

# 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 incentivize 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

# 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 model of the tuna purse-seine 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  $i = (1, 9)$

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

# Approach

- Patch-level effort is then

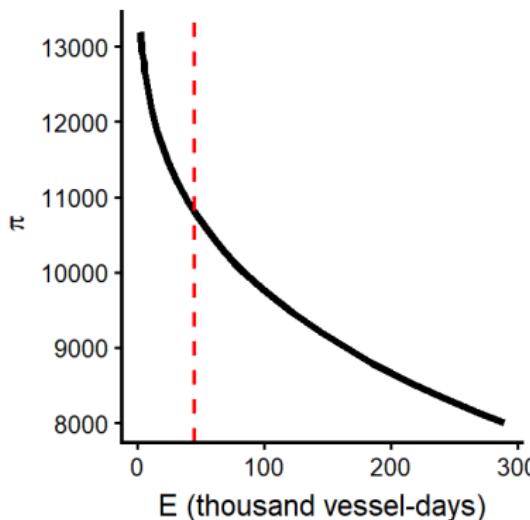
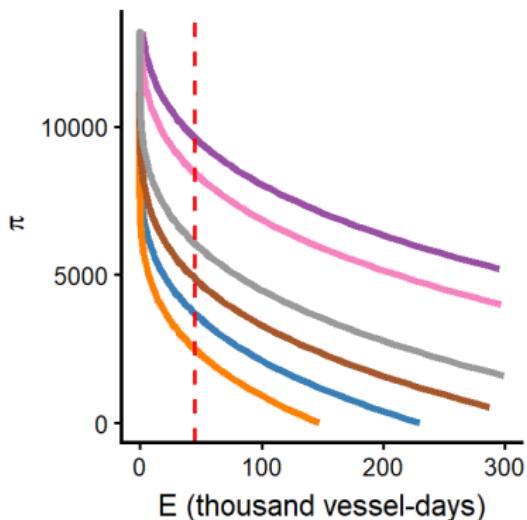
$$E_i = \left( \frac{pqX_i\Omega_i - \pi_i}{\beta c} \right)^{\frac{1}{\beta-1}}$$

