SEPARATION OF PACIFIC SKIPJACK AND BIGEYE TUNA FISHING GROUNDS USING PUBLIC DOMAIN CATCH DATA

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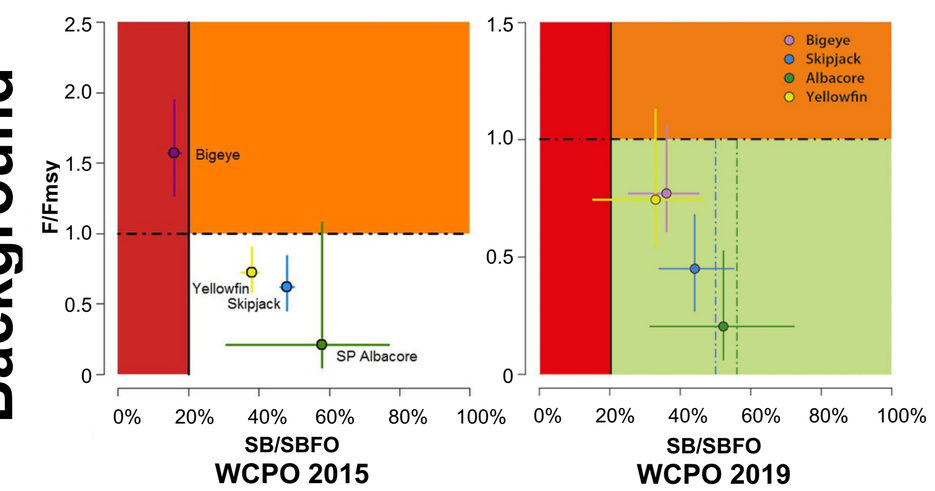
Background



Questions

- Where and when is the most bigeye (BET) bycatch occurring by purse seines targeting skipjack (SKJ)?
- What causes bigeye bycatch and bigeye:skipjack catch ratios to vary in space and/or time?
- How can this information be used to maximize skipjack catch while simultaneously minimizing bigeye catch?

