The changing catch

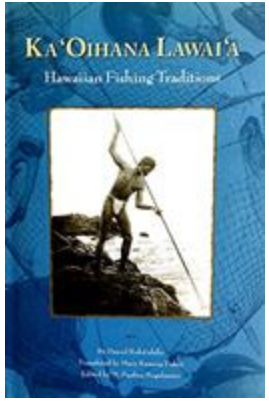
Seasonal dynamics and climate sensitivity of mahimahi (*Coryphaena* spp.) in Hawai‘i’s fisheries

Jessica N. Perelman, Justin J. Suca, Jason Helyer, Janelle Morano, Marc Nadon, Ryan R. Rykaczewski, Donald R. Kobayashi

Mahimahi: A cultural, historical, and ecological icon in Hawai‘i

- *Mahi* → strength, energy, and vigor
- Historically associated with offshore aku (skipjack tuna) fishing

Herb Kawainui Kāne



Kahā‘ulelio, 2005

- Fast-growing, short life span, epipelagic visual forager
- Popular fishing target
- Offshore circumtropical/subtropical

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A staple in Hawai‘i’s pelagic fisheries

Hawai‘i mahimahi fishing has evolved and expanded over time

Pre- 1990s

Trolling within 50 nmi of the archipelago.

Targets broad range of pelagic species at different times of year

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1989/1991

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Targets broad range of pelagic species at different times of year

Continental US longline boats started fishing around Hawai’i

Deep setting targets bigeye tuna (300m)
Sets span 25-40 nmi in length

Hawai‘i mahimahi fishing has evolved and expanded over time

Today

$3.4 million commercial mahimahi revenue

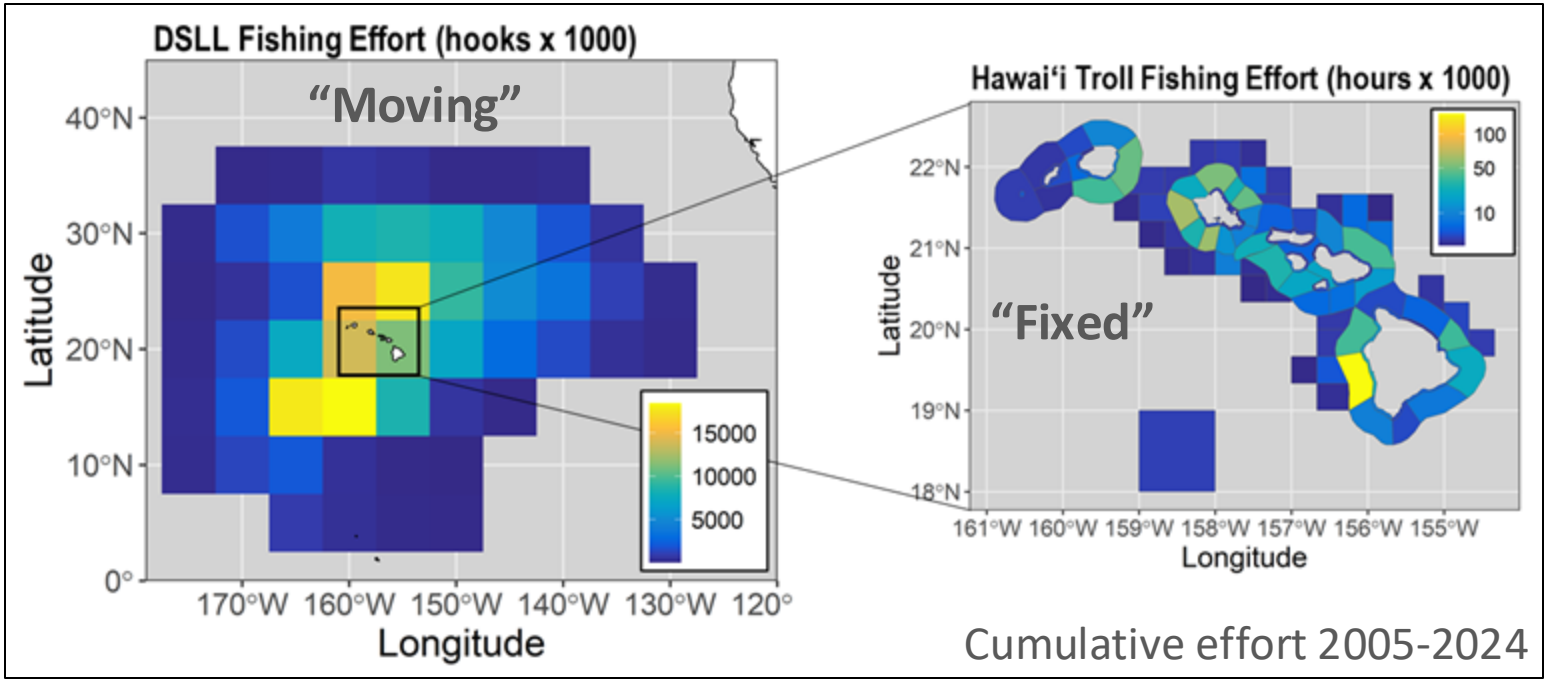
500,000 lbs mahimahi landed

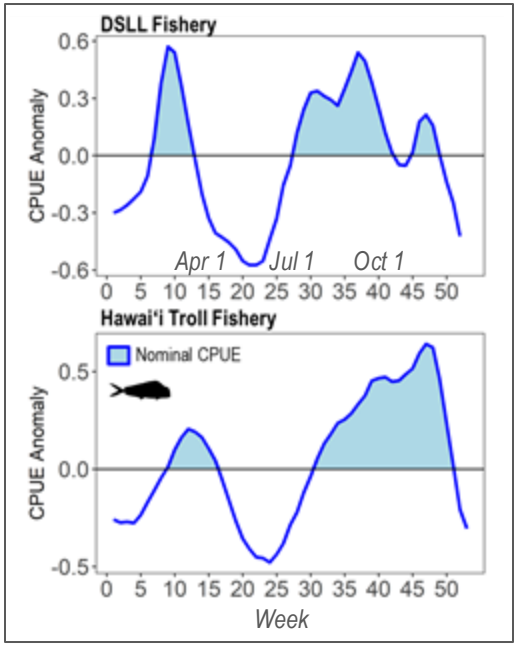
Longline Fisheries
Industrial-scale (140 boats operating)
“DSLL”

