Fishery Markets and Large-Scale Marine Conservation

Gaines Lab

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Outline

- Background and motivation
- Scope of the project
- Approach
  - Model and assumptions
- Model predictions
- Phoenix Island Protected Area*
- Palau National Marine Sanctuary
- Conclusions

Background and motivation

Motivation

- Only 3% of the ocean under "fully protected" MPAs
- Goals to meet 10 - 30%
- Opportunity costs of closing areas to fishing
- How do we incentize conservation?

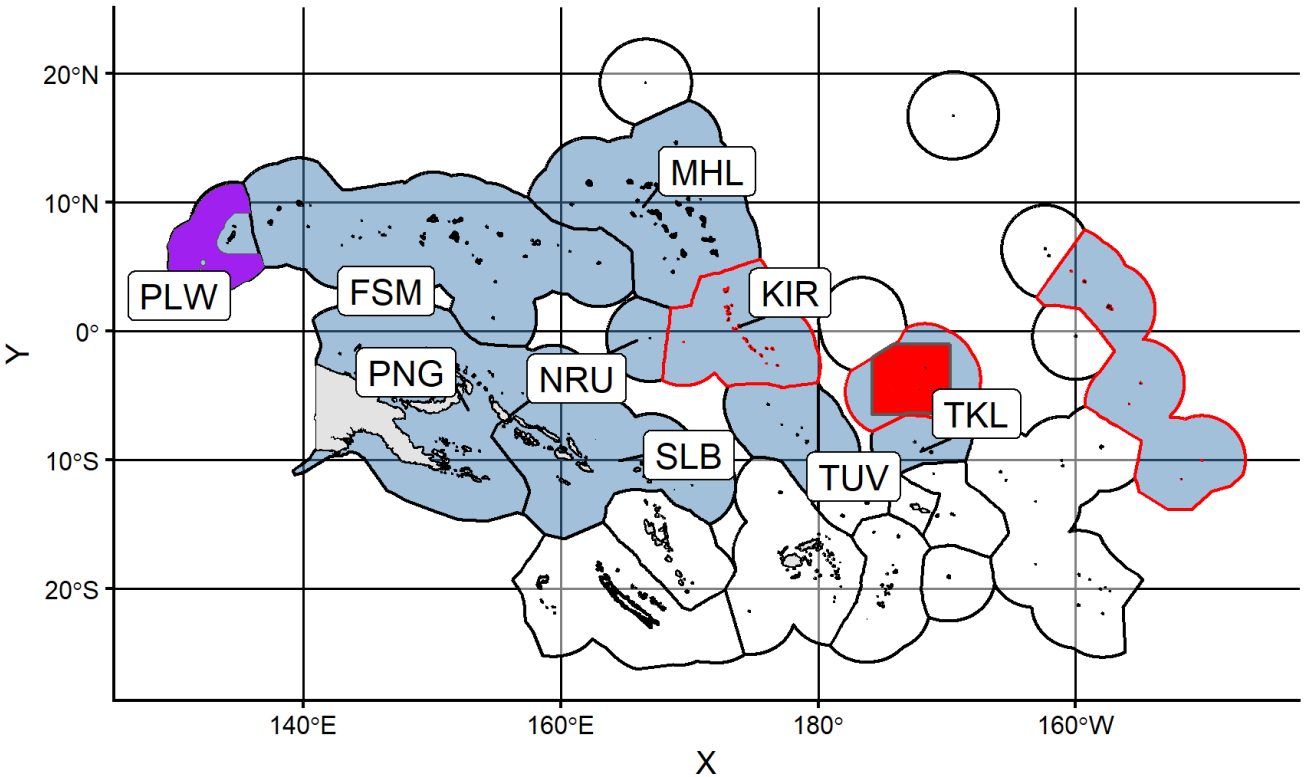
Motivation

Guiding question

- Will rights-based approaches to managing natural resources facilitate, or impede large-scale conservation?
- Vessel-day scheme in the PNA region may hold the answer

Motivation

Motivation


20°N
10°N
0°
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Y
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X
PLW
FSM
MHL
KIR
PNG
NRU
TKL
SLB
TUV

Scope and Approach

Scope

Can economic instruments incentivize conservation?

- For the countries:
  - Does a 30% closure mean a 30% effort displacement and therefore a 30% loss in revenue?
  - What are the costs associated to establishing an MPA?
  - What factors drive these costs?
  - Can these costs be reduced or eliminated by appropriately designing markets?
- For the fishing vessels:
  - Where was effort displaced to?
  - How do they respond?

Approach

- 10-patch spatial bioeconomic model of the tuna fishery
  - 9 patches under VDS
  - one patch under Open Access
- Profits from fishing in patch i are:

$$\Pi_i = pqE_iX_i\Omega_i - cE_i^{\beta}$$

$$\Omega_1 = \theta + (1-\theta)(1-R)$$

- Vessel-day price must equate the marginal profits from the last unit of effort in patches $i = (1, 9)$

