# Integrating economic and social objectives in marine resource management: Australian experiences
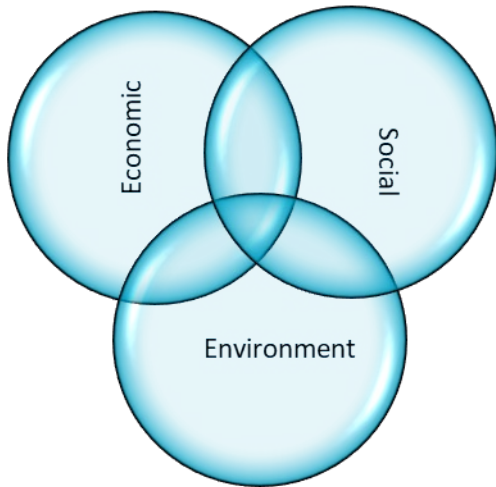
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Australia's National Science Agency

# Overview



The evolution of fisheries objectives in Australia
   MSY $\Rightarrow$ MEY $\Rightarrow$ 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
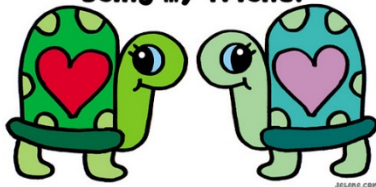
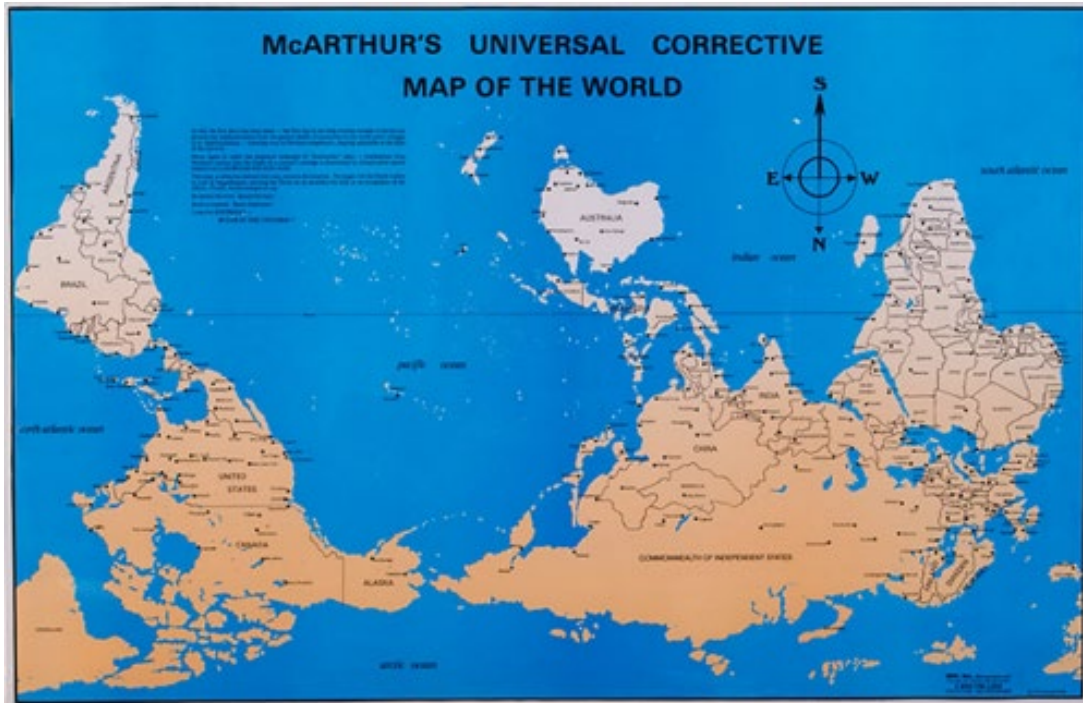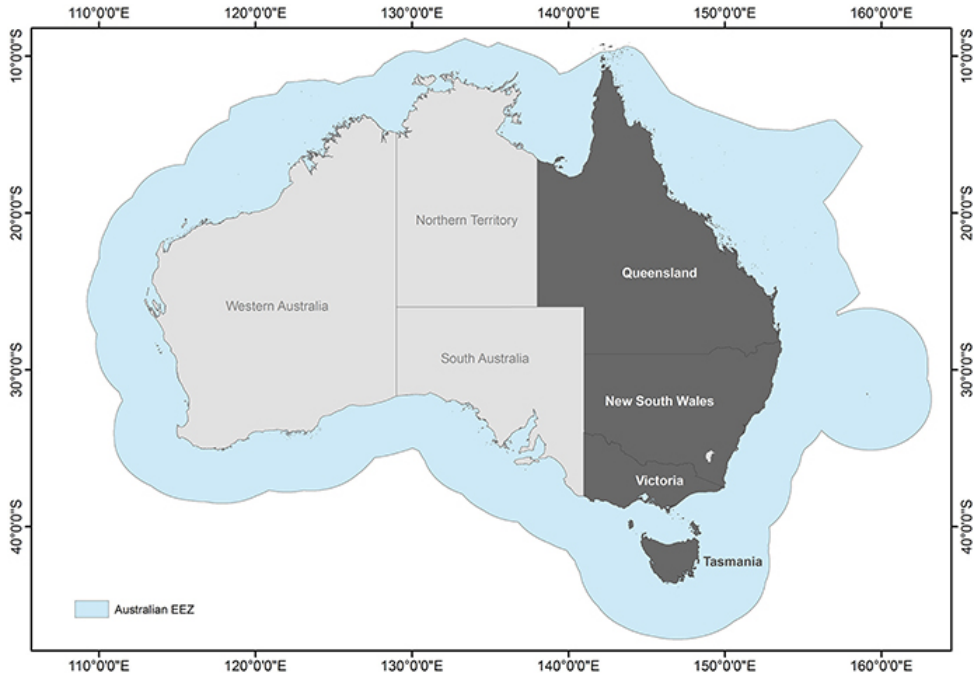# The era of "fuzzy" objectives