Troll Fishery
Local scale (1000 fishers reporting)

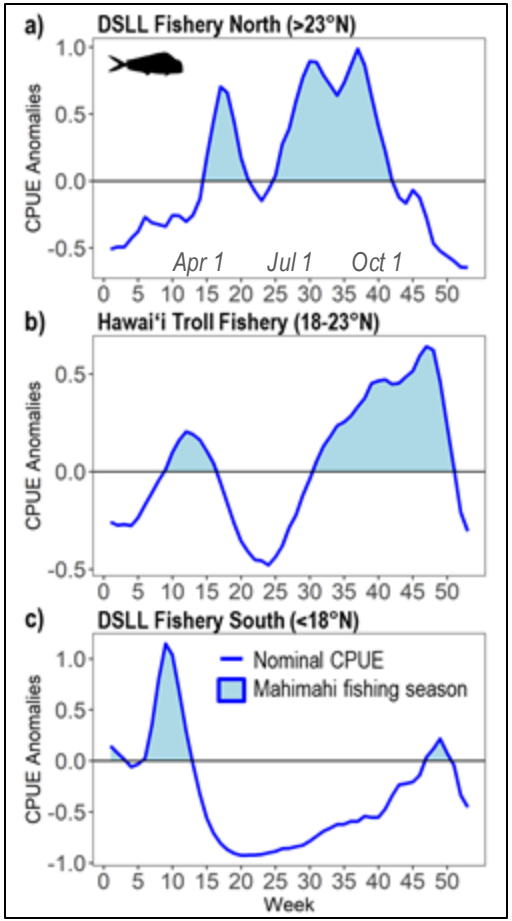
UFA dealer records, 2015-2024; J. Helyer

These fisheries operate on vastly different scales and collectively span much of the Central North Pacific Ocean





Despite differences in scale, strong seasonal patterns in mahimahi nominal catch rates persist across both fisheries



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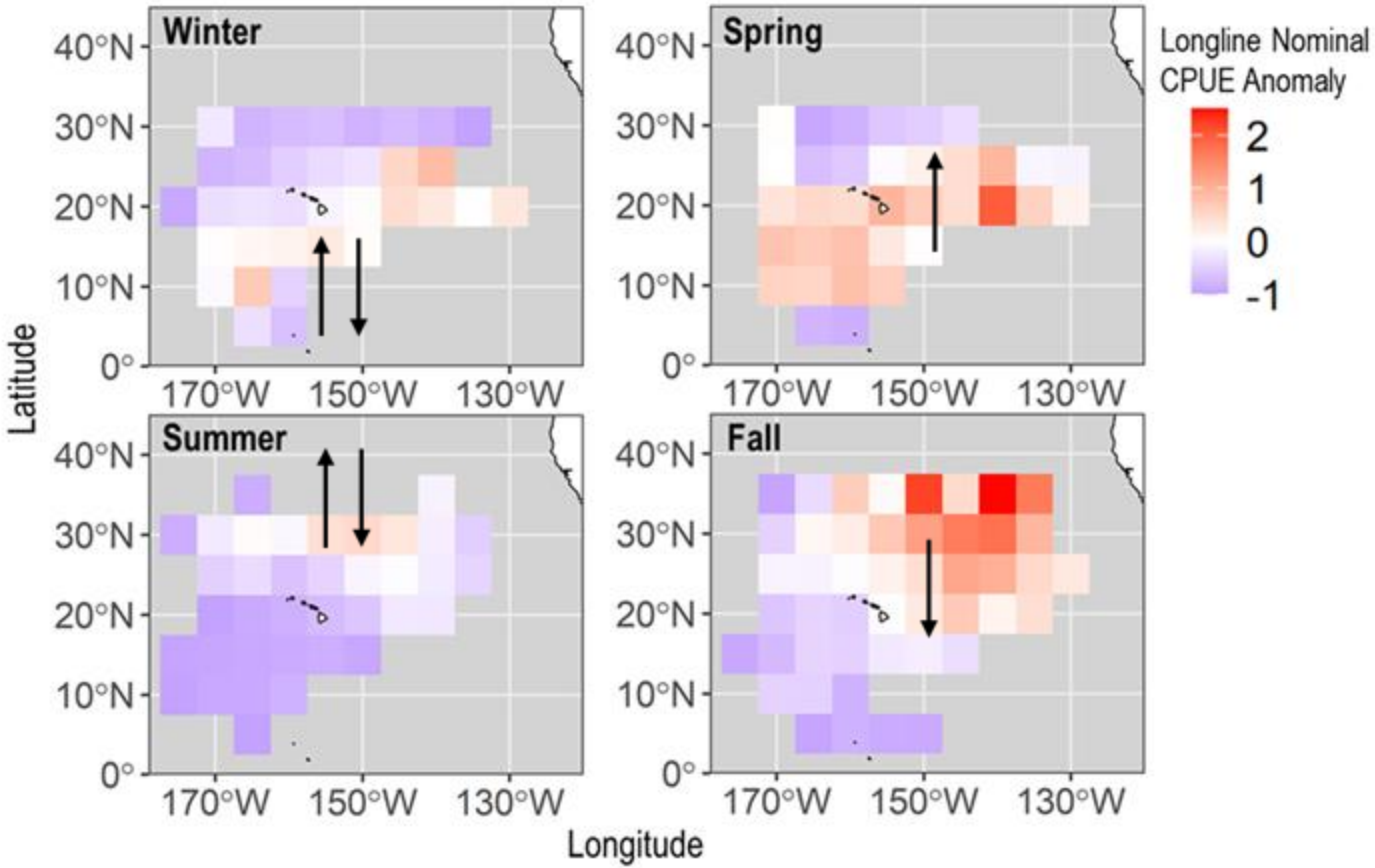
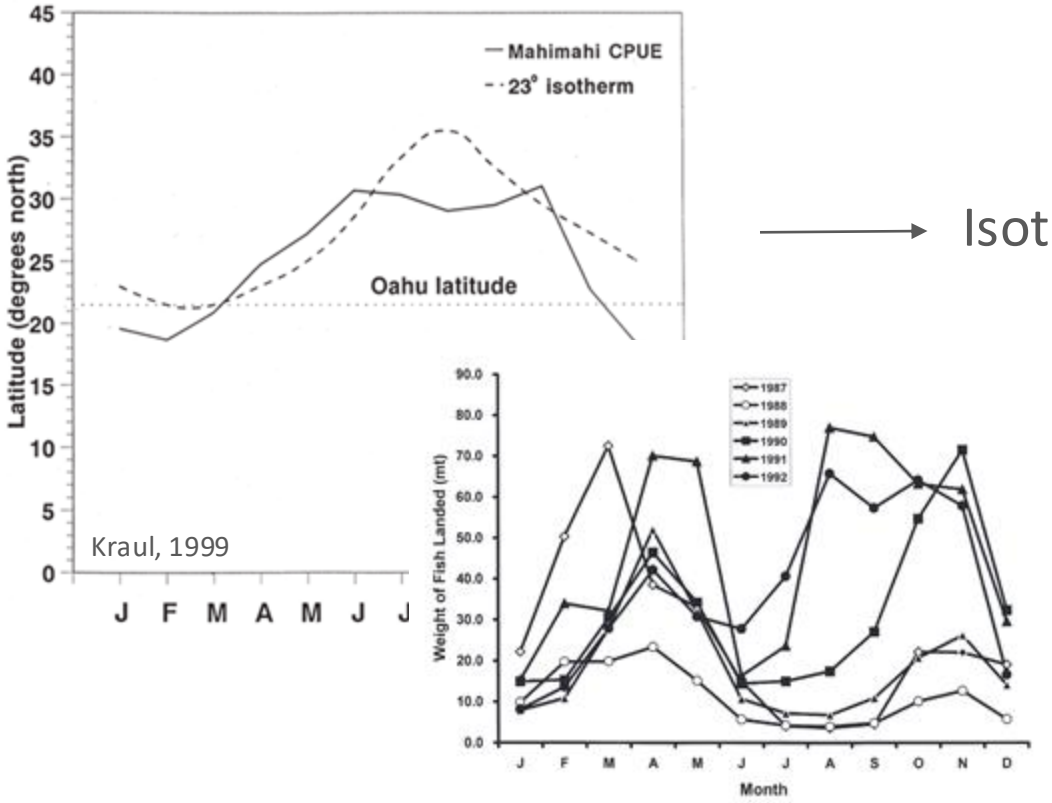
Slight shifts in the timing of “fishing seasons” across latitudes