$$\pi_i = pqX_i\Omega_i - \beta cE_i^{\beta-1}$$

Approach

- Patch-level effort is then

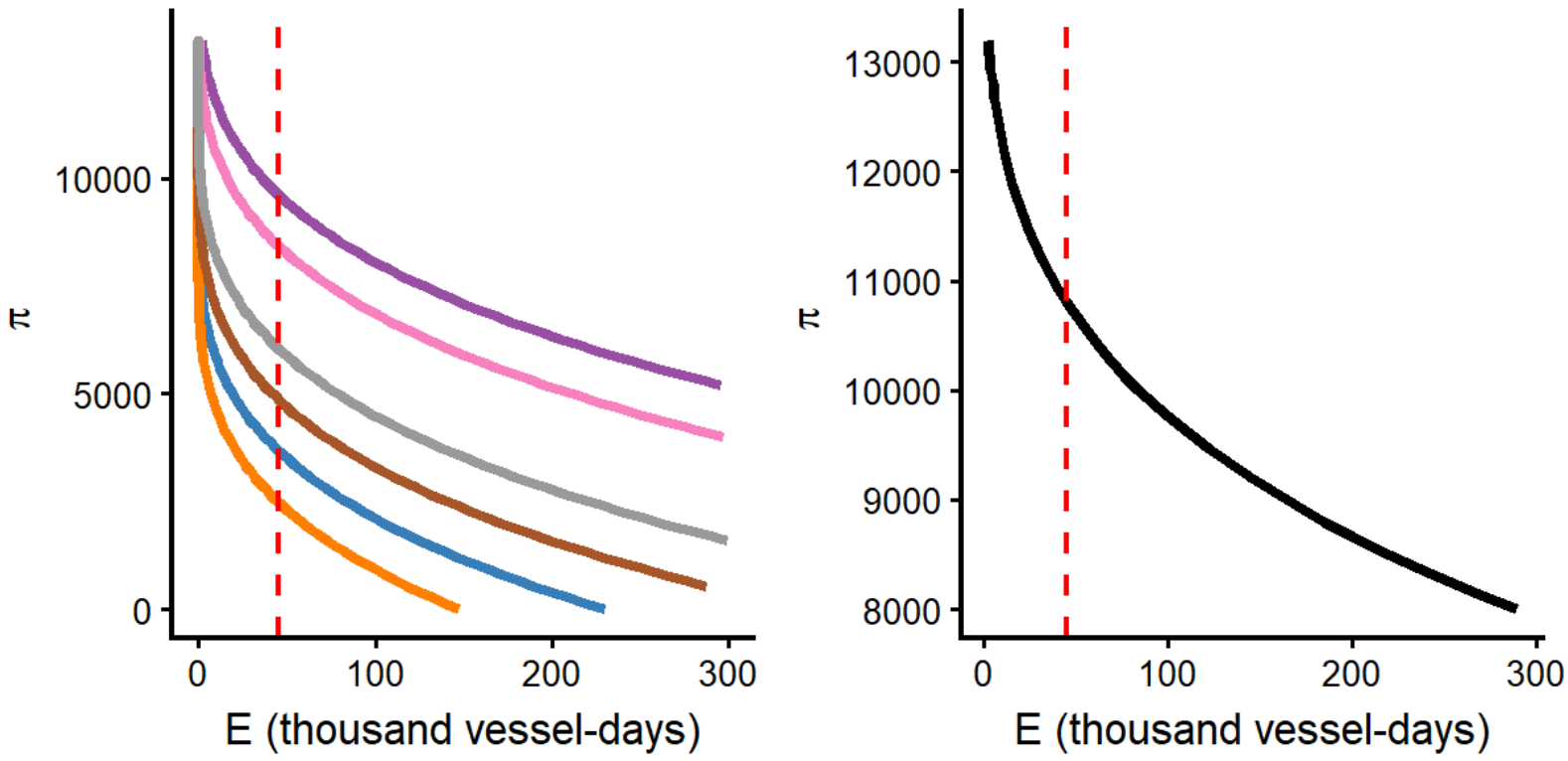
$$E_i = \left(\frac{pqX_i\Omega_i - \pi_i}{\beta c} \right)^{\frac{1}{\beta - 1}}$$

- Effort is capped at 45,000 vessel-days ($\bar{E}$)

$$\bar{E} = \sum_{i=1}^{9} \left(\frac{pqX_i\Omega_i - \pi}{\beta c} \right)^{\frac{1}{\beta - 1}}$$

Approach

- Measure country-level demand curves
  - No trading: price is patch-specific
  - Trading: price is the same for all patches