Economic

Environmental

Social

# So what is happening down under?

# Brief overview of Australian fisheries management jurisdictions

# Commonwealth fisheries management objectives

**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
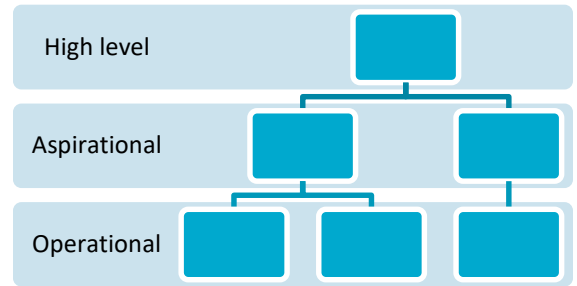- Social "considerations"

## New South Wales

- Resource sustainability
- Social and economic "considerations"
- No target reference points (just limits)

# High level versus operational objectives



High level

Aspirational

Operational

- 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)

# Operational objectives for Queensland CRFFF

| Broad Objectives | Sub-objectives (Level 2) | Specific Operational Objectives (Level 3) |
|---|---|---|
| **1. Ensure ecological sustainability** | 1.1 Ensure resource biomass sustainability | 1.1.1 Achieve $B_{MEY}$ (biomass at maximum economic yield) (~60% unfished biomass or defensible proxy) |
| | | 1.1.2 Minimize risk to Other Species in the fishery which are not included in 1.1.1. |
| | 1.2 Ensure ecosystem resilience | 1.2.1 Minimize risk to bycatch species |
| | | 1.2.2 Minimize discard mortality of target species (e.g. high grading) |
| | | 1.2.3 Minimize broader ecological risks |
| | | 1.2.4 Minimize risk to protected species |
| | 1.3 Minimize risk of localized depletion | 1.3.1 Minimize risk of localized depletion due to fishing |
| | | 1.3.2. Minimize risk of localized depletion in response to environmental events |
| **2. Enhance fishery economic performance** | 2.1 Maximize commercial economic benefits, as combined totals for each of the following sectors | 2.1.1 Commercial fishing industry profits |
| | | 2.1.2 Charter sector profits |
| | | 2.1.3 Indigenous commercial benefits |
| | 2.2 Maximize value of recreational fishers and charter experience (direct to participant) | 2.2 Maximize value of recreational fishers and charter experience |
| | 2.3 Maximize flow-on economic benefits to local communities (from all sectors) | 2.3 Maximize flow-on economic benefits to local communities |
| | 2.4 Minimize short term (inter-annual) economic risk | 2.4 Minimize short term (inter-annual) economic risk |
| | 2.5 Minimize costs of management associated with the harvest strategy: monitoring, undertaking assessments, adjusting management controls | 2.5 Minimize costs of management associated with the harvest strategy: monitoring, undertaking assessments, adjusting management controls |
| **3. Enhance management performance** | 3.1 Maximize willingness to comply with the harvest strategy | 3.1 Maximize willingness to comply with the harvest strategy |
| **4. Maximize social outcomes** | 4.1 Maximize equity between recreational, charter, indigenous and commercial fishing | 4.1 Increase equitable access to the resource |
| | 4.2 Improve social perceptions of the fishery (social license to operate) (recreational, commercial, charter, indigenous) | 4.2.1 Minimize adverse public perception around discard mortality (compliance with size limits, environmental sustainability, and waste) |
| | | 4.2.2 Maximize utilization of the retained catch of target species |
| | | 4.2.3 Maximize the potential for fishing to be perceived as a positive activity with benefits to the community (commercial, rec, and charter) |
| | 4.3 Enhance the net social value to the local community from use of the resource | 4.3.1 Increase access to local seafood (all species) |
| | | 4.3.2 Maximize spatial equity between regions or local communities |

