



# MARINE BIODIVERSITY RESEARCH

Prediction and Management of  
Australia's Marine Biodiversity



How can incentives be used in managing biodiversity?

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# The roadmap

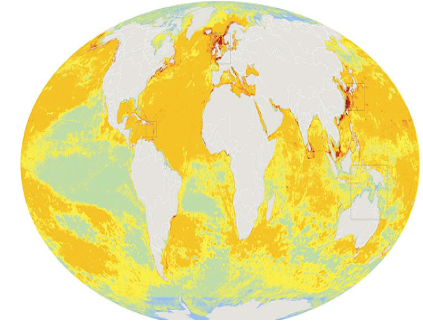
- I. A bit on the biodiversity problem
- II. Background on Incentives and market-based instruments
- III. Incentives in two contexts
  - a) Making policy more cost-effective
  - b) Addressing uncertainties around significance and impact



# How big is the biodiversity problem?

## Ubiquitous footprint

- At all scales – global, national, regional



From Halpern et al. 2009

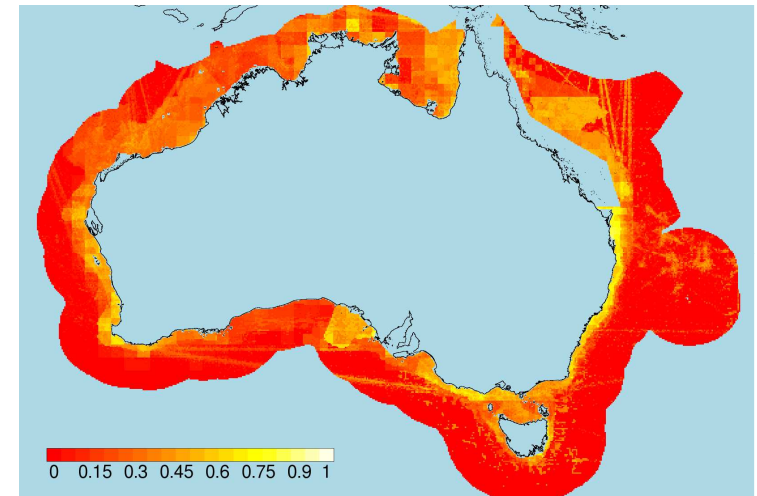
## Major impacts

- Commercial and recreational fishing – target and bycatch species, habitats and ecosystem structure
- Oil and gas production
- Ongoing habitat loss in many areas mangroves, seagrass, beaches

West Atlas rig spills oil  
(AAP Image: PTTEP  
Australasia, supplied)



Normalized density of threats in Australia.  
CSIRO WfO-DEWHA mapping project





## How are we tackling the problem?

- Threat abatement plans – marine debris, fisheries bycatch, invasive species
- Strategic assessments of fisheries
- Recovery plans for threatened species – seabirds, sharks, marine mammals, finfish, turtles and dugongs
- MPAs and Marine bioregional planning



## Are we succeeding?

- Unprecedented declines in last 50
  - 2005 Millennium Ecosystem Assessment
- Consistent decline in abundance of 40% across taxa
  - Living planet index, 1970 to 2000
- A recent review in the US is troubling
  - Only 1% of threatened species recover (13 of 1000)
  - Worryingly multispecies plans appear less successful
  - Habitat protection also doesn't appear to correlate with better management
- Impacts are likely to increase
  - A review of threatened fish across 186 nations found increasing development is correlated with biodiversity loss (Clausen and York 2007)
  - No evidence for an environmental Kuznets curve



## Unpacking failure...

Are we failing? What would happen without management?

Many Issues – resourcing, political support, etc

There are fundamental structural issues

- 1) Limitations conflict with economic goals
- 2) Challenges of managing unrelated sectors
- 3) Information is expensive
- 4) Enforcement is by nature after the fact
- 5) No motivation to move to best practices

Could incentives resolve these structural issues?



