# POSEIDON

A Tool to Explore the Impacts of Alternative Management Scenarios in the Eastern Pacific Tropical Tuna Fishery

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Model components
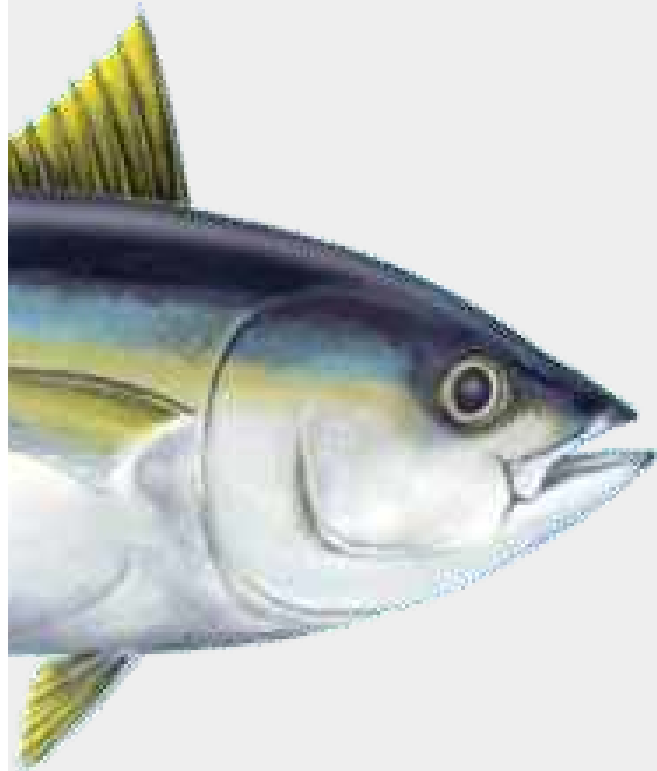
Model Inputs
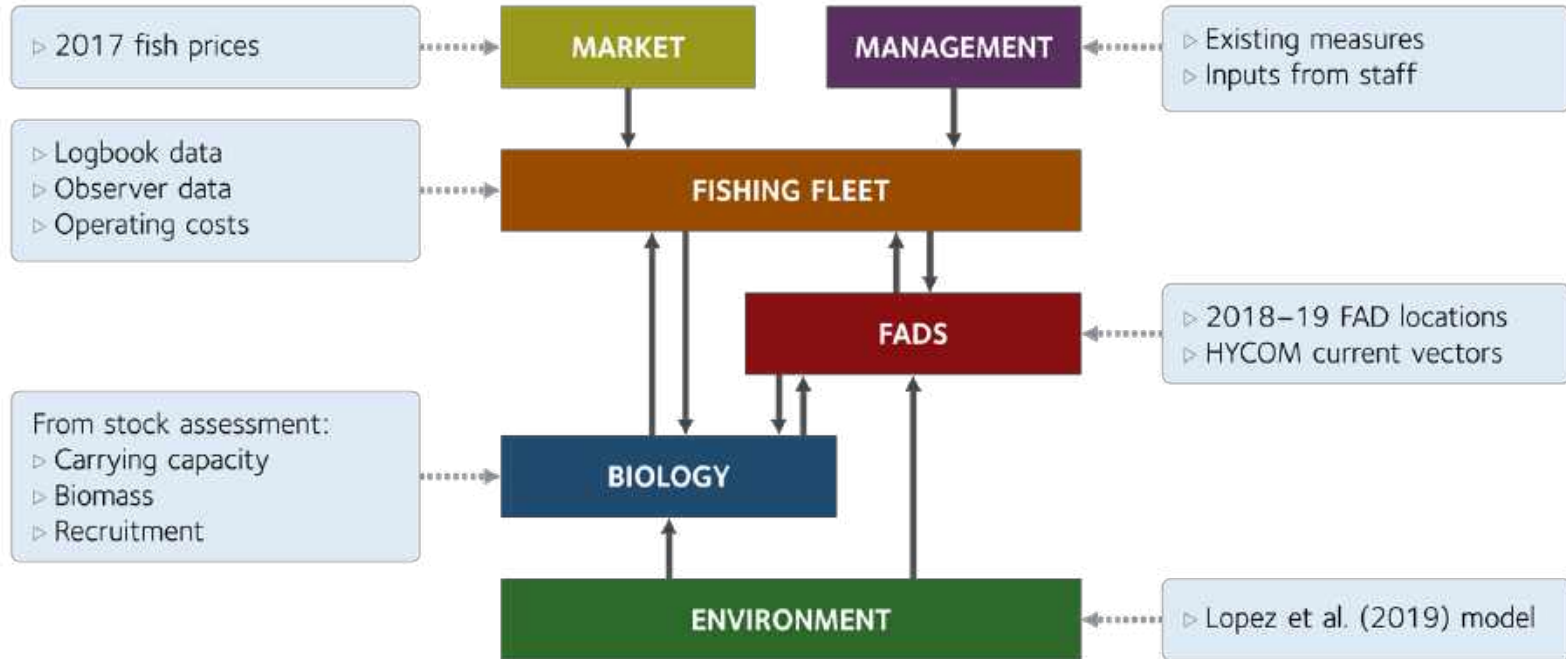
Inputs