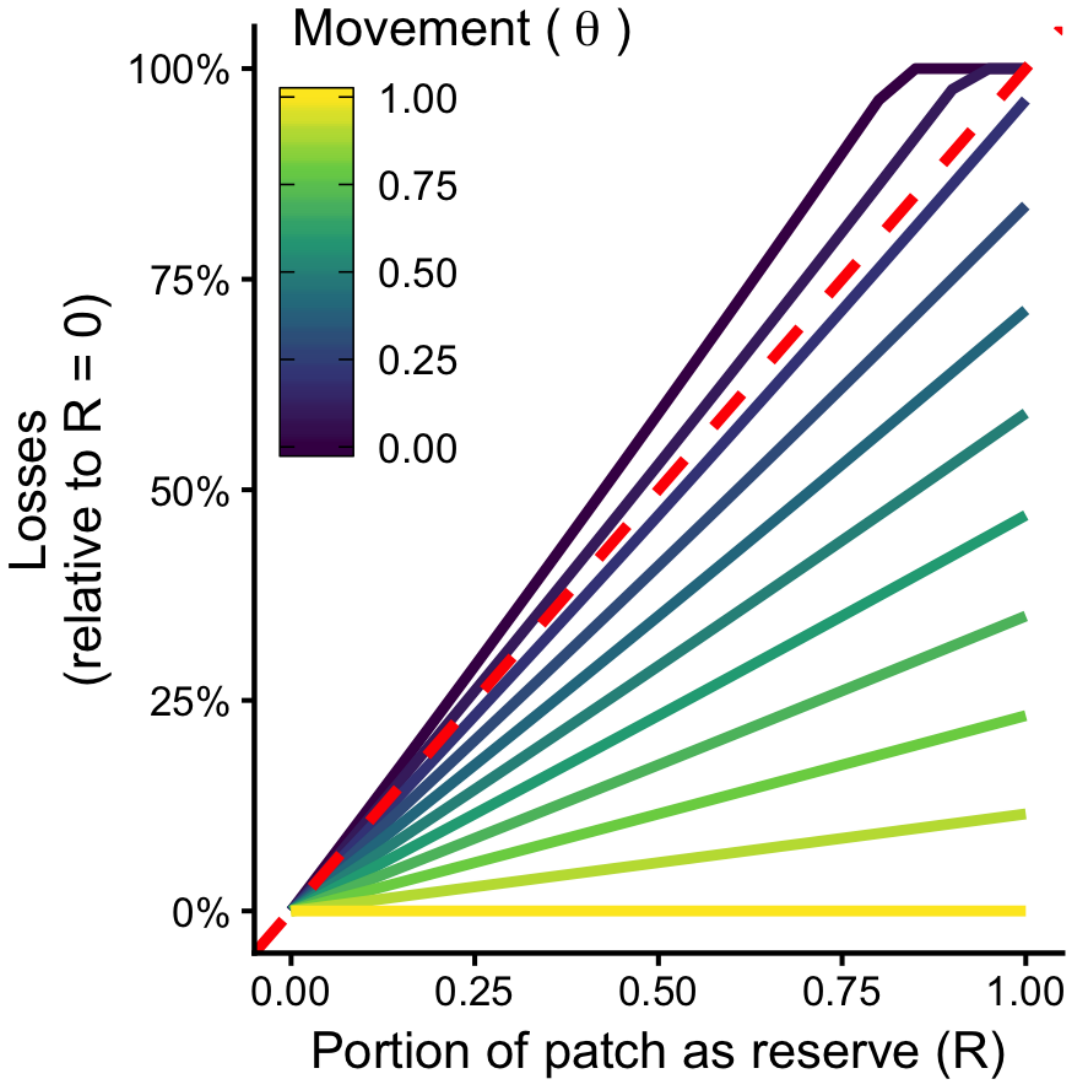
Model predictions

Model predictions

Relationship between closure size and losses

Does a 30% closure mean a 30% loss in revenue?