# What are market based instruments?

An alternative to direct regulation of environmental impacts

View impacts as externalities in production

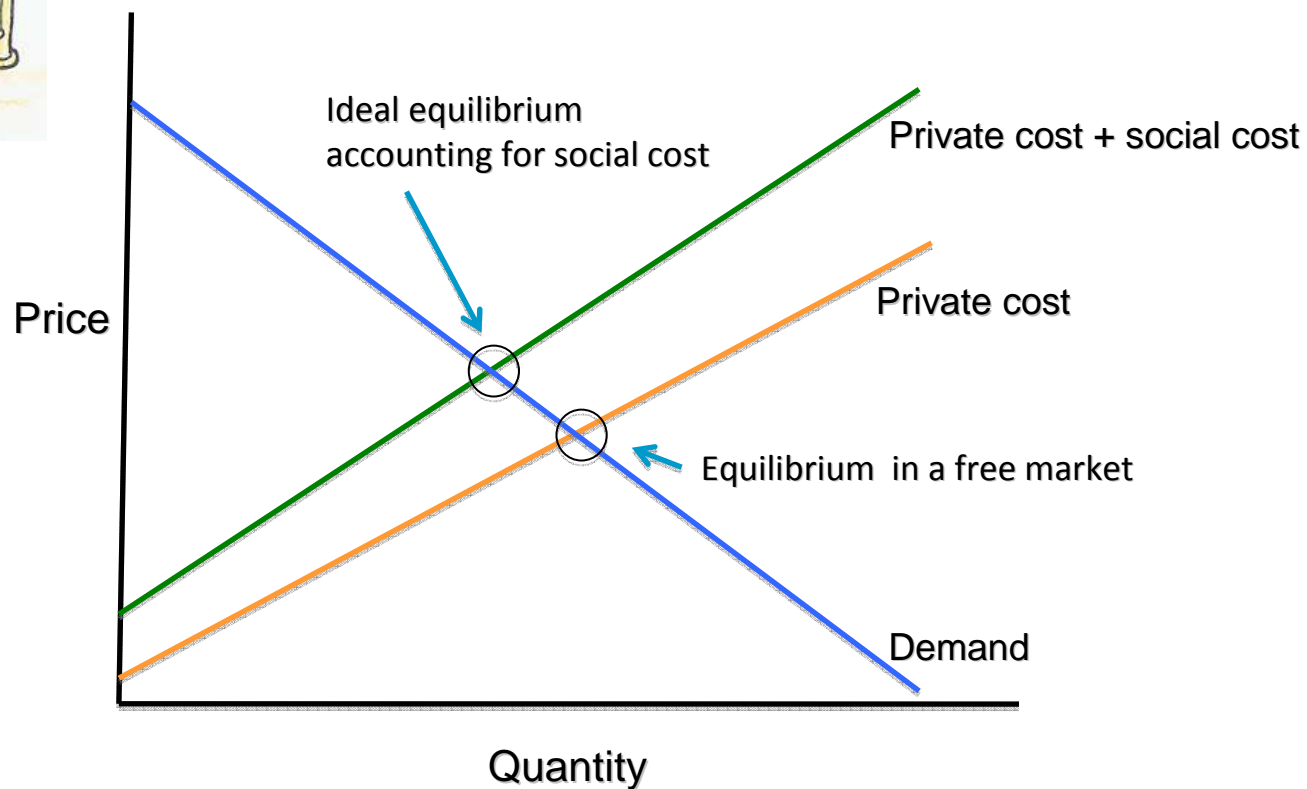
- Environmental damage producers don't pay for

Goal: incorporate damage into the cost of production





## A quick primer on externalities – air pollution







# Examples of market-based instruments

## Taxes

- A fee on the production that raises the cost directly
- Taxes on fisheries bycatch

## Environmental bonds

- A fee imposed if social costs are high
- Oil and Gas platform decommissioning



## Cap and trade systems

- A fixed and tradable total amount, scarcity drives cost
- Fisheries quota systems

## Offsets

- An “in kind” fee, i.e. compensation with a equivalent environmental asset
- Land development offsets

## Payment for ecosystem services

- A positive incentive, reducing the social cost to zero
- DEWHA Bush tender



# Market based instruments in practice

Not widely used in spatial planning – but lots of government experience

- Strategic assessments are in this vein, outcome focus and market limitation
- Tassie forest agreements were one of the early applications

Terrestrial experience in DEWHA and states

- Reverse auctions for buying land management practices
- Environmental bonding for restoration after land development
- Offsets and Cap and trade systems for habitat disturbance

Extensive history in fisheries

- Cap and trade systems for commercially harvested species
- Export certification of fisheries

Used in MPA management

- Bonds for tourism operators to prevent reef damage

Petroleum and Mining Regulations

- Bonds for decommissioning and mine reclamation are common



# Why consider incentives?

## Some advantages over direct regulation

1. Creates incentives at the level of unsustainable actions
2. Driving business to innovate, reducing impacts
3. Efficient outcomes – more social benefits per resource
4. Move information (cost) burden to private parties
5. Focus on outcomes, in line with EPBC



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## Incentives I: reducing the cost of conservation action