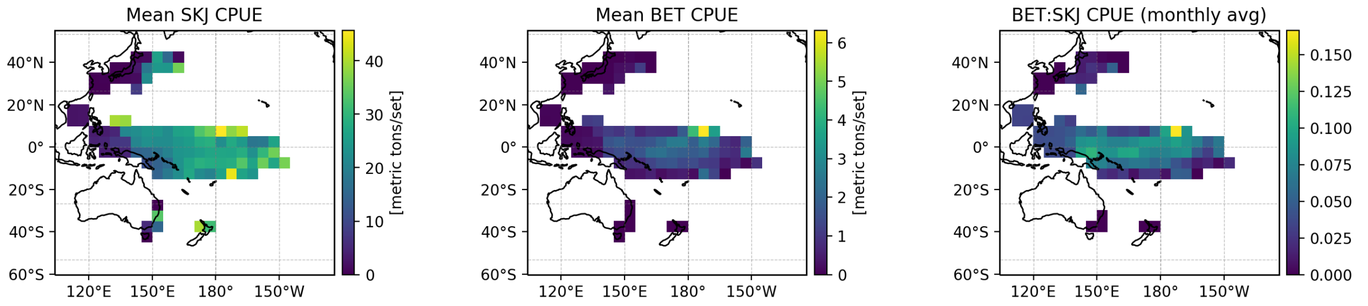
Data & Methods

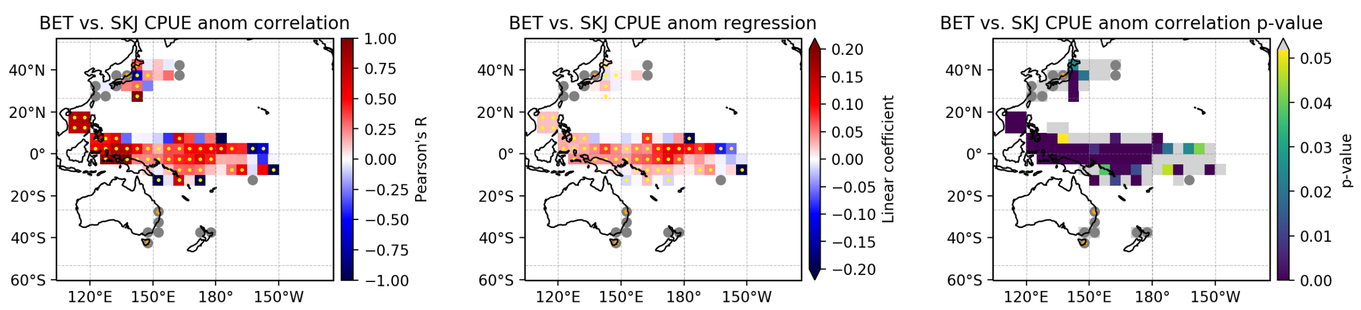
Variable	Time period	Product grid	Data type	Source
SST, O_2, SSS	Jan 1955 – July 2018	Global, raw profiles	In situ measurement	World Ocean Database 2018
CHL	Monthly means, Sep 1997 – Dec 2018	Global, 4km x 4km	Satellite	ESA Ocean Colour Climate Change Initiative version 4.0 dataset
MLD	Monthly means, Jan 1992 – Dec 2011	Global, 0.5° x 0.5°	Reanalysis	ECCO version 4, release 2
SSHA	Monthly means, Jan 1993 – Dec 2018	Global, 0.25° x 0.25°	Satellite	AVISO gridded sea level anomalies
BET, SKJ purse seine catch and sets	Monthly means, Jan 1967 – Dec 2017	WCPFC Convention area, 5° x 5°	Aggregated catch, effort from CCMs and CNMs	Western & Central Pacific Fisheries Commission (WCPFC)
ONI	Monthly, Jan 1950 – Apr 2018	No grid, a time series	Constructed from ERSSTv5 SSTs	NOAA Climate Prediction Center

- All variables regridded onto 5° x 5° monthly mean maps
- Correlation, regression, compositing, significance testing controlling for false discovery rate, quotient analysis

Results and Discussion

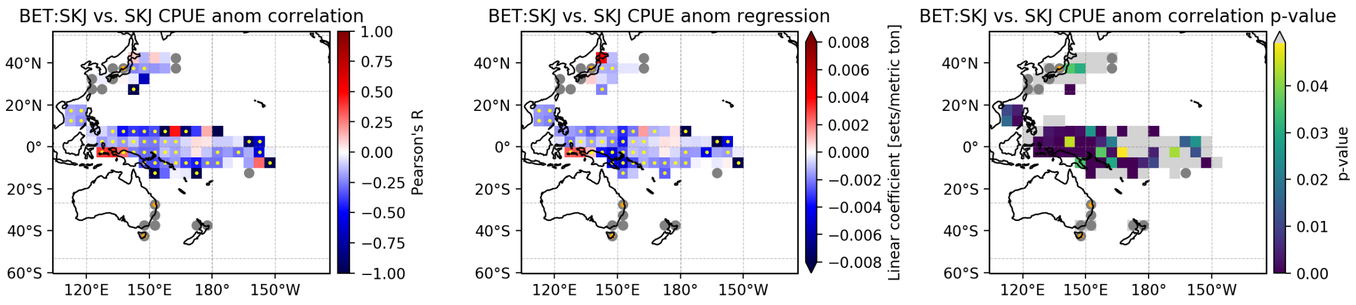
There's a sharper drop-off in BET compared to SKJ CPUE at the fringes of the WCPFC area → BET:SKJ catch ratios are lowest here.



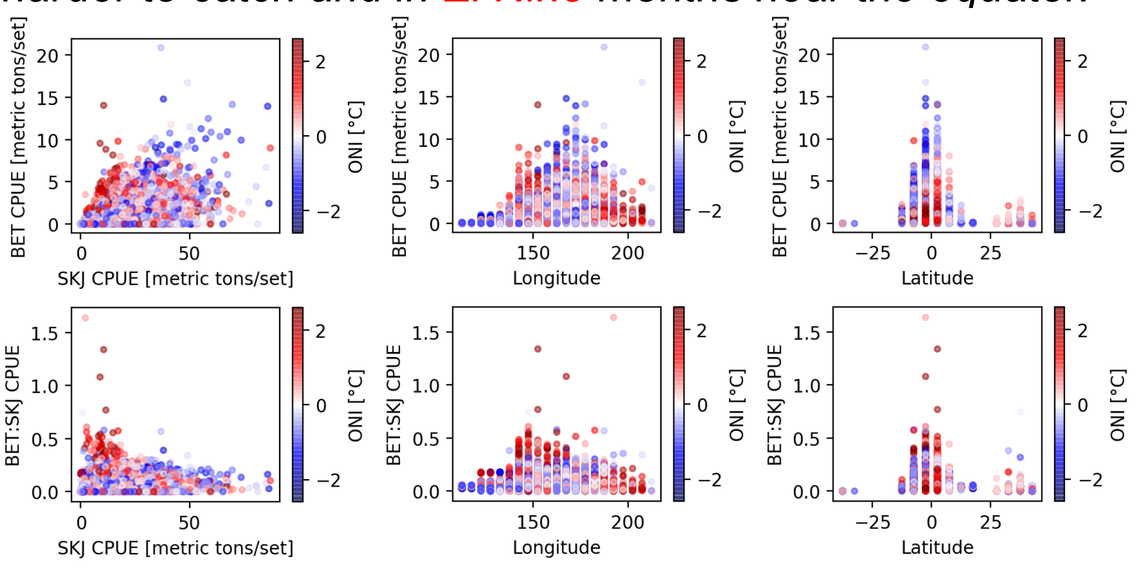


BET and SKJ CPUE are highly positively correlated temporally, but the degree of correlation varies spatially and is lower or negative at the fringes.