Meridional Migration?



This seasonality was observed in the early days of the Hawai‘i longline fishery and attributed to seasonal temperature changes



→ Isotherm hypothesis

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Approach: Develop **catch rate models** for troll and longline fisheries

NOAA Pacific Islands Regional Observer Program

- 20% coverage until recently
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Hawai‘i small boat fishing communities

- Fishing/fishery dynamics
- Fish behavior & ocean conditions

Accounting for gear and fisher behavior when modeling fisheries data

Effect	Longline Fishery	Troll Fishery
Targeting (multi-species fishery)	Subset for shallow hooks	- PCA for catch composition - Separate charters
Captain/fisher biases	Permit number (random)	- License number (random) - “Highliners” only
Gear/FADs	- Bait/hook types - Float length	- Trolling only (lures vs bait) - Windspeed
Effort	1000 hooks	Fishing hours

*P/A process perhaps more appropriate for this fishery

Generalized Additive Mixed Models

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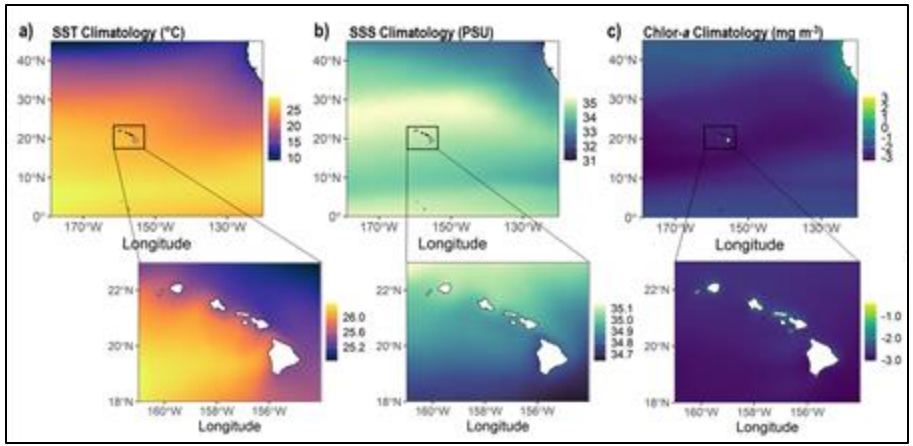
Explore oceanographic drivers of catchability



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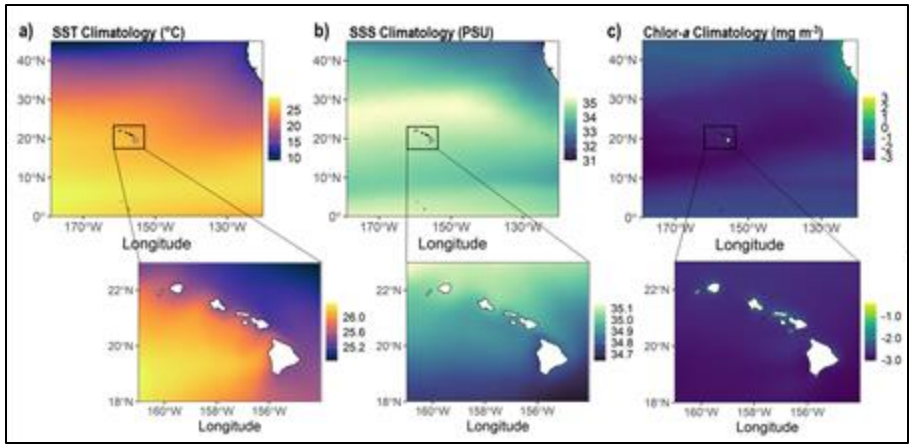


