

Marine Conservation and Fishing Effort Markets

NCEAS-Future Earth Working Group

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Outline

- Background and motivation
- Scope of the project
- Approach
 - Model and assumptions
 - Phoenix Island Protected Area
- Generalizability to Palau

Background and motivation

Motivation

Motivation

Relationship between closure size and losses

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

Scope and Approach

Scope

Can economic instruments incentivize conservation?

- For the countries:
 - What are the costs associated to establishing an MPA?
 - What factors drive these costs?
 - Can these costs be reduced or eliminated?
- For the fishing vessels:
 - How do they respond?
 - Where do they go?

Approach

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

$$\Pi_i(E_i, X_i, R) = pqE_iX_i\Omega_i - cE_i^\beta$$

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

- 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

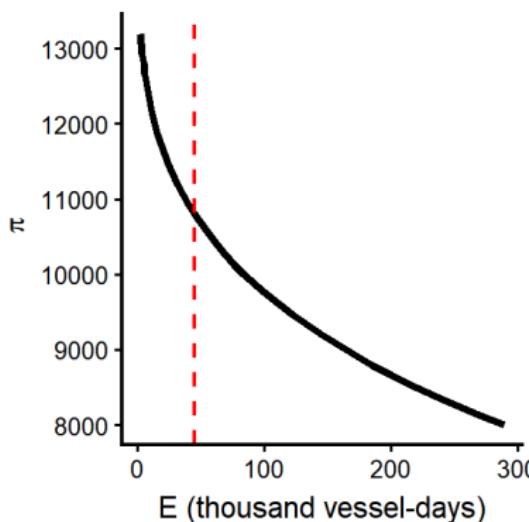
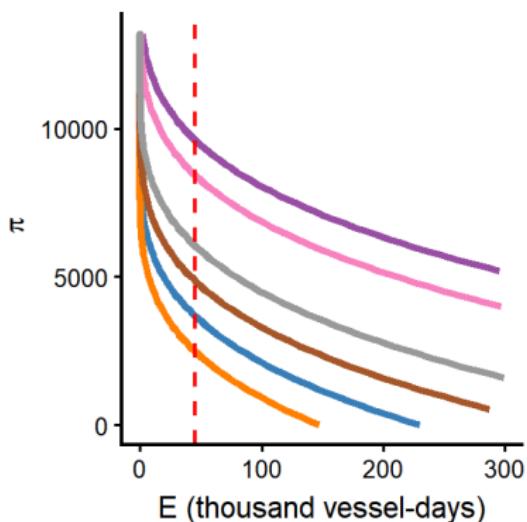
$$E_i = \left(\frac{pqX_i\Omega_i - \pi_i}{\beta c} \right)^{\frac{1}{\beta-1}}$$

