

Design and Evaluation of Conservation Interventions

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UBC Research Seminar

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Today's talk:

- Background and approach to research
 - Past research
 - Current research: A market for conservation
 - Future research and mentoring

Background



Design and evaluation of policies related to biodiversity conservation

How do interventions and institutions shape human behavior and environmental and economic outcomes?

Approaches:

- Bio-economic modelling for simulation
- Modern econometric techniques for evaluation

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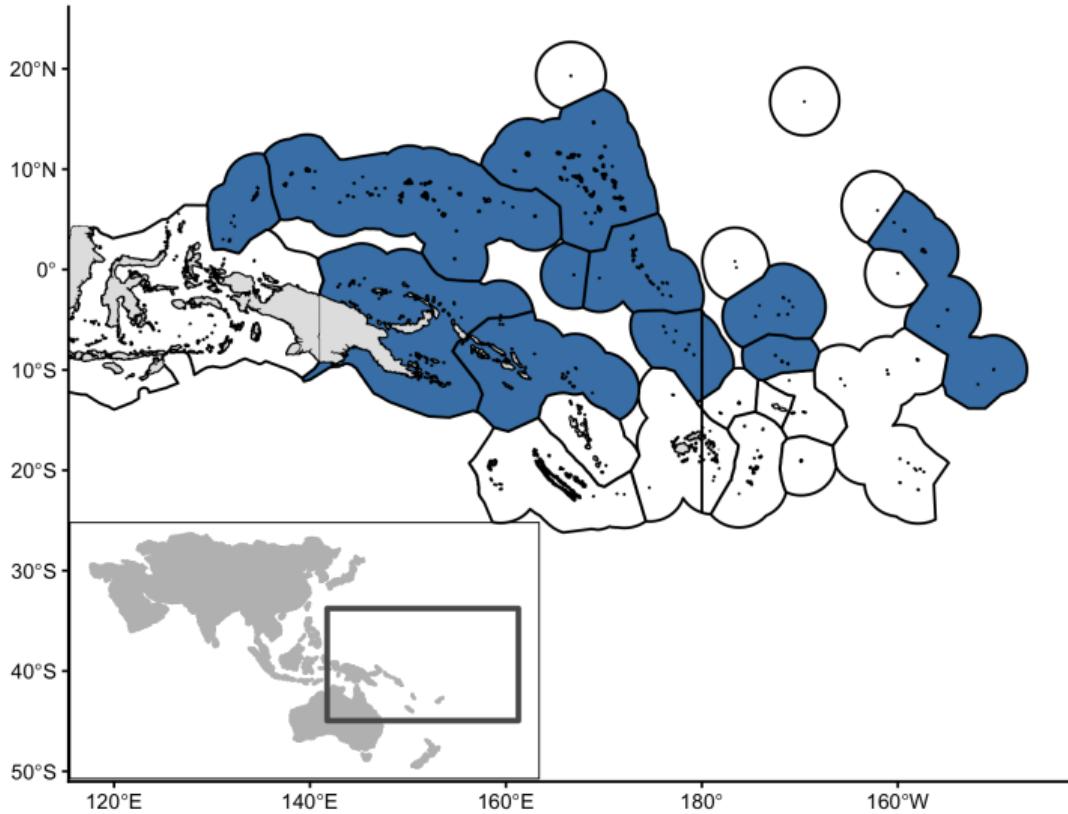
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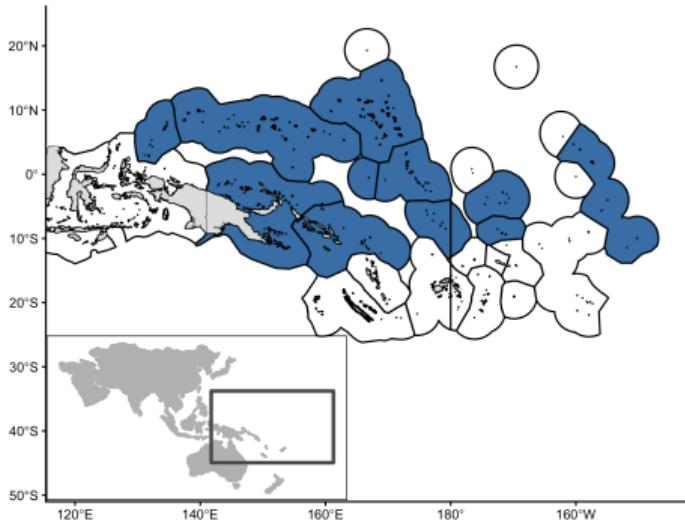
Environmental market design for large-scale marine conservation



Can fishing effort markets be (re)designed to incentivize large-scale marine conservation?

Two features are necessary to incentivize conservation:

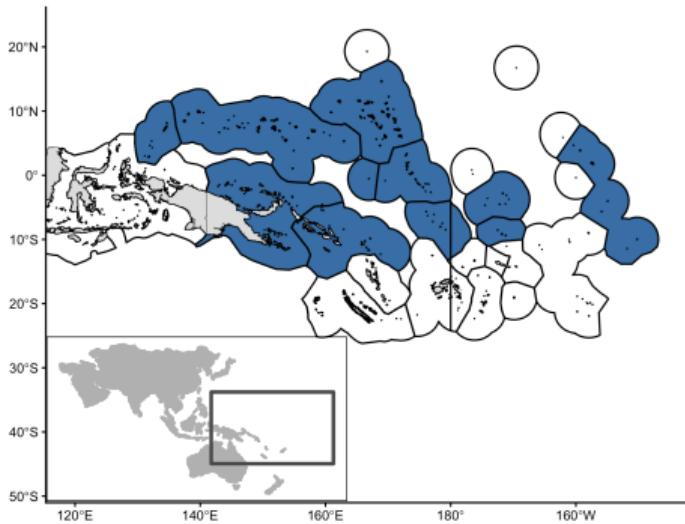
- Tradeable permits
- Biomass-based allocation rule



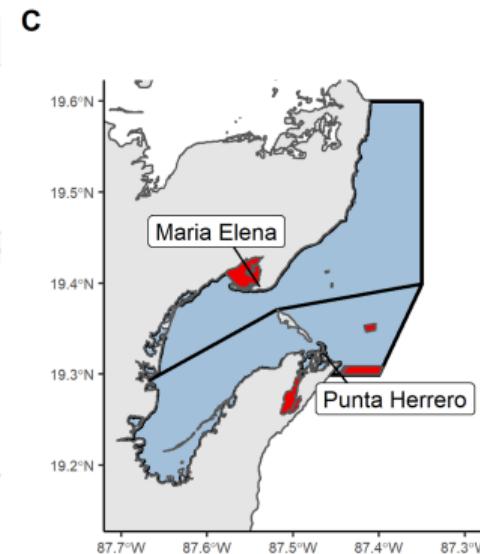
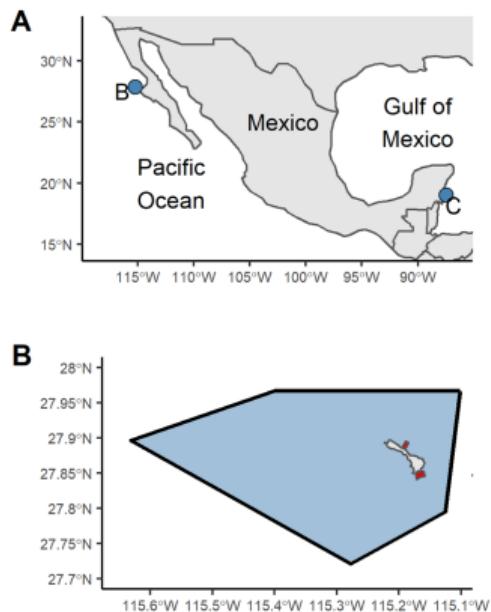
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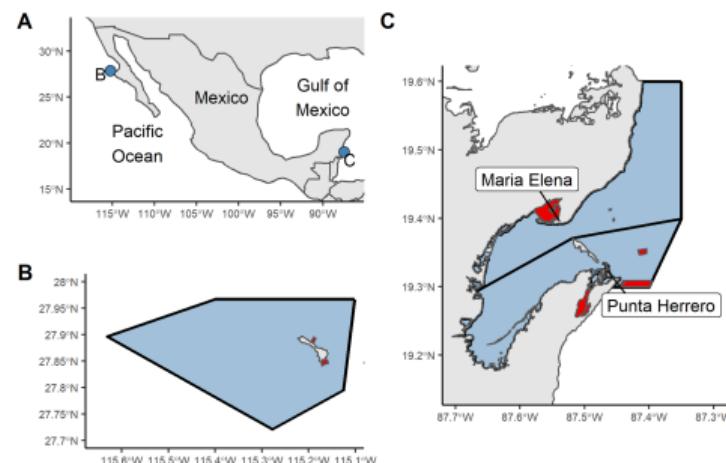
An interdisciplinary evaluation of community-based TURF-reserves



How effective are Mexican community-based marine reserves?

Combination of two approaches:

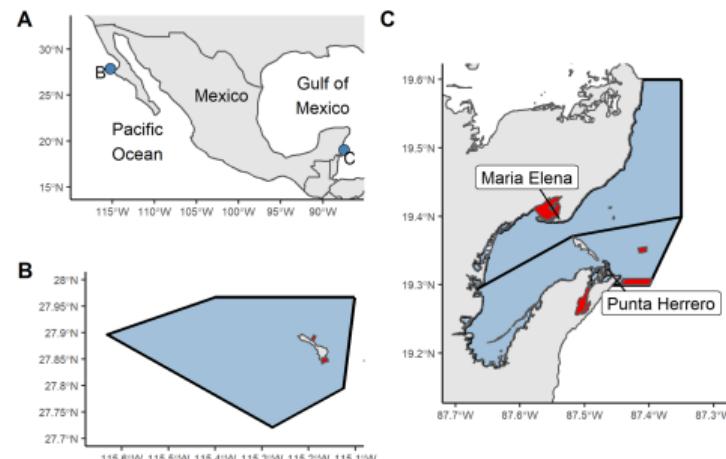
- BACI design to test reserve effectiveness
 - No change in density
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- SES framework to tease out causes
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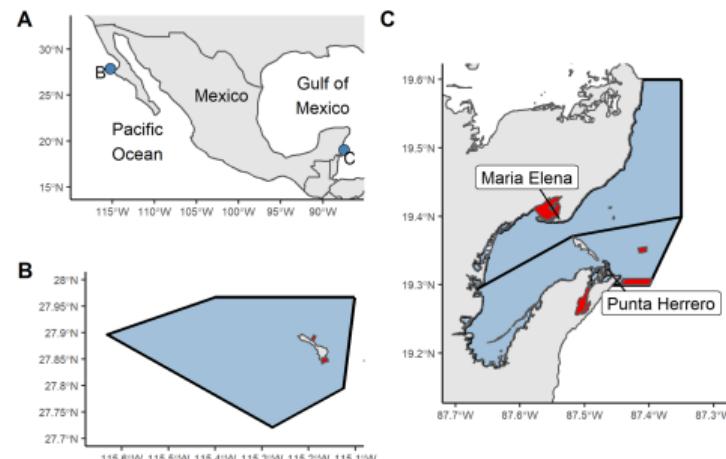


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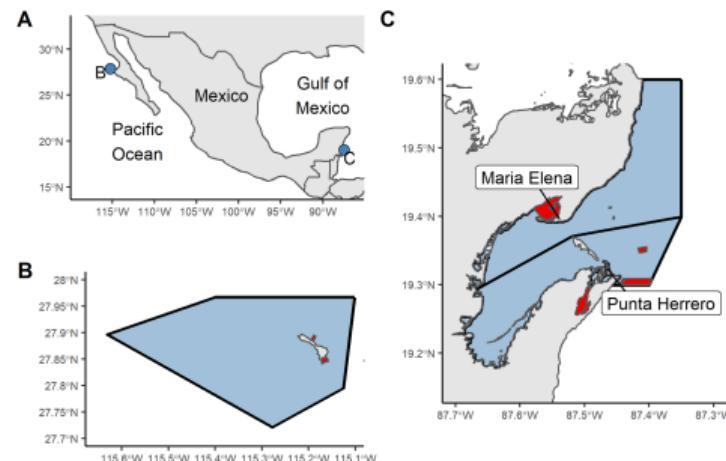
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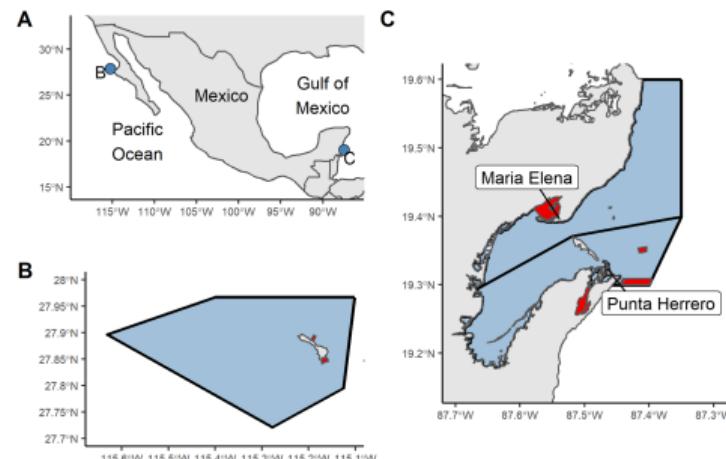


