Decision Science for Marine Spatial Planning



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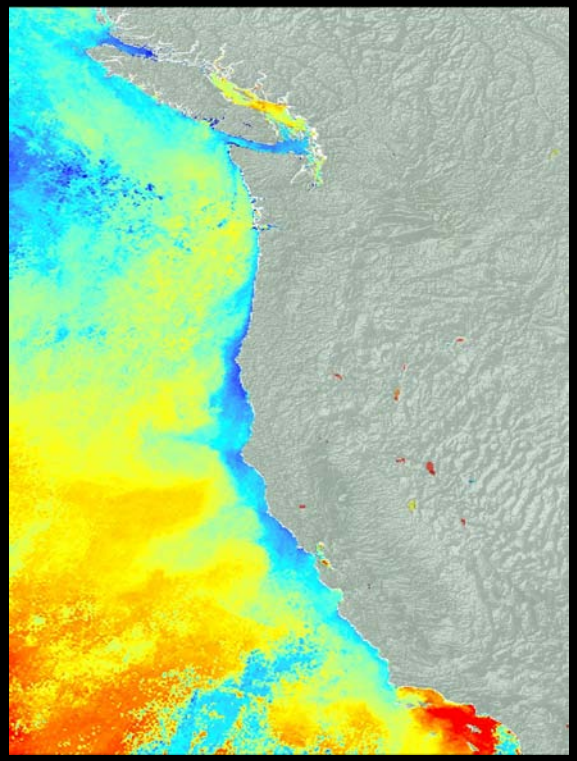
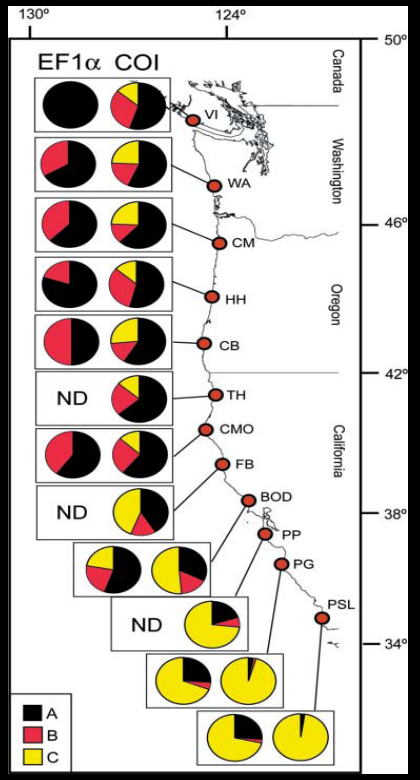
University of California, Santa Barbara





Functional Connections Play Key Role In Ecosystem Dynamics

Human Uses Are no Exception

LNG

Shipping

Fisheries

Desalination

MPAs

How do we Make Rational Decisions?

Chris Costello, Sarah Lester, Ben Halpern, Sarah Anderson, Steve Katz, Kristin Carden, Phil Levin

Wave energy

Coastal property

Recreation

Wind energy

Aquaculture

MSP is about Tradeoffs

- Multiple co-occurring activities is the norm
- Activities interact to affect ecosystem services
- Ignoring interactions creates unanticipated consequences and potential conflicts

Analysis of Tradeoffs Must Be:

- ✓Transparent
- ✓Explicit
- ✓Flexible
- ✓Useful to managers and stakeholders

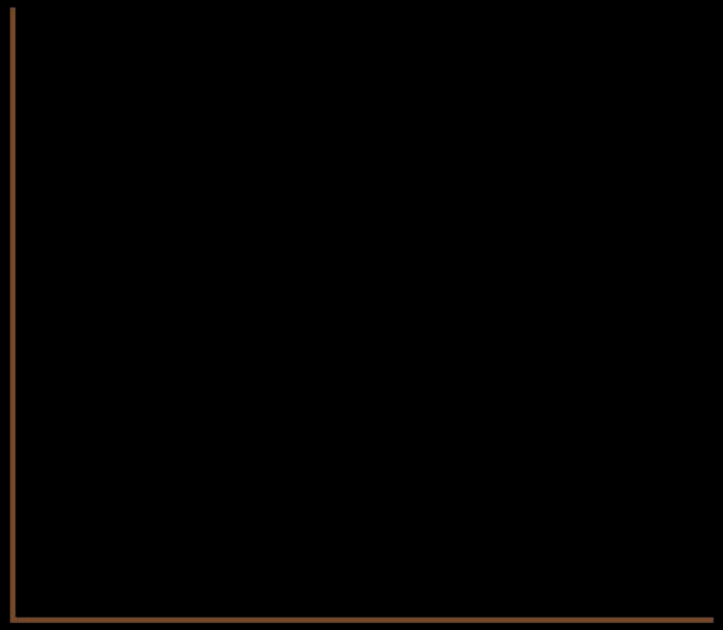
Ecosystem Service Tradeoff Analysis

- Developed from basic economic decision theory
- Visualizes relationship between 2 or more services