Environment
- Currents (2017)
- SDMs (2017)
- Temp, Chl, frontal index, SKJ-BET

Biology
- BET (2018)
- YFT(2018)
- SKJ (2016)

FADs

Fleet
- Vessel properties
- FAD inventory
- Ports
- Time at port
- Deployment cell values

Economics
- Operating costs
- Price (2016-2018)

Targets

Fleet
- Landings
- Actions (deployments, FAD, NOA)
- DEL sets
- Own vs. other FADs
- Trip duration
- Regional

## Calibrated Parameters

FAD (15)
- Attraction rate
- Carrying capacity
- Days before attraction
- Days stop attraction
- Catchability
- Dud rate
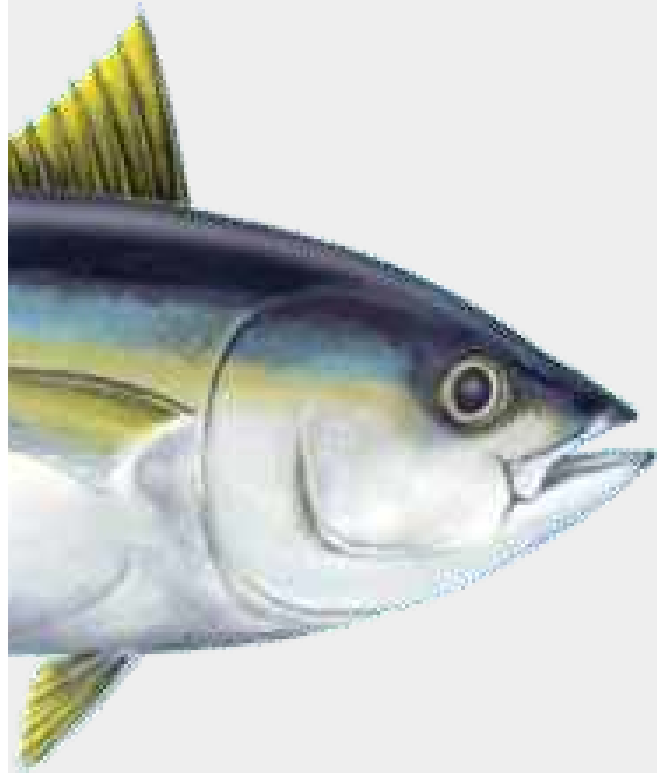- Fish release probability
- Env. thresholds

Fleet (13)
- Gear related (2)
- Destination planning (11)