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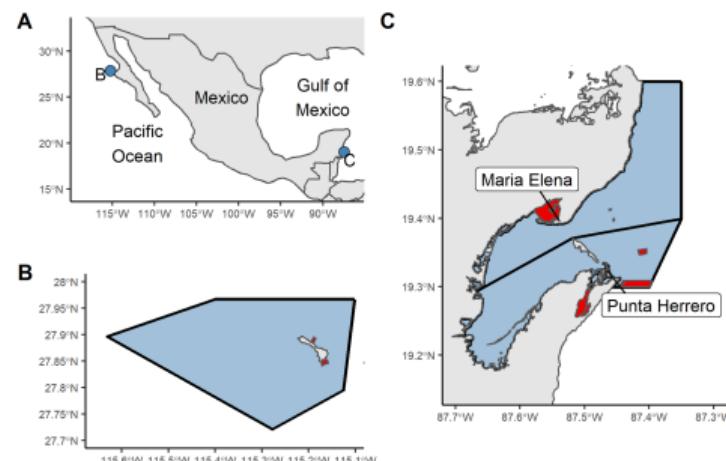
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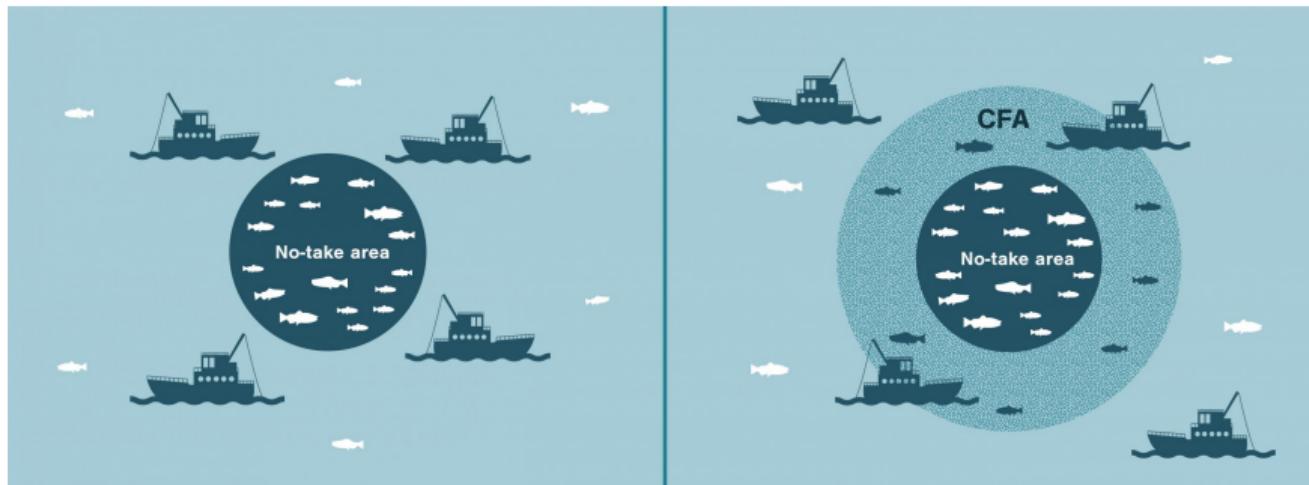
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Past collaborations

Design: Self-financed marine conservation¹

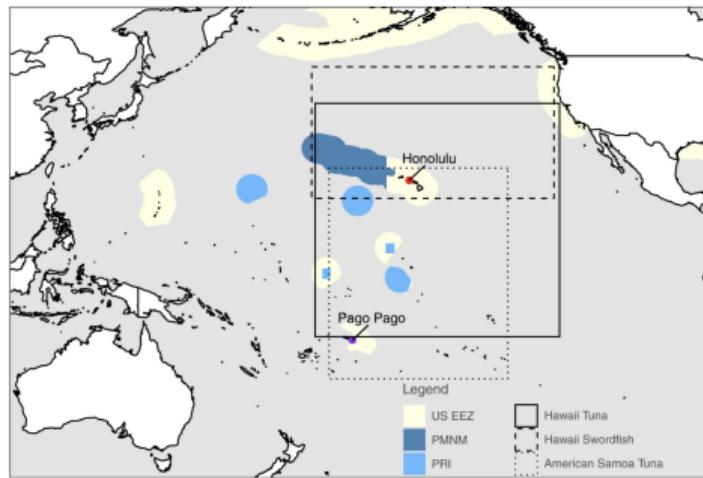


Can a "fishing lease area" around MPAs help pay for enforcement?

¹ Millage et al., 2020, *Environmental Research Letters*

Past collaborations

Evaluation: Impact of two of the world's largest protected areas on longline fishery catch rates²



Did the expansion of PMNM and PRI affect fisheries?

²Lynham et al., 2020, *Nature Communications*

Ongoing projects:

- Evaluation: Fuel fishery subsidies in Mexico
(with Costello and Deschenes)
 - With Costello and Deschenes
 - Funded by the PEW Charitable Trust
 - Panel on fuel subsidy allocations + panel on fishing effort (VMS) and catch
 - Average vs marginal prices
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A Global Market for Marine Conservation

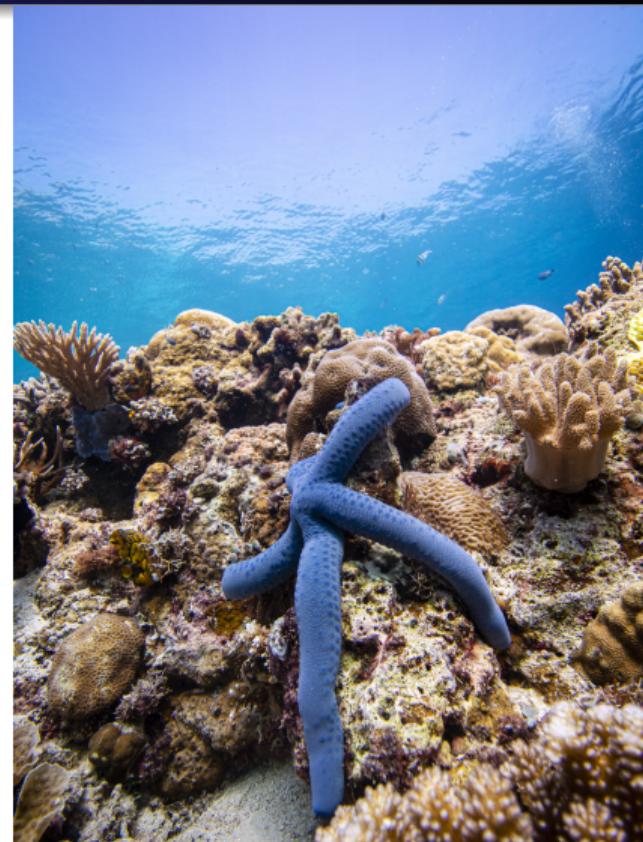
With: Costello, Bradley, Mayorga and Plantinga

Funding by: Schmidt Environmental Solutions Fellowship (UCSB) and
The Institute on Global Conflict and Cooperation (UCSD)

Background

Current status of marine conservation:

- Twice, we have failed to meet protection targets in time
- We have long-known *where* and *how much* to protect³
- Heterogeneity in habitat suitability and costs of protection
- There is no institution to help this

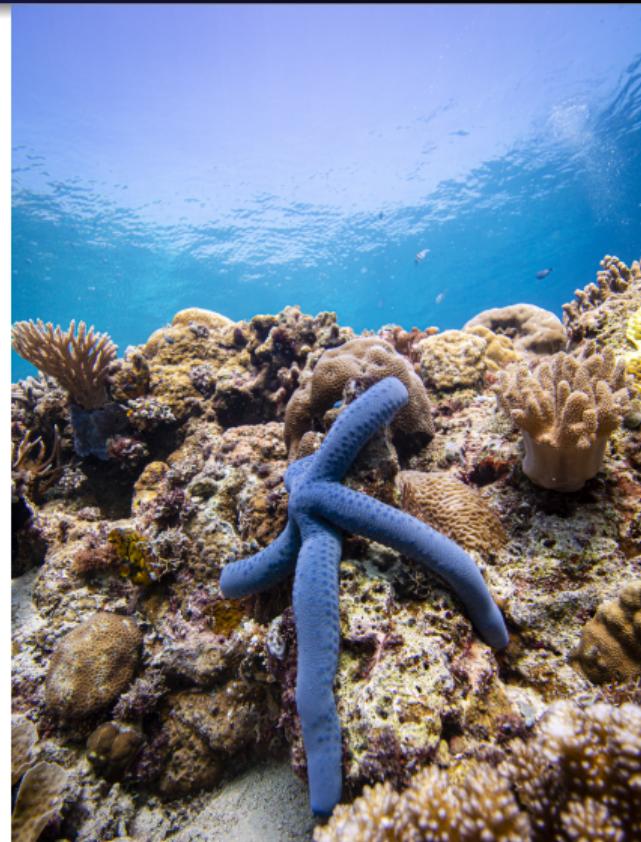


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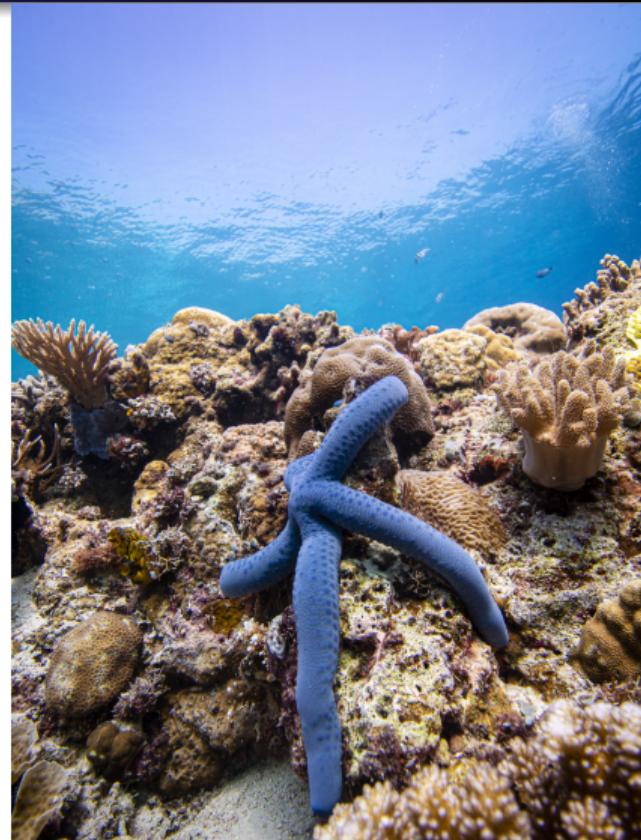


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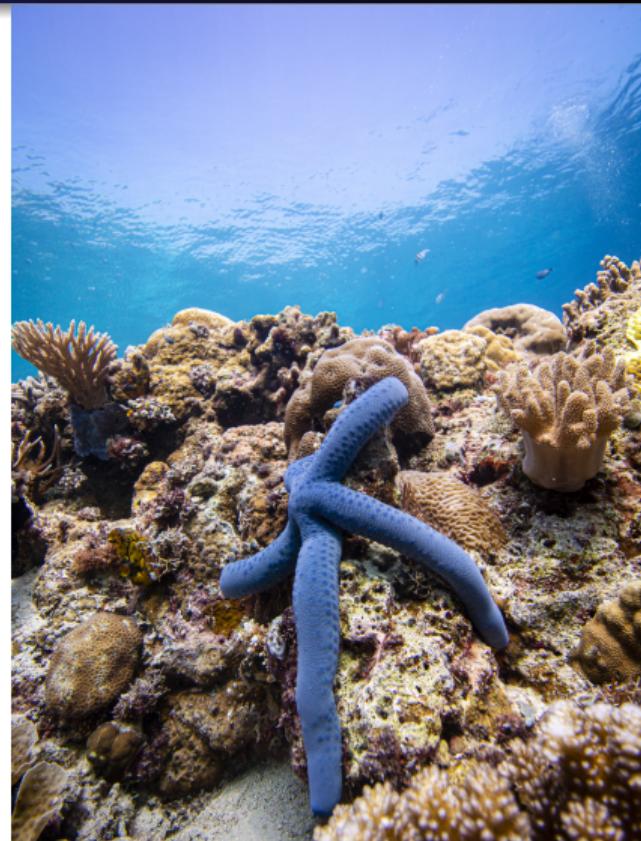


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- Efficiency gains: Lower the cost and induce cooperation
- Voluntary: Everyone participating in it is better off
- Avoids perverse incentives: Don't protect only sand
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A market for marine conservation: nations have the option to conserve in their waters, or pay other nations to conserve in their name

This piece:

- How can markets reduce the costs of conservation?
- Construct conservation supply curves
- Use Ecological principles to inform market design
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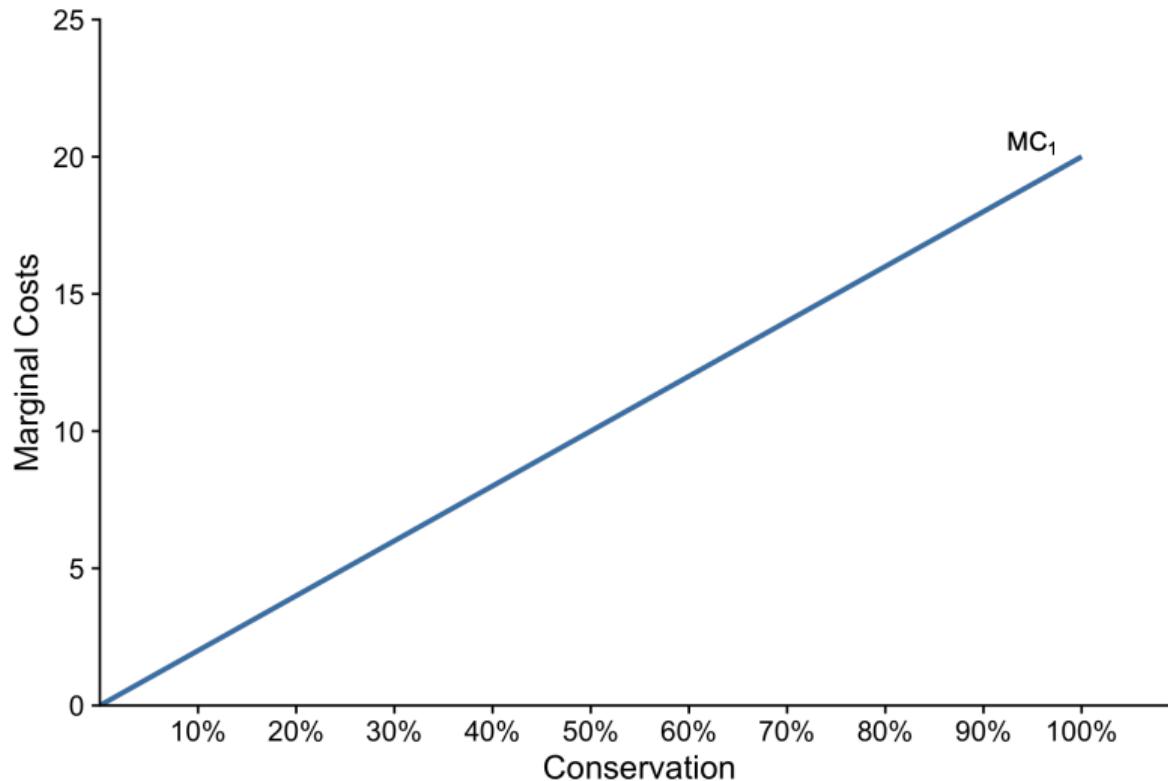
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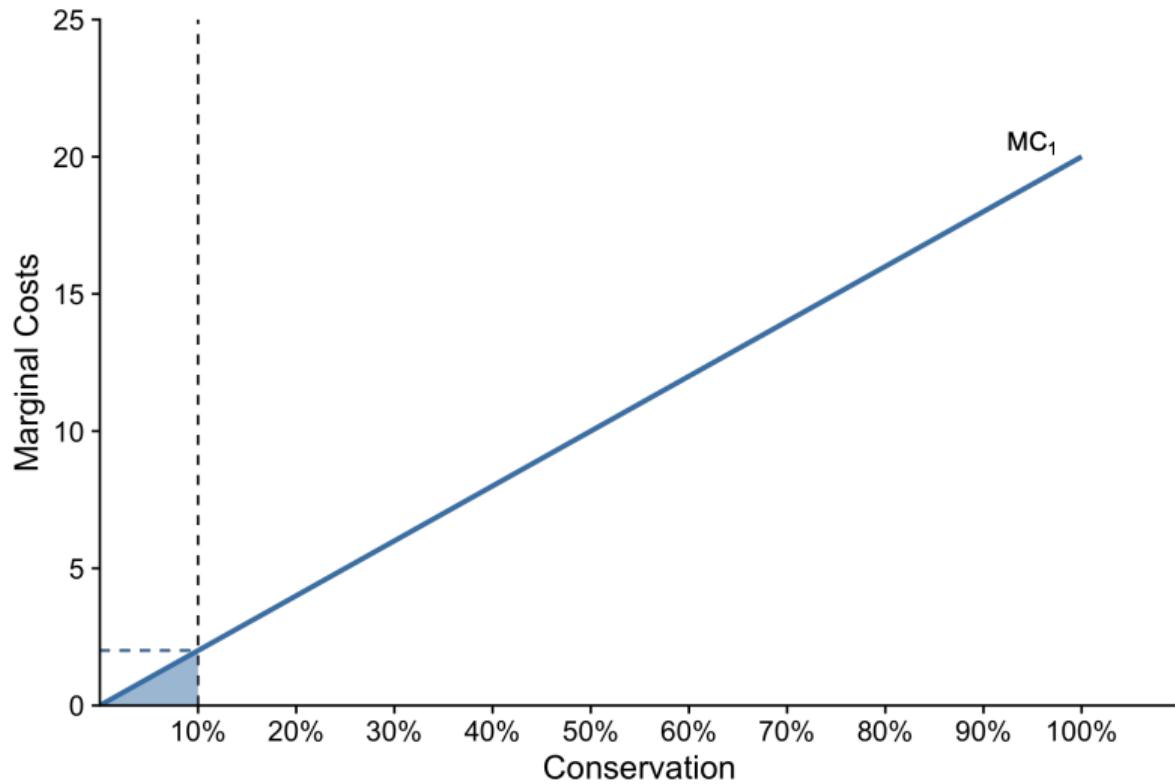
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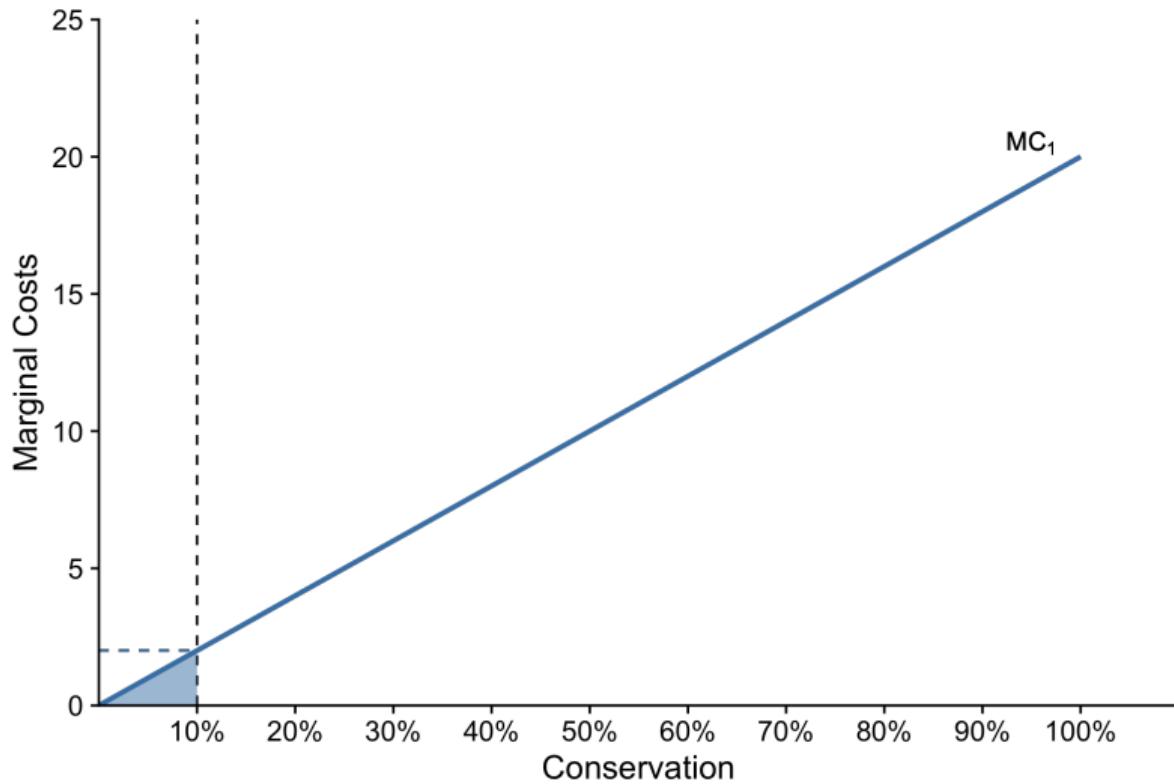
Stylized example: Conservation supply curves