- 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



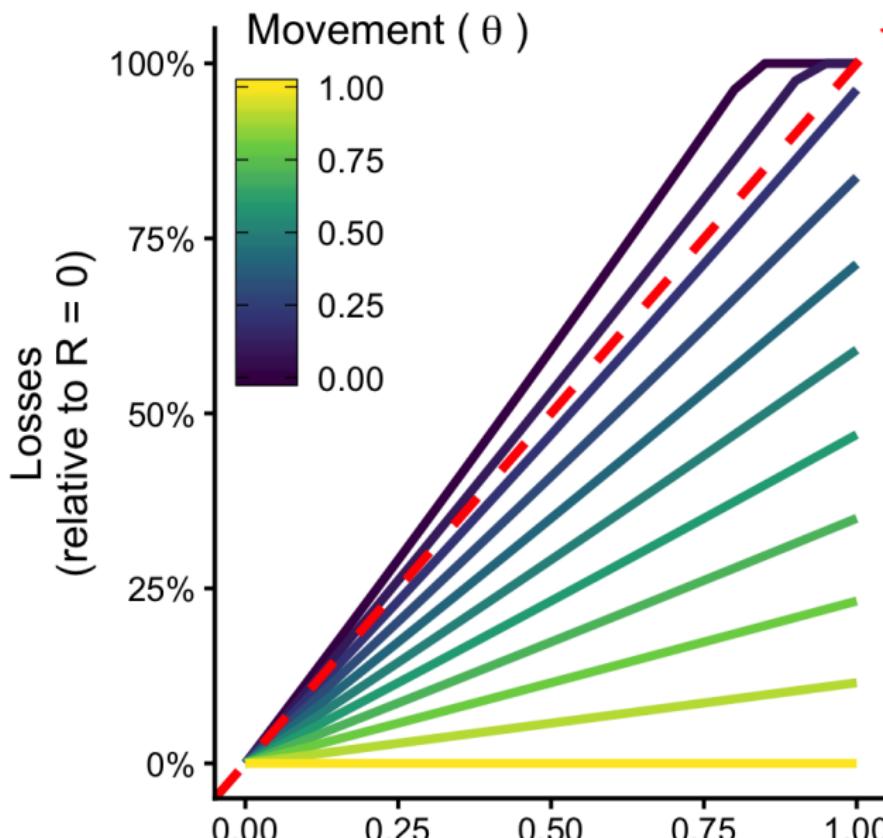
# Model predictions

# Model predictions

Relationship between closure size and losses

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

# Losses with no trading

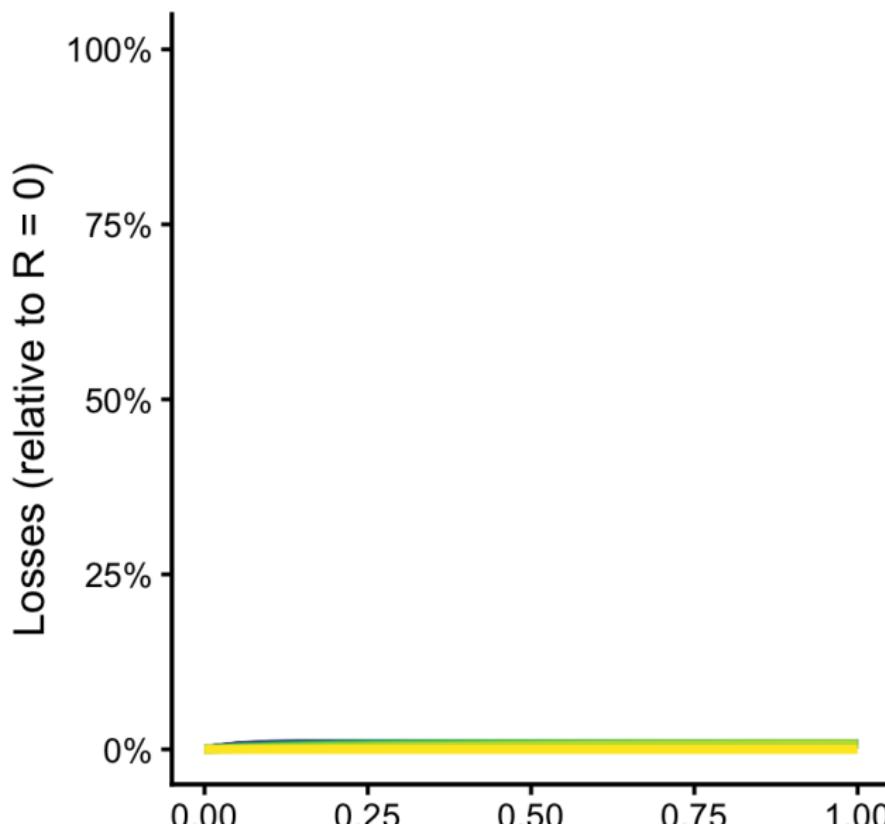


# Model predictions

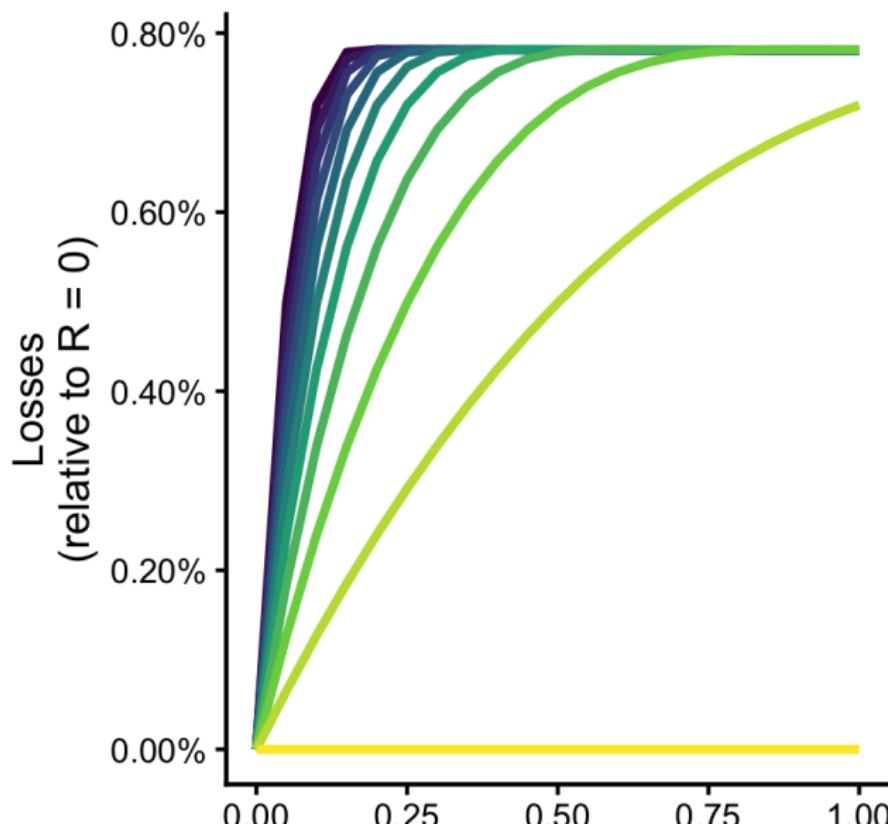