EPBC act requires the Department to take action in some cases

- Species recovery plans
- Threat abatement plans

However, there are some issues:

- planning costs money
- conservation actions cost even more money
- frequently underlying knowledge is poor
  - impacts unknown
  - status uncertain
  - effect of management alternatives unclear

In this context both SEWPC and AFMA invest

- Monitoring fisheries performance
- Developing procedures for threat reduction



## An example from Threat Abatement Plans

### Incidental Catch of Seabirds During Commercial Longline Fishing

#### Goals

- Aspirational: no bycatch
- Practical: catch rate  $<0.05$  birds/1000 hooks

#### Management measures

- Procedural requirements: weighted line, streamers
- Outcome requirements: threshold for catch levels

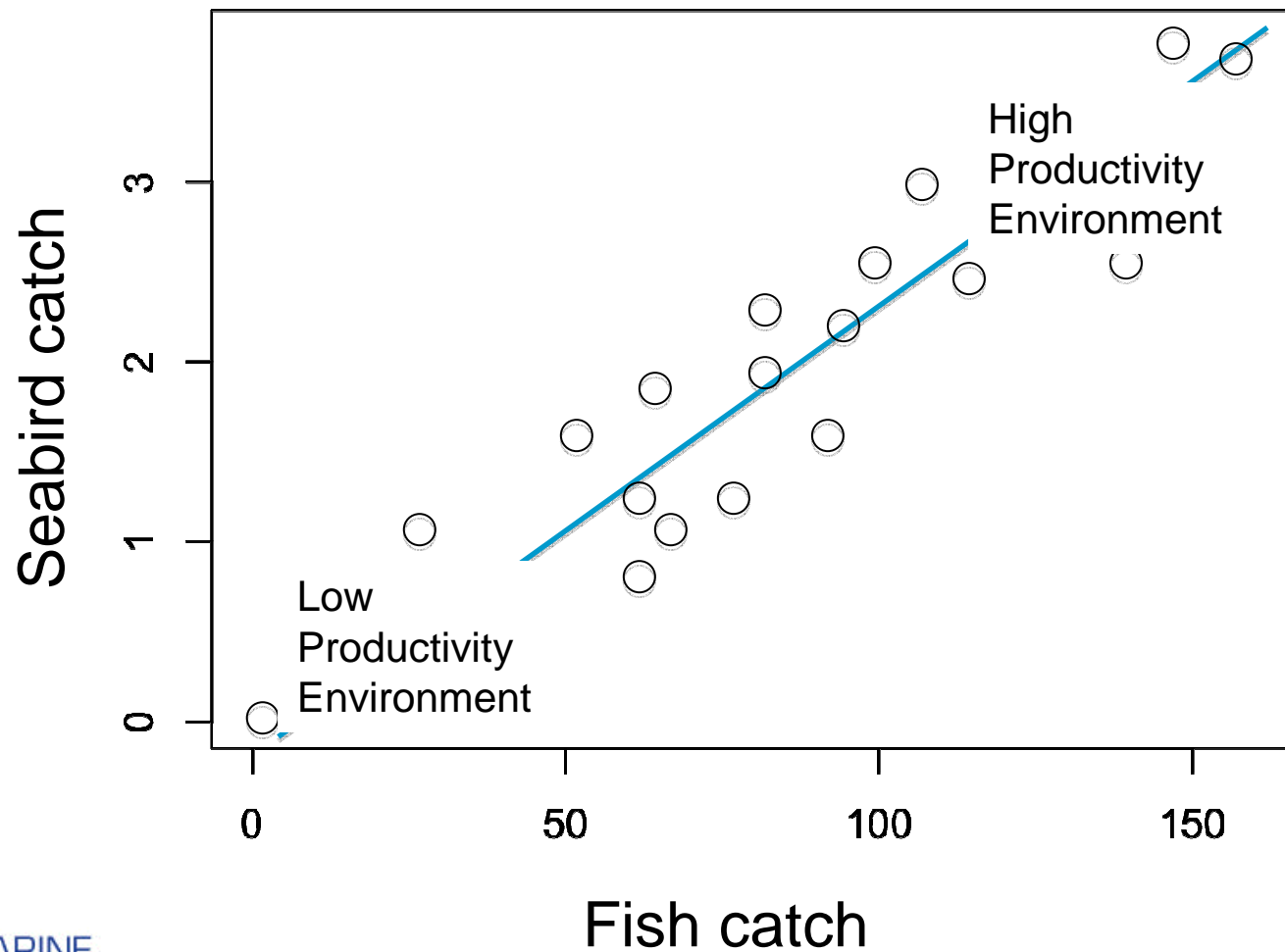
#### Enforcement sanction

- Closure of areas to fishing