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

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

Approach

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



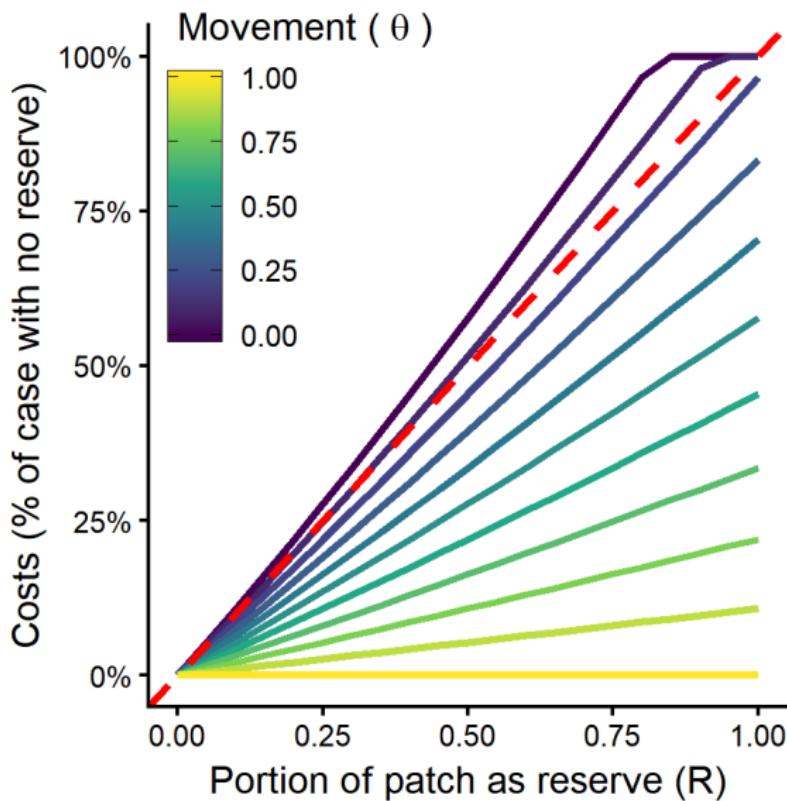
Model predictions

Model predictions

Relationship between closure size and losses

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

Losses with no trading

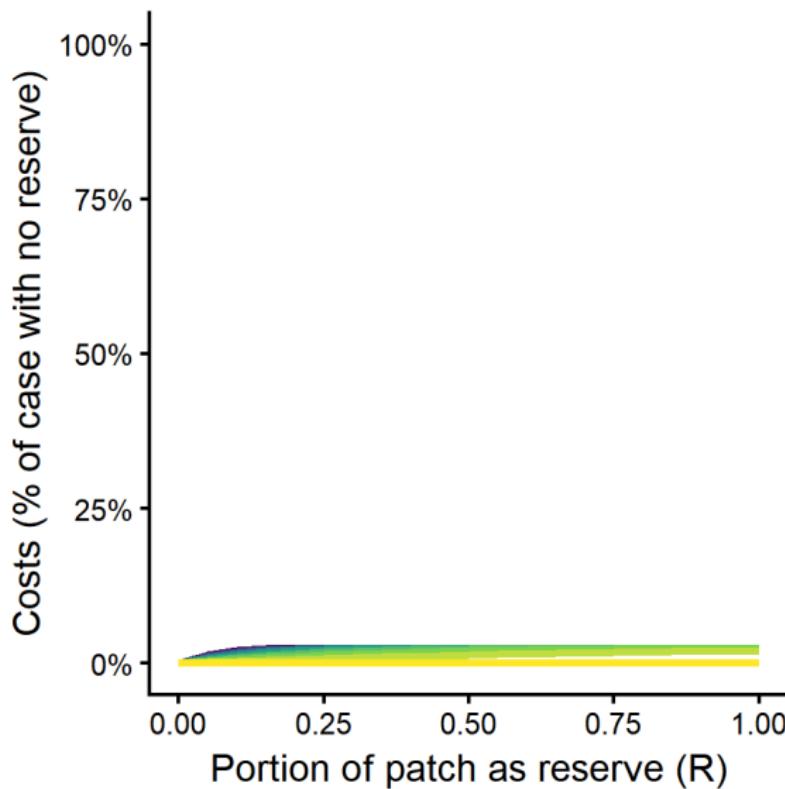


Model predictions

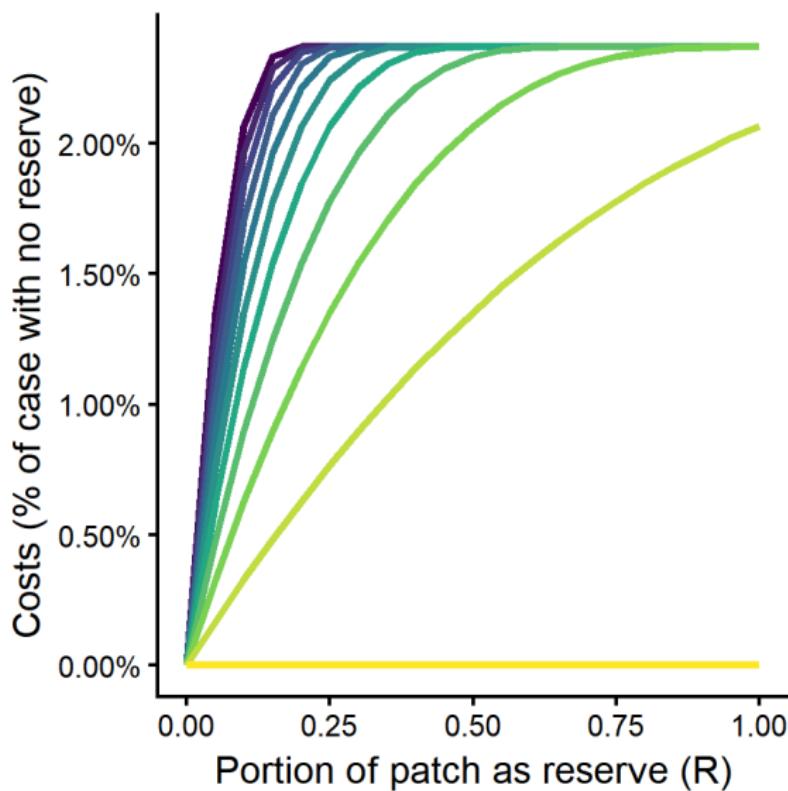
A market for fishing efforts