ABM dynamics

- Fleet dynamics are emergent based on calibrated behavior

- Produces realistic trip trajectories, timing and actions (FAD distributions, FAD sets and other purse seine sets)
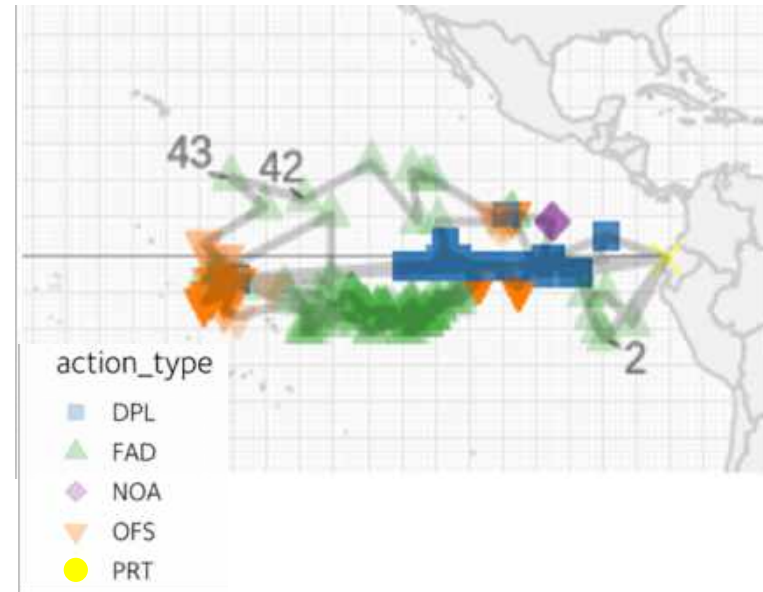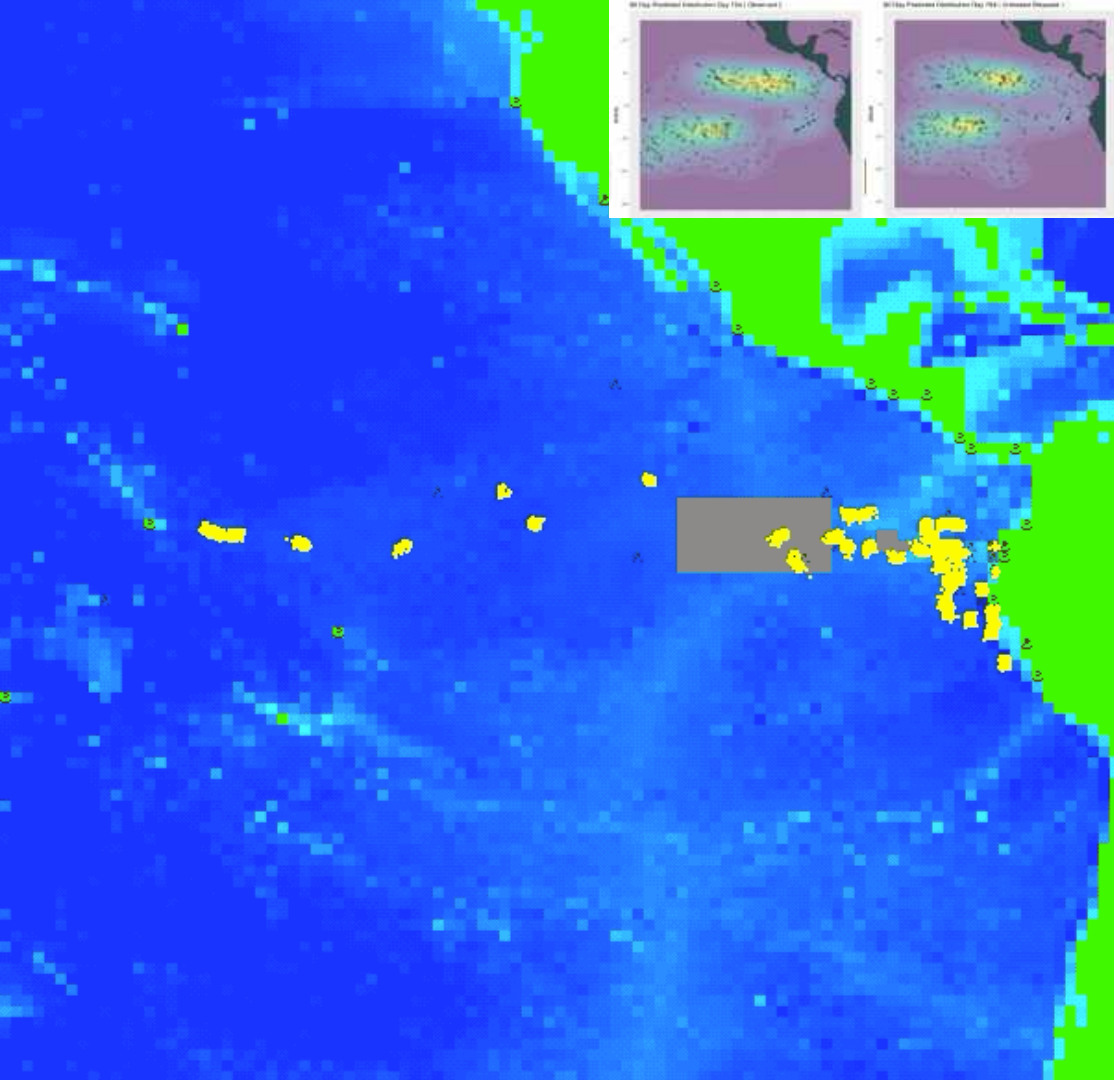
Diagnostics