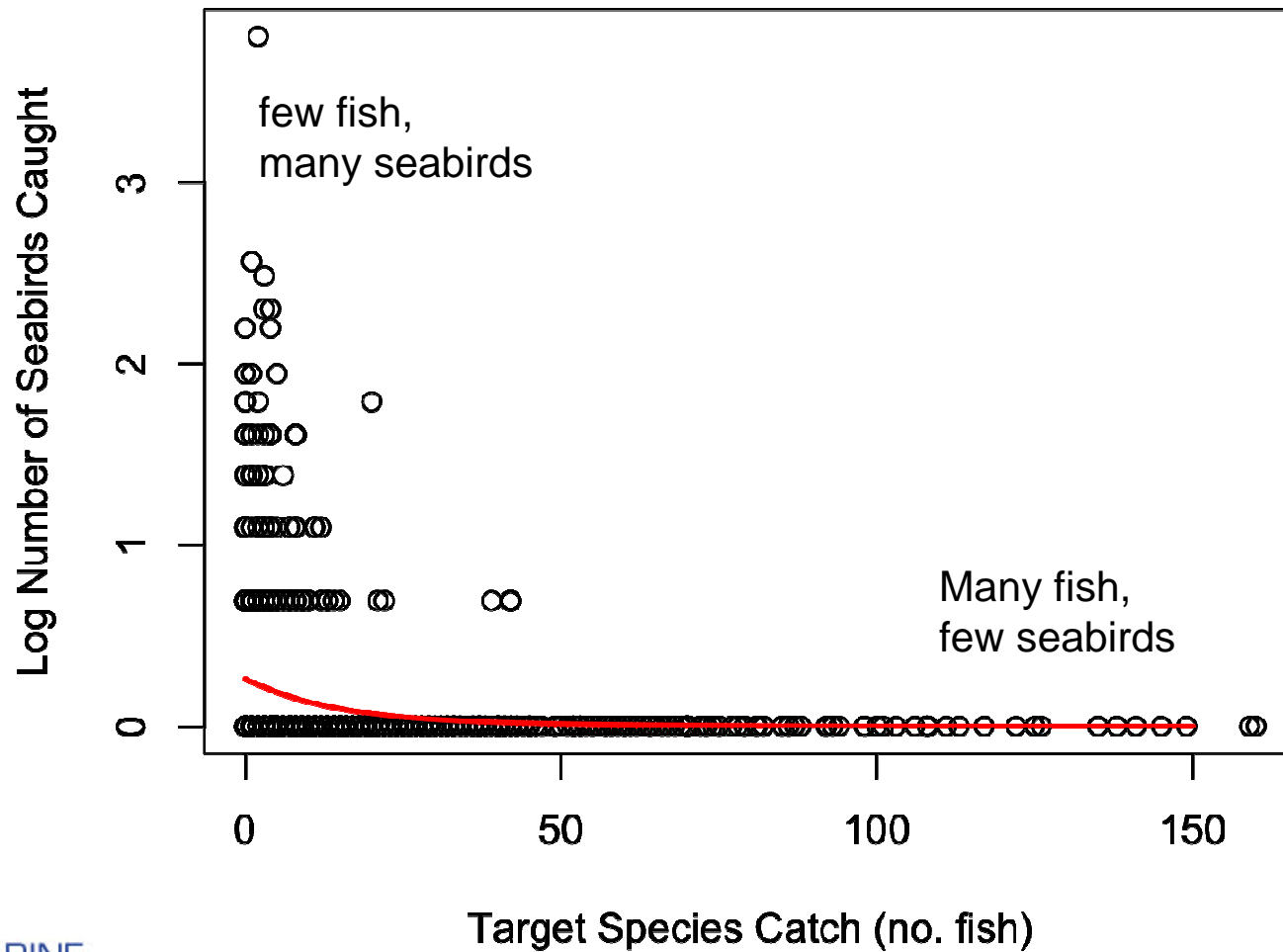


## Are landings and environmental impact related?



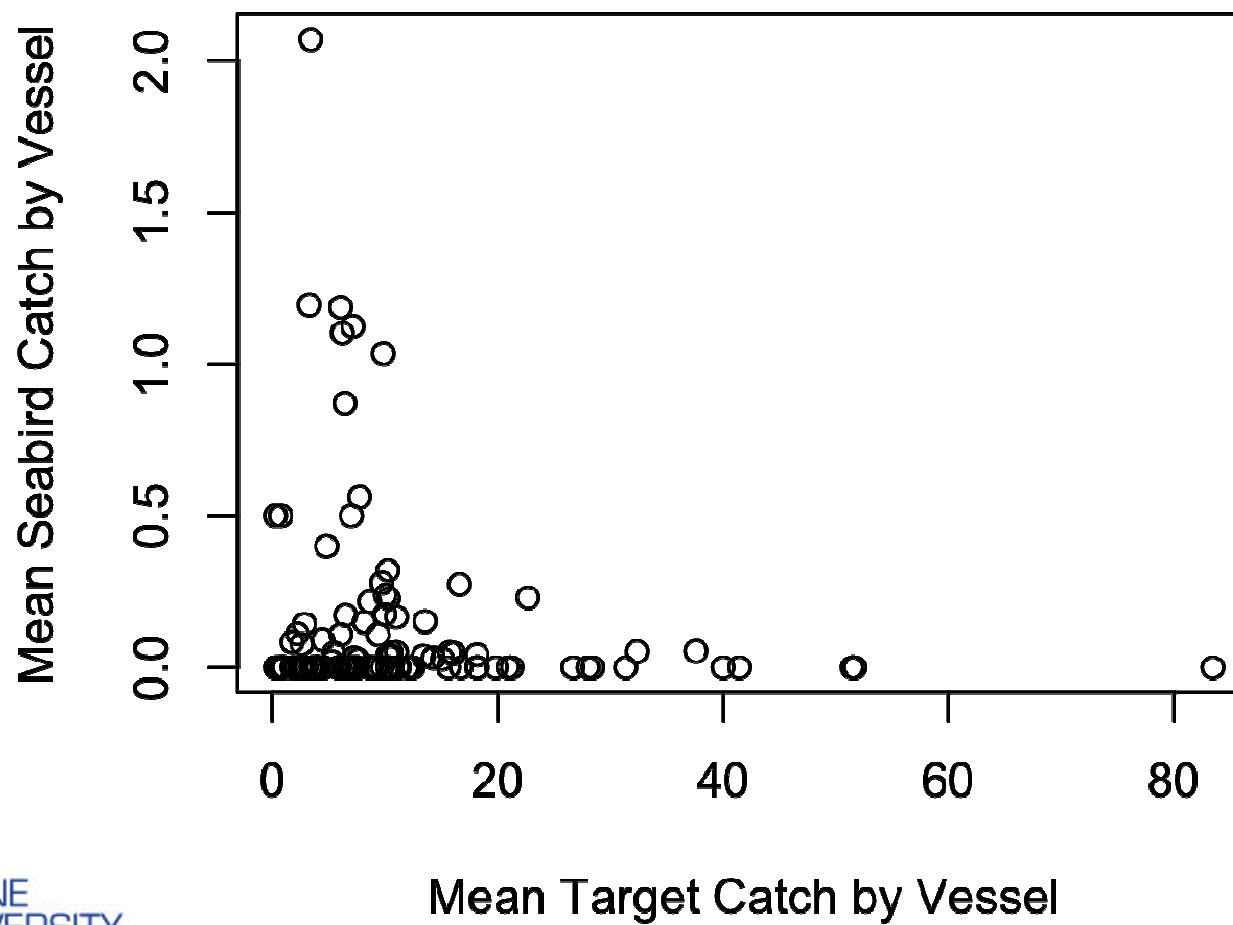


## The data says no, clean fishing is possible





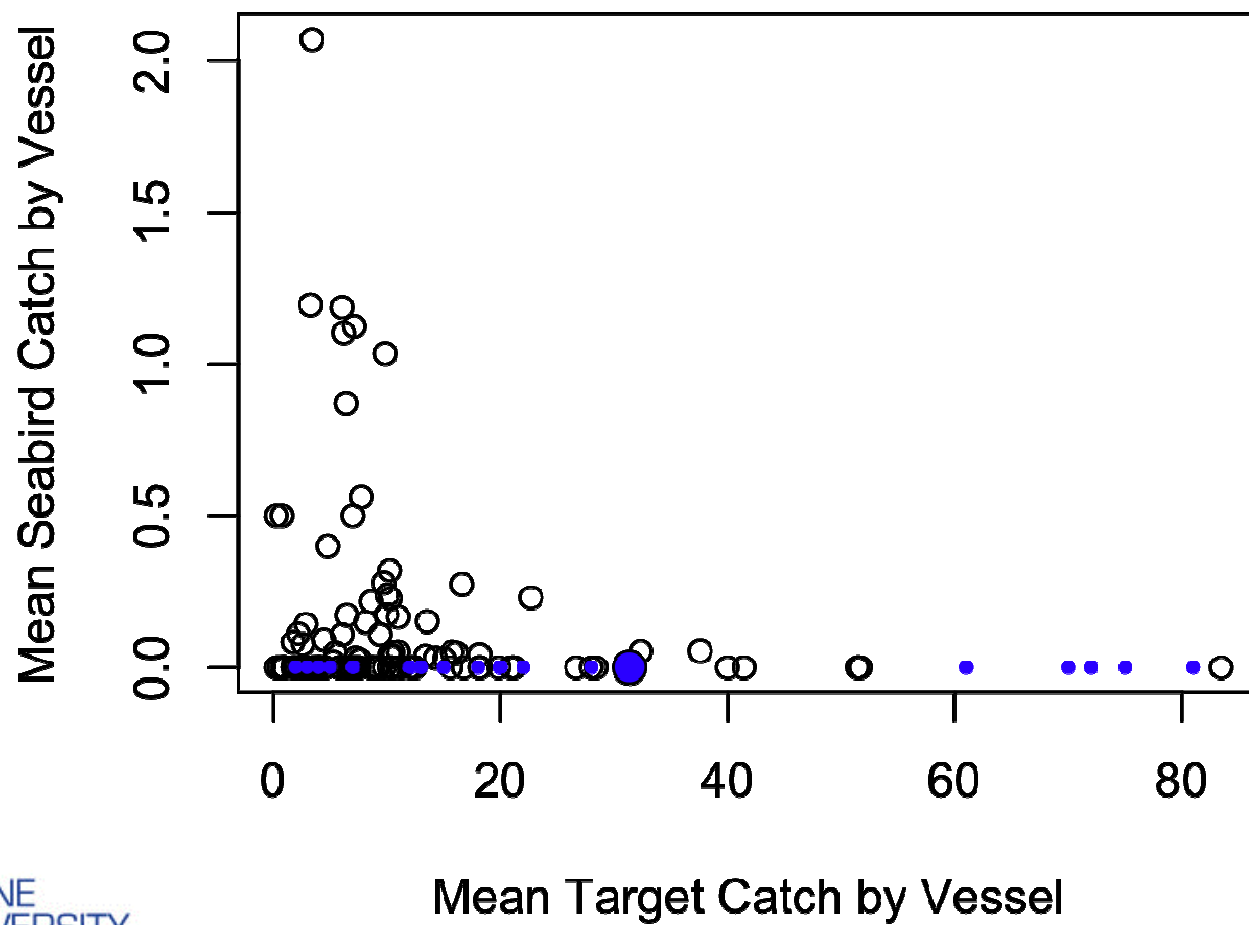
## Sampling effect or operator effect?