Losses with no trading

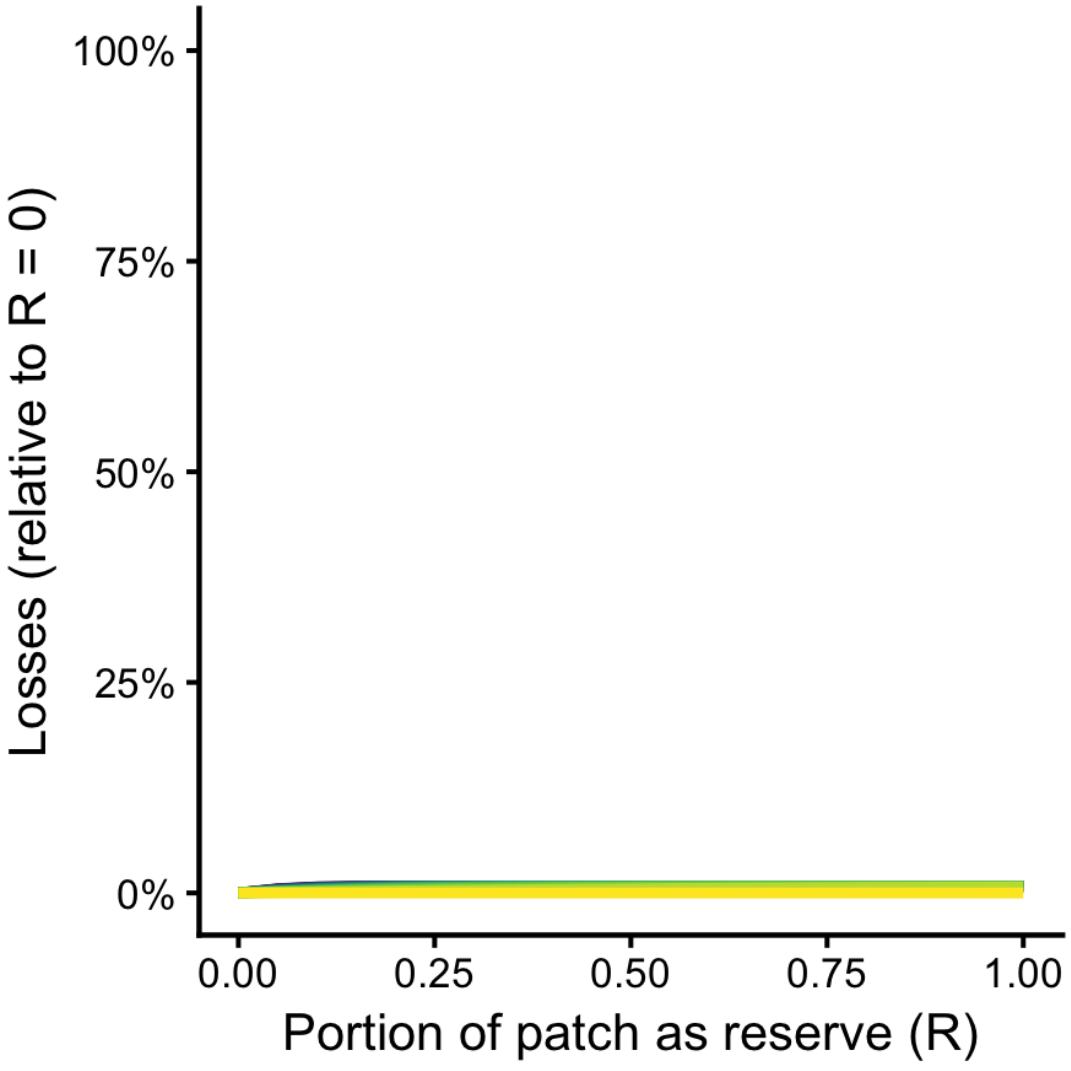


Model predictions

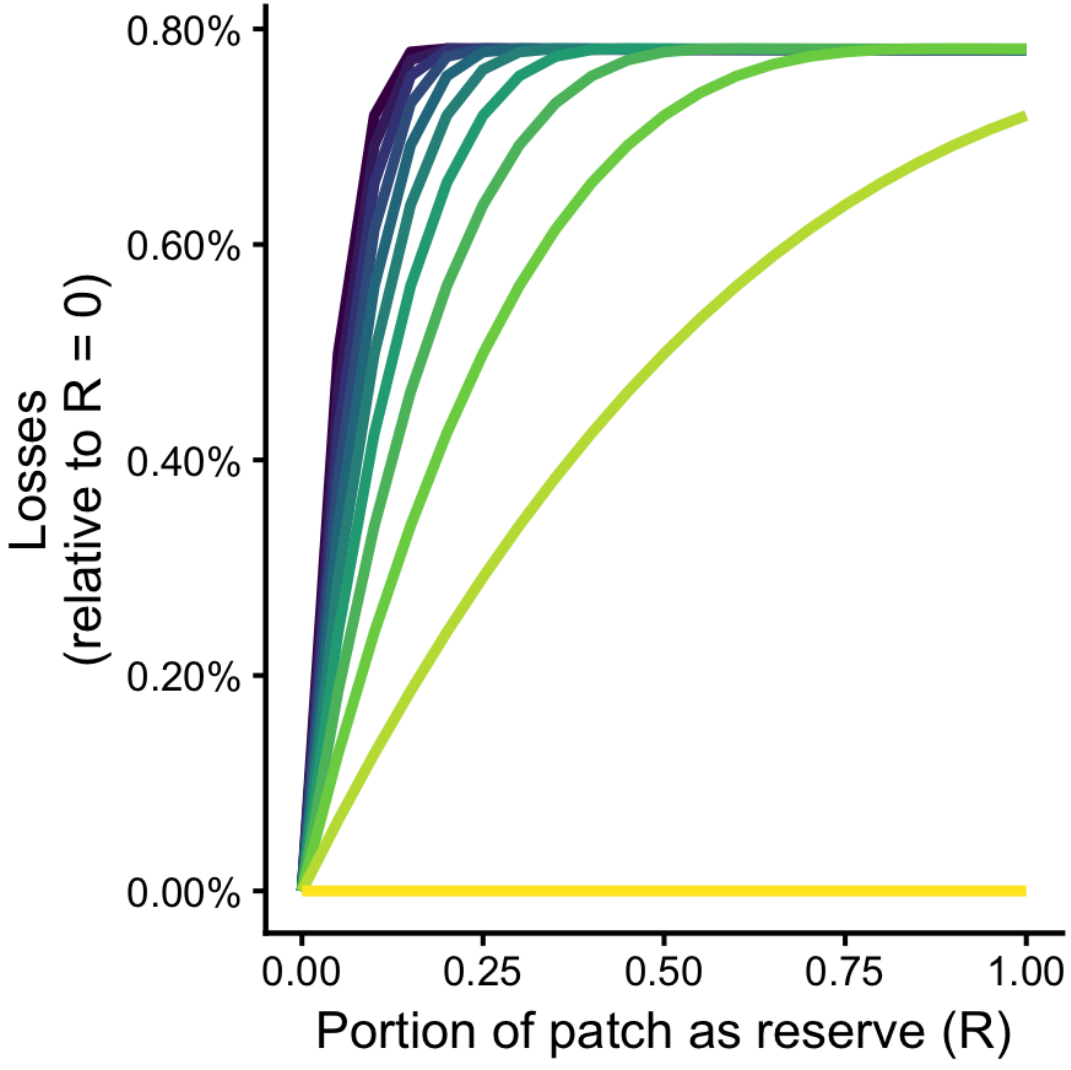
A market for fishing efforts

- What is the effect of trading?
- Can costs be reduced?