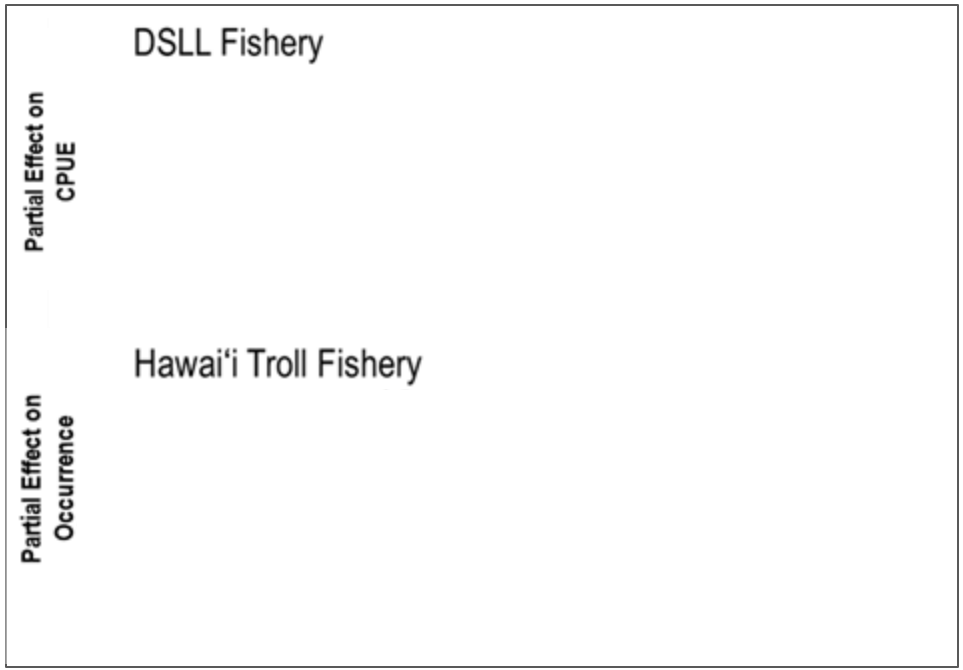
Standardize indices of mahimahi abundance

Nominal CPUE -

Catchability (behavior + environment) =

Standardized Abundance Index
(“year effect”)

GAMMs reveal common oceanographic trends in mahimahi catch



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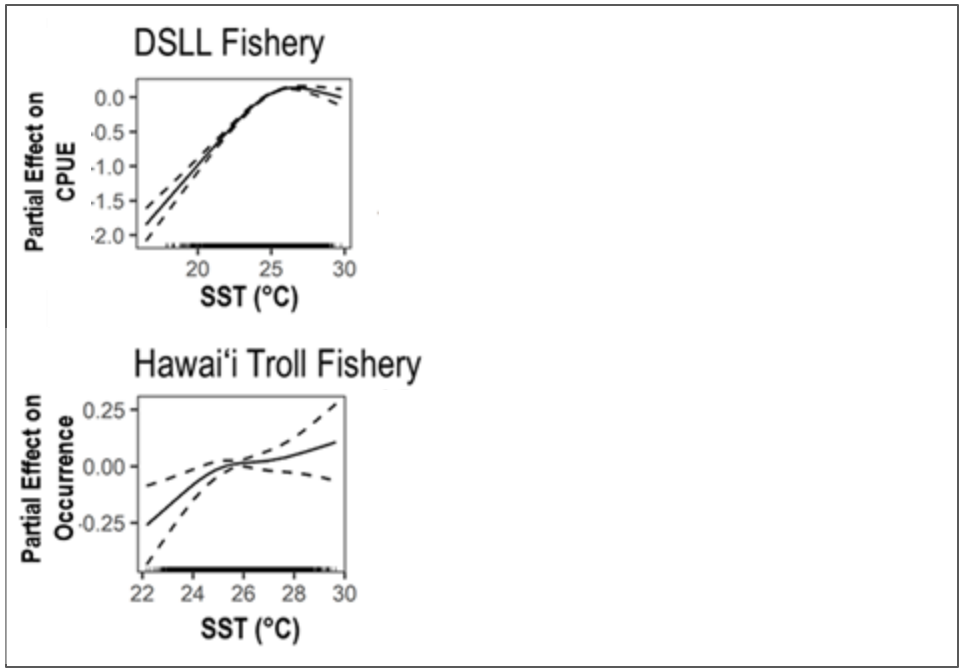

- Warm SST (>25℃)

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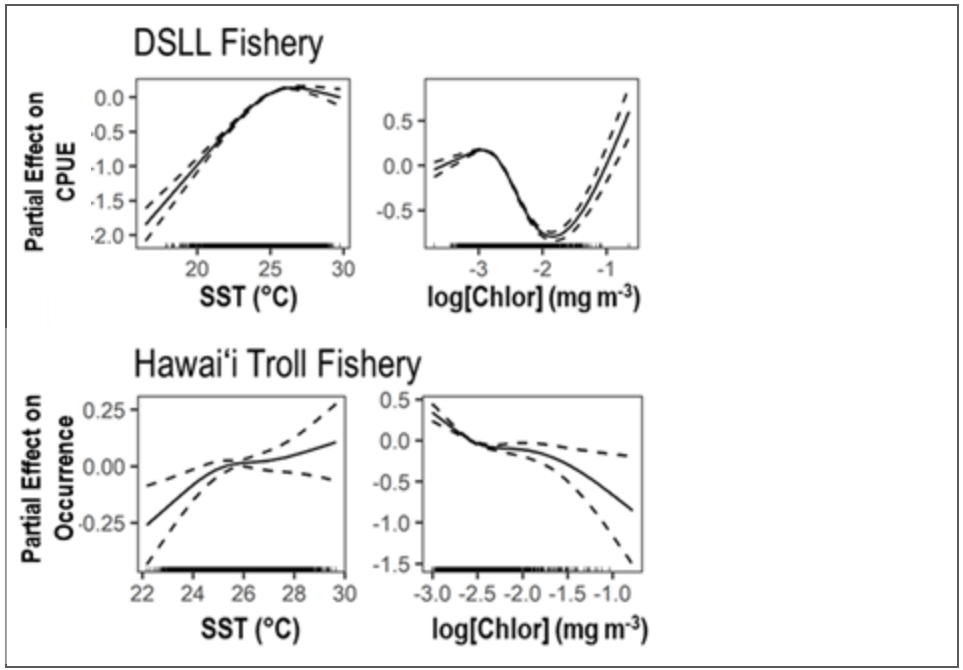

