



Bella Garfield (MSc)

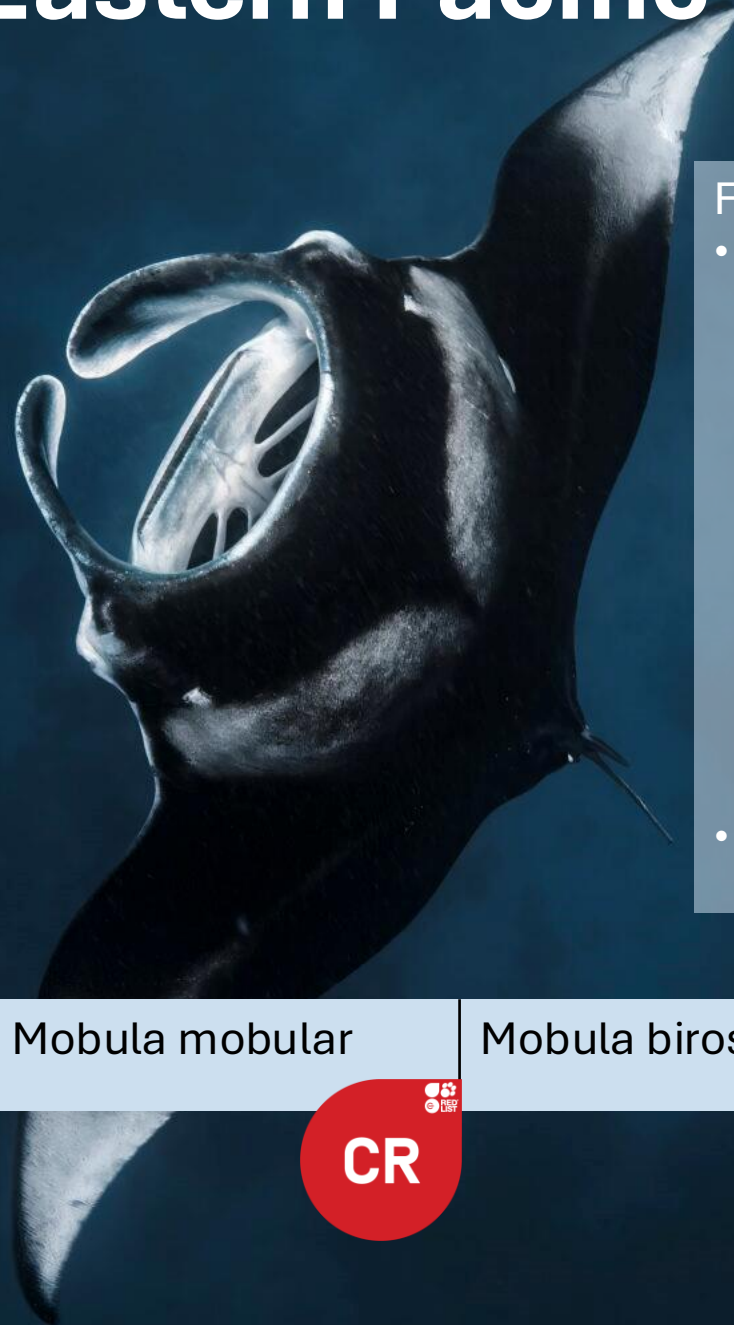
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Fisheries Oceanography

Identifying anthropogenic drivers of mobulid ray bycatch in the Eastern Pacific Ocean (EPO) purse seine fishery

Mobulids of the Eastern Pacific Ocean (EPO)

- Filter feeding megafauna
 - Found in tropical productive regions
- K-selected species
 - Low fecundity (1 pup every 1-3 years) and late maturity (Couturier et al., 2012)
- Decreasing populations: 51 – 99%
(Laglbauer et al., 2026, Couturier et al., 2012; White et al., 2015)



Fisheries impact:

- ~1,900 mobulid rays caught annually by EPO purse seine fishery (IATTC, 2024a)



- Observed post-release survival: 20 – 74% (Stewart et al., 2024)

Five mobulid species of EPO region:

Mobula tarapacana

CR

Mobula thurstoni

CR

Mobula mobular

CR

Mobula birostris

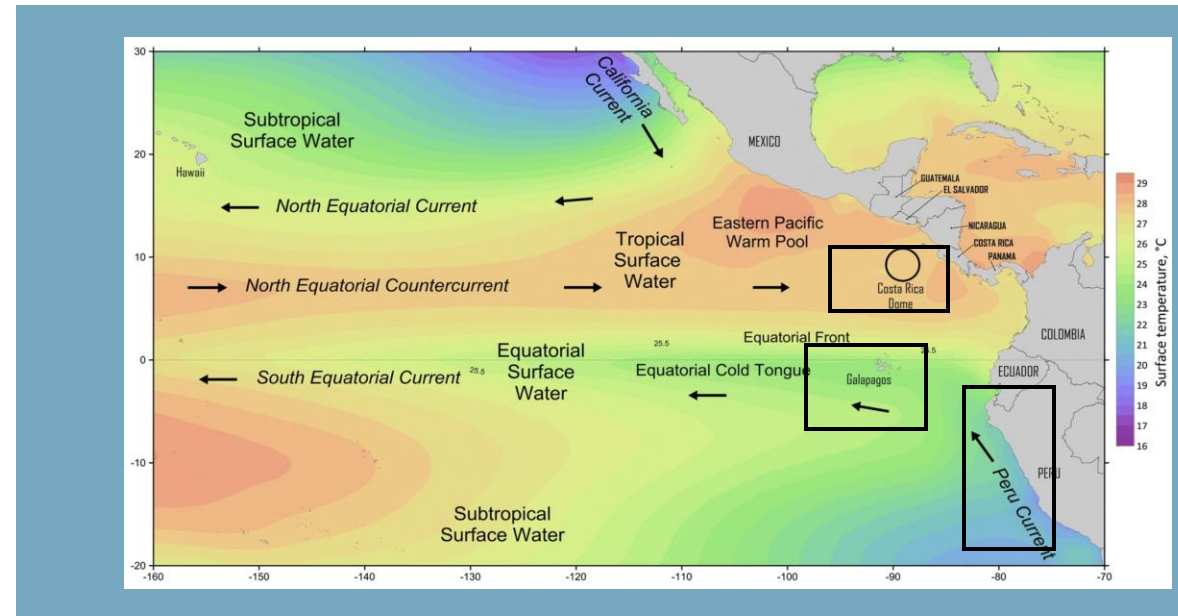
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Mobula munkiana

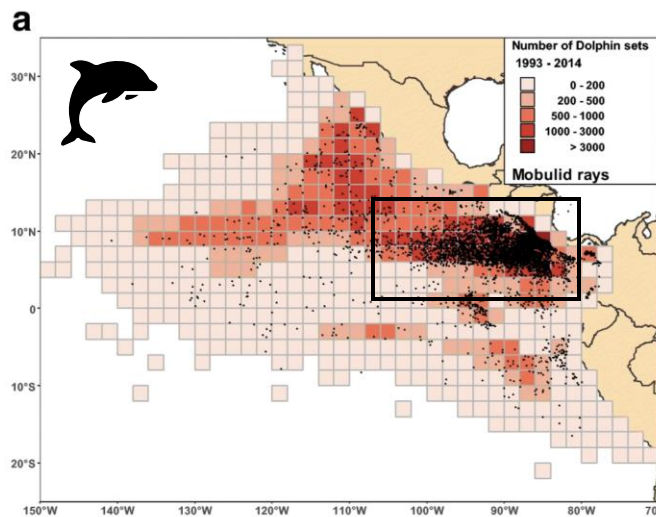
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Spatial distribution of mobulid bycatch by set type

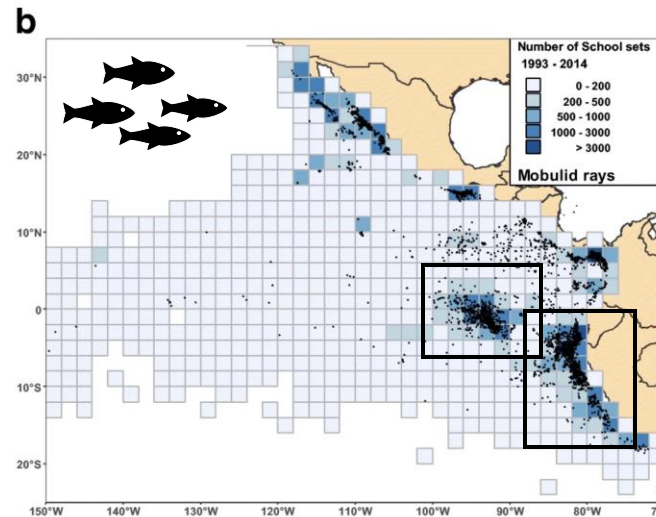
- Environmentally-driven **spatiotemporal variation** in mobulid bycatch
- Hotspots:
 - Peruvian upwelling system, Galapagos region, Costa Rica Dome