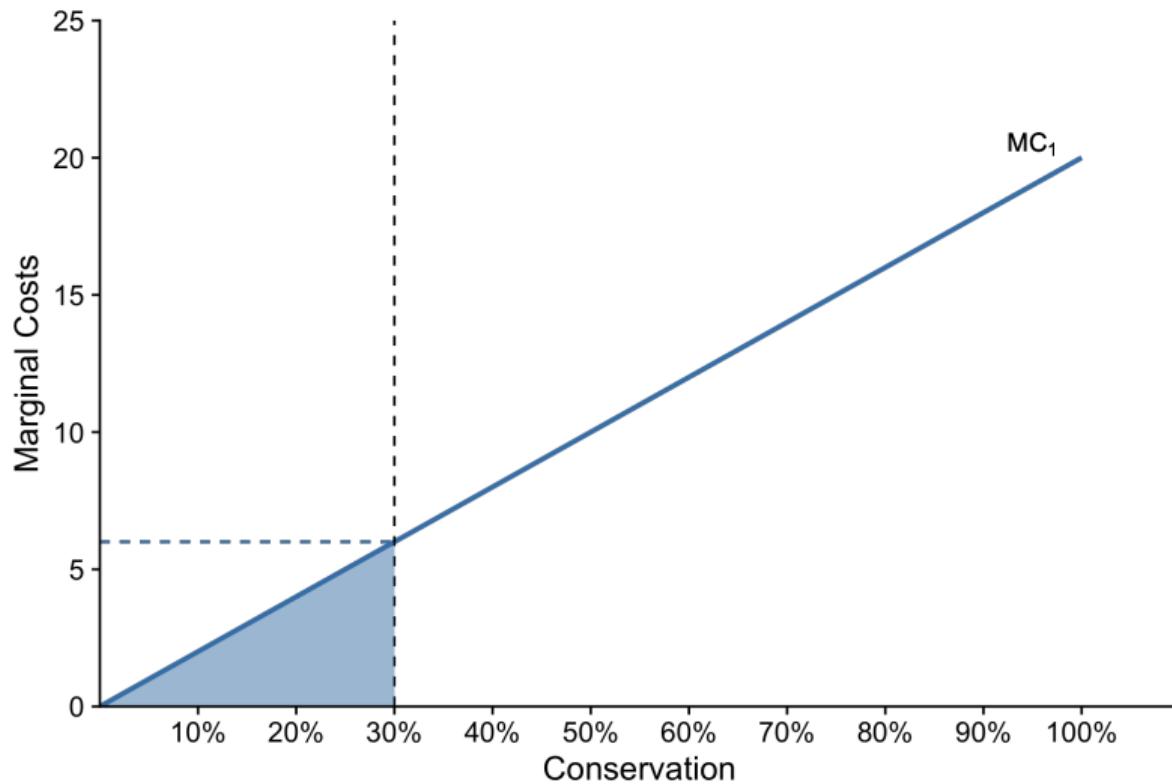
Stylized example: Costs under BAU



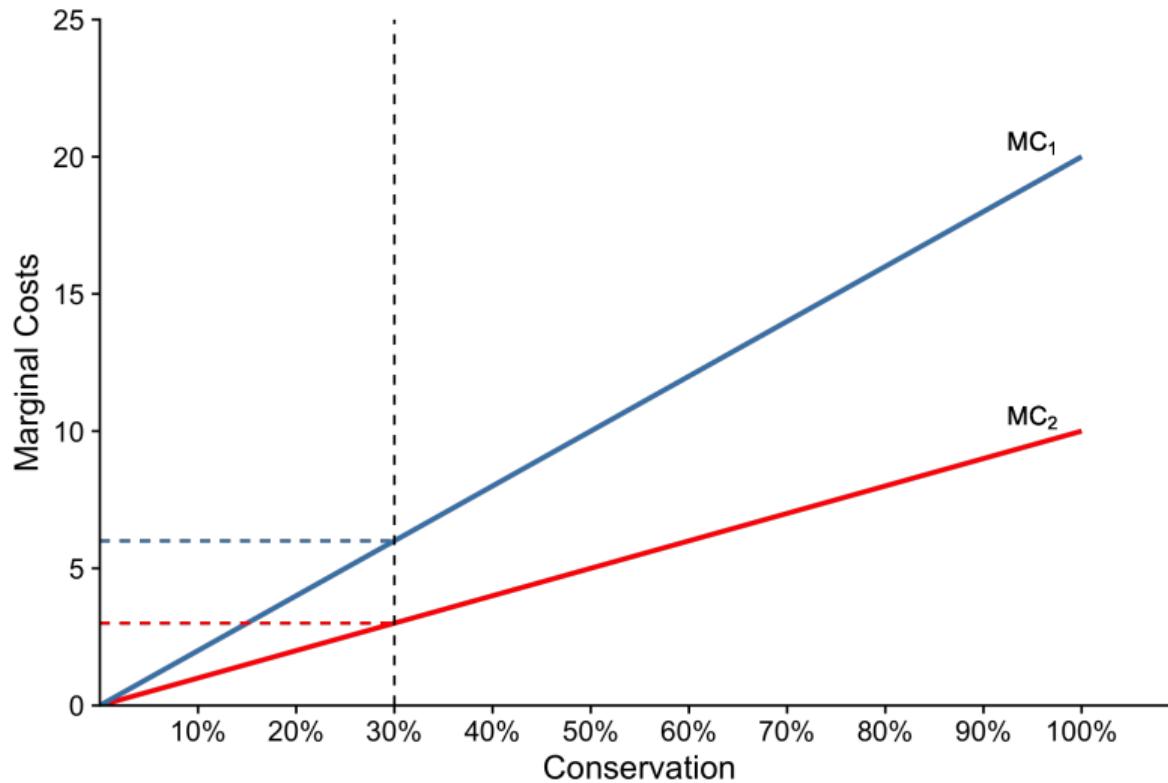
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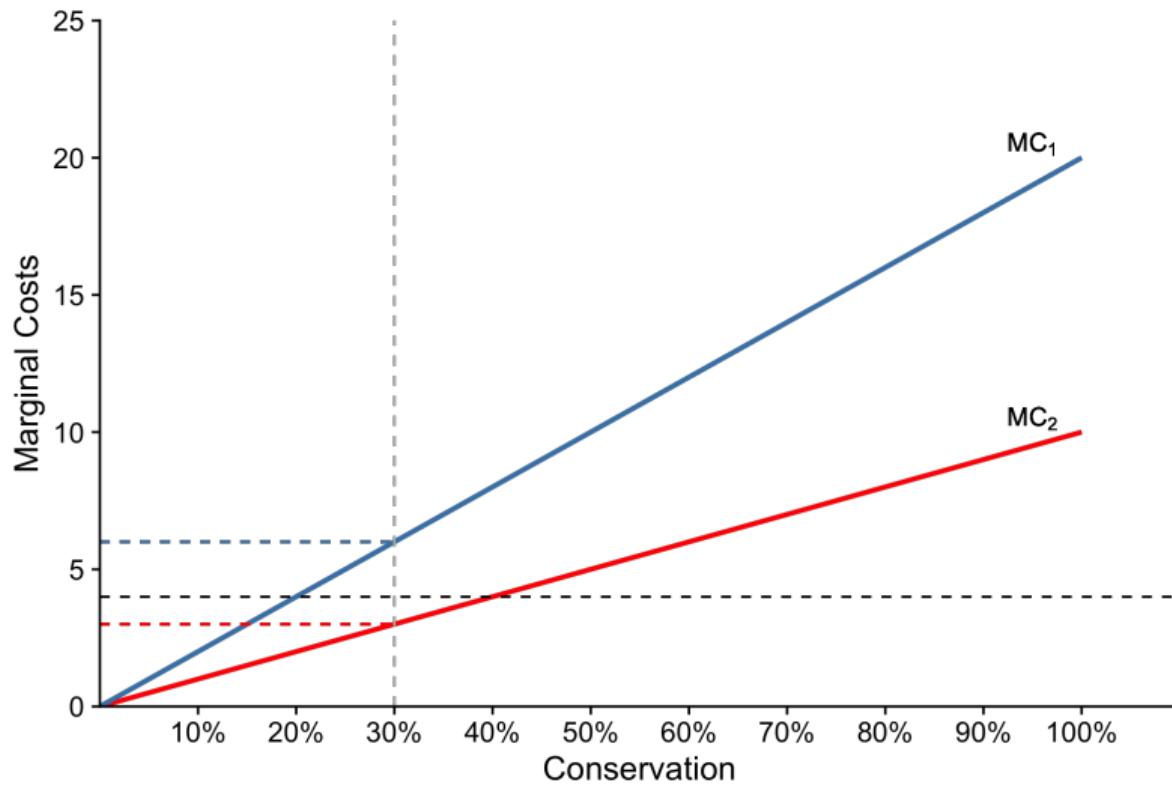
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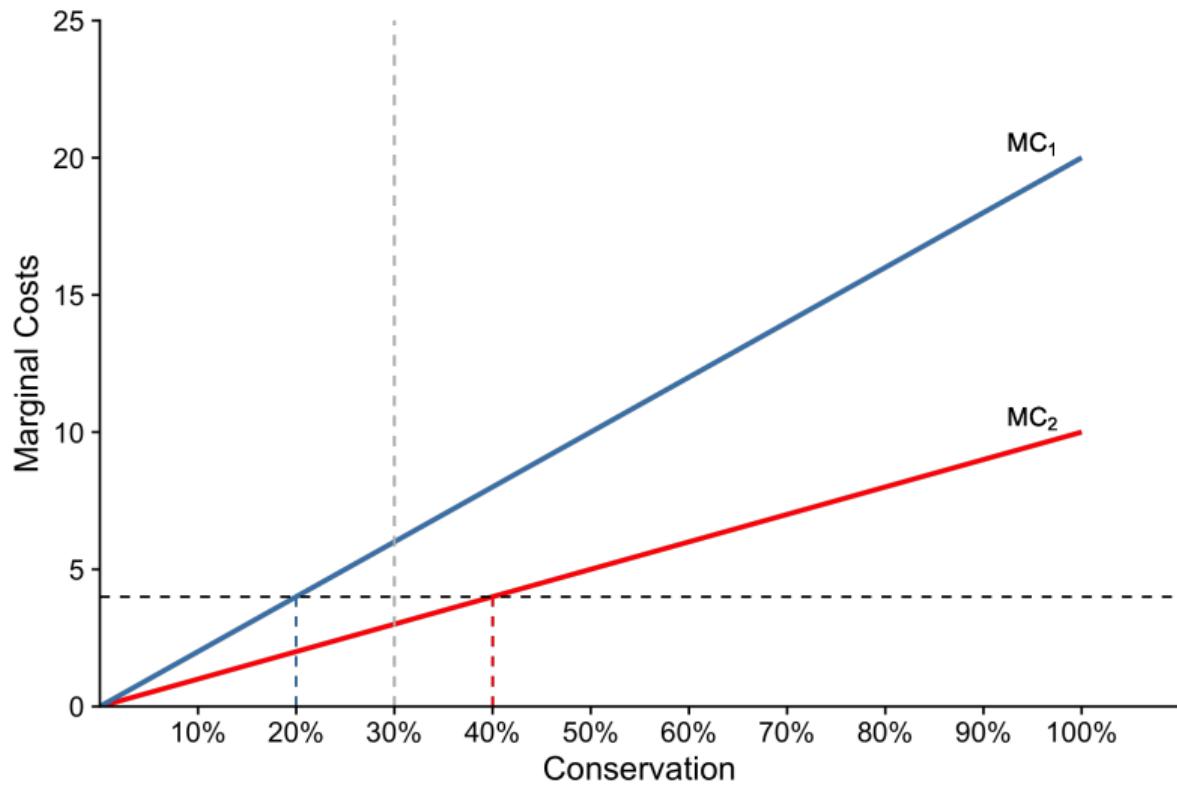
Stylized example: Heterogeneous costs



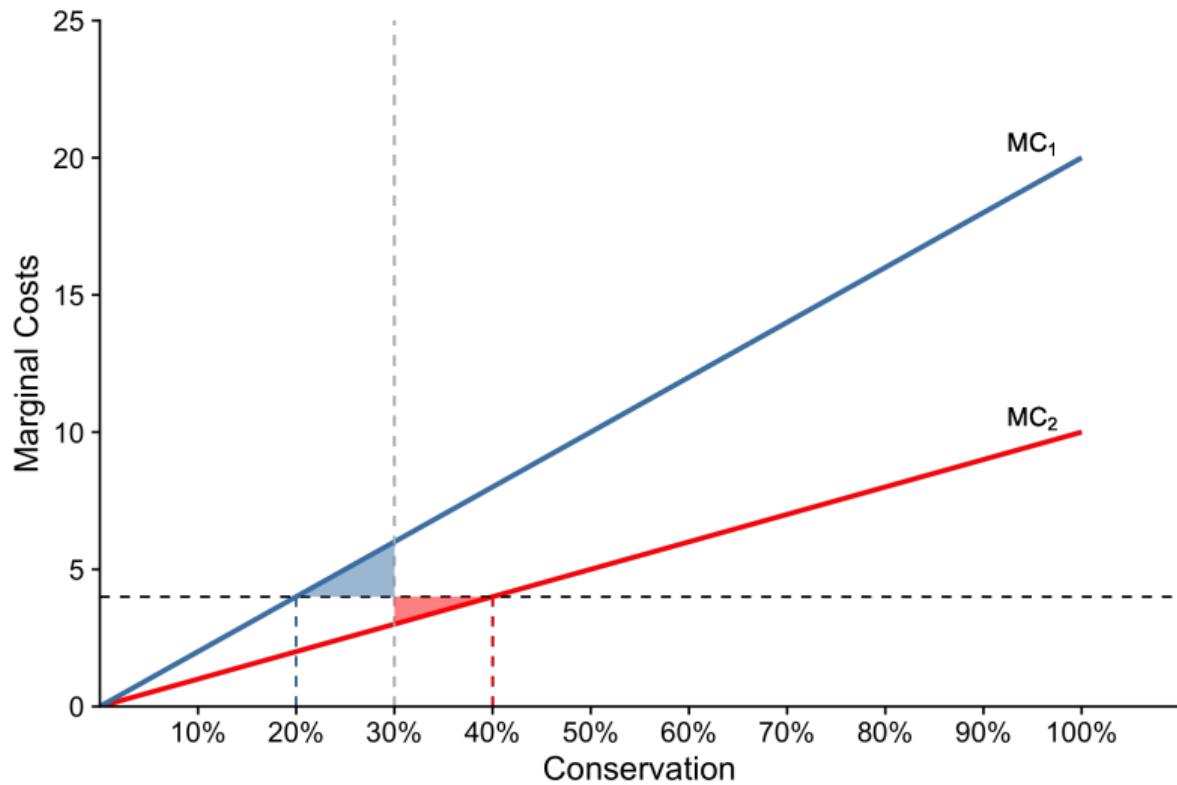
Stylized example: Opportunity for trade



Stylized example: Outcome



Stylized example: Gains from trade



How to constructing conservation supply curves?

Constructing a nation's conservation supply curve

i	Q_i	C_i	C_i/Q_i
1	10	20	2
2	8	40	5
3	1	10	10
4	5	5	1

Stair step supply curve:

- Rank ascending C_i/Q_i
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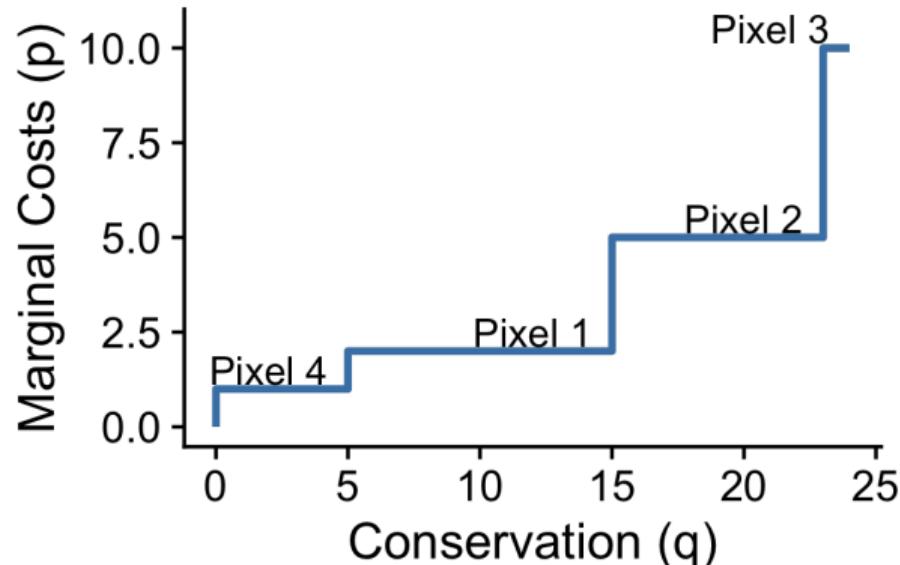
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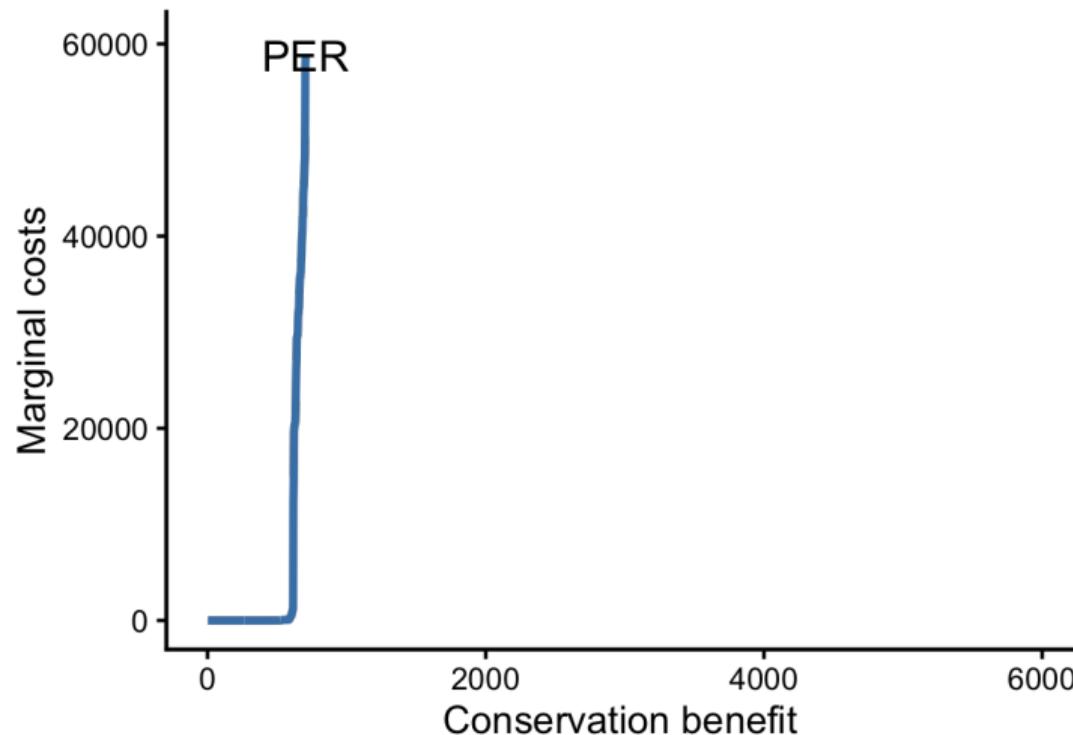
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$$Q_i = \underbrace{\alpha_i}_{\text{Area of pixel } i} \times \underbrace{\frac{\sum_{j=1}^S (\omega_j p_{ji} D_{ji})}{\sum_{j=1}^S \omega_j D_{ji}}}_{\text{Habitat suitability index}}$$