Potentially interacting services

e.g., urchin yield, tourism profits, biodiversity, wave energy

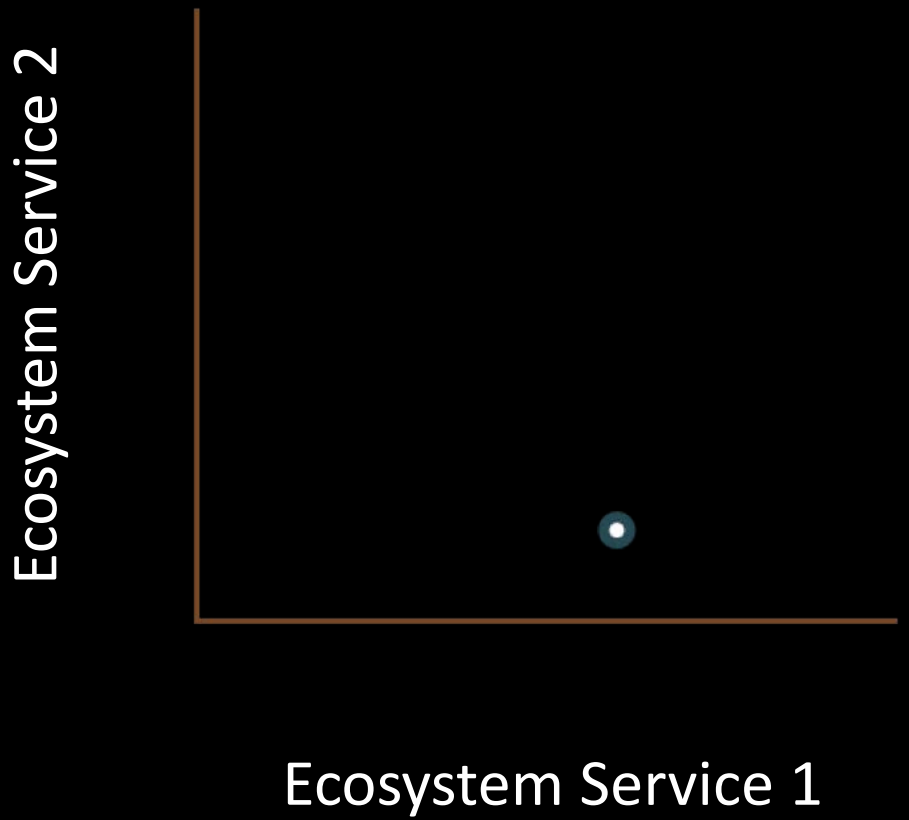
Ecosystem Service 2



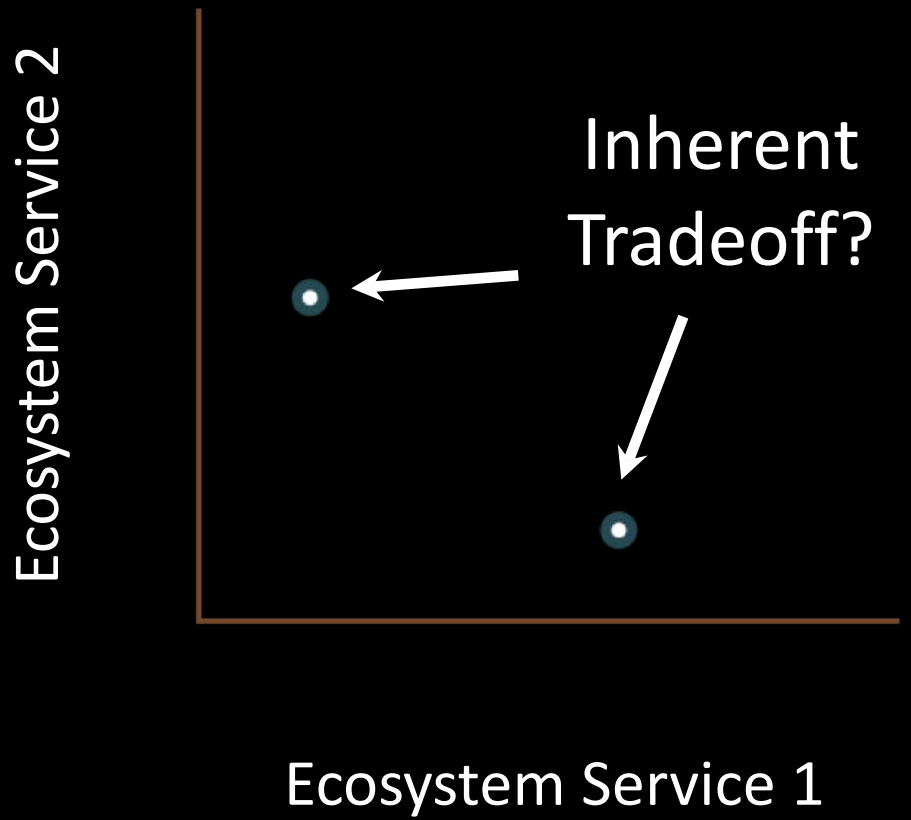
Ecosystem Service 1

e.g., lingcod yield, shoreline protection, aesthetic value, aquaculture

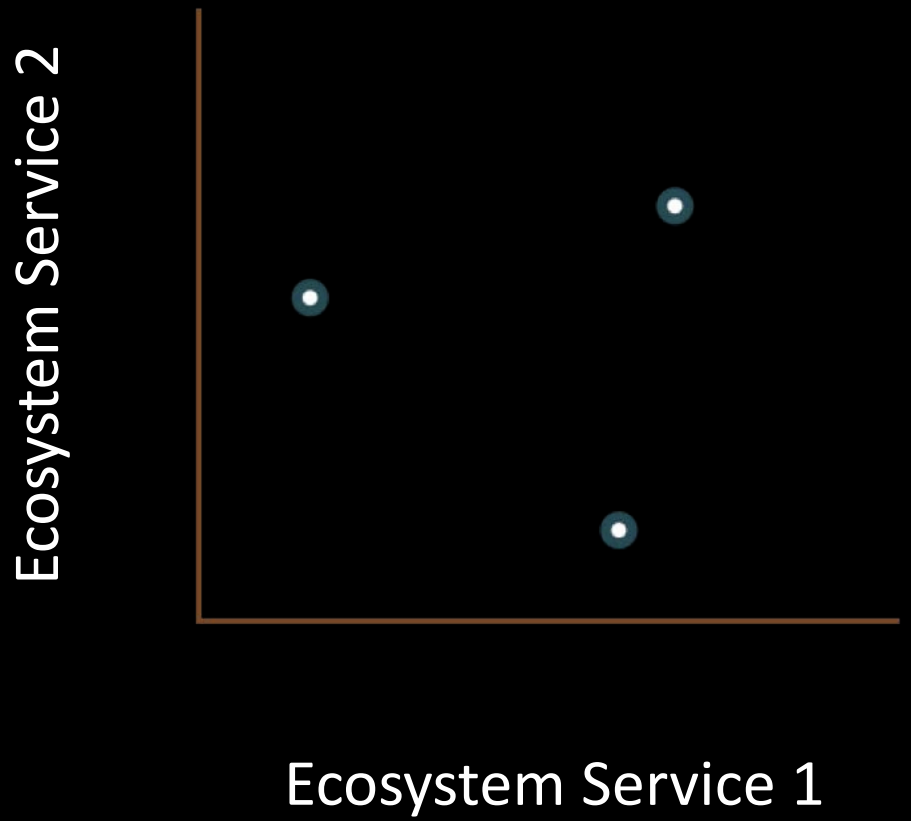
Any management action yields an ecosystem services outcome



Different actions yield different ecosystem services outcomes

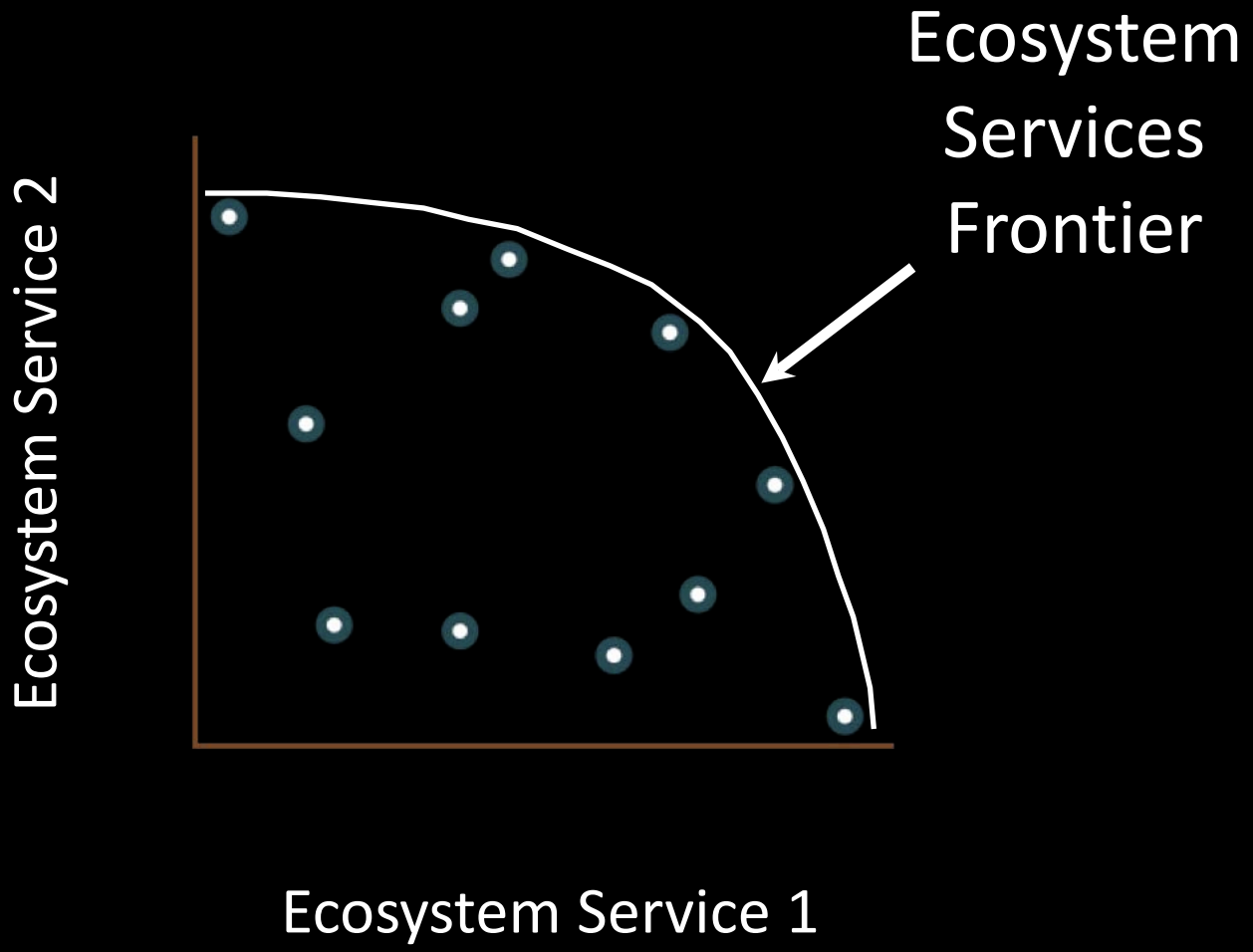


How can you distinguish between trade-offs and suboptimal decisions?