# 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

# Example model output
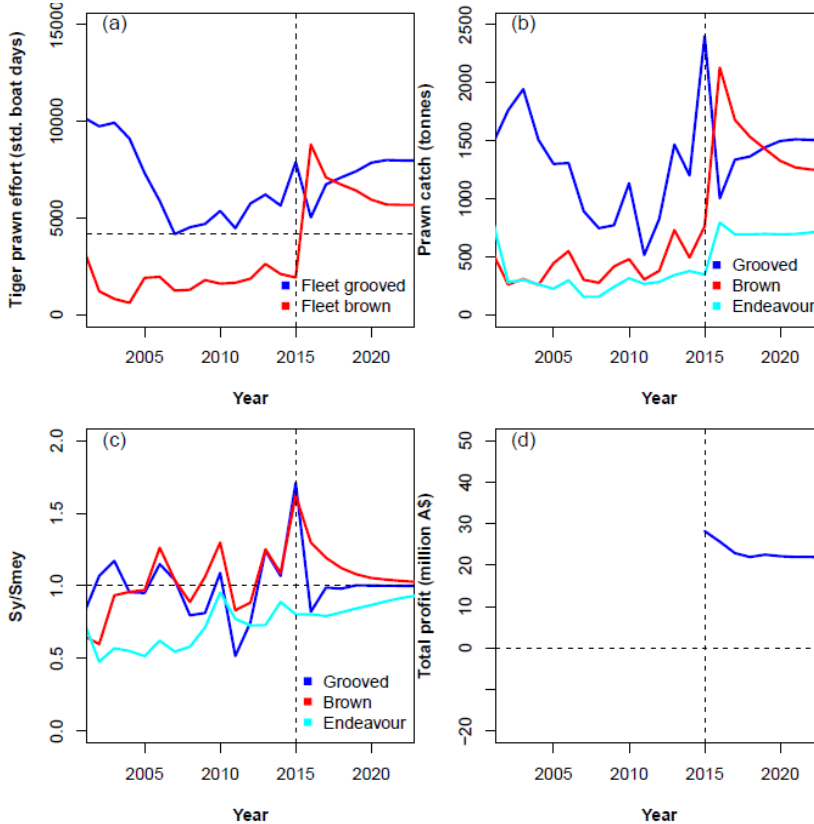


Hutton, T., Deng, R. A., Plagányi, É., Pascoe, S., Miller, M., Upston, J., Punt, A., Moeseneder, C., Kompas, T., Sterling, D., & Lawrence, E. (2018). Northern Prawn Fishery Assessments 2015-18 *Report No. 2015/0811*. Canberra: Australian Fisheries Management Authority.