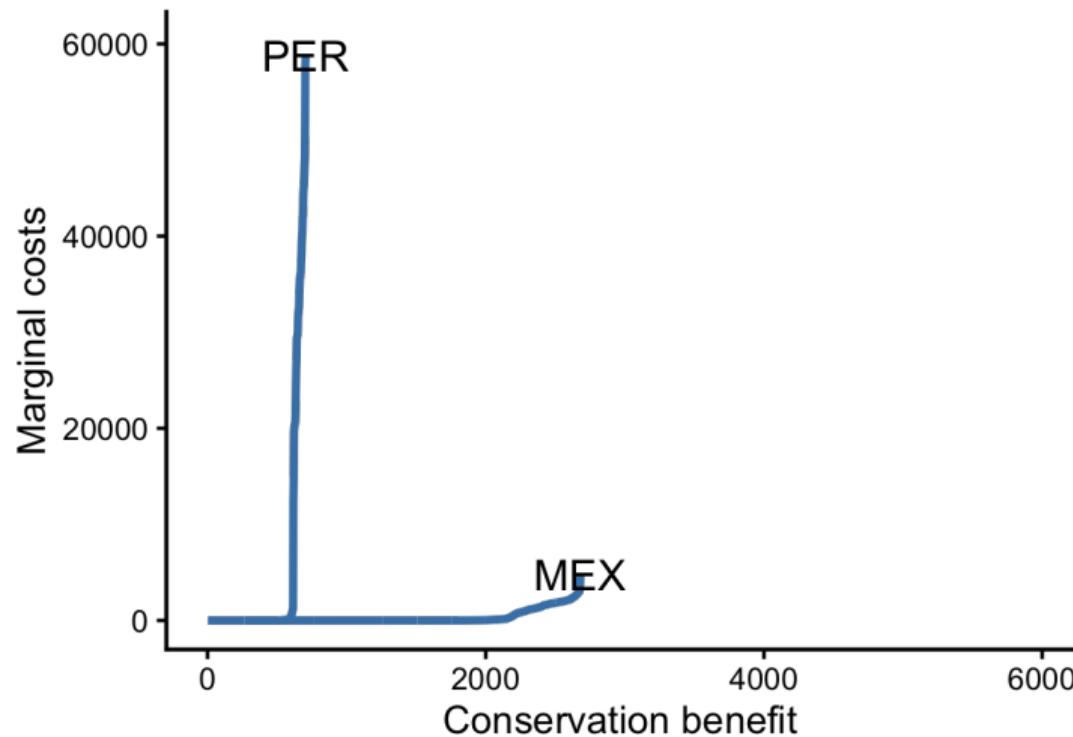
Fisheries revenue:

- Watson
 - Spatially explicit panel on catch by species
 - 2005 - 2015 Average catch of species j in pixel i
- Melnychuk et al., 2017
 - Ex-vessel prices for species j
 - V2.0 by McDonald

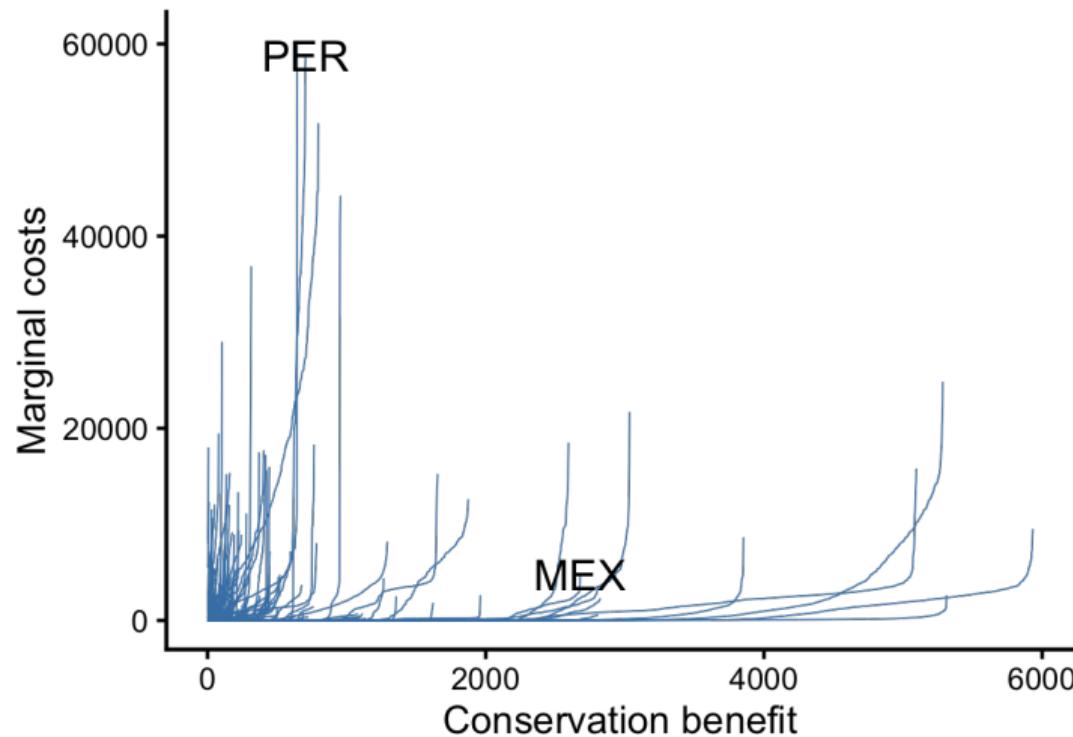
Conservation supply curves



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Not all ecosystems are created equally



Ecology can inform market design

A bubble policy: Sets a cap or target

- First used in air pollution regulation
- Segments the market
- Limit trade within ecologically-coherent spatial units
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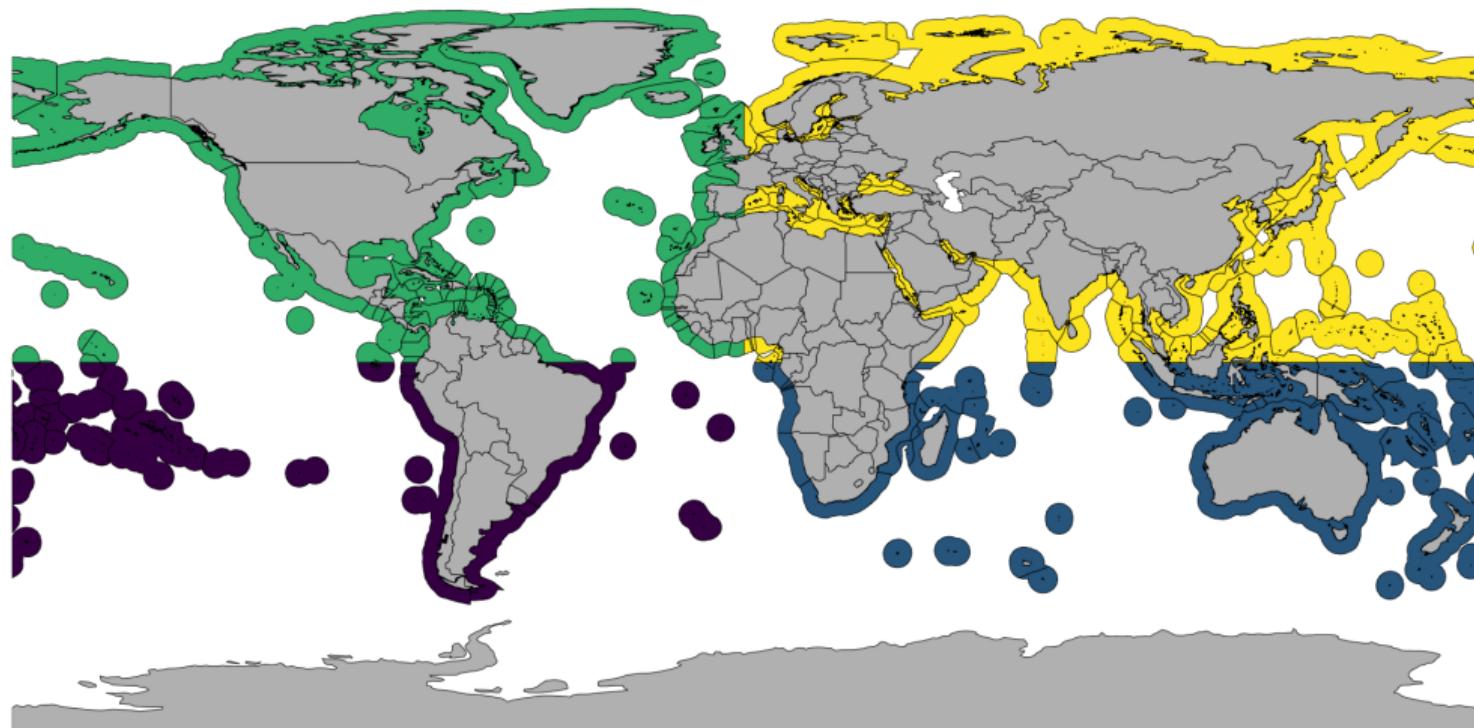
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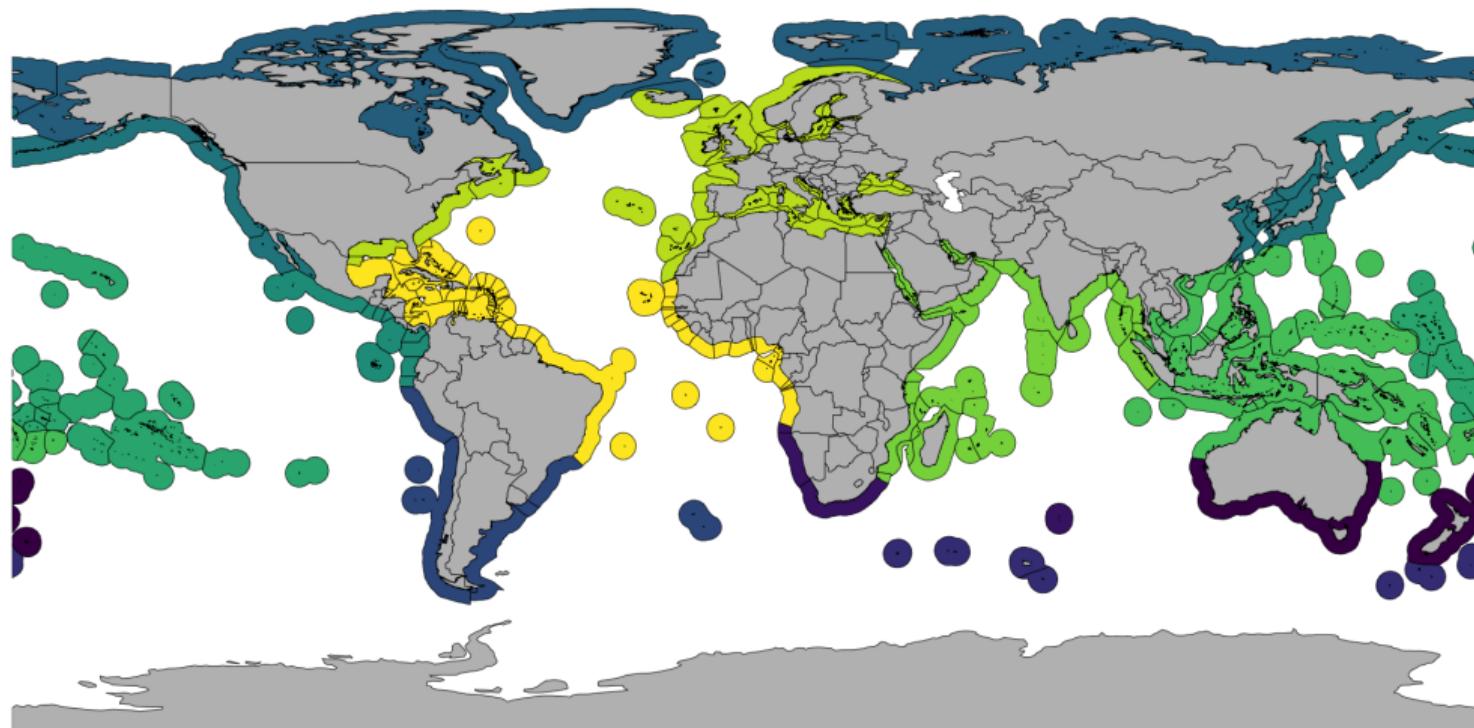
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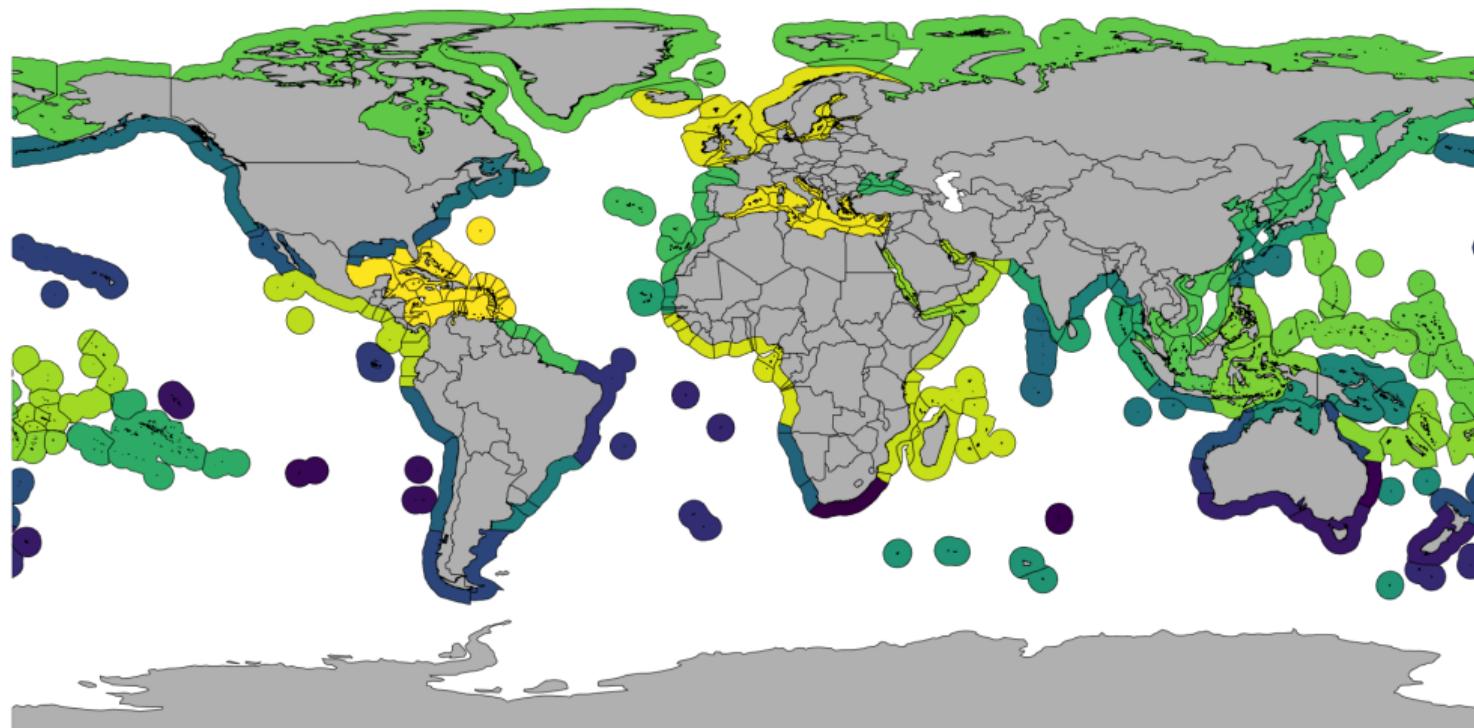
Bubble policy: Hemispheres (n = 4)