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

Trading significantly reduces costs



Trading significantly reduces costs



Allocation rules matter

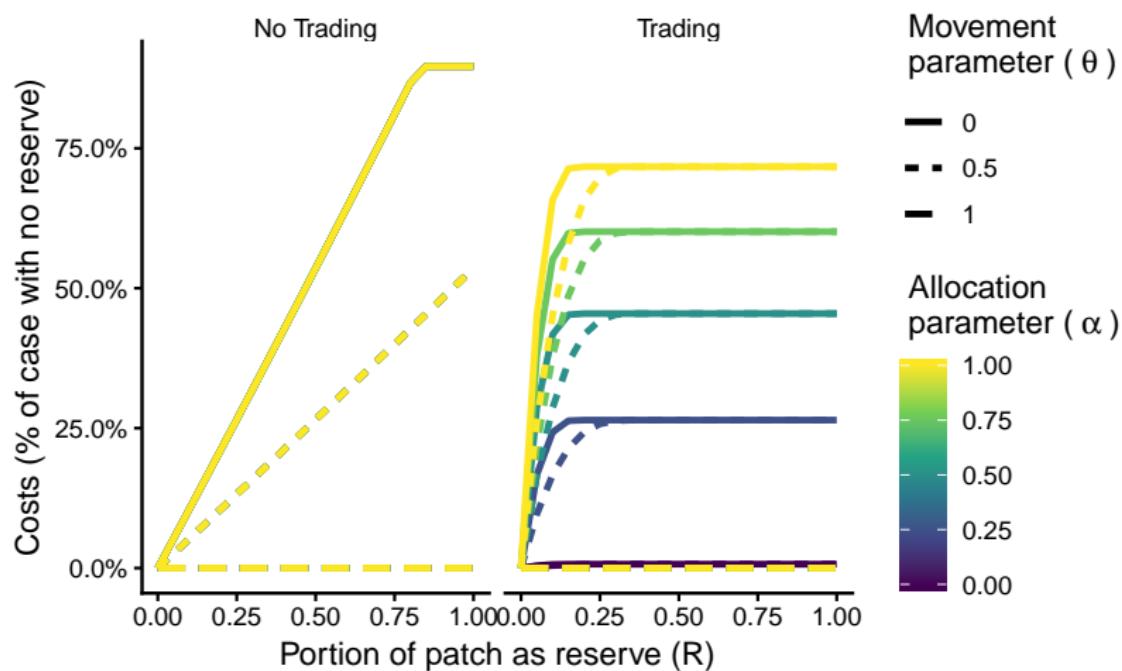
- Vessel-days are allocated to countries each year
- Combination of biomass and in-EEZ usage

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

- 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



PIPA

What can we learn from PIPA?

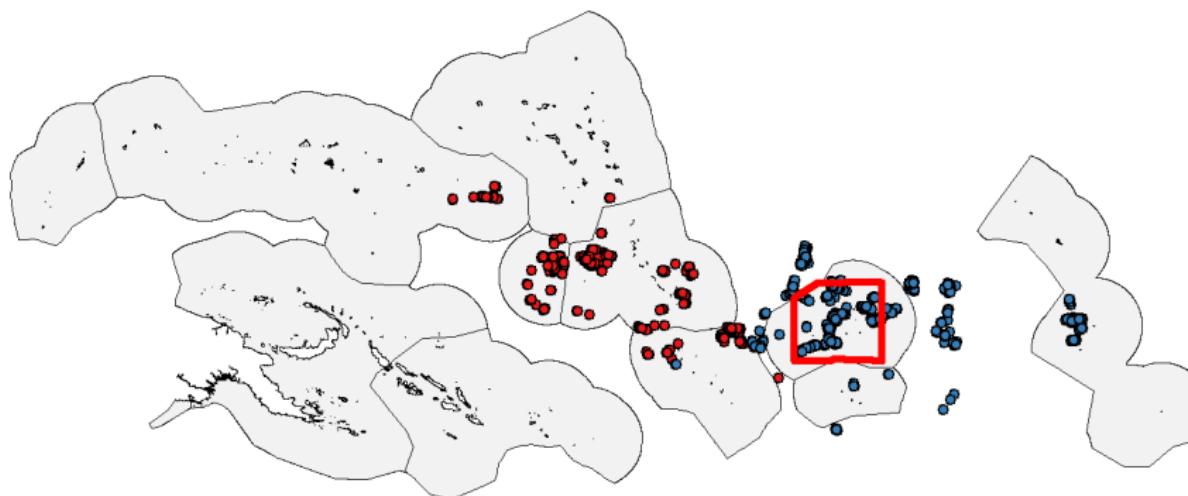
PIPA:

- Implemented in January, 2015
- $397,447 \text{ Km}^2$
- $\sim 2\%$ of total PNA area
- $\sim 10\%$ of fishing activity in PNA

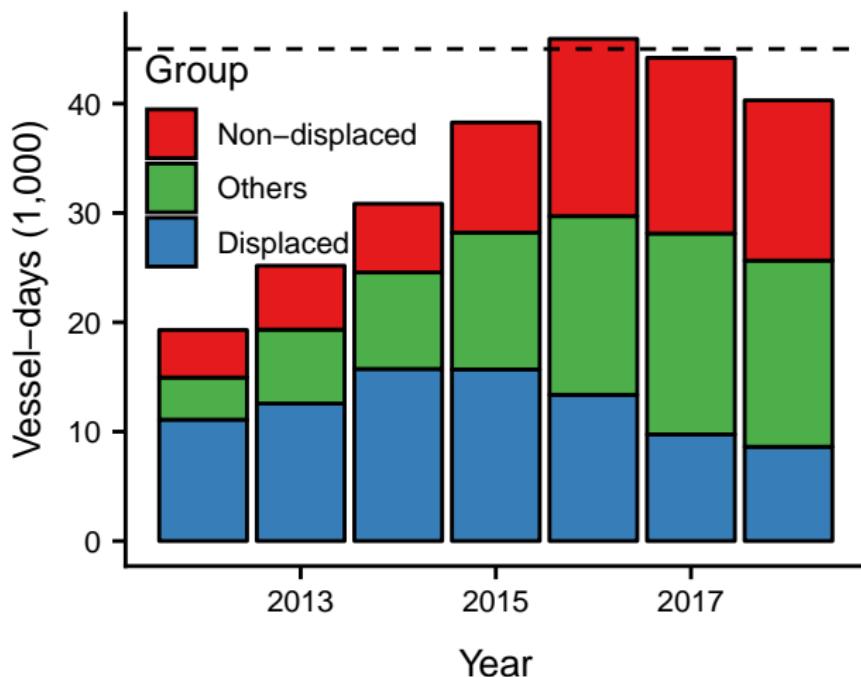
GFW data:

- 313 tuna purse seine vessels that fished in PNA
- 92 Fished both before and after PIPA implementation:
 - 64 Fished within PIPA before implementation
- Devideed into three groups