ABM diagnostics for fishery management

Verification

Is the implementation of the model performing as it was intended?

Calibration

Is the difference between the simulation results and various empirical targets minimized?

Validation

Validating the fully calibrated model with independent data sources

Forecast

Does the model provide a reasonable one-step ahead prediction of data sets that are related to each of the different management measures?

Best model

Calibration results (2017)
Mean error: 5.96%

Number of actions
- Sets on own FADs
- Sets on others' FADs
- Non-associated sets
- FAD deployments
- Dolphin sets

(0, 10 k, 20 k, 30 k)

Catches from sets on own FADs (t)
- Bigeye
- Skipjack
- Yellowfin

(0, 50 k, 100 k)

Catches from sets on others' FADs (t)
- Bigeye
- Skipjack
- Yellowfin

(0, 10 k, 20 k, 30 k, 40 k, 50 k)

Catches from non-associated sets (t)
- Bigeye
- Skipjack
- Yellowfin

(0, 25 k, 50 k, 75 k)

Catches from dolphin sets (t)
- Bigeye
- Skipjack
- Yellowfin

(0, 30 k, 60 k, 90 k)

Total catches (t)
- Bigeye
- Skipjack
- Yellowfin

(0, 100 k, 200 k)

Trip duration
- Average trip duration

(0, 250, 500, 750, 1 k)

Average Hours Out
- Average hours out

(0, 2 k, 4 k)

Above target   Below target

VPS (Value per Set): The agent picks the area with the best total value
divided by number of FADs

Spatialized FAD actions

Total catch from FAD and OFS sets (2017)
observed / simulated / difference
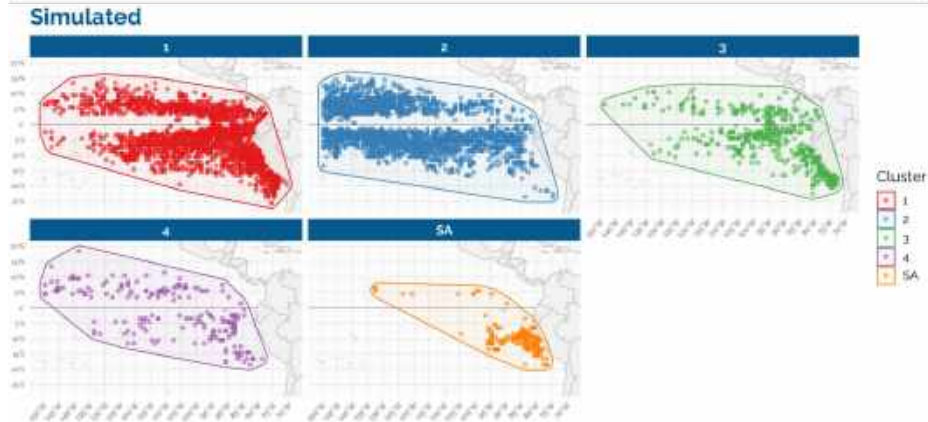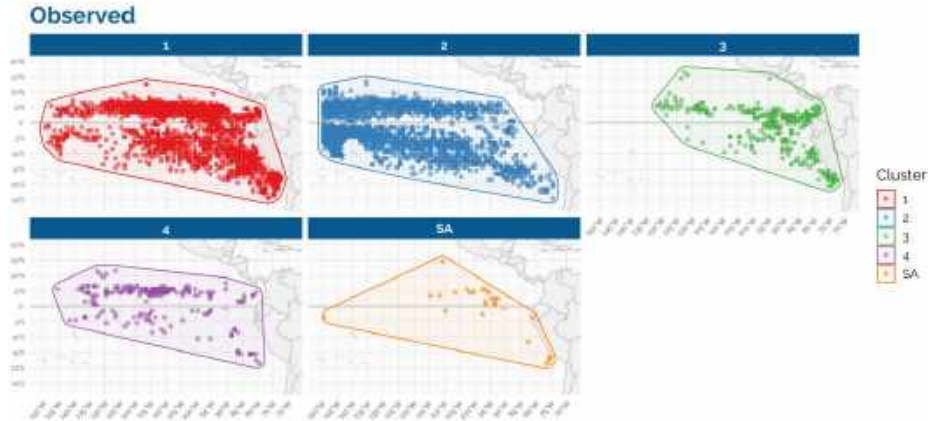