## Efficient fishers just avoid seabirds

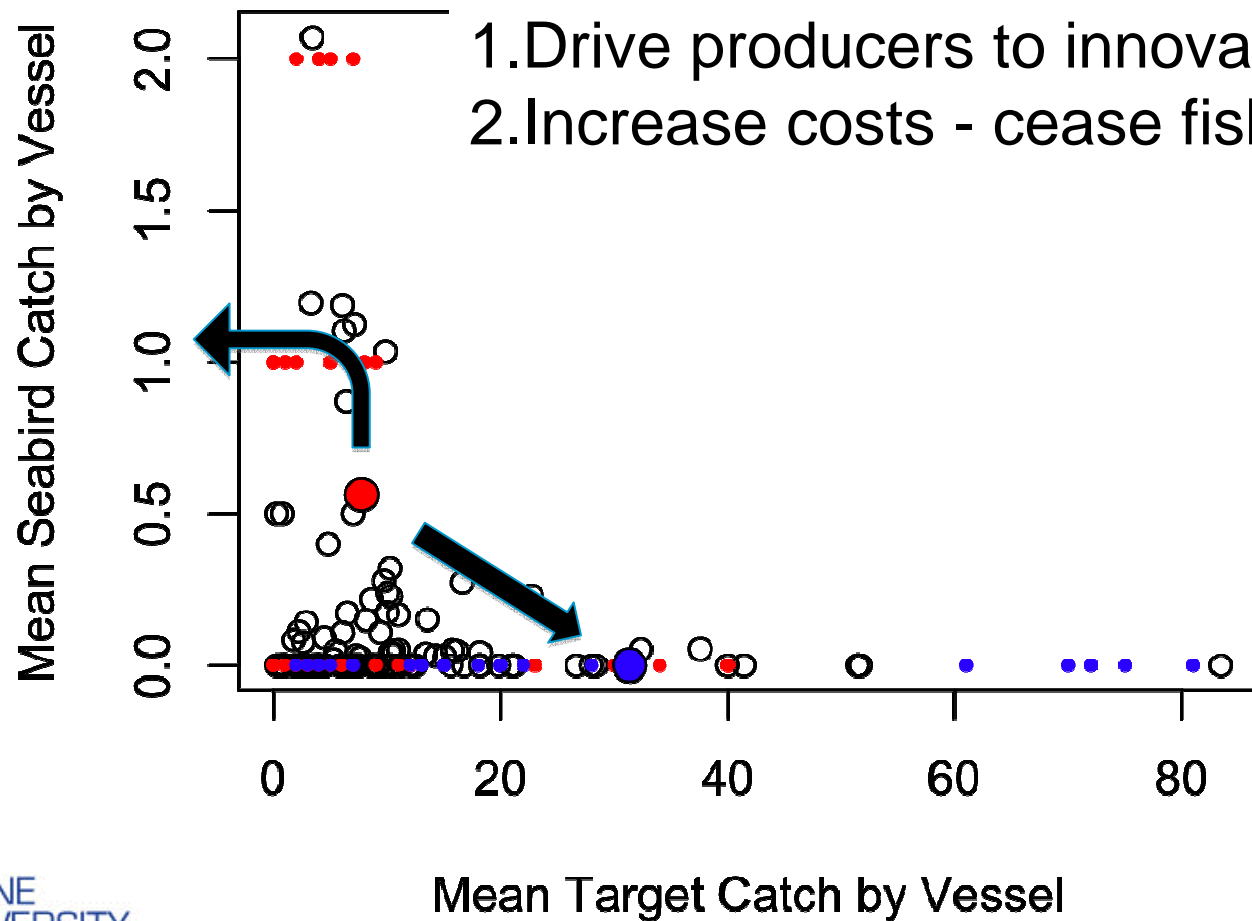




## Moving to MBIs as a way to tackle bycatch

Two outcomes

1. Drive producers to innovate
2. Increase costs - cease fishing







## Three potential applications of MBIs

- Taxes
- Performance Bonds
- Cap and Trade

For each, at least two possible objectives

1. Keep fishery below 0.05 birds/1000 hooks
2. Reduce bycatch to zero



## Taxes for managing bycatch

Taxes can be set at an initial level

- E.g. using data on fishing events with birds calculate:

$\text{Tax} = \text{Average profit per shot} / \text{average birds caught}$

Based on monitoring of bycatch rates, taxes can be adjusted

- Upward if bycatch is too high
- Downward if there is complete compliance

Disadvantages

- Calculation of the appropriate tax is difficult – what is the difference between the private cost and the public cost of bycatch?



## Performance bonds for managing bycatch

Bond is posted in order to operate, bycatch results in seizure

Bond amounts differs from taxes      $\text{Bond} \geq \frac{\text{Abatement Cost}}{\text{Chance getting caught}}$

- Reputational costs also affect decisions due to repeat players
- Can be adjusted based on performance

Successful in altering behavior in mine reclamation

- <0.5% bond forfeiture (n > 8,000)
- 99% sites compliant 10 years after bond return

Disadvantages

- Cost, especially for small businesses



# Cap and trade systems in fisheries

## (1a) ALLOCATION PROCESS

Management objectives identified



Participants in the system determined



Use rights are allocated



## (1b) ANNUAL MANAGEMENT CYCLE

Fishers required to hold or purchase adequate quota to cover catches

Risk analysis relates Total Allowable Catch to probability of achieving objectives

TAC set based on ad-hoc process OR formal decision rules

After fishing season

Prior to fishing season

TAC distributed to fishers based on quota holdings

During fishing season

Quota traded among holders during season



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# Cap and Trade Systems for Bycatch

## Three part process

- Determination of who can hold mortality allowances
- Setting sustainable number of seabirds that can be killed
- Auction of permits to applicants

## Differs from quota systems for commercial species

- No creation of private property rights to animals
- Annual auction with reserves

## Some examples, but none for threatened species so far

- Dolphins and tuna in purse seine fishery – not tradable
- Quota for sharks in NZ

## Significant success for target species (Costello et al. 2009)

- Catch shares management reduced declines by 50%



# Thoughts and heresy

## Simple complement to MPAs

Easily adjusted so adaptive management is possible

Low information requirements – shifting from MPA design to fishing on the water

## MBIs have differing advantages and disadvantages

- Social return per resource -  $C\&T > \text{taxes} > \text{bonds} ?$
- Information requirement -  $C\&T > \text{taxes} > \text{bonds}$
- Bond effectiveness appears high, taxes unknown, C&T depends....