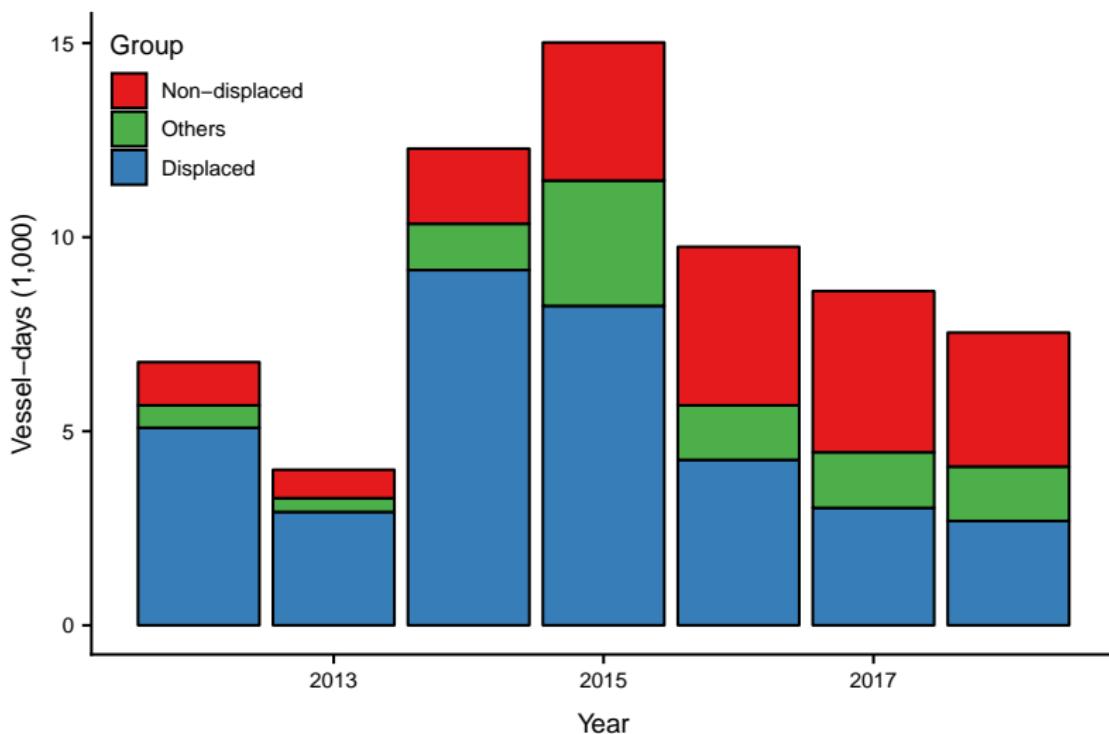
Two fleets



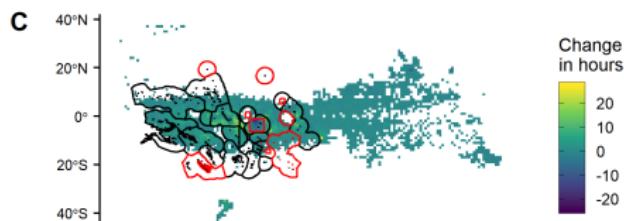
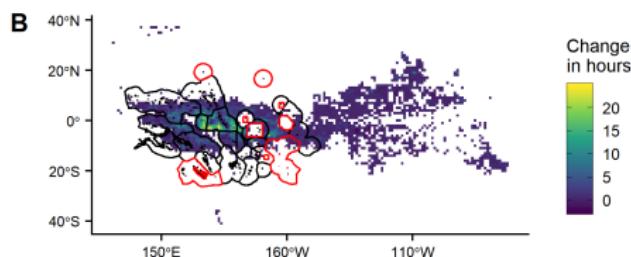
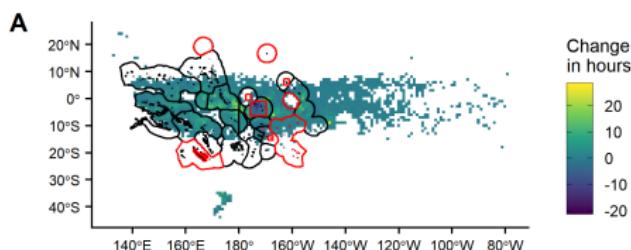
Effort displacement