Number of FAD and OFS sets (2017)
observed / simulated / difference
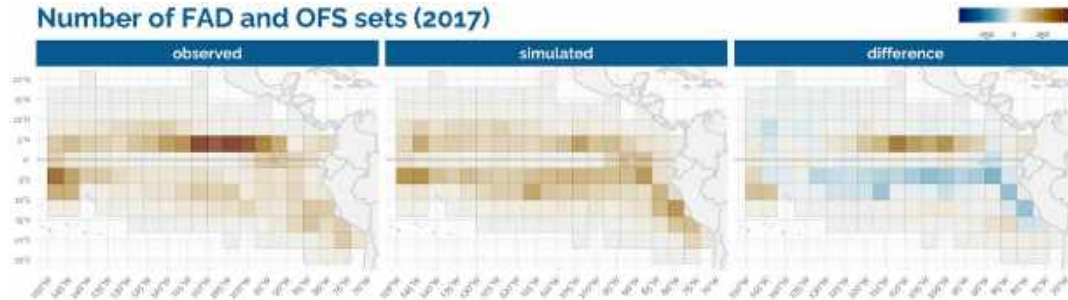
- Underestimated catch and effort west and north of equator and overestimated effort in the south due to fish non available in real life

- Working with IATTC staff to reduce residuals in the next year.

Model captures heterogenous fisher behavior

Observed

Simulated

- Model captures the spatial distribution of sets within clusters from Lennert-Cody et al. (2018)