- Warm SST (>25°C)
- Low productivity (< 0.06 mg m^{-3})

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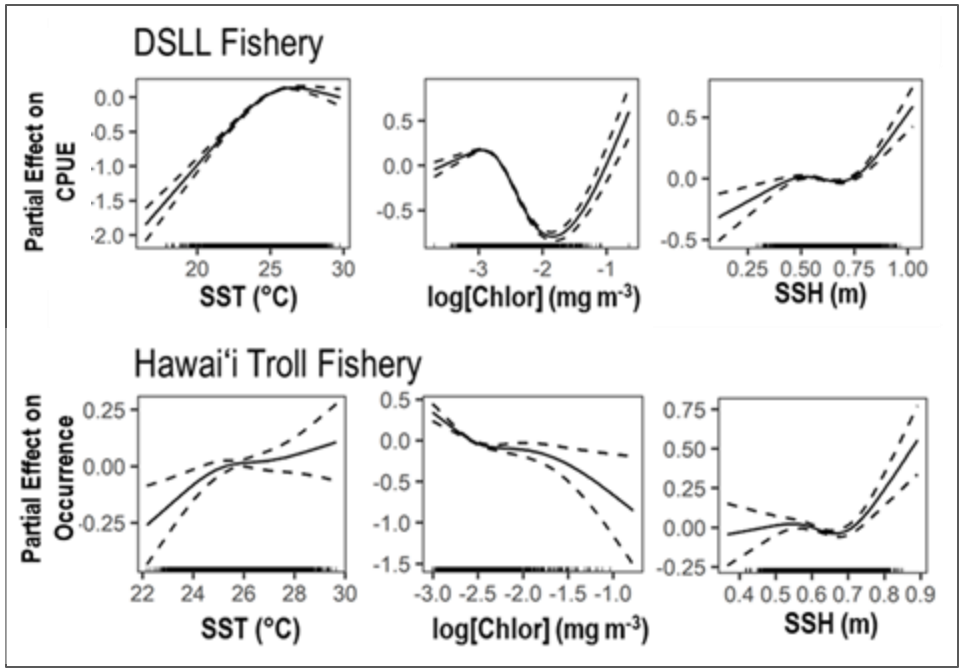
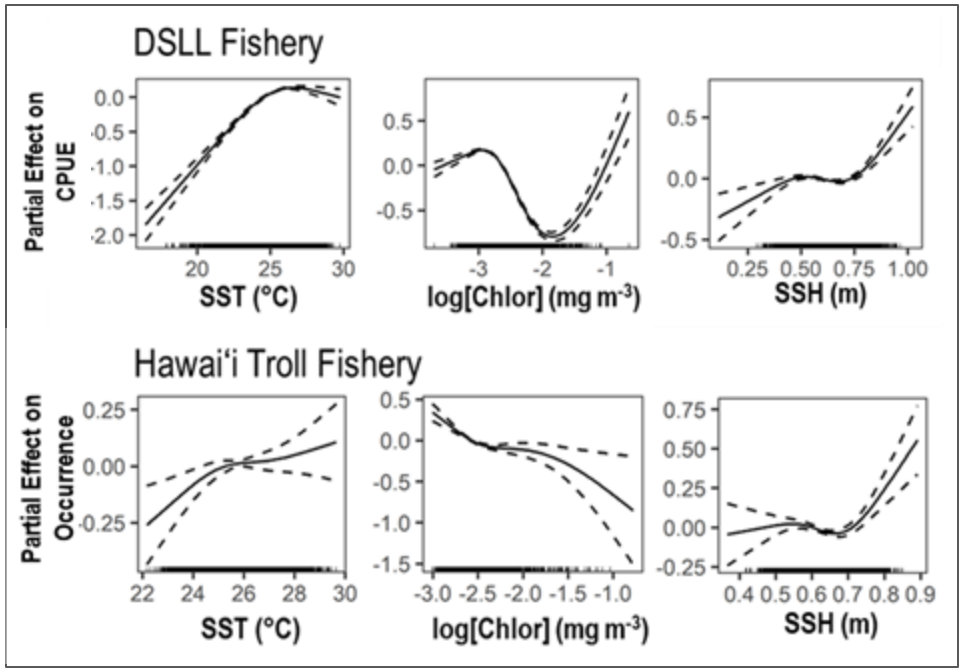
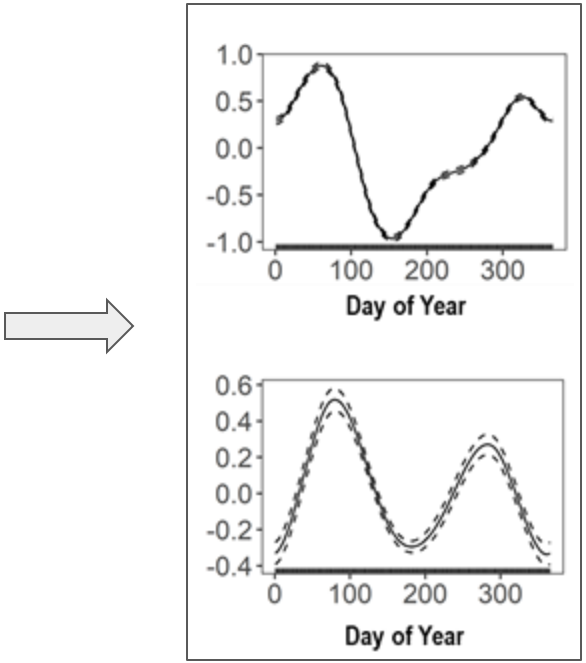