Bubble policy: Realm (n = 12)



Bubble policy: Provinces (n = 60)



Simulate a market for marine conservation and calculate
cost savings

Simulating a market for conservation

Gains from trade:

- Set conservation target: 30%
- Calculate total costs under BAU (TC_{bau})
- Calculate total costs under market (TC_{mkt}):
 - Determine the bubble-level target (30%)
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- Gains from trade ($G = \frac{TC_{bau} - TC_{mkt}}{TC_{bau}}$)

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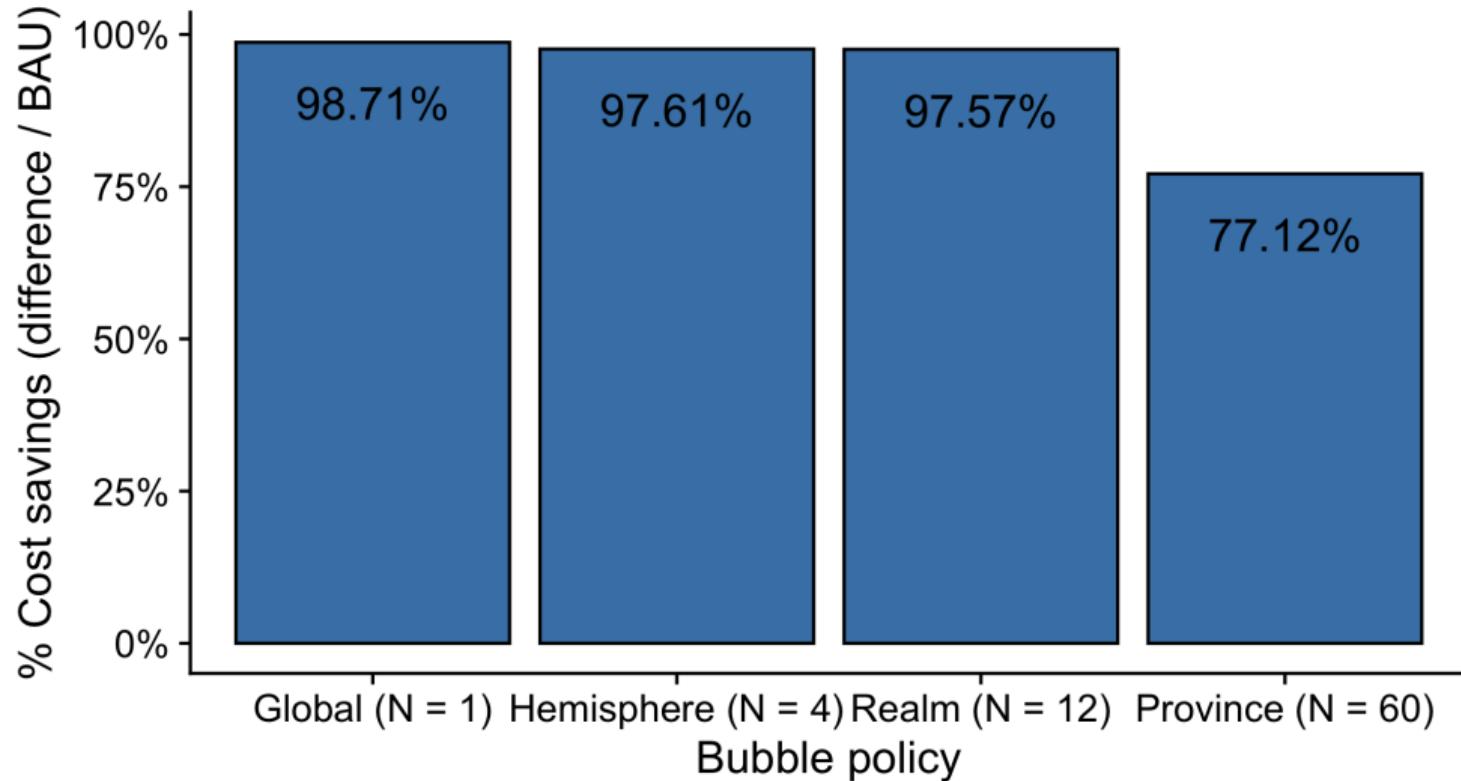
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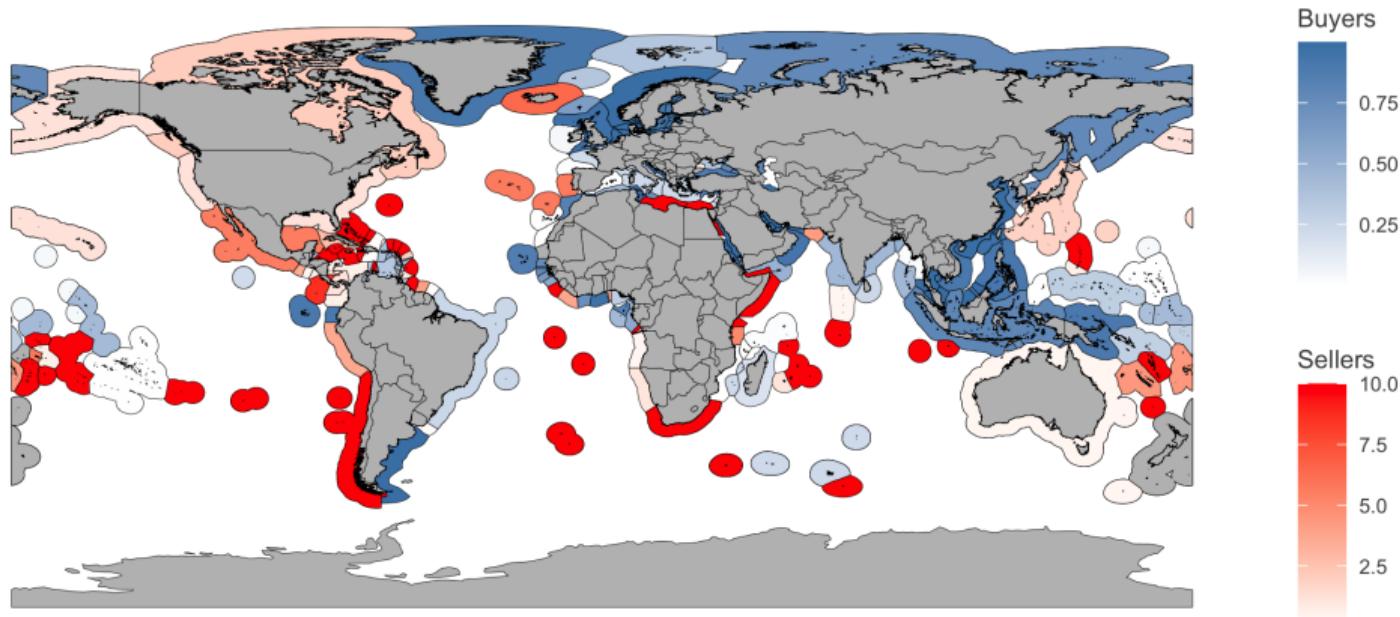
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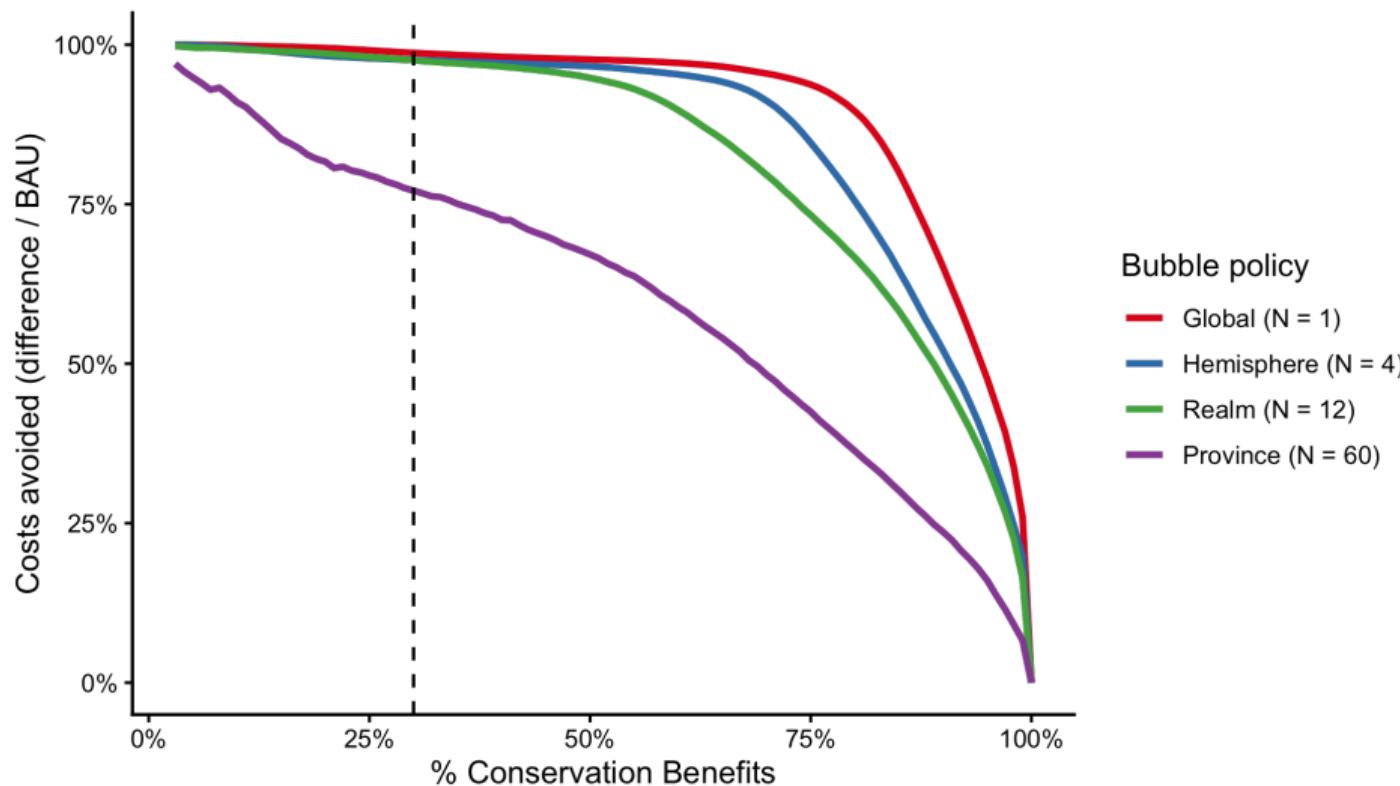
Gains from trade: 30%