- Cluster 3 is composed of mixed fishing strategies, hence is harder to model

- Emergent good fit of timing of FAD related actions

Action timing within trip per cluster (2017)
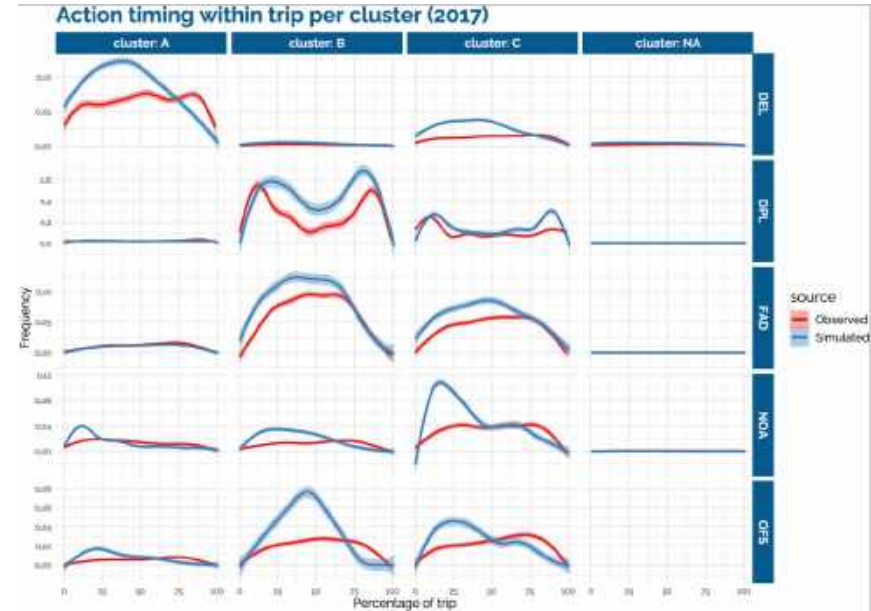
Results
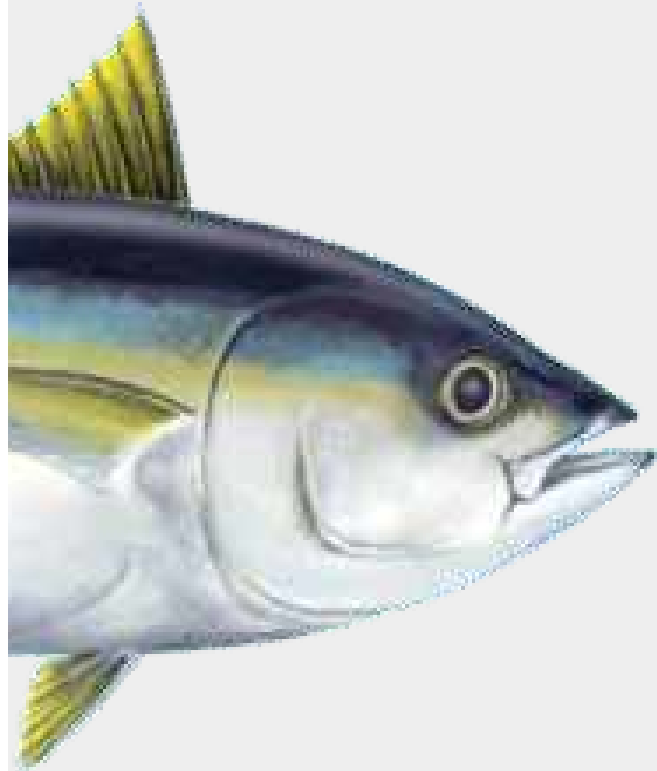
POSEIDON
a tool to explore the impacts of alternative management scenario

Evaluate multispecies spatial management outcomes

Develop science-based FAD management measures and evaluate their effectiveness

Minimize spatial bycatch hotspots

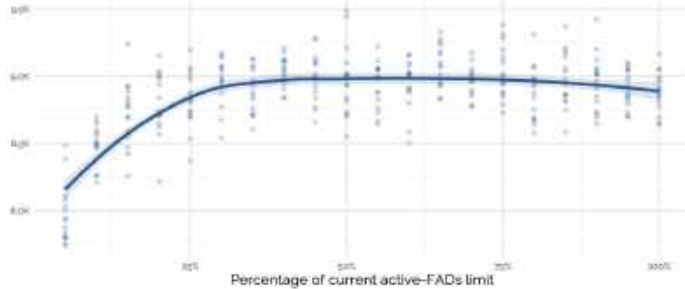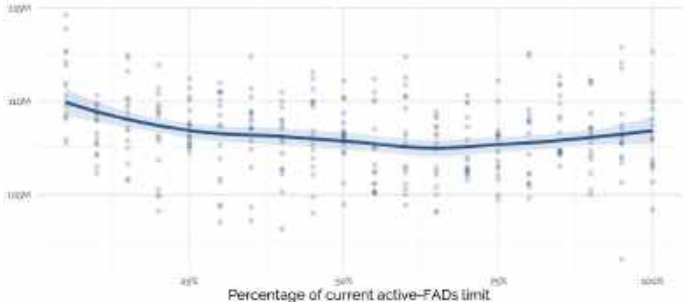Explore vessel and ecological behavior around FADs
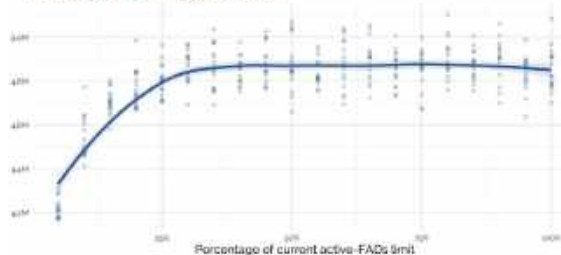
Sum of catches from FAD sets (2017)
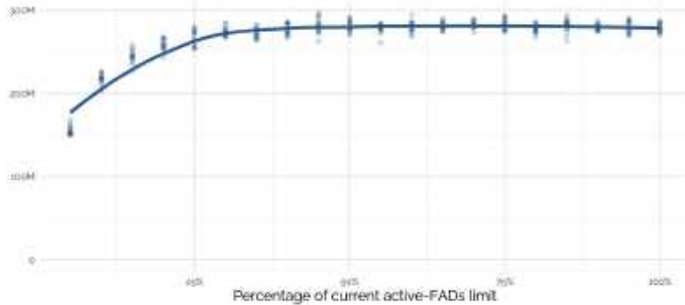