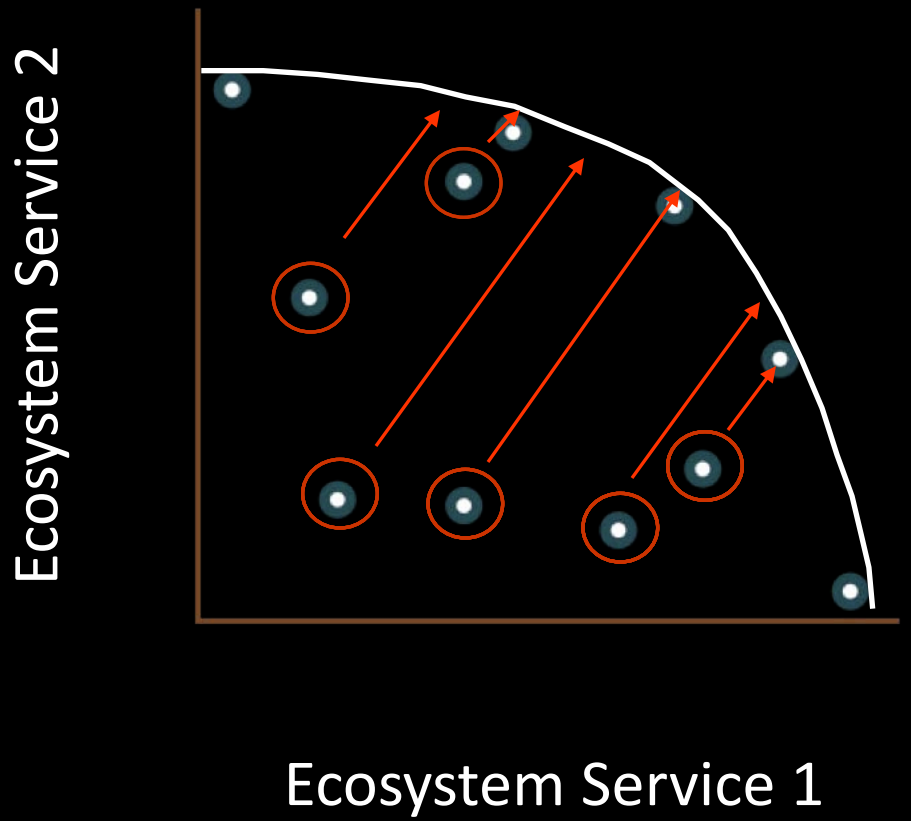


Explore all management options

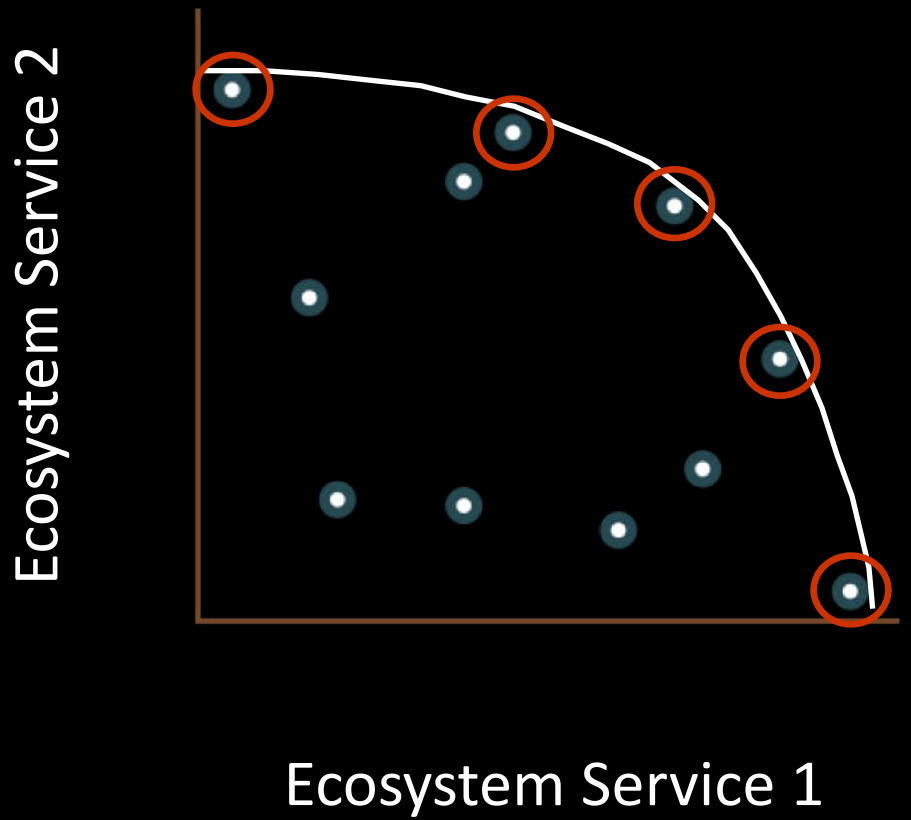
Management options that maximize two services combined lie on the frontier



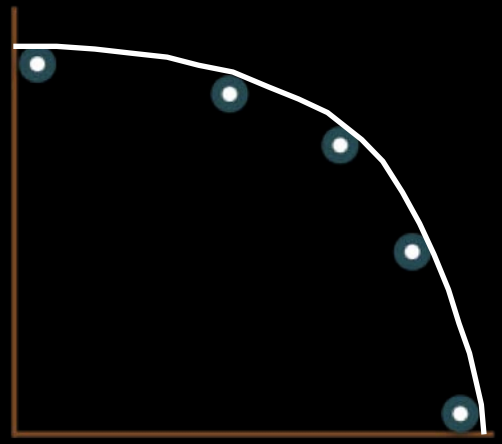
Reveals sub-optimal decisions



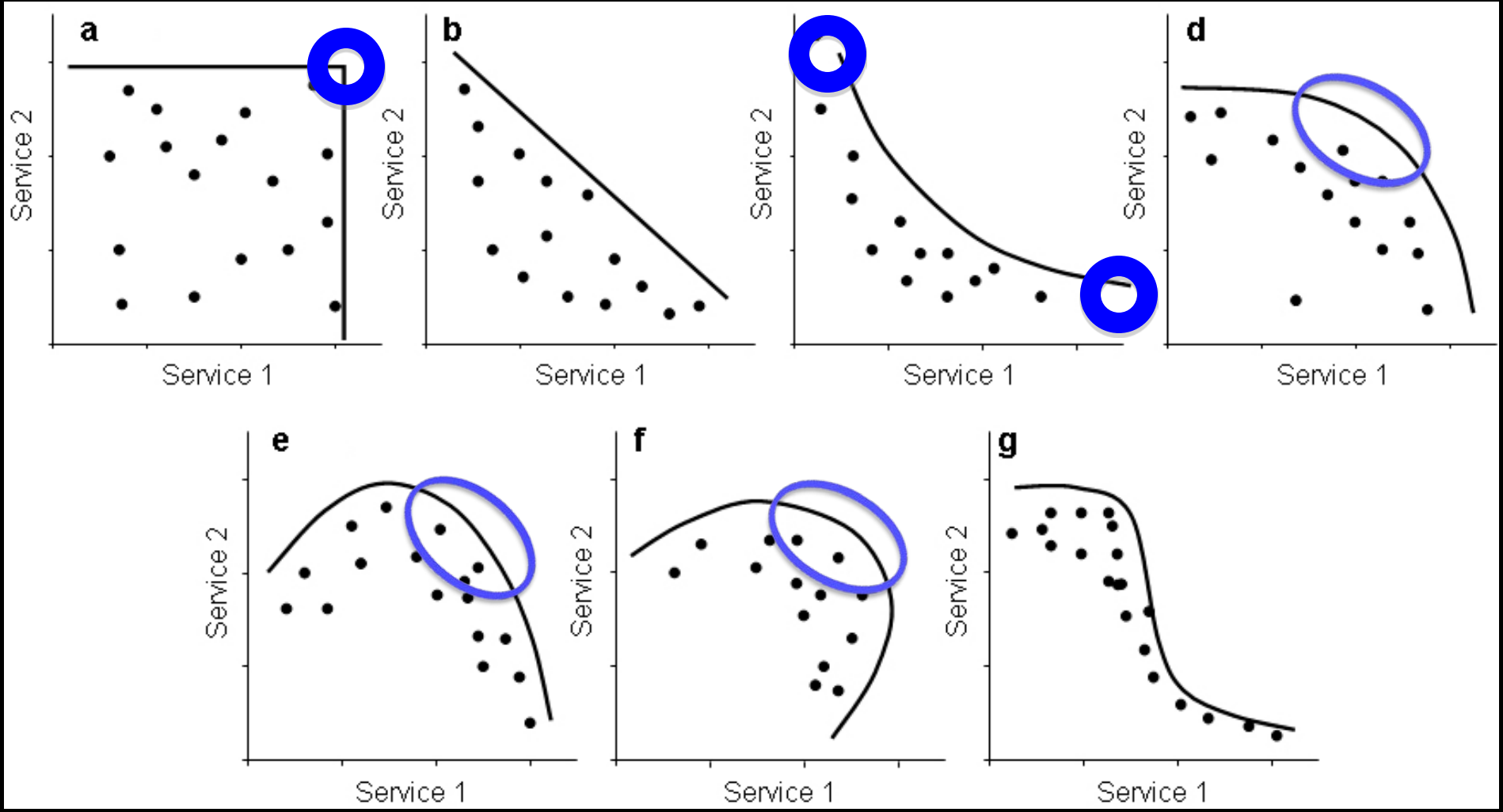
Choosing among optimal solutions depends on societal values/preferences



Does the frontier always have this shape?