## Creation of incentives

- Empirically innovations exist, the question is how to motivate adoption
- The only mechanism likely to reach the aspirational goal of zero bycatch

## Regulatory and political hurdles exist

- Environmental agencies unable to permit mortality,
- But primary industry agencies may use tools within bounds





## Incentives II: Addressing Uncertainties

Environmental management frequently involves significant uncertainty

Incentives can help as they can be used to:

1. Extend the time frame over which decisions take effect
2. Shift the burden of proof from regulator to proponent

Example – Barrow Island Gas Development



# Uncertainty in environmental management

Often substantial uncertainty

Status of an asset is often unclear

- population size
- extent of habitat



Importance of an impact is unknown

- will impact significantly increase threat?
- can the asset recover?
- are there cumulative effects?
- how long before effects are fully known?

Unknowable within the decision timeframe and available resources



## Gorgon LNG development

New compression and shipping facility for natural gas

- Largest petroleum development in Australia
- Thousands of jobs and substantial economic effect

However there are impacts

- Barrow island, the site, is a class A nature reserve
- Largest population of flatback turtles, a protected endemic

Conservation measures include

- Avoidance – e.g. minimal footprint
- Mimimization – e.g. reduced lighting
- Offsetting - ????





# A complex environmental problem

There is substantial uncertainty

Uncertainty around the species

- Some populations may be declining, others not
- Demographic parameters poorly known
- No estimate of population size



Uncertainty around the impact

- Lighting disorients hatchlings, but unknown effects on survival
  - Potential increases in vulnerability to predators
- Dredging and other activities could affect habitat quality
  - Sedimentation of seagrass beds, reductions in water quality
- Cumulative impacts may be an issue as region develops
  - increases in boat strikes and lighting





## Uncertainty makes assessment difficult

Difficult to determine the magnitude of the impact

- Indirect evidence for many possible impacts
- Actual impacts are going to be difficult to detect
  - Many likely to be sublethal impacts
  - Lethal impacts likely to be rare

Even knowing impact, assessing significance is difficult

- No estimates of survival in natural populations
  - Thus impacts cannot be interpreted against baseline
- Other threats likely but unknown magnitude
  - Predation on nests, fisheries bycatch, marine debris
- Absence of a population for integrating risks





## Can Market Based Instruments provide any advantage?

Regulation includes an offset, essentially a Market based instrument

Imposes cost on operator in proportion to environmental damage

Could this be improved to address these uncertainties?

Steps in developing an offset

- Determine size of impact
- Identify potential offsets which could compensate damage
- implement the offset

Steps 1 and 2 are hampered by uncertainty

- Change the approach
- Change the time span for decision-making







## Precautionary application of offsets

Understanding scale of impact will be expensive and time consuming

- Funding committed prior to understanding
- Funding could be
  - a) consumed in investigating impact
  - b) inadequate to fund required offset

However, could approach problem differently





## Precautionary application of offsets

However, could approach problem differently

- Part of a regional population,
- Some exchange between nesting sites
- Threats at other sites
- Some threats inexpensive to manage





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### 1. Set a management goal

E.g. Population at pre-development level within 15 years of closure

### 2. Assume worst case scenario – loss of Barrow

### 3. Determine offset options by investigating other threats

### 4. Determine cost to remediate other threats

### 5. Invest in the most cost-effective remediation actions



# Performance bonds as an alternative

## Current approach

1. proponent to pay government
2. Government takes action to offset impact

However, government bears the risk of unknown costs and unsuccessful outcomes

An alternative is to require a bond as an assurance that any impacts to Barrow island rookeries will be remediated

## Two issues

-How to set the conditions for seizure/release

Status of the population at a fixed time post project

-How to estimate the size of the bond

Cost the government would have if it remediated + margin



## Using Market Based Instruments

There are some advantages:

- Can be lower cost
- Cost passed on to proponent, instead of public
- Less effect on business, as they choose actions

However, requires a shift from procedural to outcome focus

Can be a challenging policy problem

Direct regulation of activities may be better if possible

Incentives (Market-Based Instruments) likely to be best when:

1. Information on impacts and assets is limited
2. Outcomes are important (e.g. whaling vs. seismic impacts)
3. Cost effectiveness is important



# Partners



National Research  
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**Australian Government**  
**Geoscience Australia**



**Australian Government**  
**Department of the Environment, Water, Heritage and the Arts**



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