Average catches by FAD sets (2017)

Sum of catches from dolphin sets (2017)

Average Earnings (2018)

Average Trip Variable Costs (2018)

Hypothetical FAD limits scenario

- In this hypothetical management scenario reduction of greater than 70% of current active FADs reduces FAD catch

- Fishers respond to that limited availability

- Simple and effective method to explore the impact of management strategies on a fishery
  - 448 simulations took 1 hour and 10 minutes
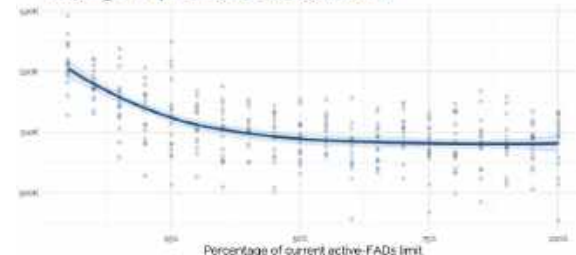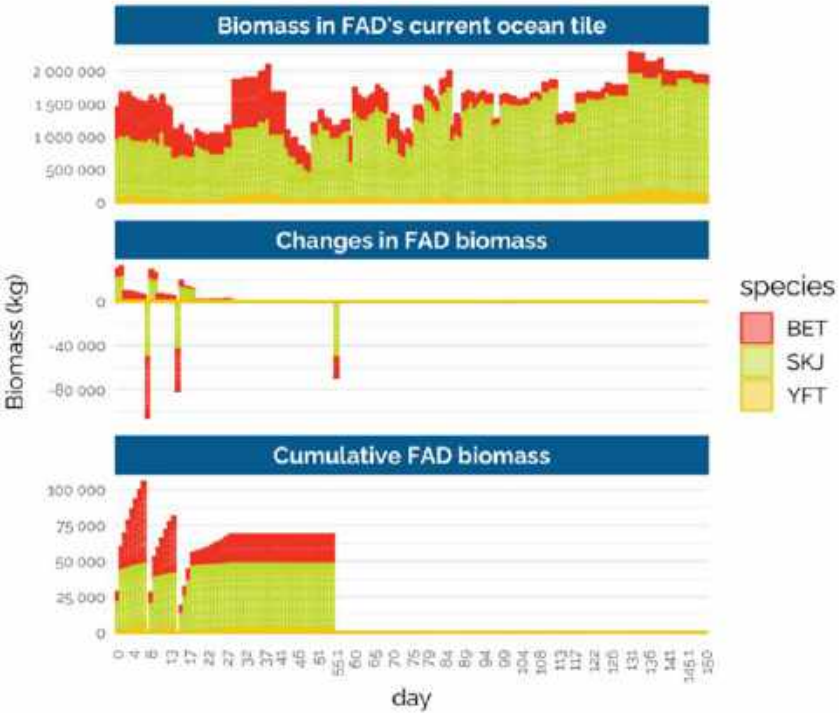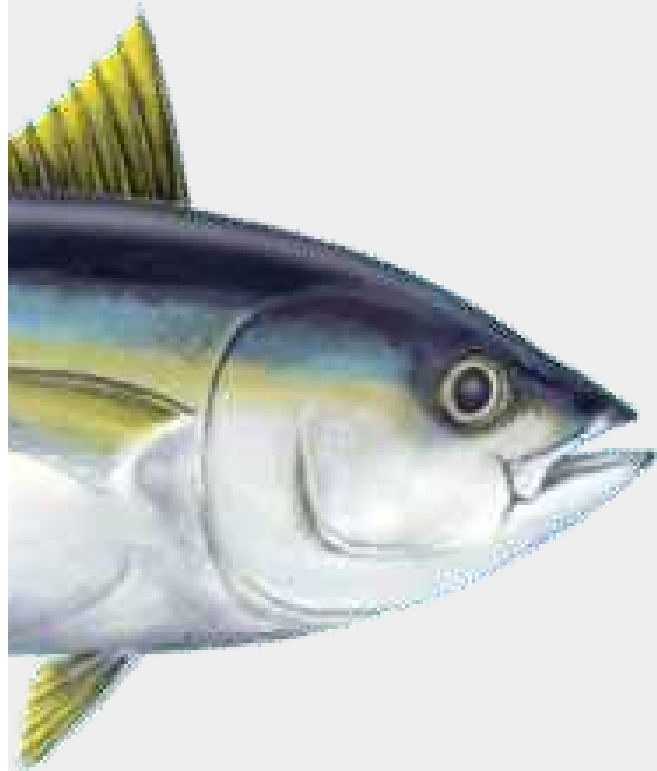
Illustrative example