## A market for fishing efforts

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

# Trading significantly reduces costs



# Trading significantly reduces costs



# Allocation rules matter

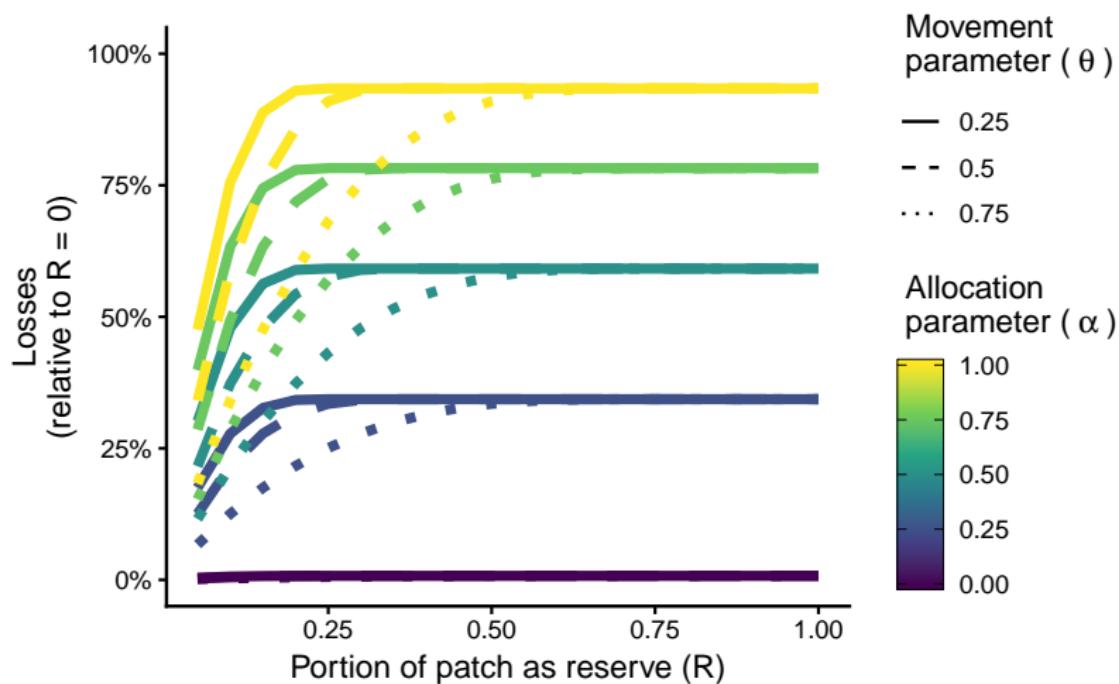
- Vessel-days are allocated to countries each year
- Combination of biomass and in-EEZ usage