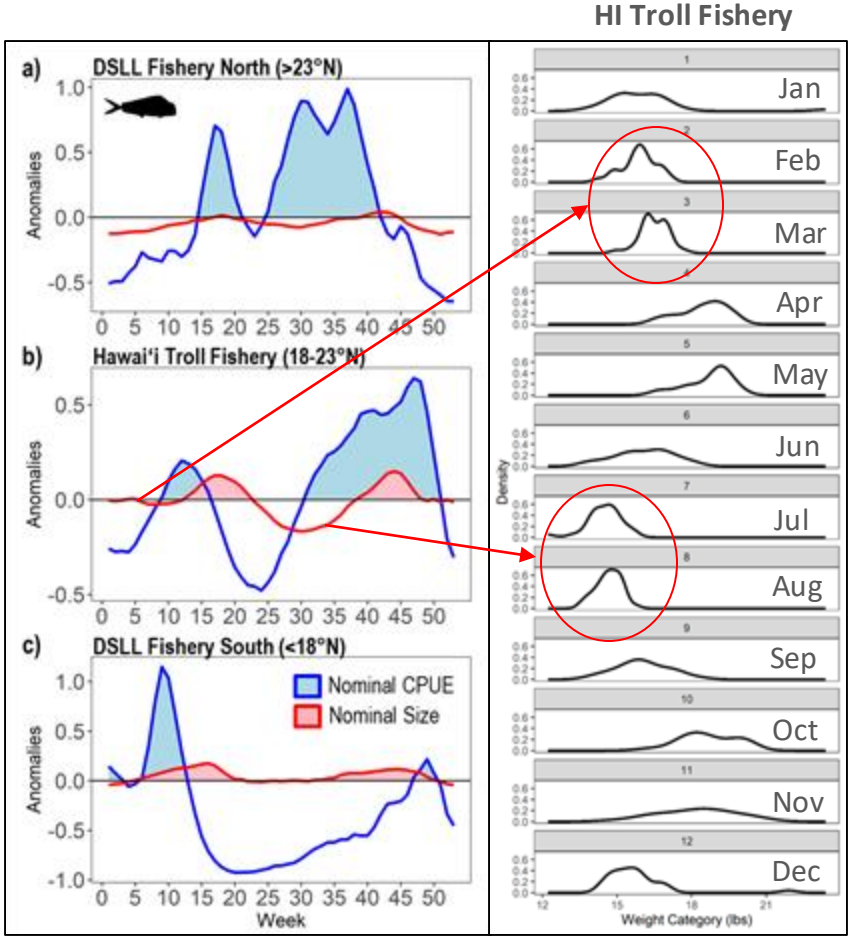
- Warm SST (>25°C)
- Low productivity (< 0.06 mg m^{-3})
- High SSH (> 0.7 m)