# CRFFF



Area of the L2 and L3 Line Fishery Symbol

- 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)
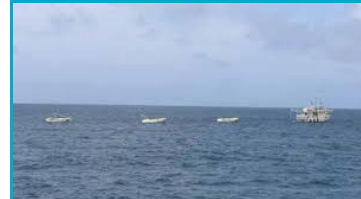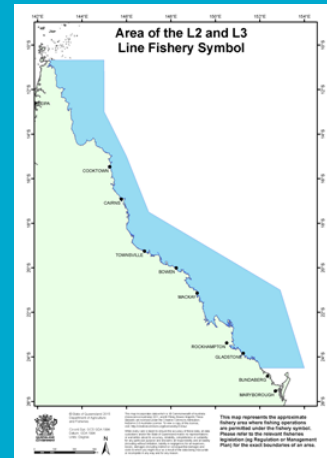
# Operational objectives

Weights
derived
using
Analytic
Hierarchy
Process
(AHP)
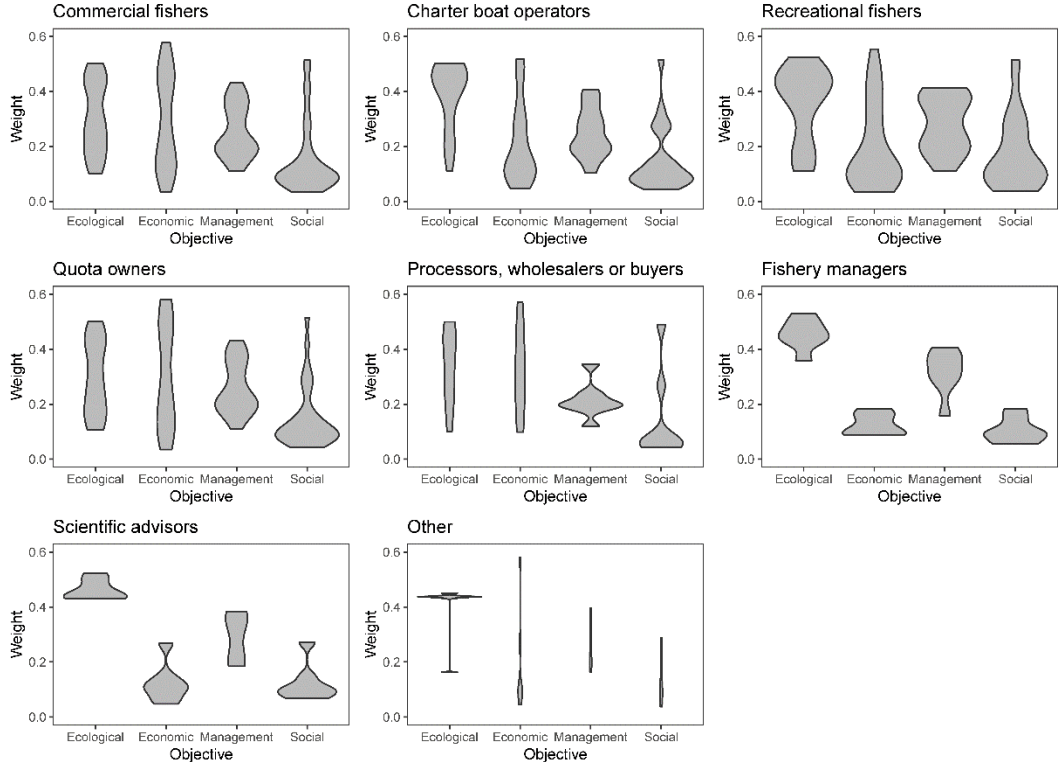
# Two approaches