The shape of the frontier provides important information

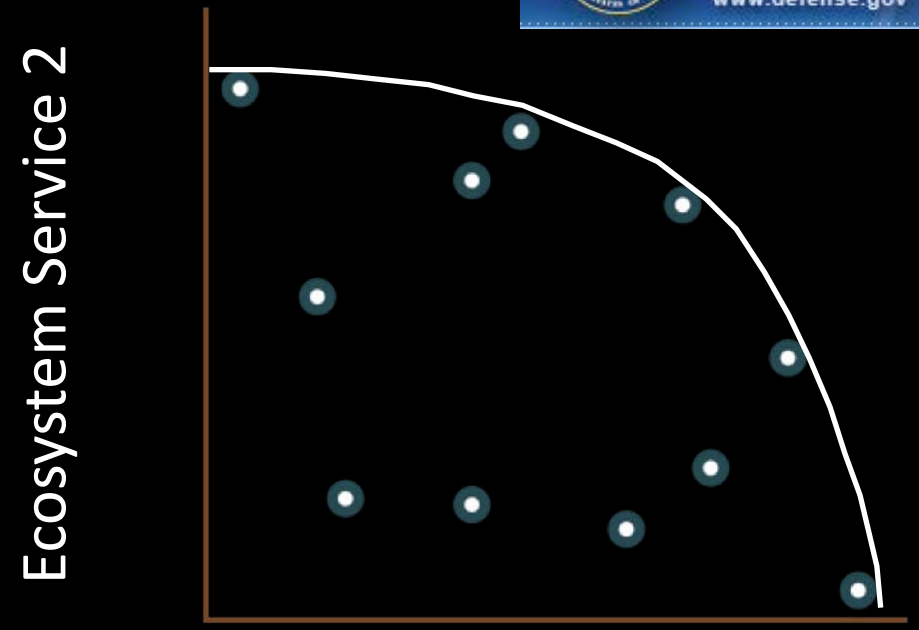


The Cost of Institutional/Legal Bottlenecks

NMFS

FWS

FERC



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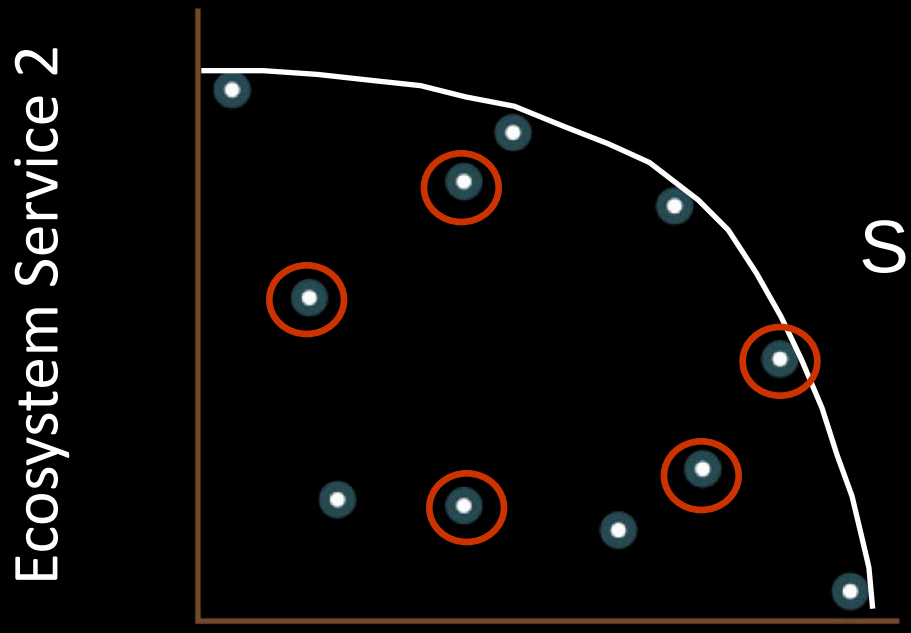
The Cost of Institutional Bottlenecks



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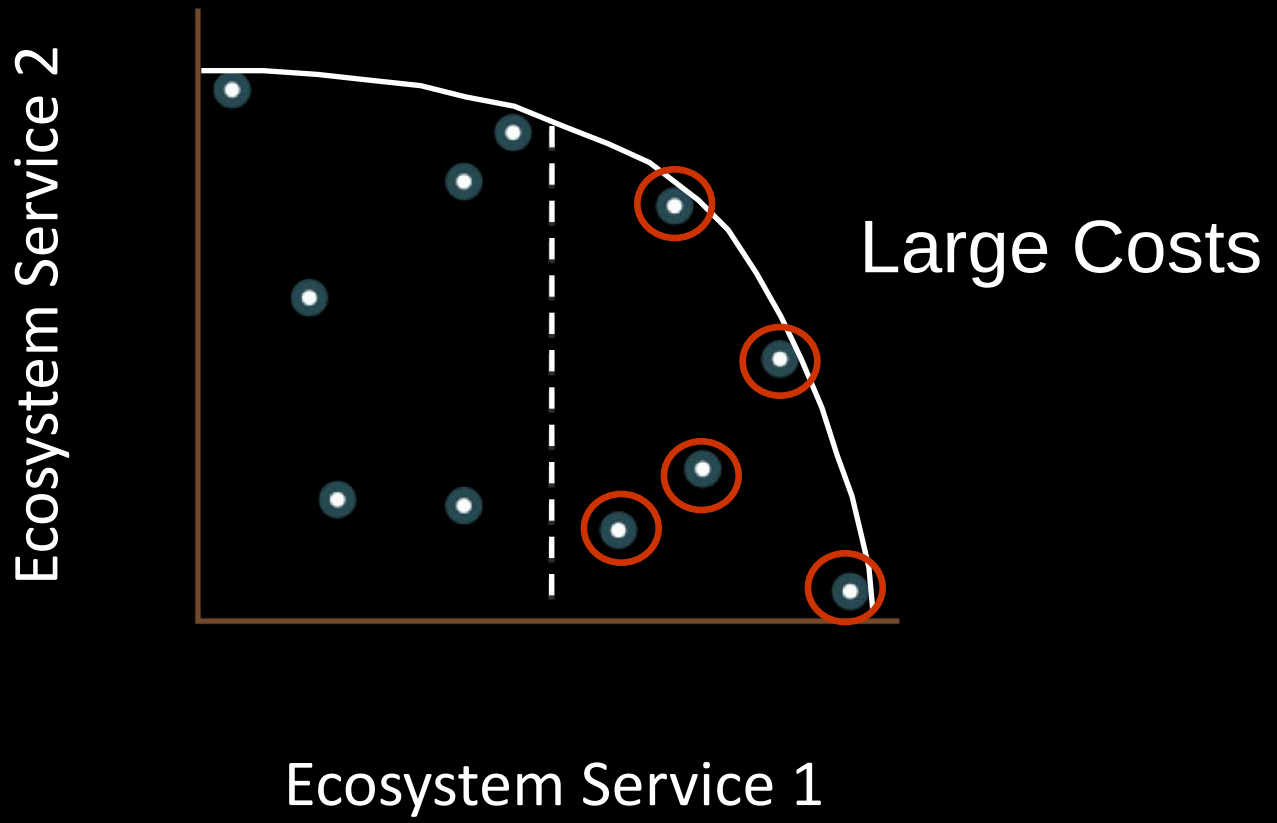
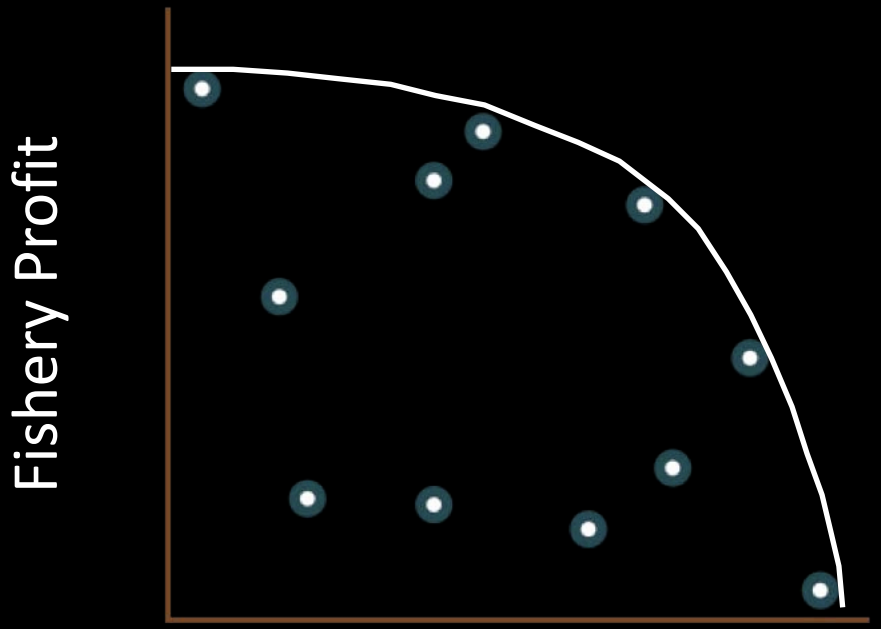