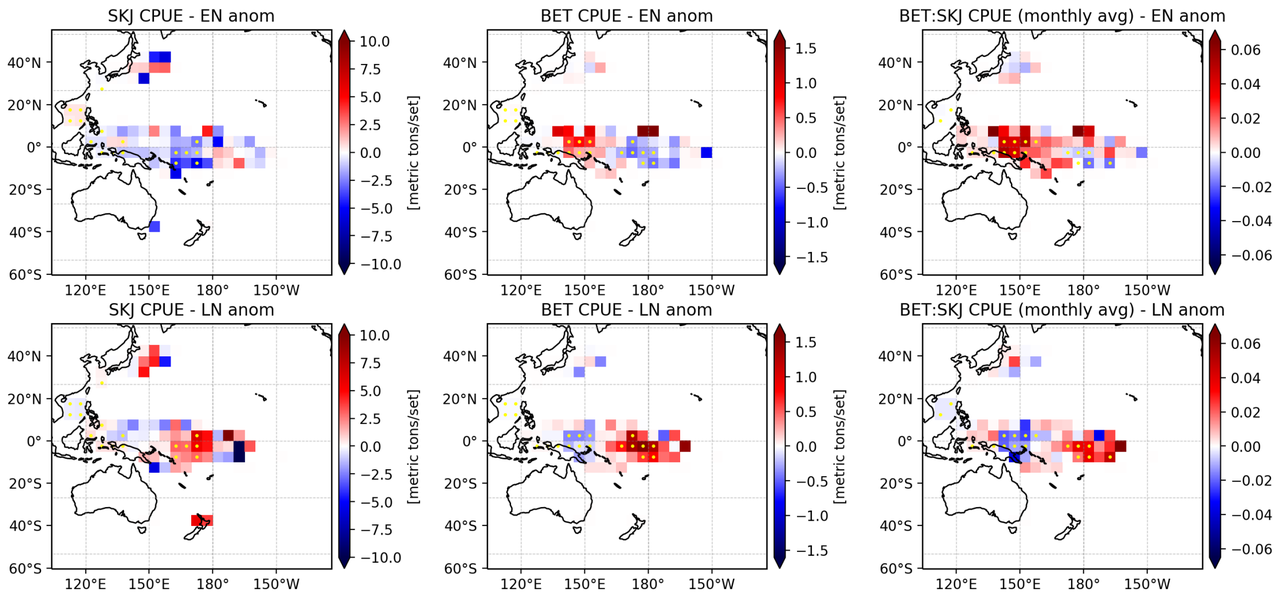
When SKJ are easier (harder) to catch, BET:SKJ catch ratios decrease (increase).



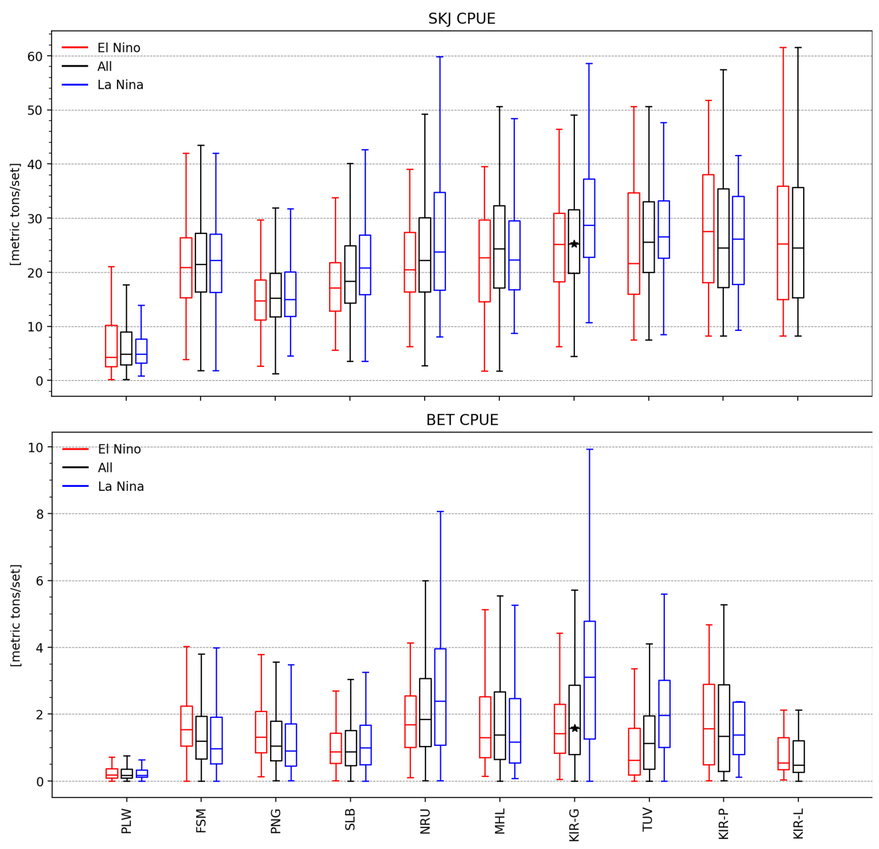
The highest BET:SKJ catch ratios occur when SKJ are harder to catch and in El Niño months near the equator.