Effort displacement in Kiribati



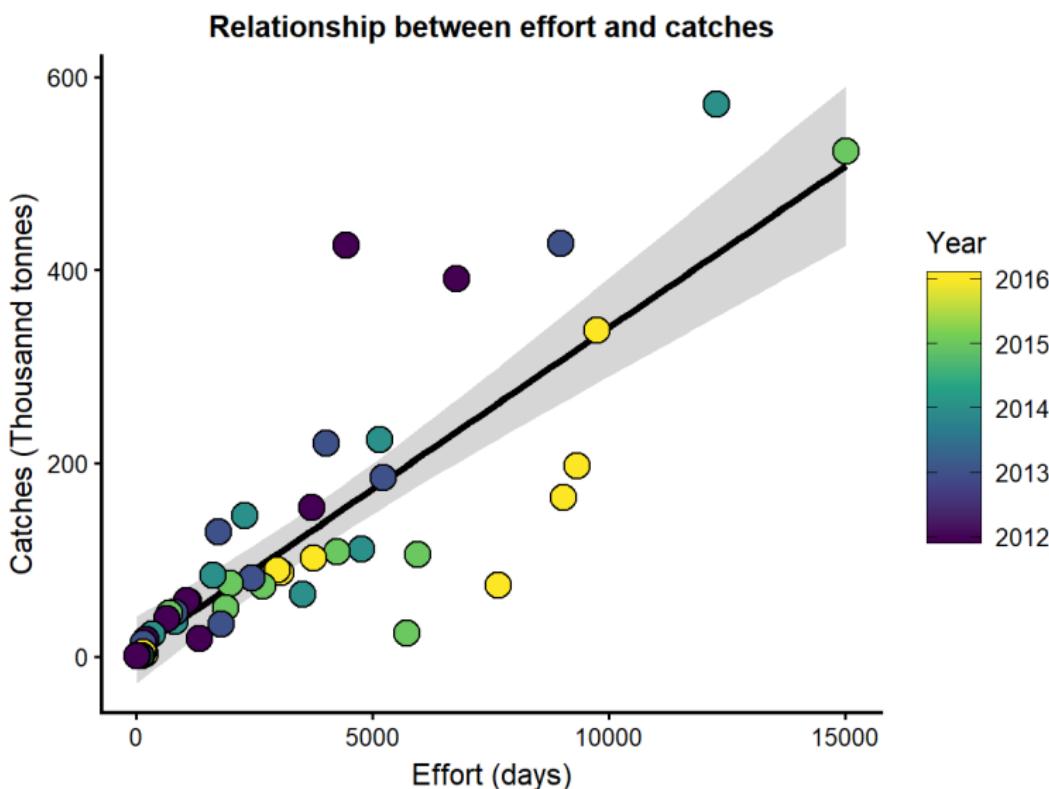
Effort displacement raster



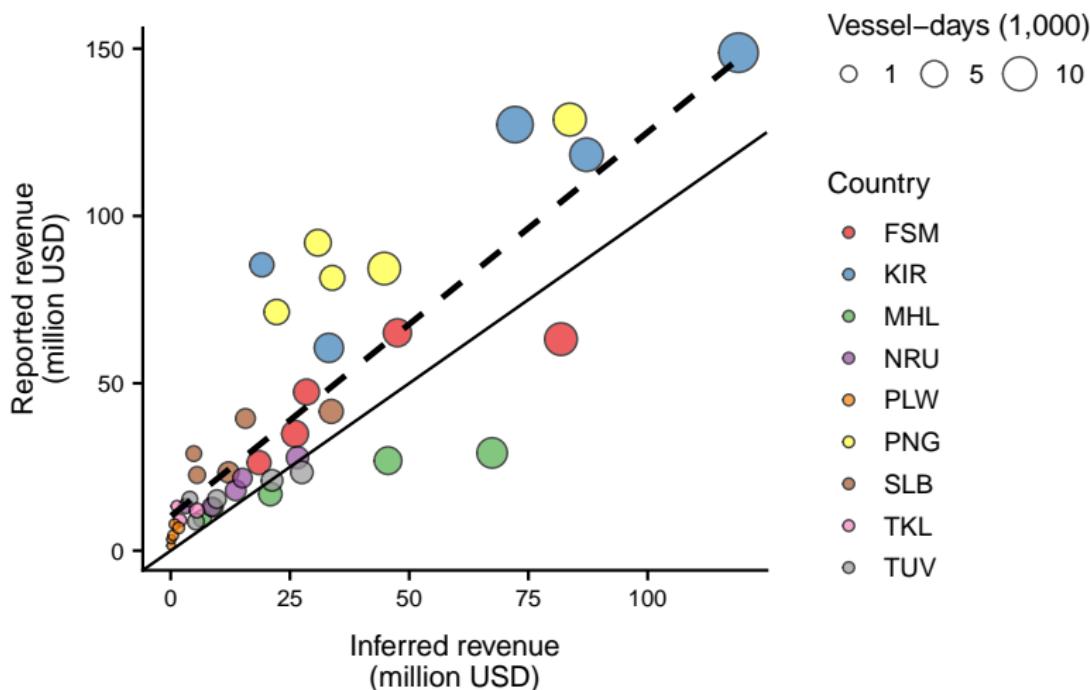
Generalizability to Palau

Extra slides - GFW data

Effort vs catches



Effort and revenues



Vessel statistics

A short table with information on number of vessels per year and class

Palau-specific information about longliners