Trading significantly reduces costs



Trading significantly reduces costs



Allocation rules matter

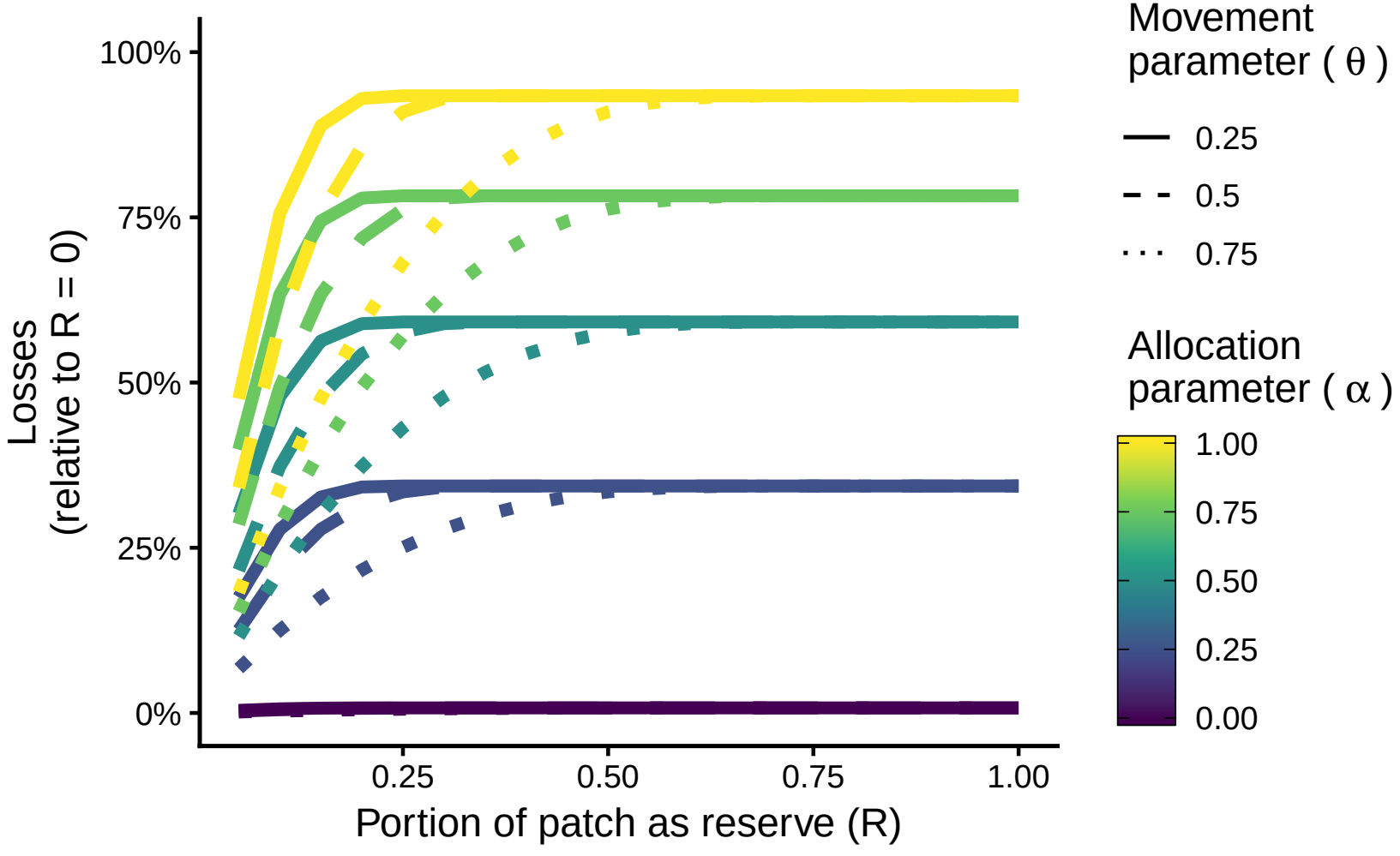
- Vessel-days are allocated to countries each year
- Combination of biomass and in-EEZ usage

$$E_i^* = \alpha \left(\frac{\sum_{\tau=0}^{\hat{\tau}} E_{i,t-\tau}}{\bar{E}\hat{\tau}} \right) + (1-\alpha) \left(\frac{\sum_{\tau=0}^{\hat{\tau}} X_{i,t-\tau}}{\bar{X}\hat{\tau}} \right)$$

- α is a weight on historical effort (E_i) and historical biomass (B_i)

What is the importance of allocation rules?

"*Biomass-based*" allocation reduces costs



What can we learn from PIPA?