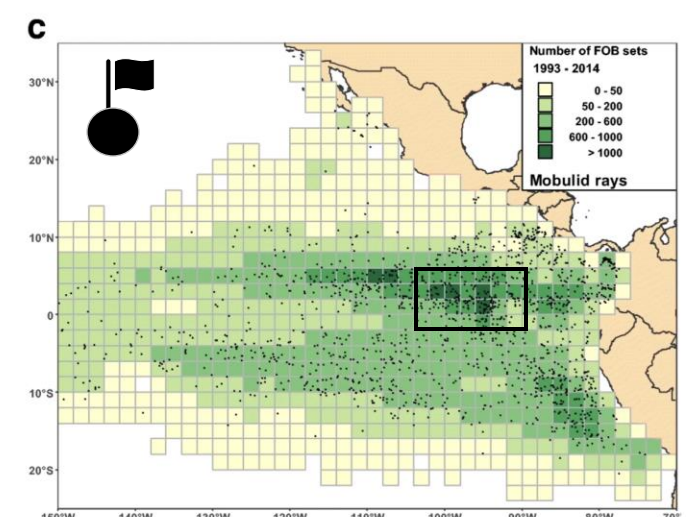
Dolphin



Free school (tuna)



Floating Object



Fishing fleets are not homogenous

- **"Individual Operator Affect"**

- Diversity of operator's experience, skill, and decision-making priorities lead to variation in outcome (Branch et al. 2006; Roberson & Wilcox, 2025)

- **Targeting individual operators has effectively reduced bycatch**

- Dynamic access plan introduced to the Bering sea pollock trawl fishery reduced chinook salmon bycatch by 59% (Sugihara et al., 2018).
- Atlantic longline fishery reduced bluefin tuna bycatch by 65% (NOAA, 2019)