- 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



Charter fishery option
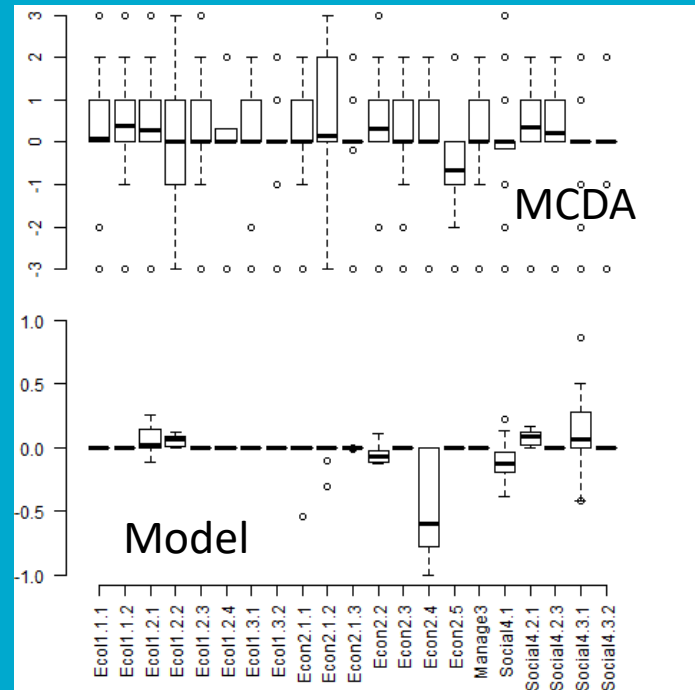
# MCDA results

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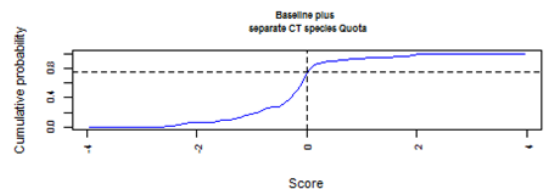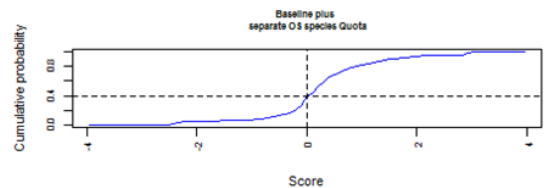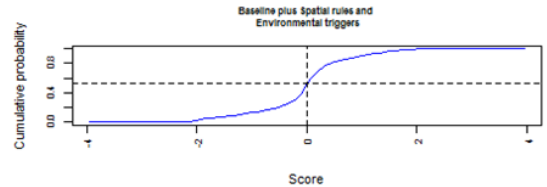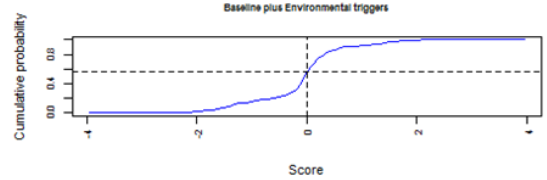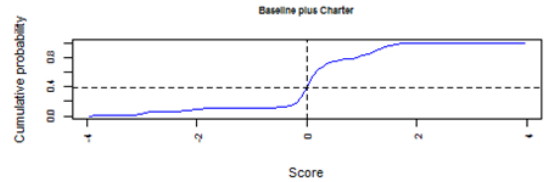
# But what about the targets?