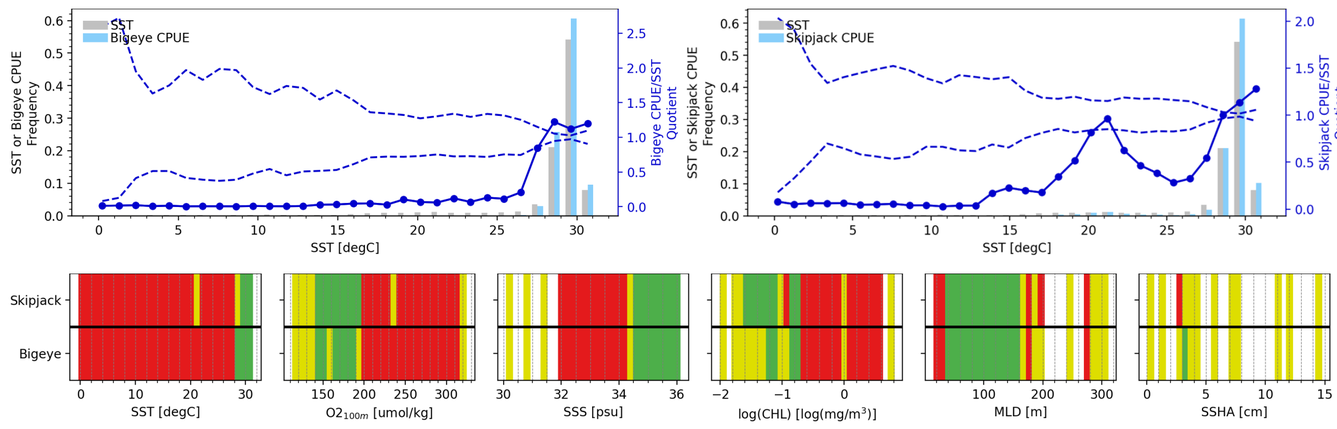
To minimize BET:SKJ catch ratios while maximizing SKJ CPUE during El Niño, fish east of 180° longitude.
To minimize BET:SKJ catch ratios while maximizing SKJ CPUE during La Niña, fish just east of PNG.



Fish in Micronesia, Papua New Guinea, and maybe Solomon Islands EEZs during La Niña.
Fish in Kiribati (Gilbert Islands) and maybe Tuvalu and Kiribati (Phoenix Islands) EEZs during El Niño.



It may be difficult to separate BET and SKJ based on environmental conditions, but more work is needed here.



Conclusions

- BET:SKJ catch ratios are lower along the fringes of the WCPFC Convention area.
- BET:SKJ catch ratios are higher in El Niño years, along the equator, and when/where SKJ are harder to catch.
- To minimize BET catch while maximizing SKJ catch during El Niño, fish in the eastern part of the WCPFC area within the EEZs owned by Kiribati and Tuvalu.
- To minimize BET catch while maximizing SKJ catch during La Niña, fish in the western part of the WCPFC area within the EEZs owned by Micronesia, Papua New Guinea, and Solomon Islands.
- Separating BET and SKJ based on environmental conditions may be difficult.

Future Work

- GAMs for SKJ CPUE, BET CPUE, and BET:SKJ catch ratios to better determine potential environmental variables that can separate SKJ and BET
- Add tuna hypoxic depth and thermocline depth to quotient analysis and GAMs
- Analyze how BET-SKJ separation differ depending on the type of set
- Apply GAMs with projected environmental conditions to see how BET-SKJ separation may change with climate change
- Add in data from IATTC