Example: Fisheries vs. Conservation



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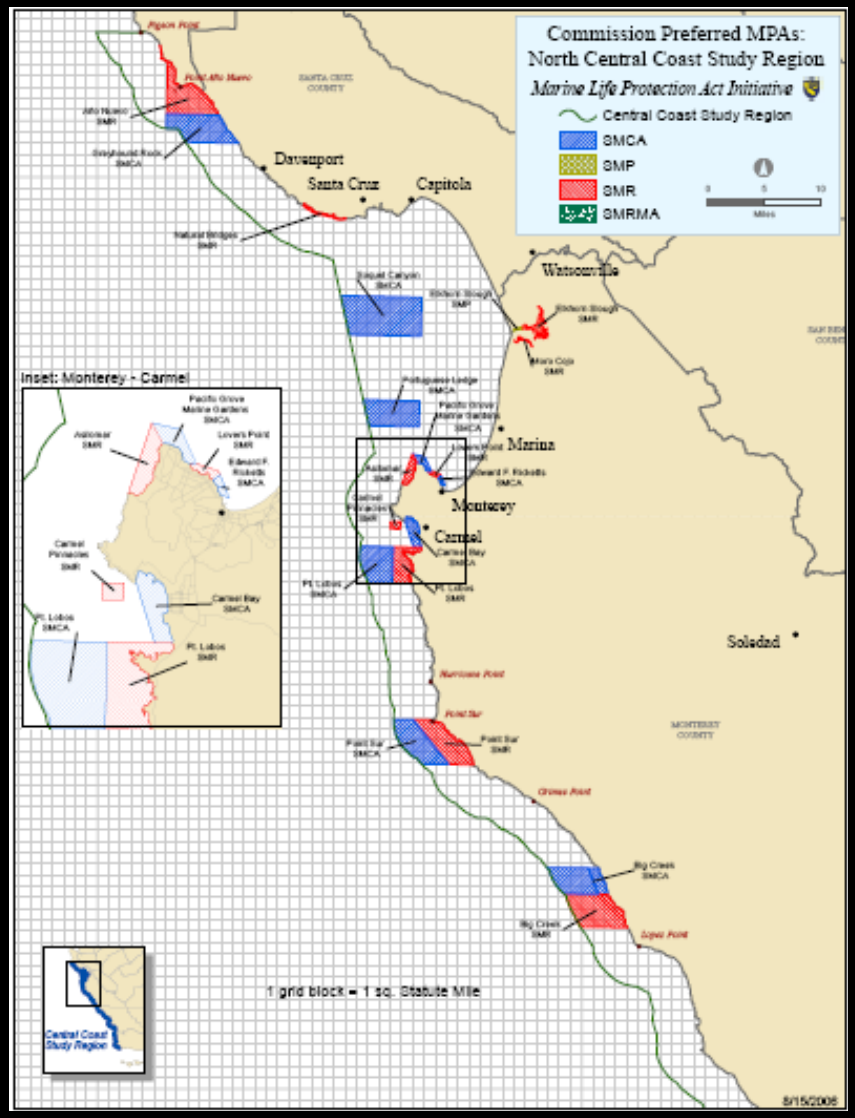

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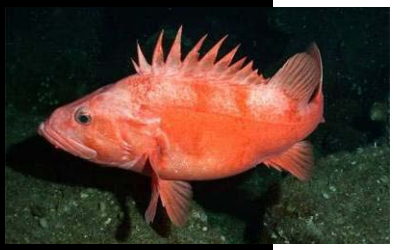