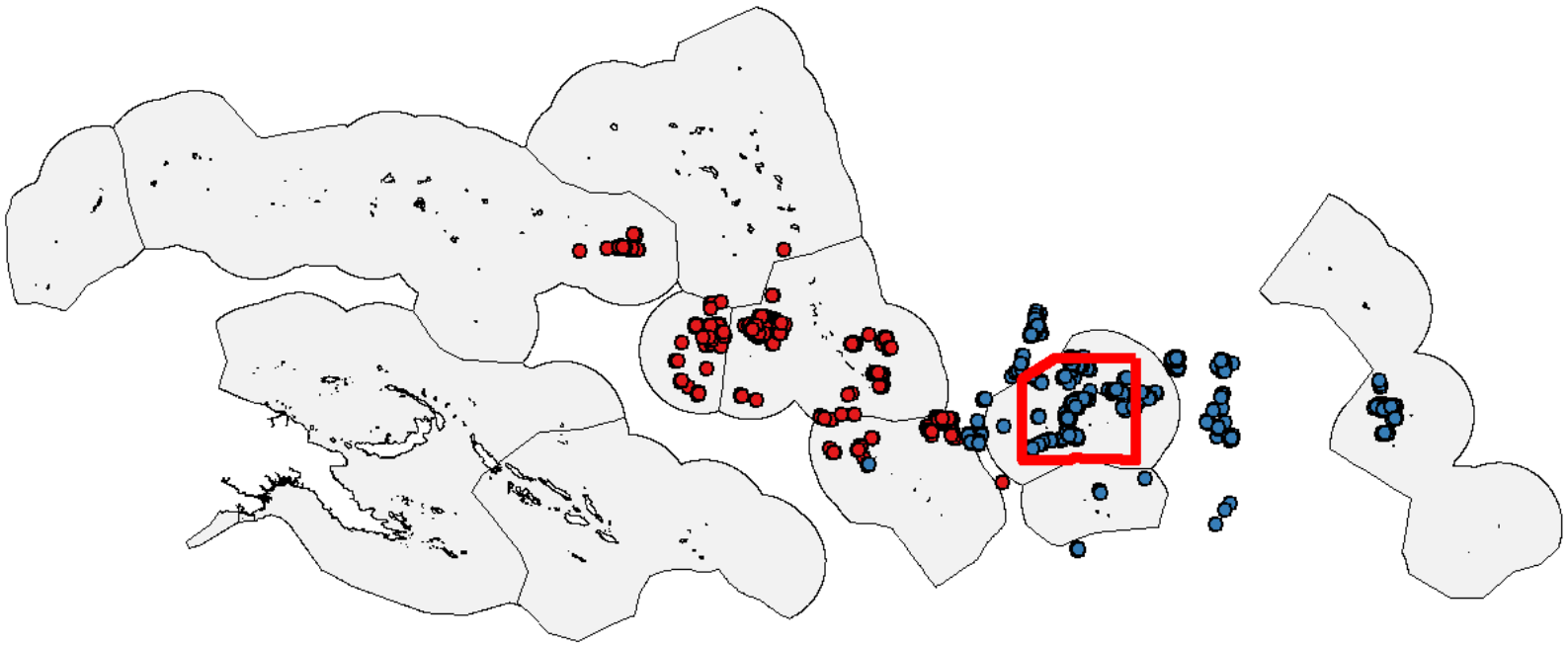
PIPA:

- Implemented in January, 2015
- 397,447 Km^2
- 2.7% of total PNA area
- 11% of Kiribati EEZ
- 22% of Kiribati EEZ (excluding Line Islands)

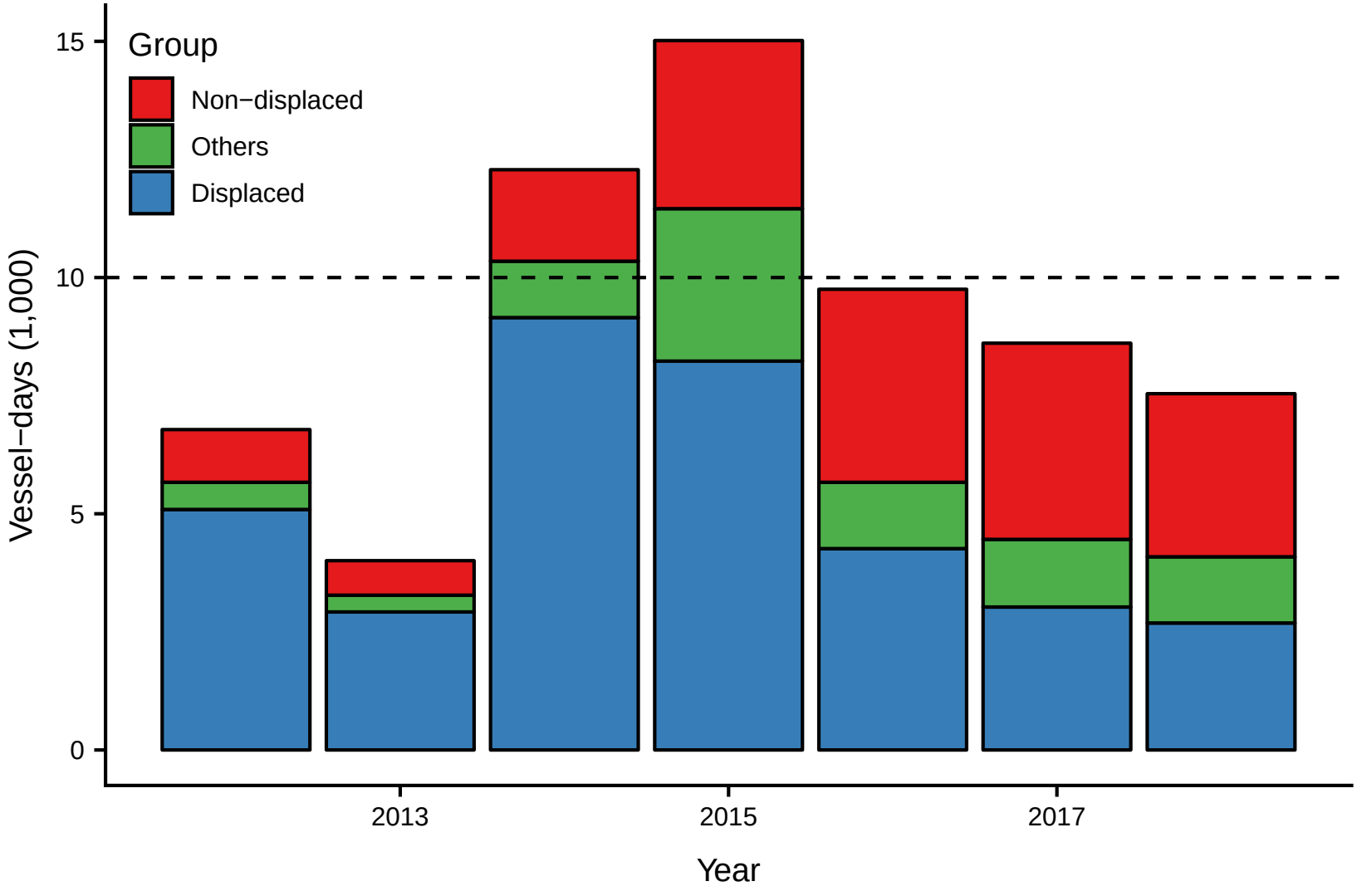
GFW data:

- 313 tuna purse seine vessels that fished in PNA
- 92 Fished both before and after PIPA implementation:
  - 64 Fished within PIPA before implementation
- 2012 - Present

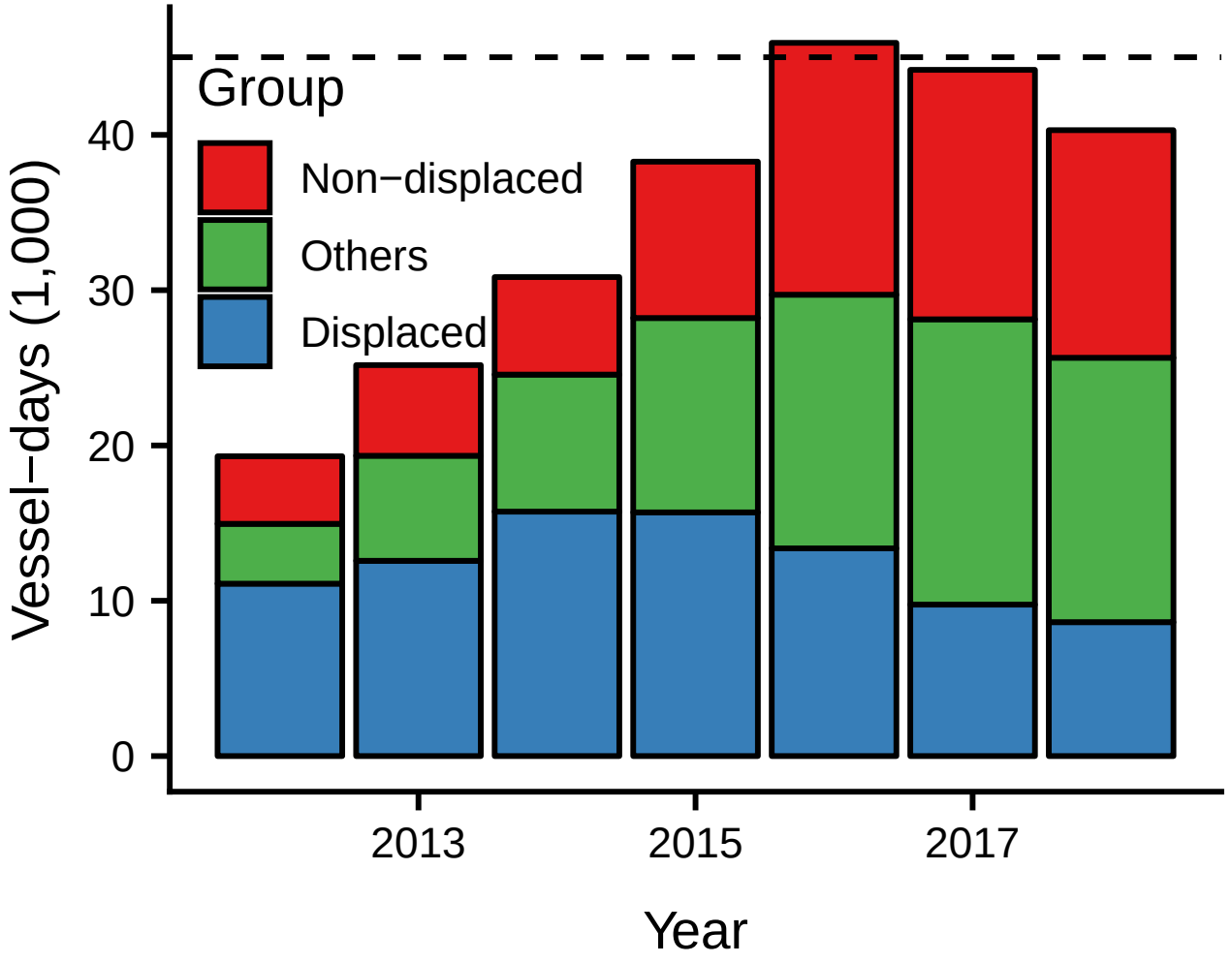
Two “fleets”