**Are individual
vessels
predictors of
mobulid
bycatch?**



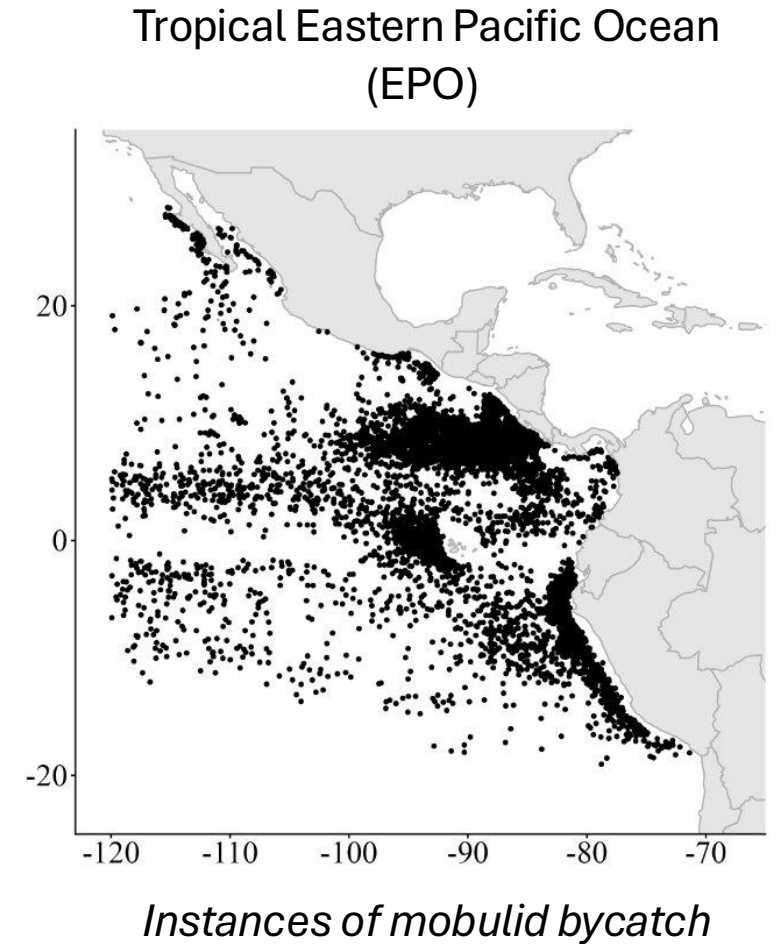
Methods

Data

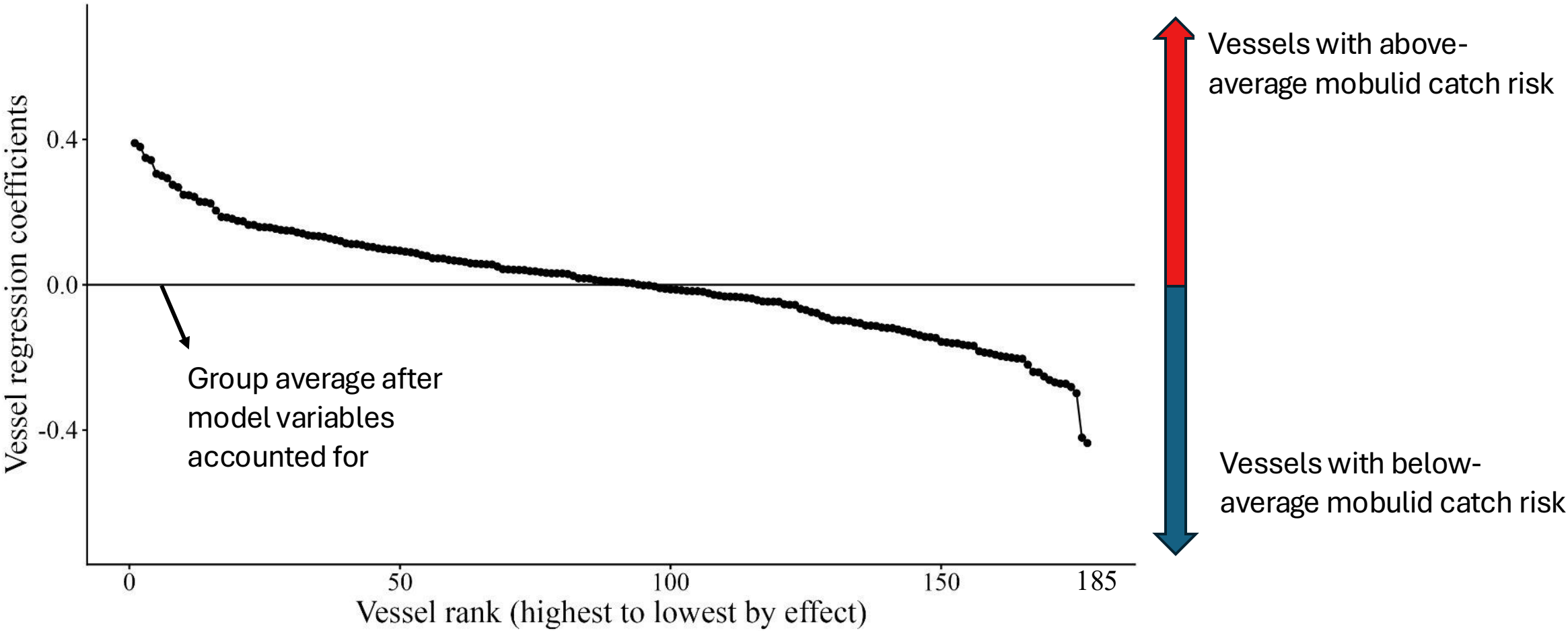
- Inter-American Tropical Tuna Commission (IATTC) observer data (2005 – 2025)
- Oceanographic data

Model

- Spatiotemporal generalized additive mixed model (GAMM)
- Response variable: Mobulid bycatch event (binomial)
- If Vessel ID improves model fit, extract regression coefficients
 - Fixed effects: Loaded MT tuna, Set type, Oceanographic, Time parameters, Spatial parameters
 - Random effects: Vessel ID



Individual vessel variation in mobulid bycatch



Next Steps

1. Refine modeling approach

2. Assess:

- Bycatch variation between individual skippers
- Effectiveness of Fishery Improvement Projects (FIPs) in minimizing bycatch
- Magnitude of bycatch variation between and within hotspot regions

3. Interview skippers directly

- Contextualize findings

Implications for management and conservation

- Results can support more tailored management approaches
- Bycatch avoidance strategies can be shared to improve overall fleet performance
- Understanding fleet dynamics can improve modeling efforts (ex. ERA and Species Distribution Models)



ISTOCKPHOTO



Thank you!

Special thanks to Jon Lopez, Dan Ovando, Dan Crear, Melanie Hutchinson, Gala Moreno, Nerea Lezama-Ochoa, and Melissa Cronin

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