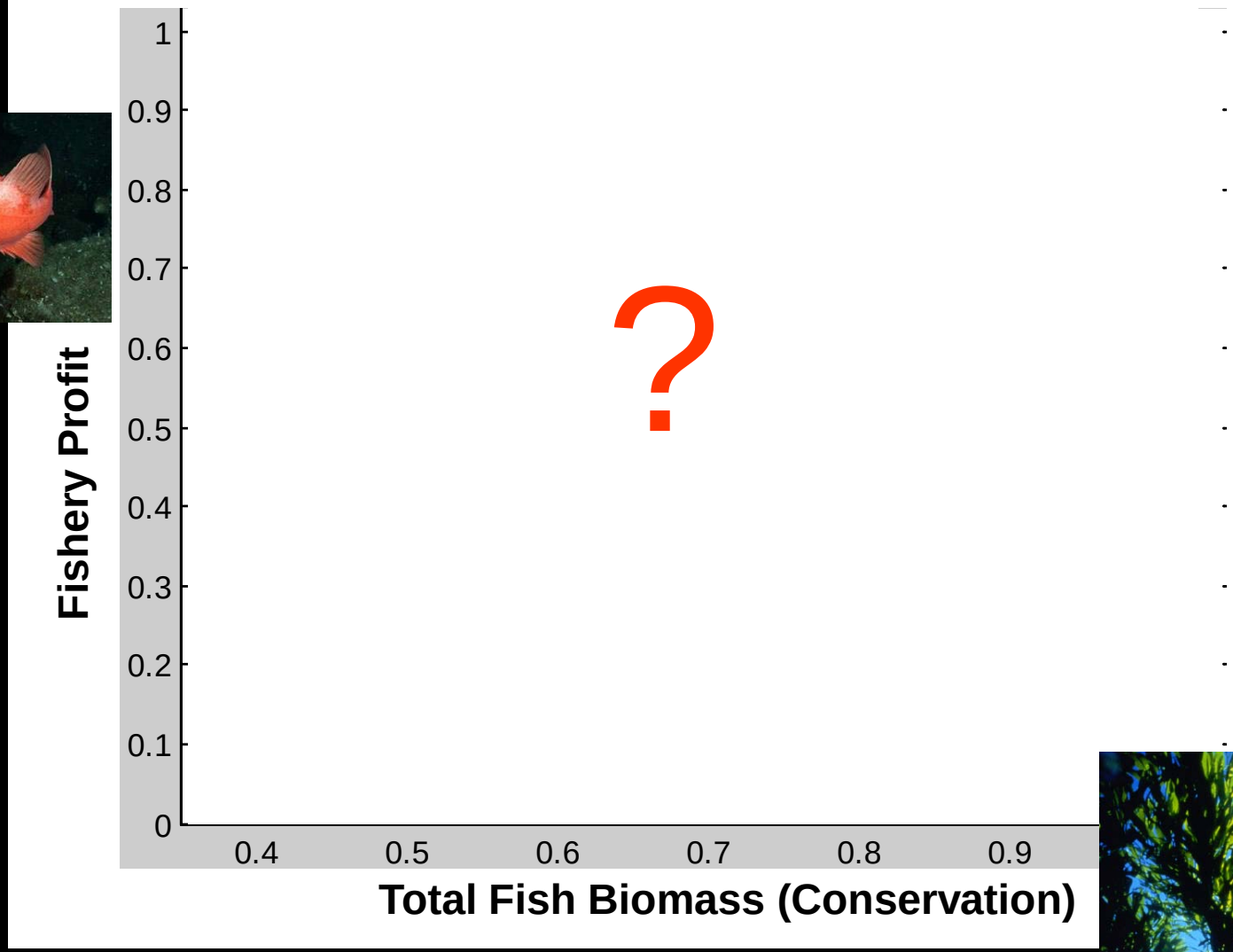

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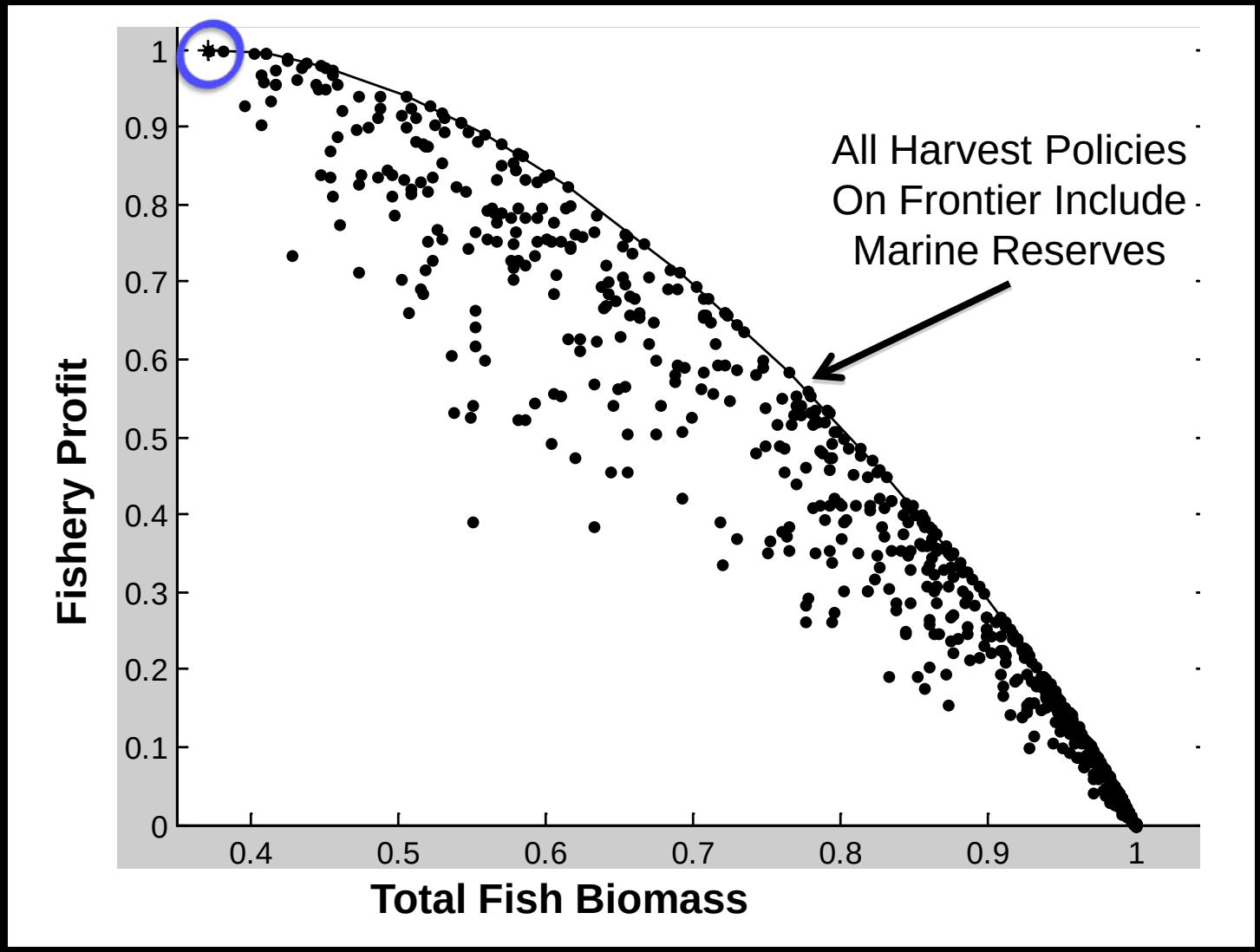


Applying tradeoff analysis to emerging ocean uses

LNG

Desalination

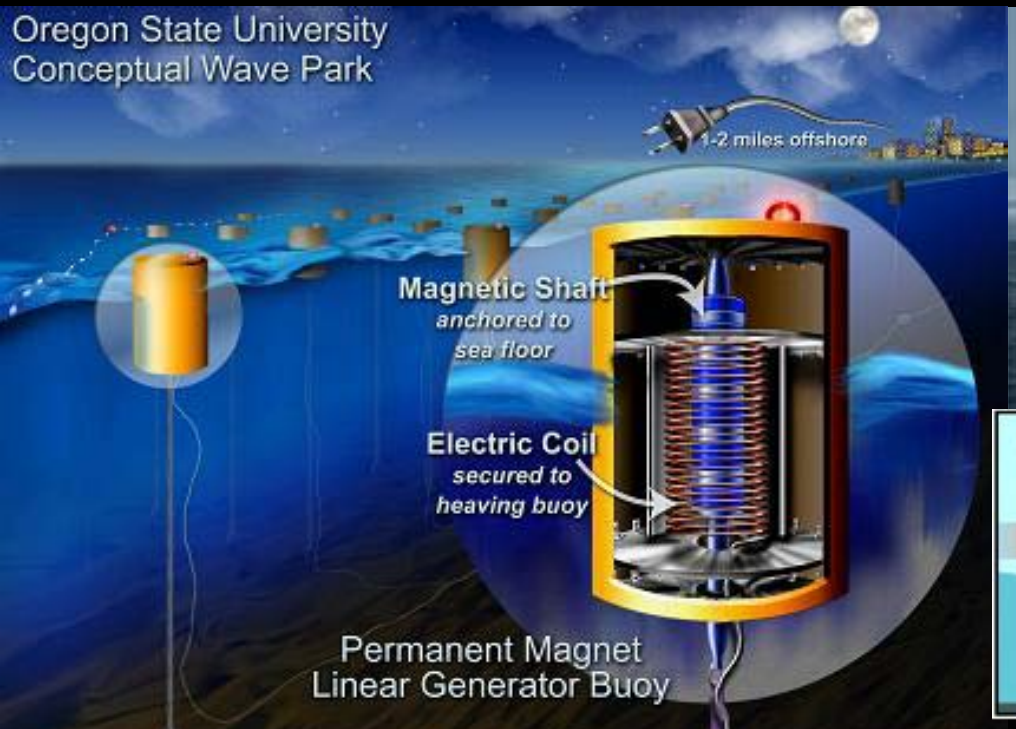
Wave energy

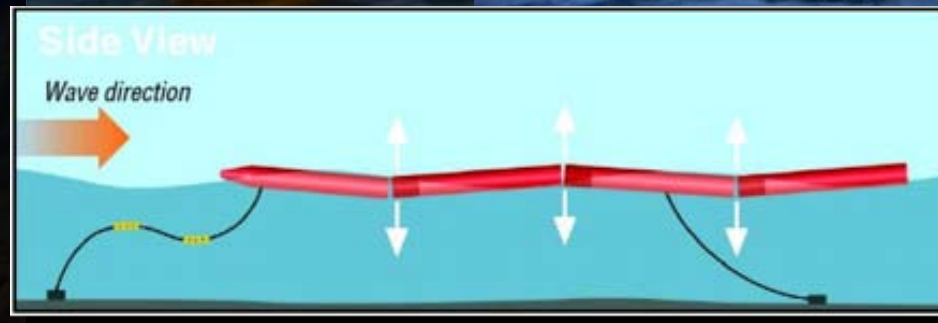
Wind energy

Aquaculture

Many competing technologies

- pistons and forced air
- hinged, articulating
- wave overtopping
- Faraday principle