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

- $\alpha$  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
- $397,447 \text{ Km}^2$
- 2.7% of total PNA area
- 11% of Kiribati EEZ
- 22% of Kiribati EEZ (excluding Line Islands)

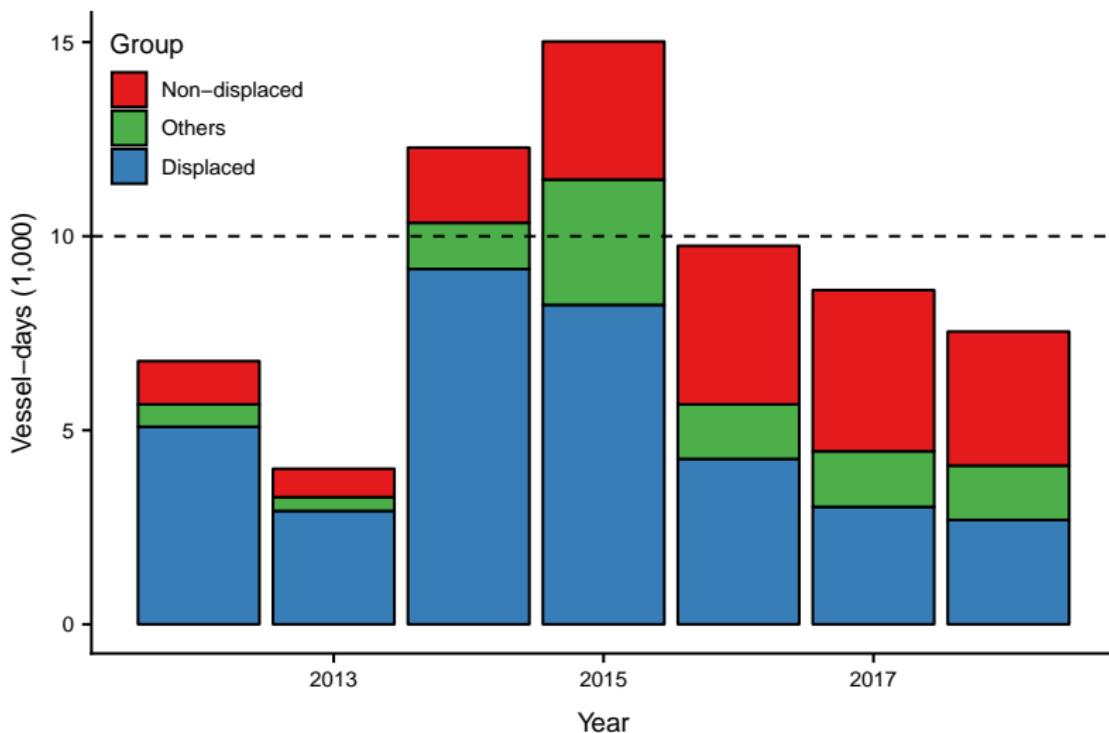
GFW data:

- 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

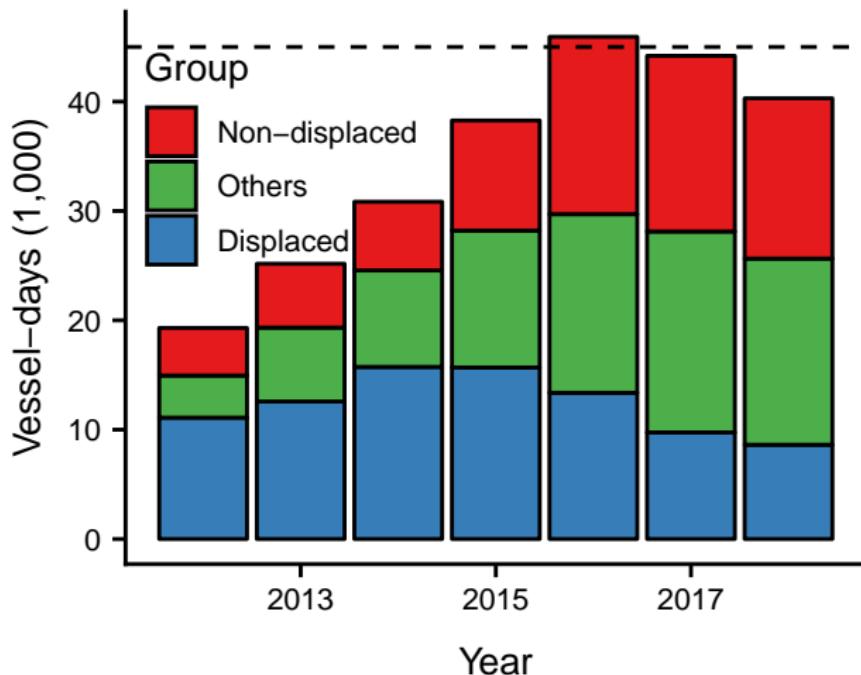
# Two “fleets”



# Effort displacement in Kiribati



# Effort displacement in all PNA



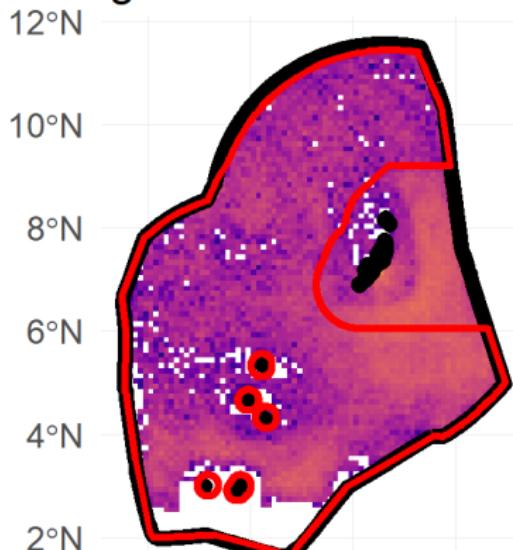
Palau

# Palau National Marine Monument

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

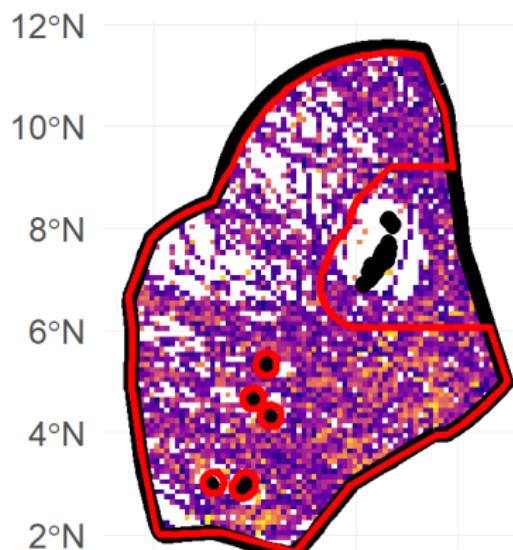
# Likely costs to Palau

Longlines



130°E 132°E 134°E 136°E

Purse seines



130°E 132°E 134°E 136°E

# 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