Map of trade



Gains from trade



Extensions and next steps

Not included here:

- Species- or pixel-level characteristics
- Climate change
- Other measures of cost or benefit

Conclusions

- We propose a market approach, informed by Ecology
- Large potential for cost savings in 30X30 (Between 77-98%)
- All countries stand to gain
- Renders agreement more likely
- Sets stage for other market opportunities in ocean

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Future research and mentoring

Design and evaluation of policies related to biodiversity conservation

How do interventions and institutions shape human behavior and environmental and economic outcomes?

Approaches:

- Bio-economic modelling for simulation
- Econometric techniques for evaluation

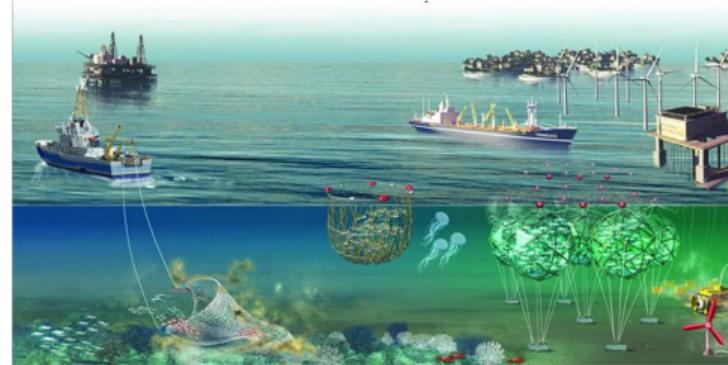
Tools:

- BigData
- Spatial analytics
- Machine learning
- Field work

The oceans are becoming increasingly crowded

The Blue Economy brings the expansion of:

- Ocean-based energy
- Marine transport, ports, and shipbuilding
- Aquaculture
- Commercial fisheries
- Coastal and Marine tourism



What are the drivers and extent of customary use and ownership of the ocean?

How will customary use and ownership of the ocean conflict with these activities?

Why might this matter?

- Help avoid unequal burden on resource users
- Inform just compensation mechanisms
- Help negotiations
- Incentivize investment

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Funding sources:

- Oceans Canada: Blue Economy Strategy
- Environmental Justice Grants

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- Foreign "National Science Foundations": CONACyT, CONICET, CONICyT, etc
(Masters and PhD)

Building a diverse lab

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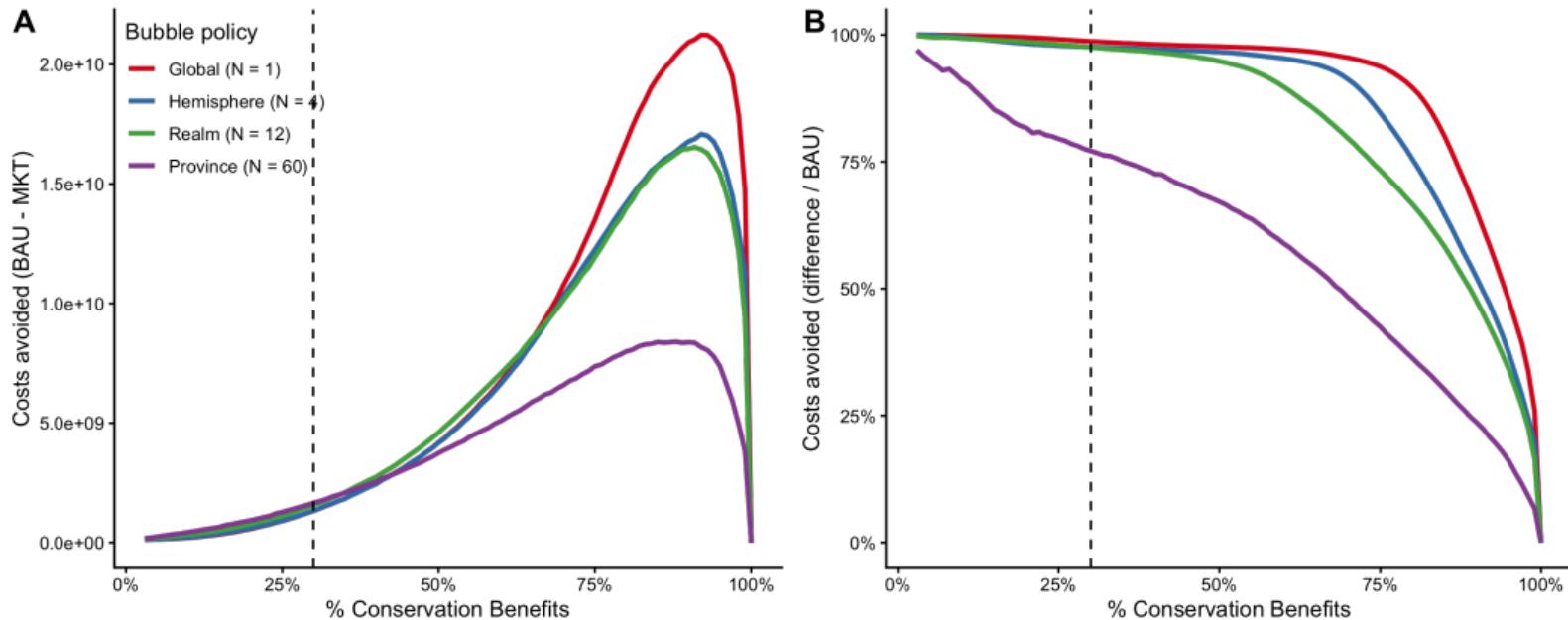
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Contact info:

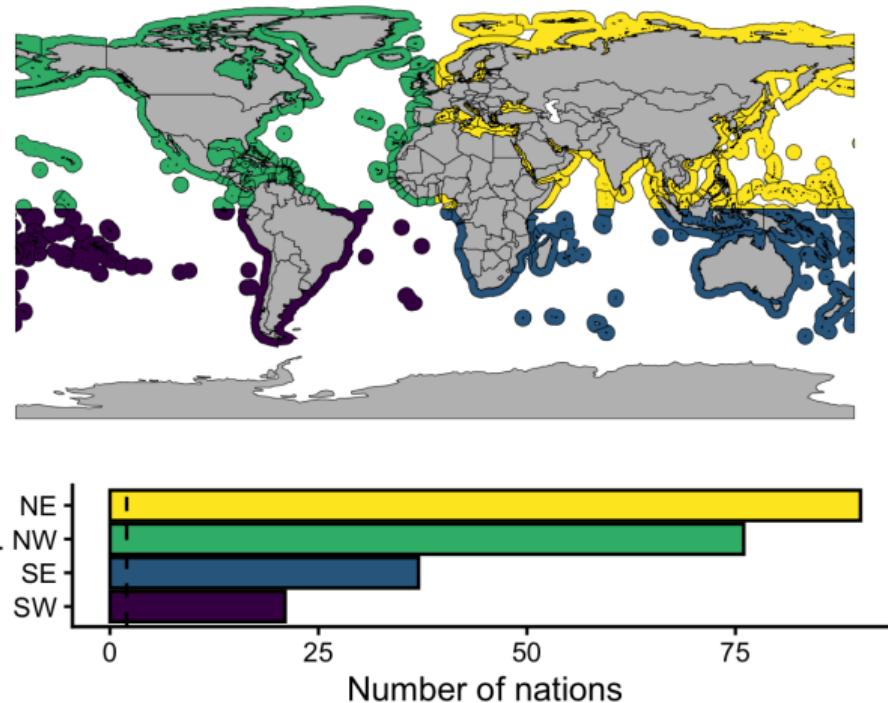
Juan Carlos Villaseñor-Derbez
juancarlos@ucsb.edu
villasenor-derbez.com

Extra slides

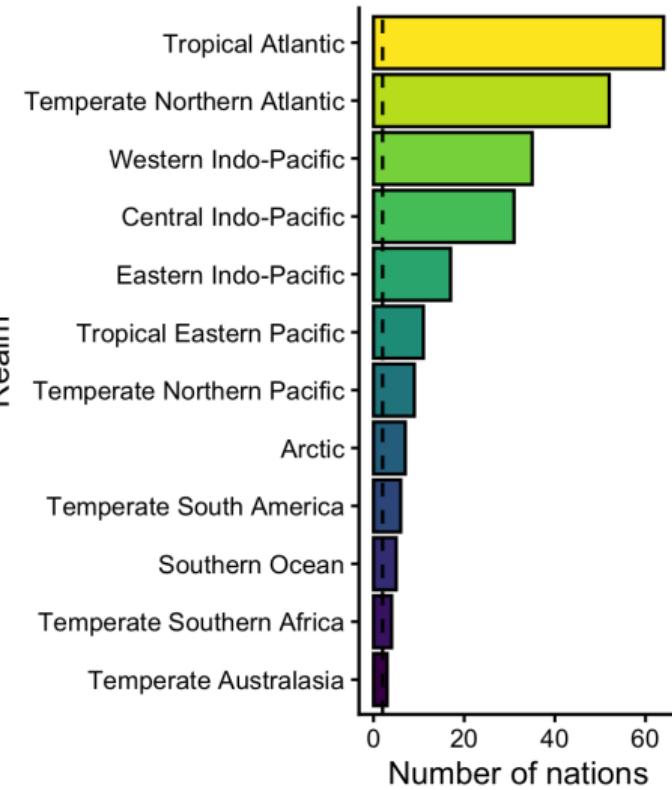
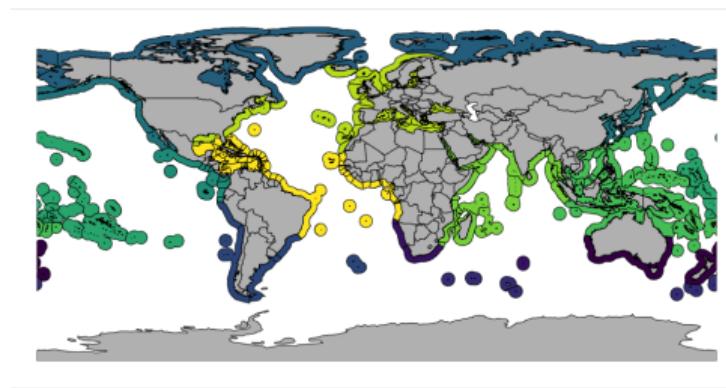
Gains from trade



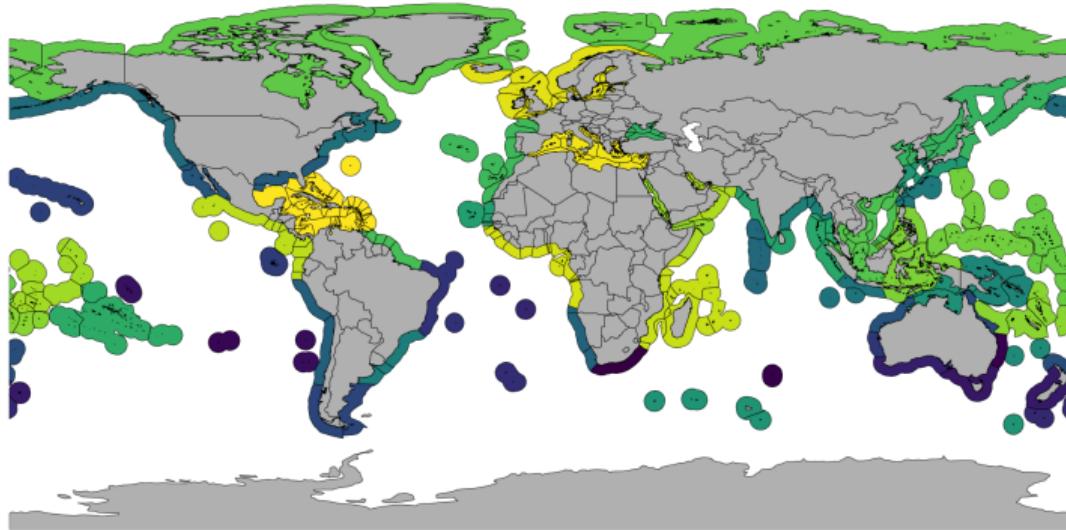
Bubble policy: Hemispheres (n = 4)