Explore vessel and ecological behavior around FADs
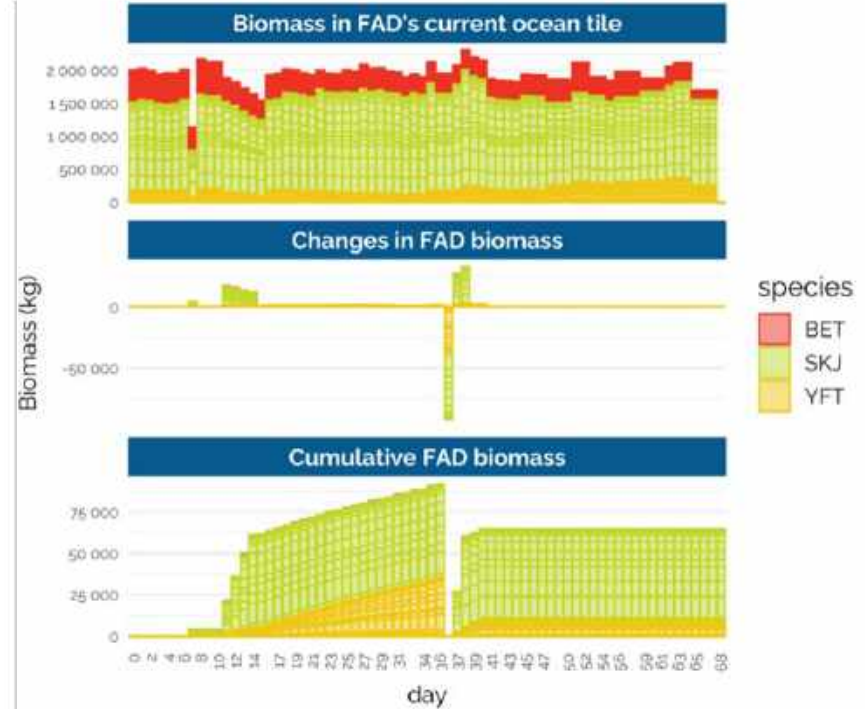
Conclusion

Summary

- POSEIDON captures the behavior of FAD and fishers with accuracy

- Simulated system responds to management strategies in a realistic way

- Work is being done to reduce error on the spatial fit in the southern region

- Practical tool to explore science-based management strategies and their biological, social and economic output for the eastern tropical tuna fishery

- Poseidon could reduce staff time to explore management strategies

Future Work

- Developing an R-interface to run POSEIDON

- Training IATTC staff to use the R-interface in the next year

- Running management scenario listed by IATTC staff

- Exploring implementation in the Atlantic Ocean with AZTI, U MIAMI, ISSF for a potential Atlantic ocean implementation

Thank You & Questions

Design partners

Past Funding partners

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