Oceanography does not “replace” mahimahi seasonality

SST is not sufficient to describe movement patterns of CPUE

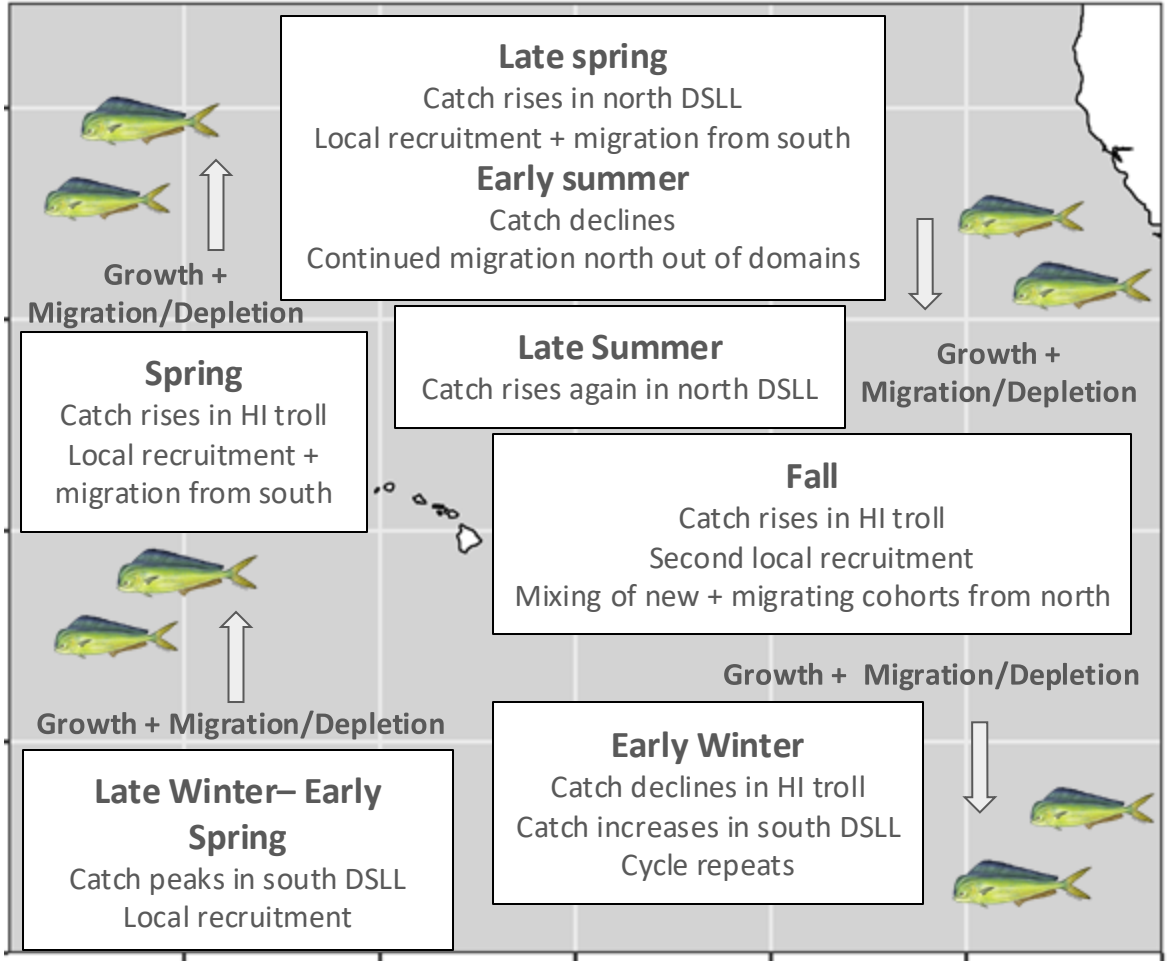






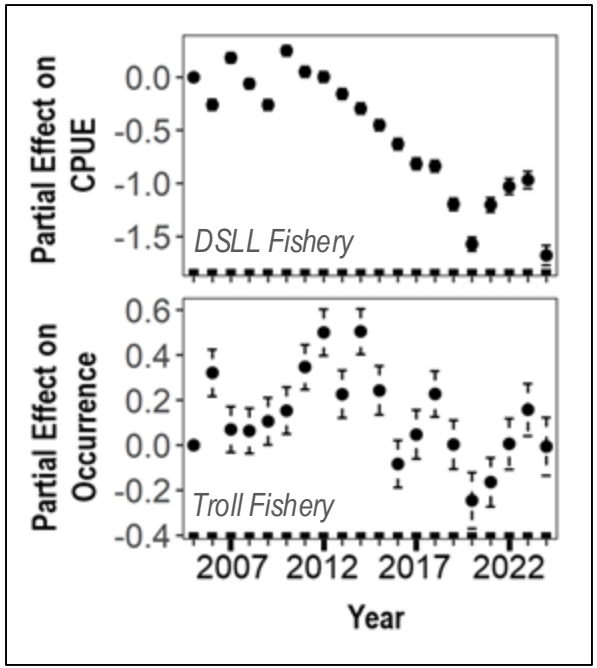
Both migration and recruitment are likely driving seasonality in mahimahi catches.

Mahimahi migration and recruitment hypothesis



Standardized indices indicate clear annual declines in mahimahi catch

Nominal CPUE - Catchability (behavior + environment) = **Standardized Abundance Index**



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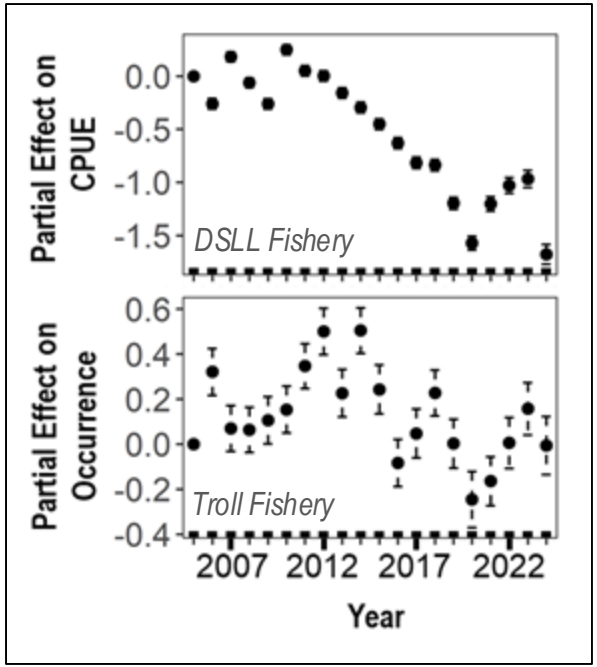

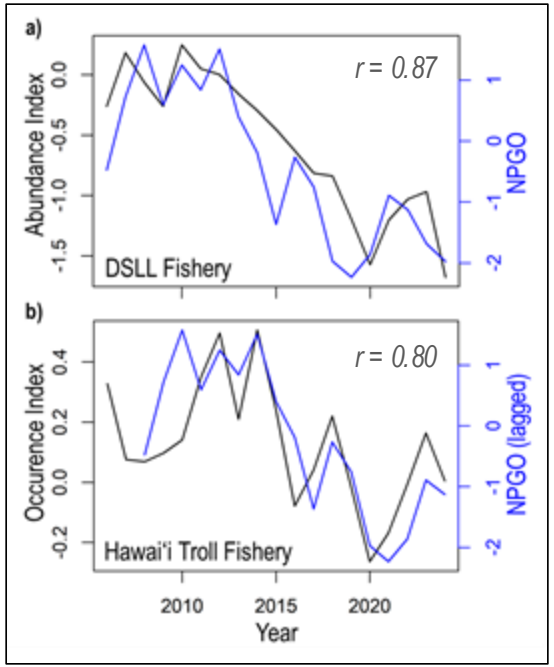

Image: NOAA's West Hawai'i Integrated Ecosystem Assessment

The NPGO is associated with fluctuations in salinity and nutrient levels supporting phytoplankton dynamics and is evident in sea level/temperature trends.