Bubble policy: Realm (n = 12)



Bubble policy: Provinces (n = 60)

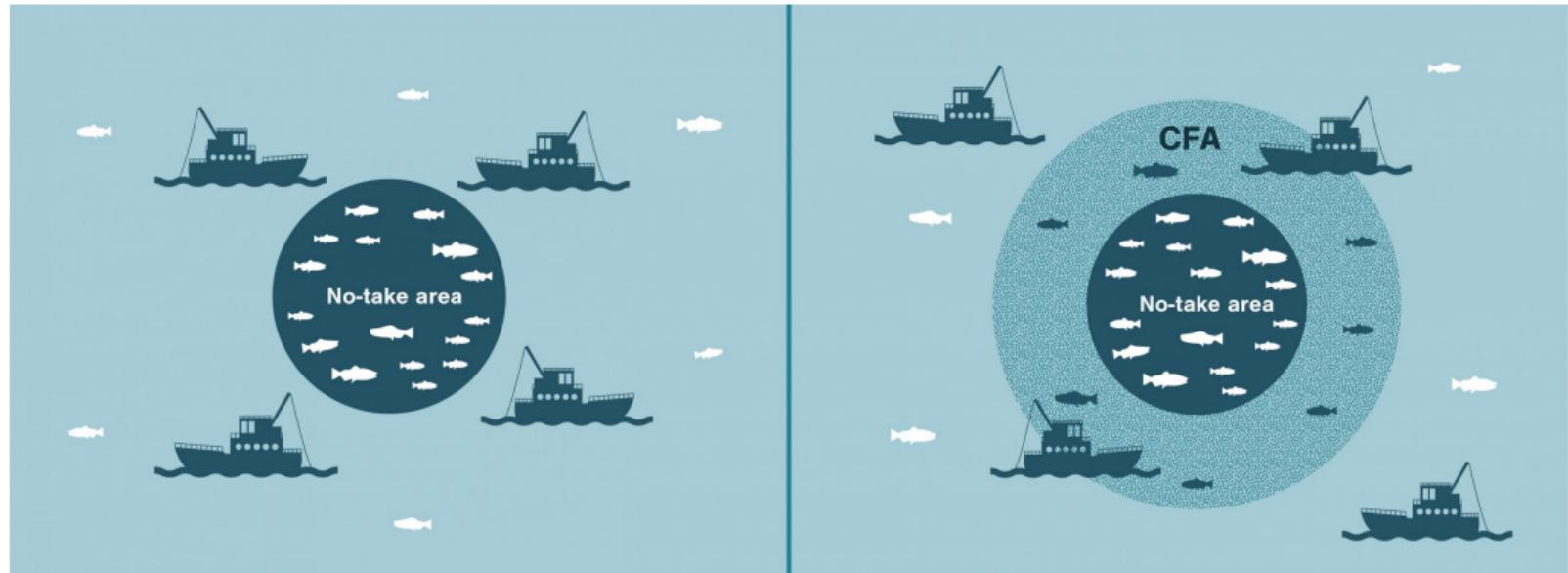


Notes:

- 14 provinces are only found in 1 nation (*i.e.* unilateral conservation)
- 9 provinces are only found in 2 nations (*i.e.* bilateral trade)

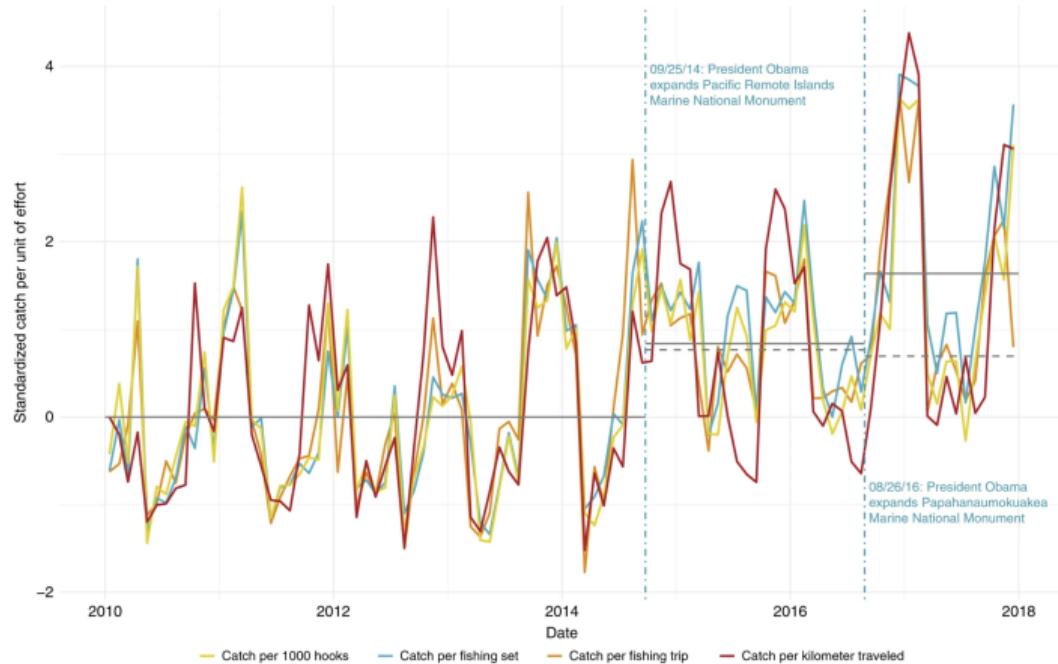
Other research

Self-financed marine conservation⁴



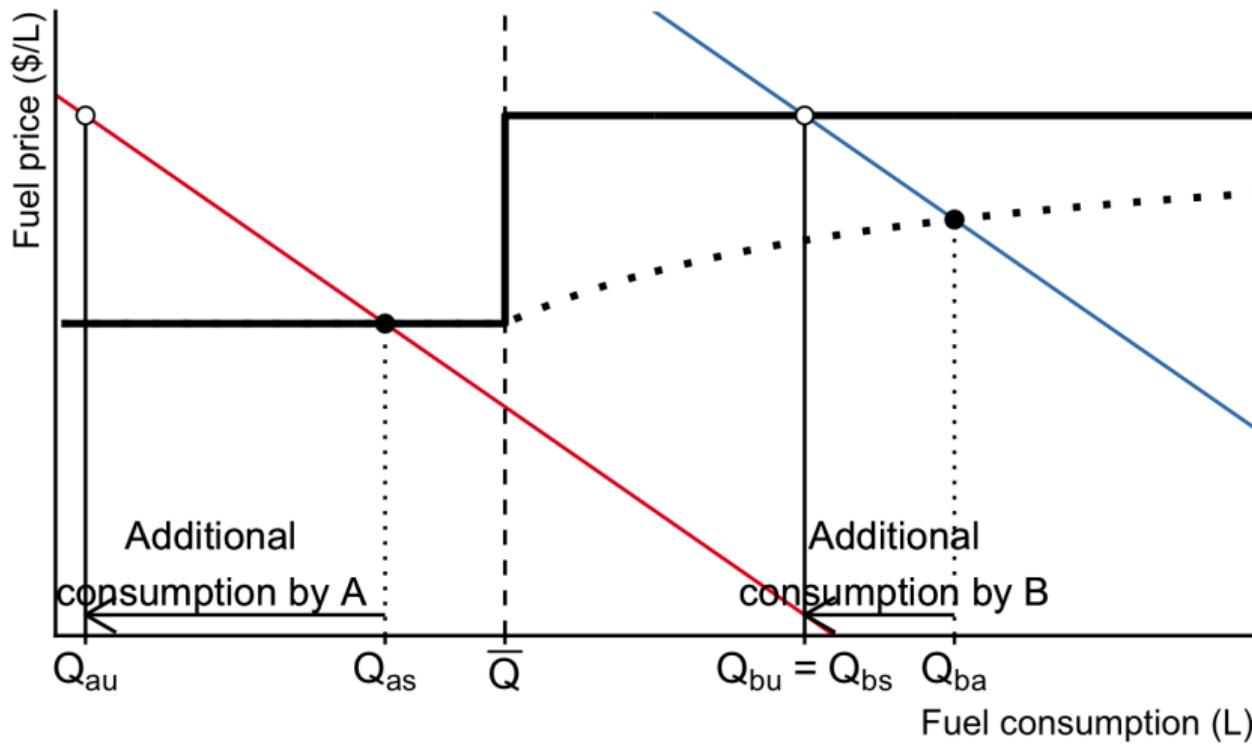
⁴Millage et al., 2020, *Environmental Research Letters*

Impact of two of the world's largest protected areas on longline fishery catch rates⁵



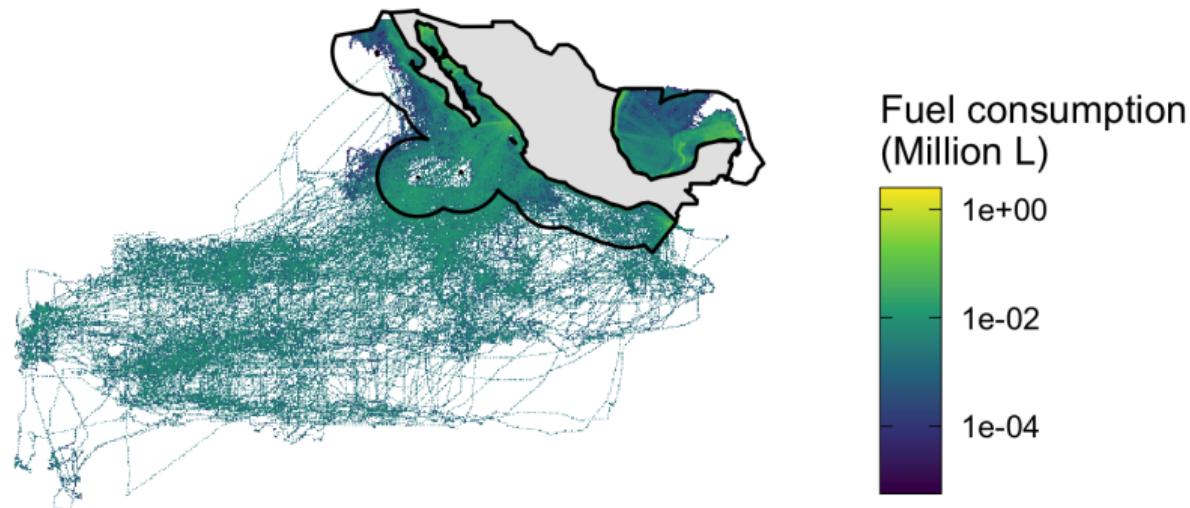
⁵Lynham et al., 2020, *Nature Communications*

Mexican fuel fisheries subsidies



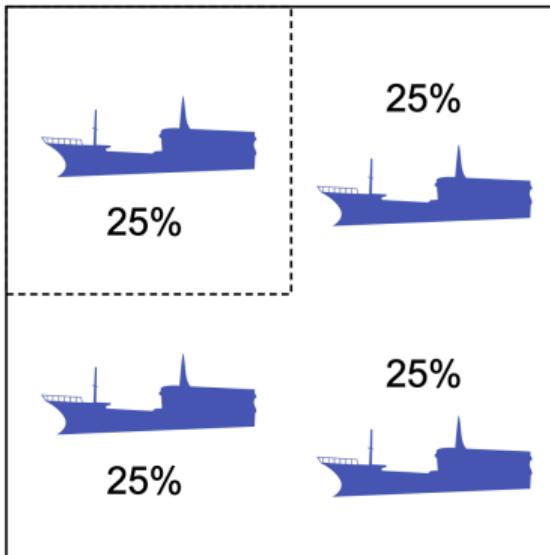
Mexican fuel fisheries subsidies

AIS-derived fuel consumption (2019)

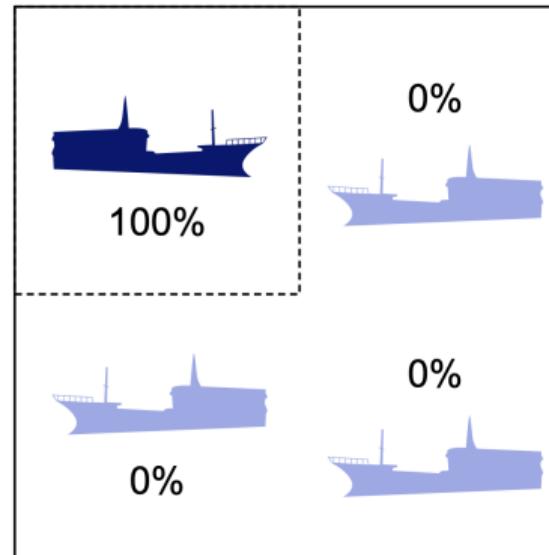


Customary use of ocean space

Aggregate



Distributional



Example of empirical setting: Revillagigedo MPA in Mexico

