fishery
  • Coral trout (CT) (mostly live, basket of 6 species)
  • Red throat emperor (RTE) (dead)
  • Other species (OT) – basket quota of covering around 100 species
• Substantial recreational component
  • Bag limits
• Commercial charter fishery
  • Bag limits based on fisher numbers
• Operates within the Great Barrier Reef Marine Park (World Heritage Area)
Operational objectives

Weights derived using Analytic Hierarchy Process (AHP)
Two approaches

• MCDA approach
  • Derived relative impacts against each objective from expert opinion
    – Members of the fishery working party (18 people)
  • Applied weights for the individual stakeholders
  • Derived a subjective probability distribution of net benefits of each option
  • Mean outcome by stakeholder group

• Bioeconomic model
  • Model estimated outcomes
    – Spatial structure
    – Assumptions that social outcomes would be linked to catch and effort
    – Impacts based on deviations from status quo
    – Simulation over 20 years
    – TACs for each year based on maximising a weighted value function based on stakeholder group weights
Comparison MCDA and bioeconomic model

- Less variability in model estimated impacts
  - Deterministic links based on model assumptions
  - No uncertainty
  - Different outcomes reflect different objective weightings
- Variation in MCDA impacts may reflect
  - Potential subjective bias
  - Different experiences
  - Different cognitive models
## MCDA results

<table>
<thead>
<tr>
<th>Stakeholder Group</th>
<th>Charter</th>
<th>Environmental Overrides</th>
<th>Spatially Explicit Control Rules and Environmental Overrides</th>
<th>Split OS Quota</th>
<th>Split CT Quota</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial fisher</td>
<td>0.06</td>
<td>-0.13</td>
<td>-0.06</td>
<td>0.28</td>
<td>-0.28</td>
</tr>
<tr>
<td>Charter boat operator</td>
<td>0.09</td>
<td>-0.02</td>
<td>0.07</td>
<td>0.37</td>
<td>-0.23</td>
</tr>
<tr>
<td>Recreational fisher</td>
<td>0.09</td>
<td>-0.07</td>
<td>0.02</td>
<td>0.34</td>
<td>-0.26</td>
</tr>
<tr>
<td>Quota owner</td>
<td>0.06</td>
<td>-0.15</td>
<td>-0.07</td>
<td>0.28</td>
<td>-0.29</td>
</tr>
<tr>
<td>Processor/w wholesaler</td>
<td>0.09</td>
<td>-0.02</td>
<td>0.04</td>
<td>0.38</td>
<td>-0.24</td>
</tr>
<tr>
<td>Fishery manager</td>
<td>0.10</td>
<td>0.03</td>
<td>0.08</td>
<td>0.49</td>
<td>-0.23</td>
</tr>
<tr>
<td>Scientific advice</td>
<td>0.11</td>
<td>0.02</td>
<td>0.09</td>
<td>0.46</td>
<td>-0.22</td>
</tr>
<tr>
<td>Other</td>
<td>0.10</td>
<td>0.00</td>
<td>0.08</td>
<td>0.40</td>
<td>-0.24</td>
</tr>
</tbody>
</table>
But what about the targets?

- MCDA and simulation models with a weighted value function aim to develop estimates of relative utility based on stakeholder preferences
  - Useful for comparing outcomes from different management strategies
- But most management strategies rely on harvest control rules linked to target reference points that do not reflect all objectives

- Many ecosystem services have a non-market value that can be estimated
  - Values can be developed for individual species
- Including these estimates allow a “better” estimation of the target reference points
How do these change the TRP?

- Example: Impact of including monetary cost of bycatch on target effort levels
  - Higher costs shift target from MEY to MEY*
- Other objectives may shift the optimal the other way
  - E.g. local community benefits
- Not all objectives will result in a different target
  - E.g. social acceptance, equity
Some observations

• Simple economic and resource sustainability objectives relatively easy to incorporate into a bioeconomic model
  • MEY captures both objectives
• Fisheries often have many other objectives!
• Bringing social objectives into models requires assumptions about how social impacts change with fishing activities
  • Not very well understood
• Management changes also can affect fisher behaviour, and these are also difficult to capture in a model

• Use of MCDA and expert opinion introduces additional uncertainty through different subjective cognitive models and biases
• However, these cognitive models may better reflect the combination of drivers of behaviour and outcomes in the fishery
• Differences in opinion may be considered as uncertainty, and probabilistic outcomes determined
Conclusions

• Ultimately, we would like to move more towards comprehensive models that capture social and economic outcomes
  • But still have a way to go, particularly in estimated changes on social outcomes
• MCDA approaches are not perfect, but offer a pragmatic approach to assess management options from a multi-objective perspective
• Potential for use of non-market valuation in defining “better” target reference points
Thank you

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