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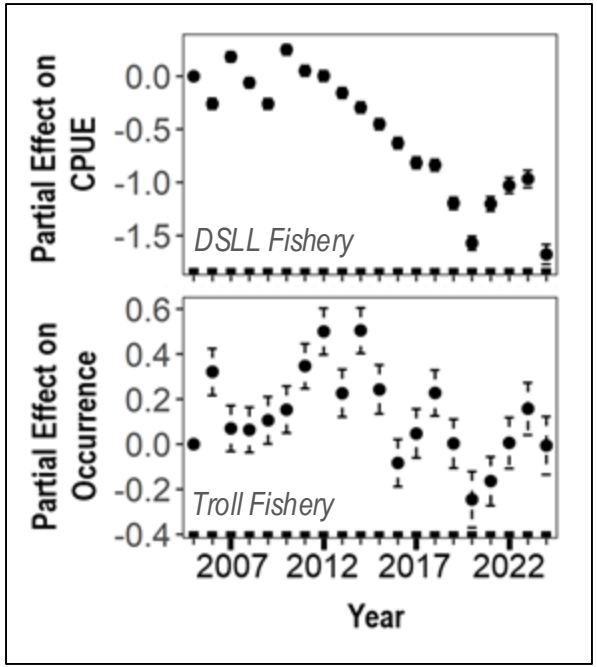

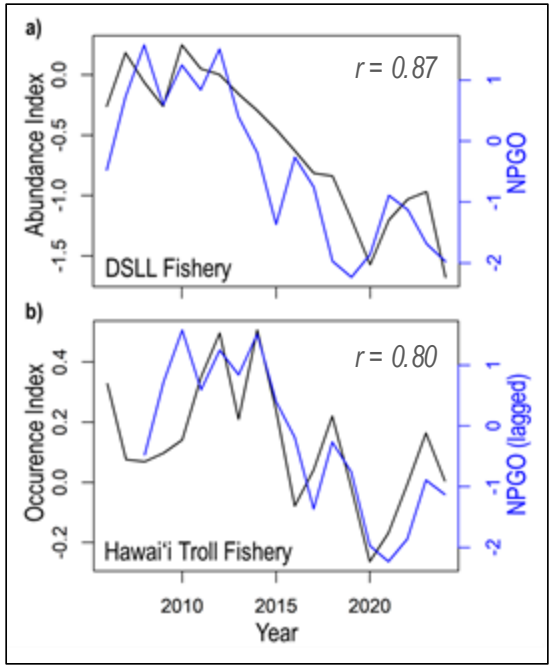

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**Additional work is required to understand mechanisms and rule out fishing pressure*

Summary

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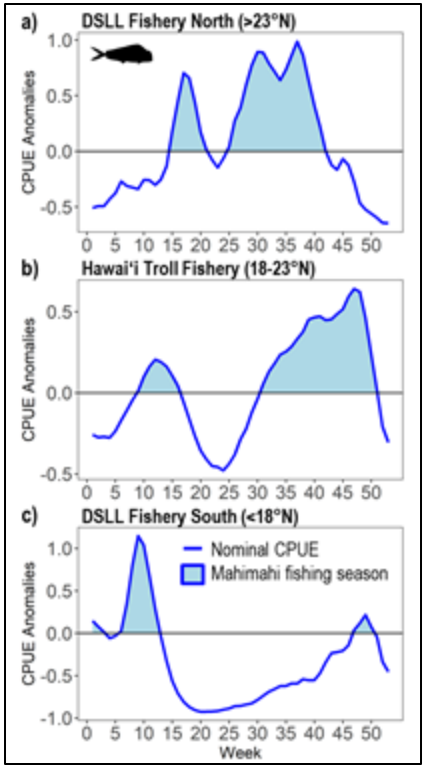

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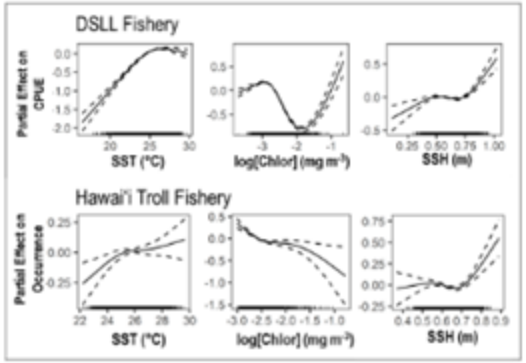

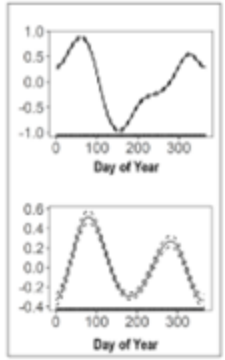

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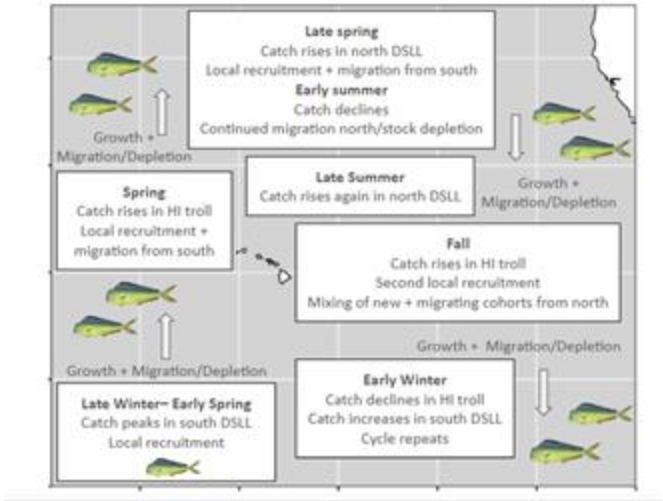

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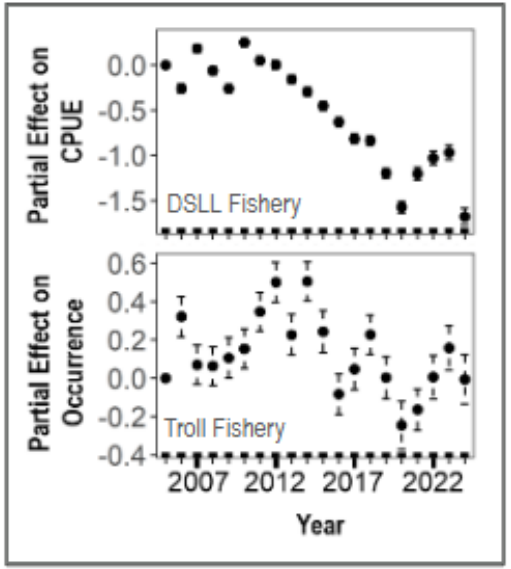

Mahalo nui

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Hawai'i fishers

Funding, data, host institutions

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Questions?

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