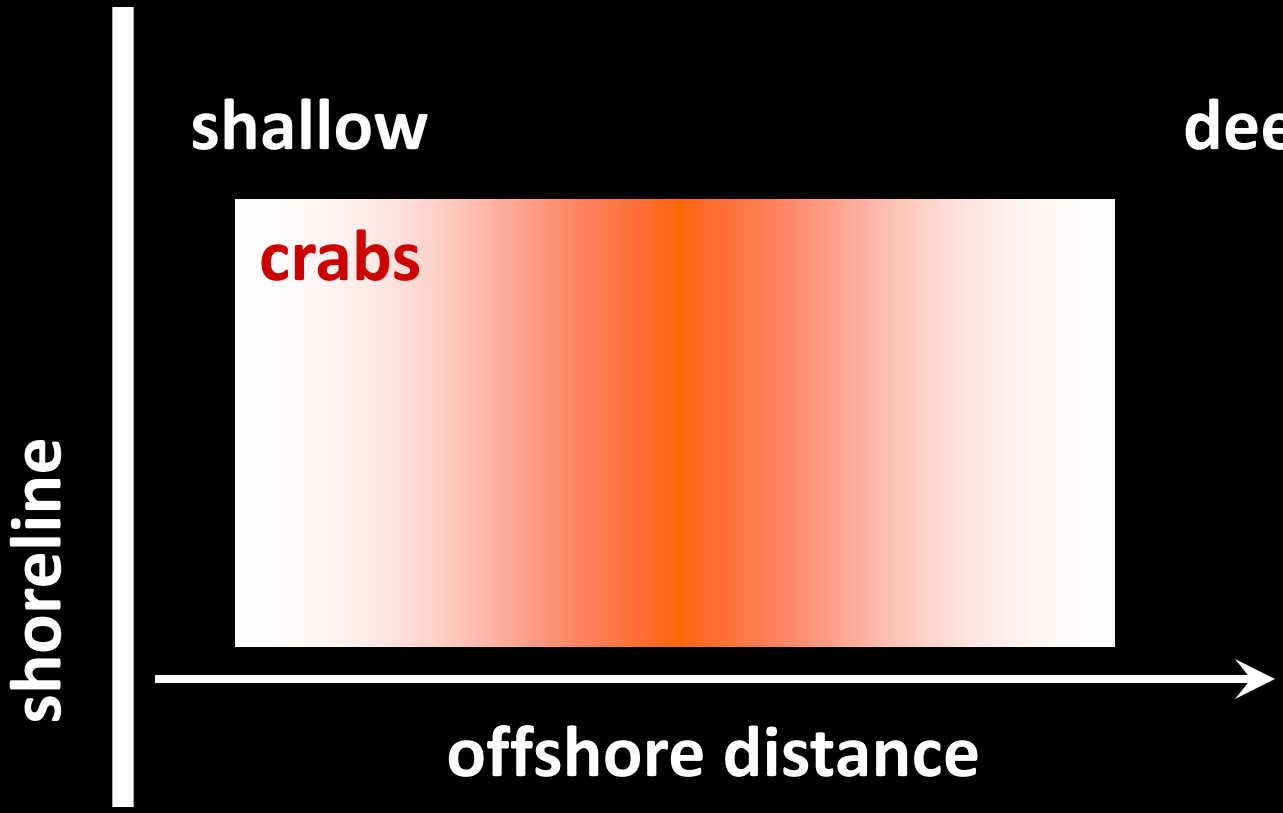




Crab fishery, wave energy & coastal property value

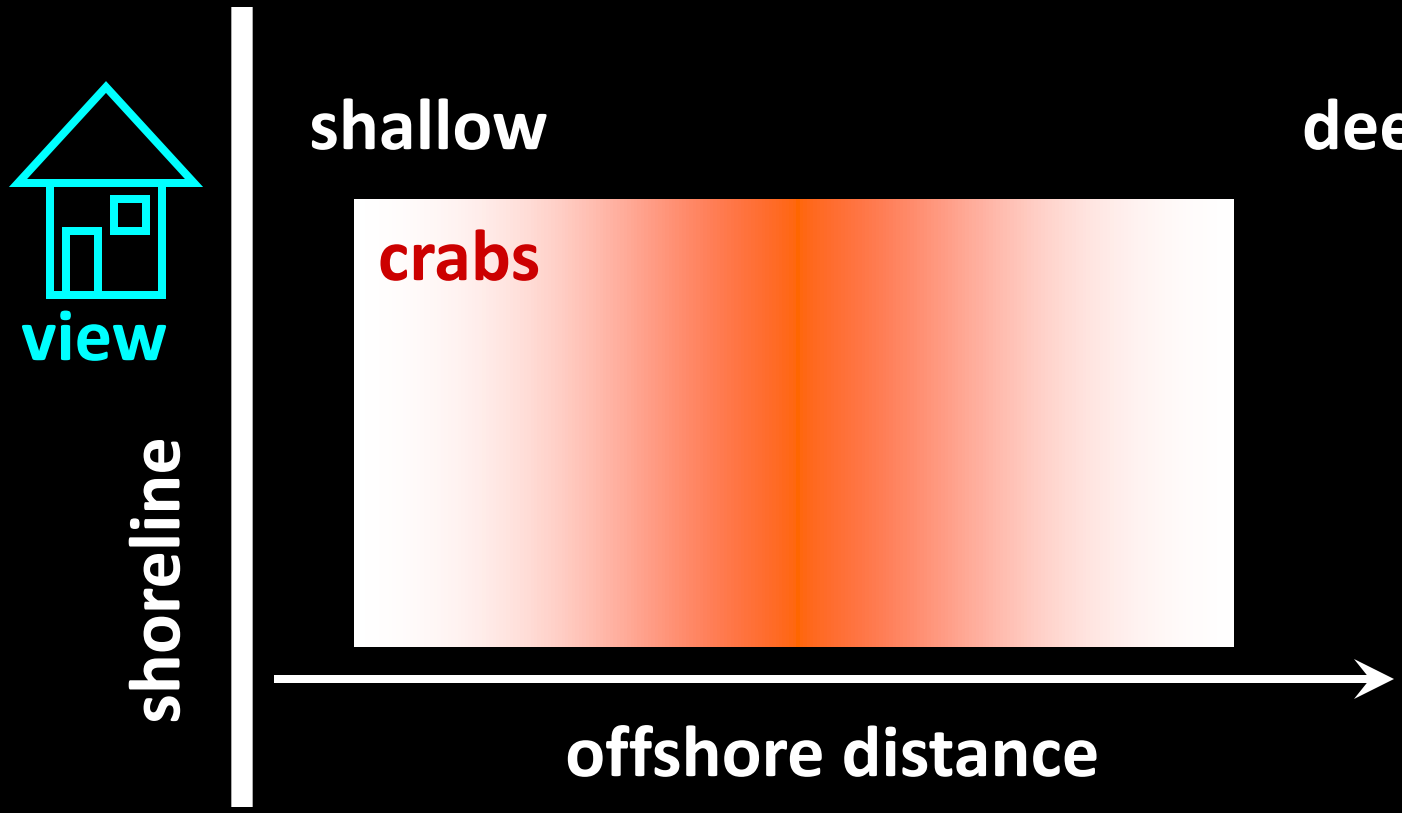
Crab fishery, wave energy & coastal property value

- What distance from shore to site wave farm?
- Estimate value of fishery per km (from 3-9km offshore)
- Assume WE displaces crab fishing with no benefits



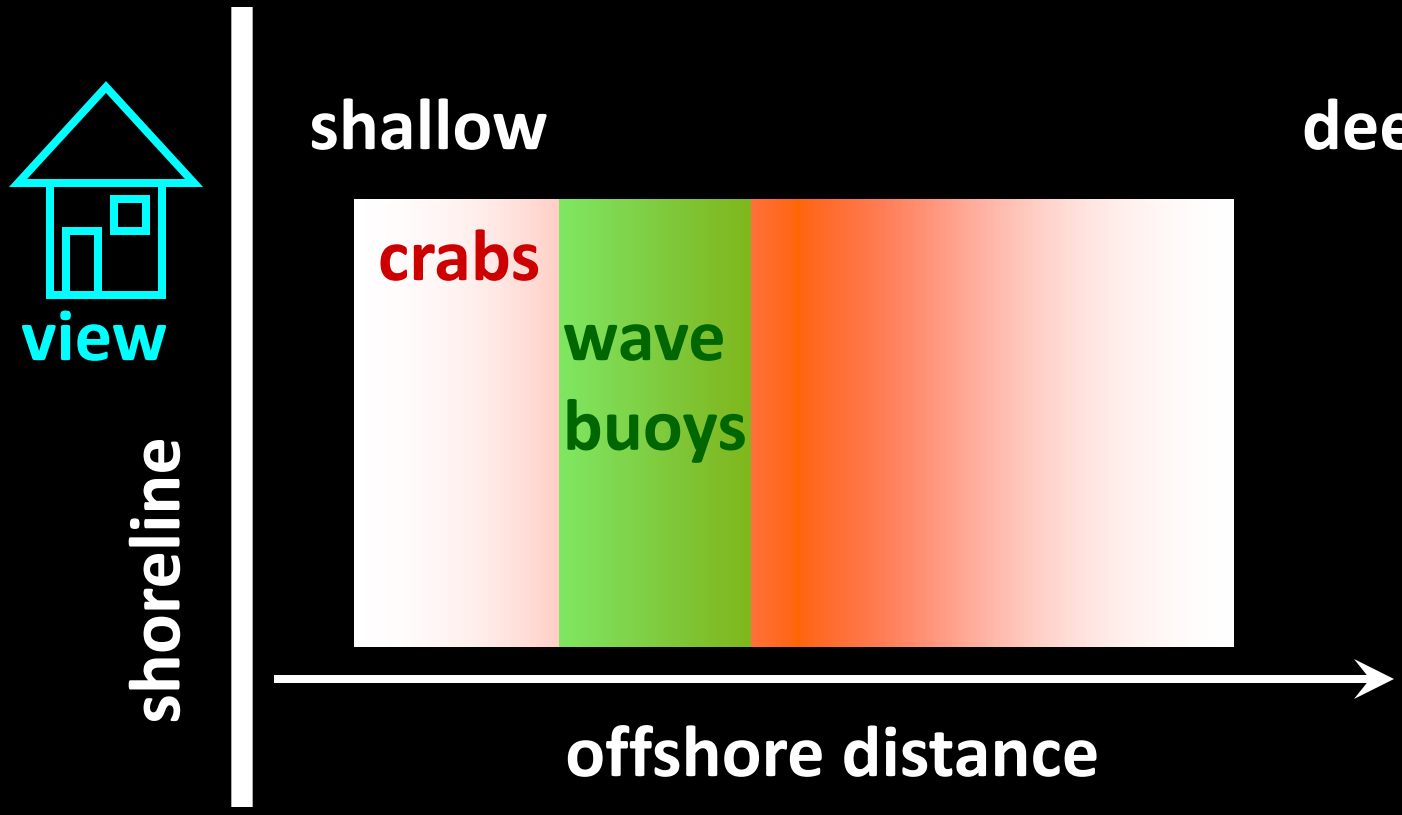
Crab fishery, wave energy & coastal property value