- 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



By HikingArtist.com

- 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
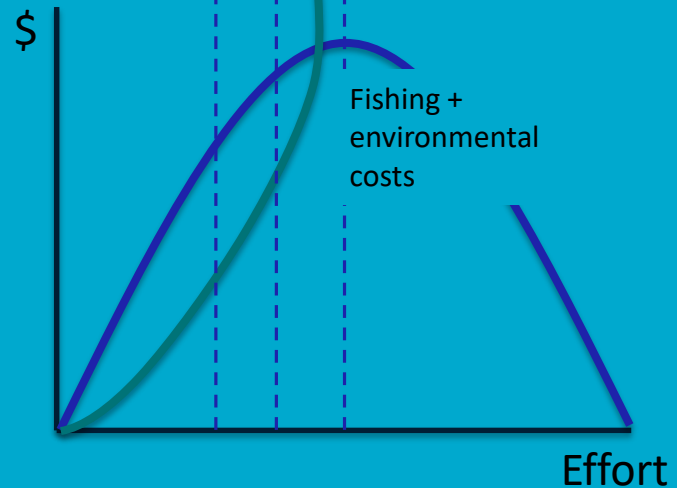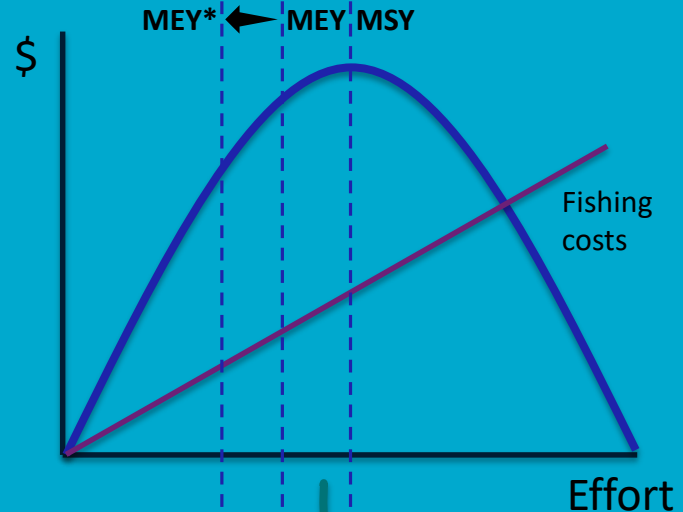
# Some observations

- 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

Social

Economic

Resource and environment
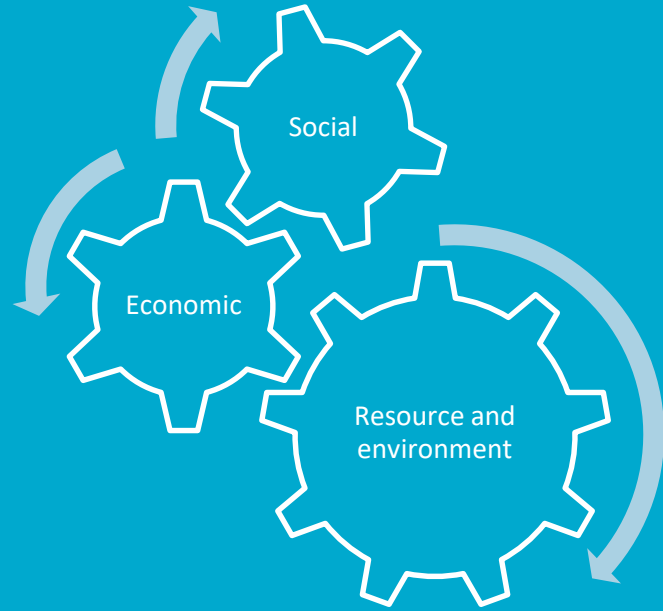
# Thank you

**Oceans and Atmosphere**
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