Effort displacement in Kiribati



Effort displacement in all PNA

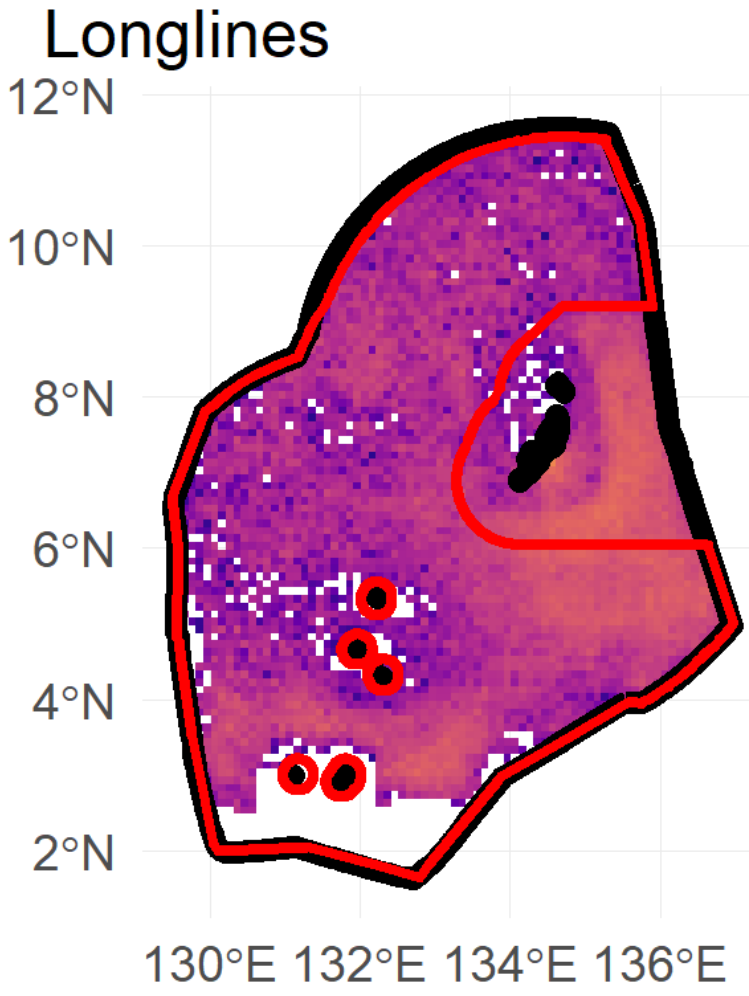


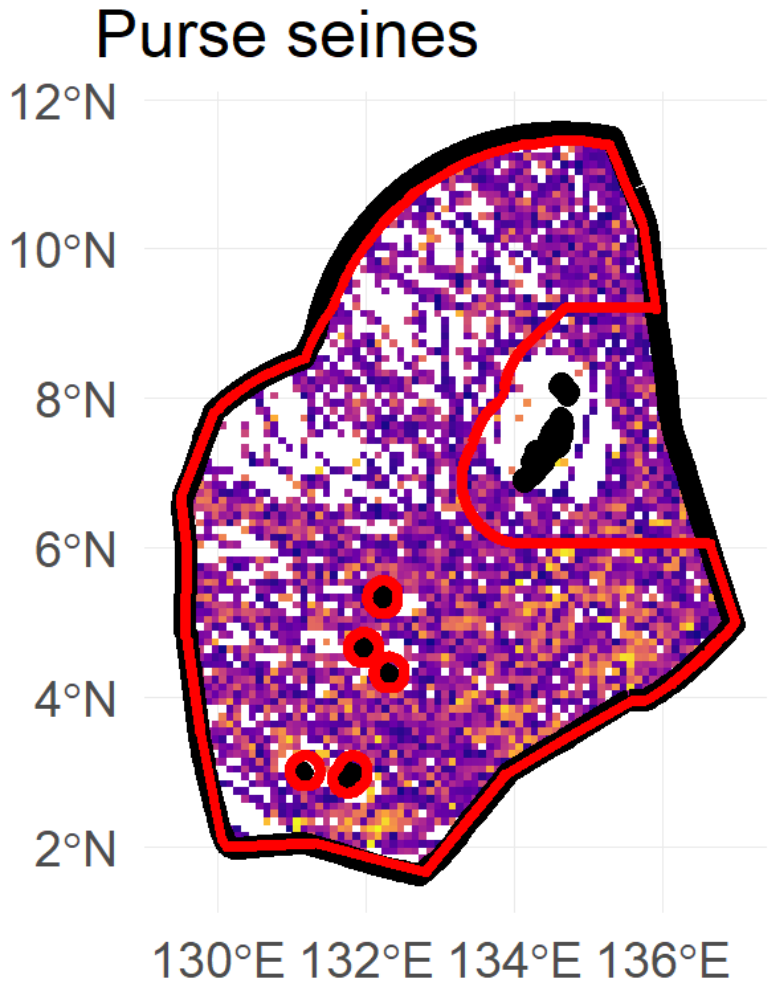
Palau

Palau National Marine Monument

- Close **80%** of its EEZ to **all** industrial fishing activities
- To be closed December 2020
- Have not evaluted the possible implications

Likely costs to Palau (2018)





Fisheries management in Palau

- Purse seine vessel-days
  - 700 purse seine vessel-days
  - $5.60 - $8.75 Million USD
  - "Tradable"
  - Trading might reduce costs, but allocation rules matter
- Longline vessel-days
  - 10,500 longline vessel-days
  - $2.10 Million USD
  - Non-tradable

Conclusions

Rights-based management for conservation

Two market features can eliminate costs of conservation:

- Trading
- Biomass-based allocation

Extra slides

GFW summary for Palau