- What distance from shore to site wave farm?
- Estimate value of coastal real estate
- WE reduces value by amount of view impacted by buoys

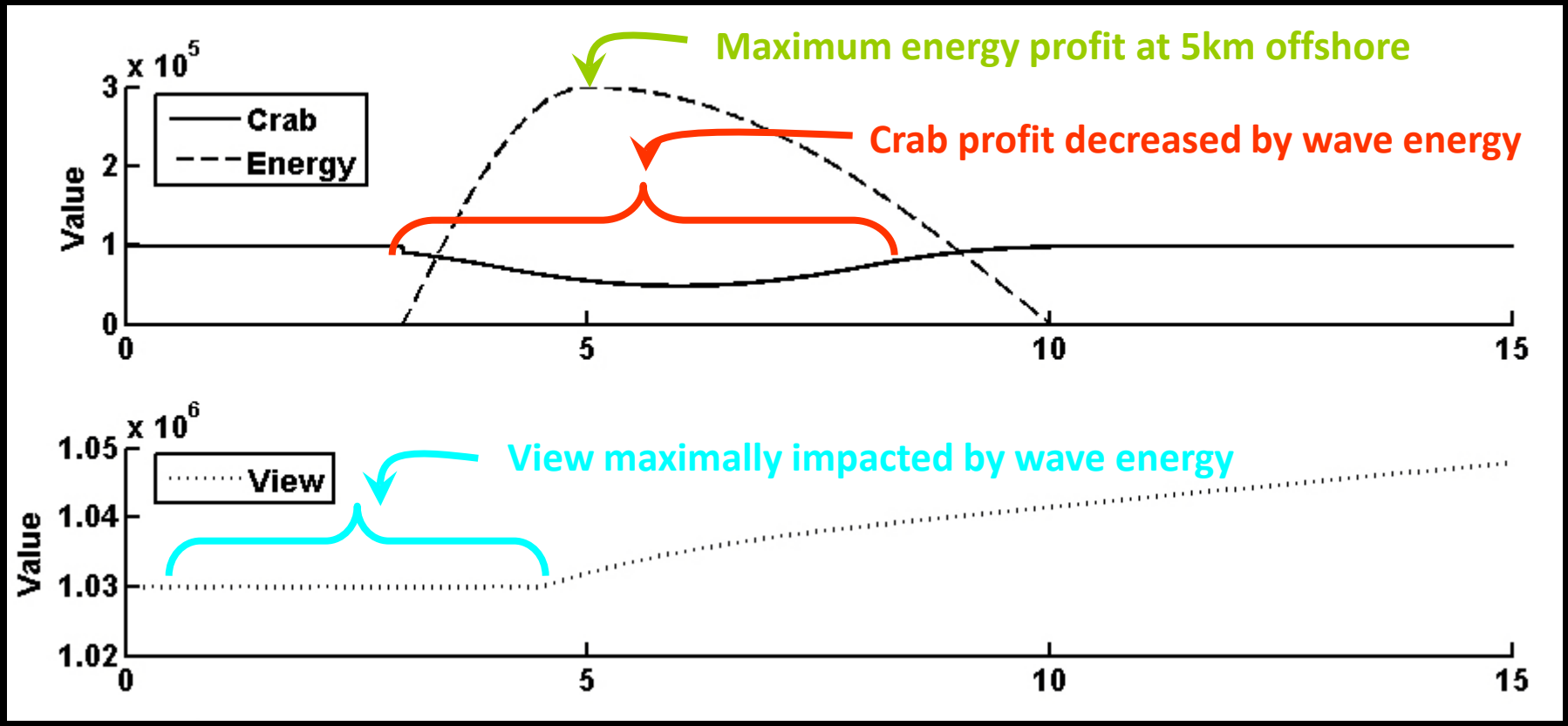


Crab fishery, wave energy & coastal property value

- What distance from shore to site wave farm?
- Estimate value of wave energy per km (from 3-10km)
- Evaluate range of offshore distance siting options



Putting the pieces together



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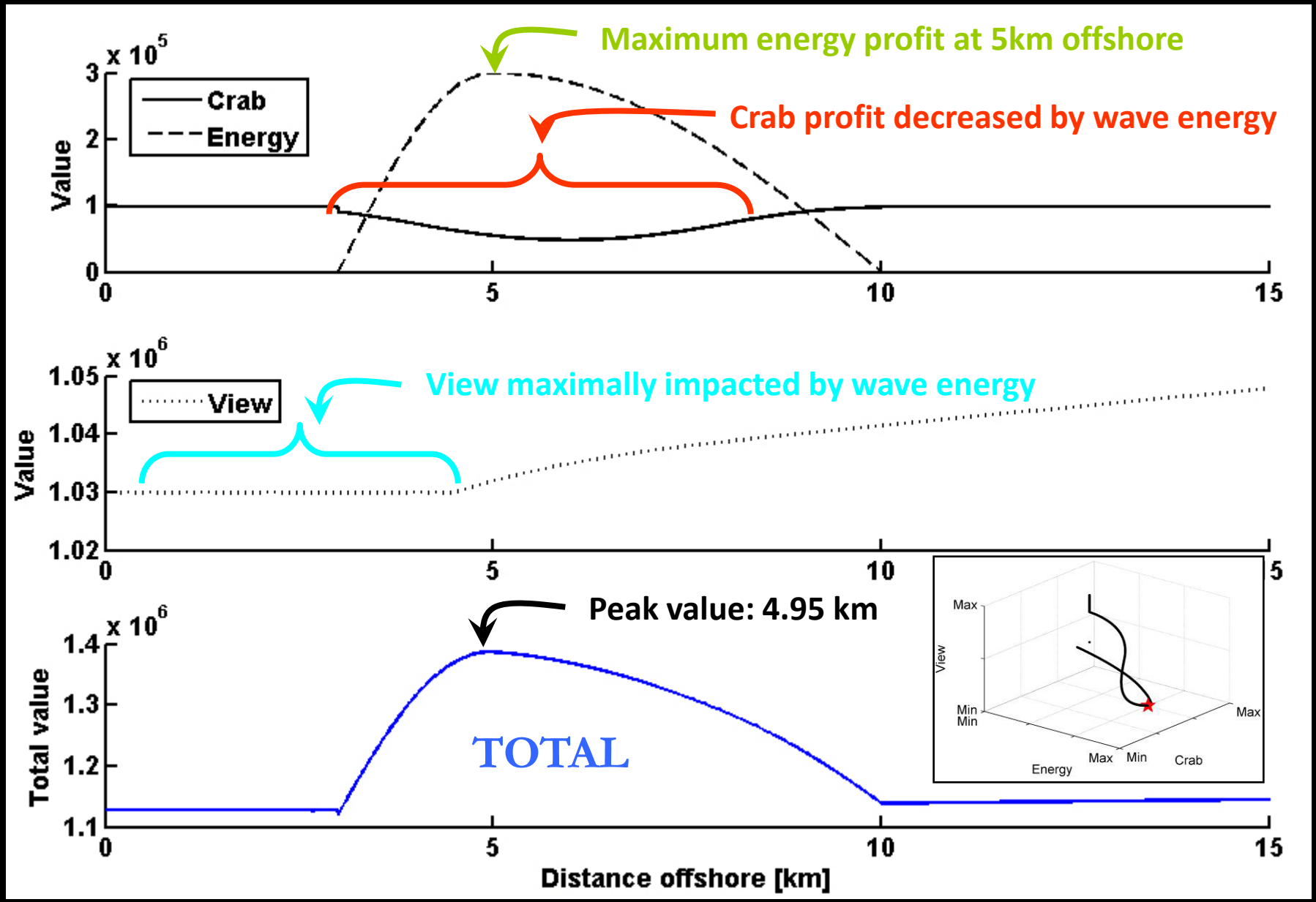

Adding More Reality

- Coastal Erosion
- Barriers to Movement (boats, mammals)
- Benefits to Fisheries?
- Alongshore Locations




Benefits of an MSP Decision Framework

- Separates Real Tradeoffs from Poor Decisions
- Identifies Critical Science Needs
- Measures Costs of Ignorance & Suboptimal Governance