The Safina Center

# AREA-BASED MANAGEMENT OF THREATENED SPECIES BYCATCH IN A PACIFIC OCEAN TUNA PURSE SEINE FISHERY

## WHAT:

Analyzed observer program data of Papua New Guinea and Philippine flagged tuna purse seine vessels operating in the western Pacific Ocean in order to estimate the effect of the spatial and temporal distribution of fishing effort on target and at-risk catch rates.


## WHY - STUDY OBJECTIVE:

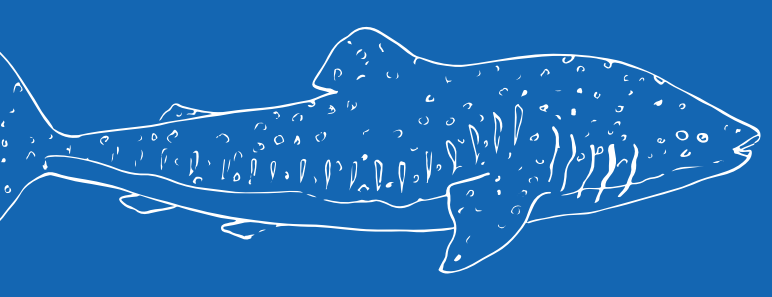
Determine if there are temporally and spatially predictable hotspots and coldspots for catch rates of at-risk species and of target tunas to determine if these can be feasibly separated.

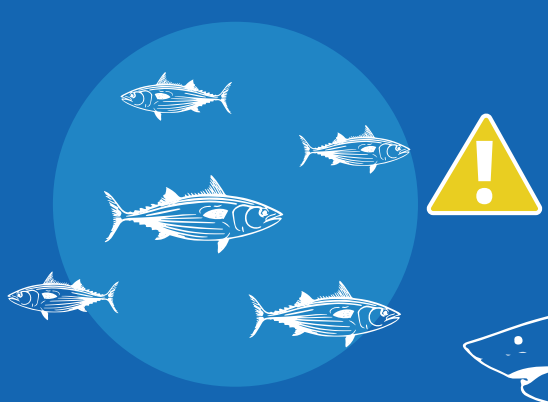
## HOW:

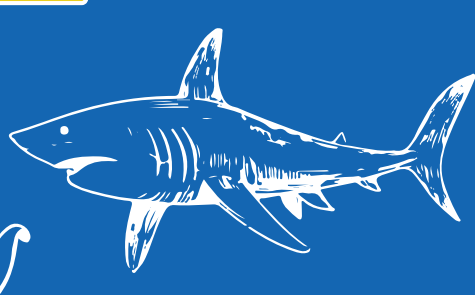
With effort conditioned to account for other potentially informative predictors of catch risk, the observer data were fit to spatially-explicit generalised additive multilevel regression models within a Bayesian inference framework.

## INFORMING THE MANAGEMENT OF THE SPATIAL DISTRIBUTION OF EFFORT:

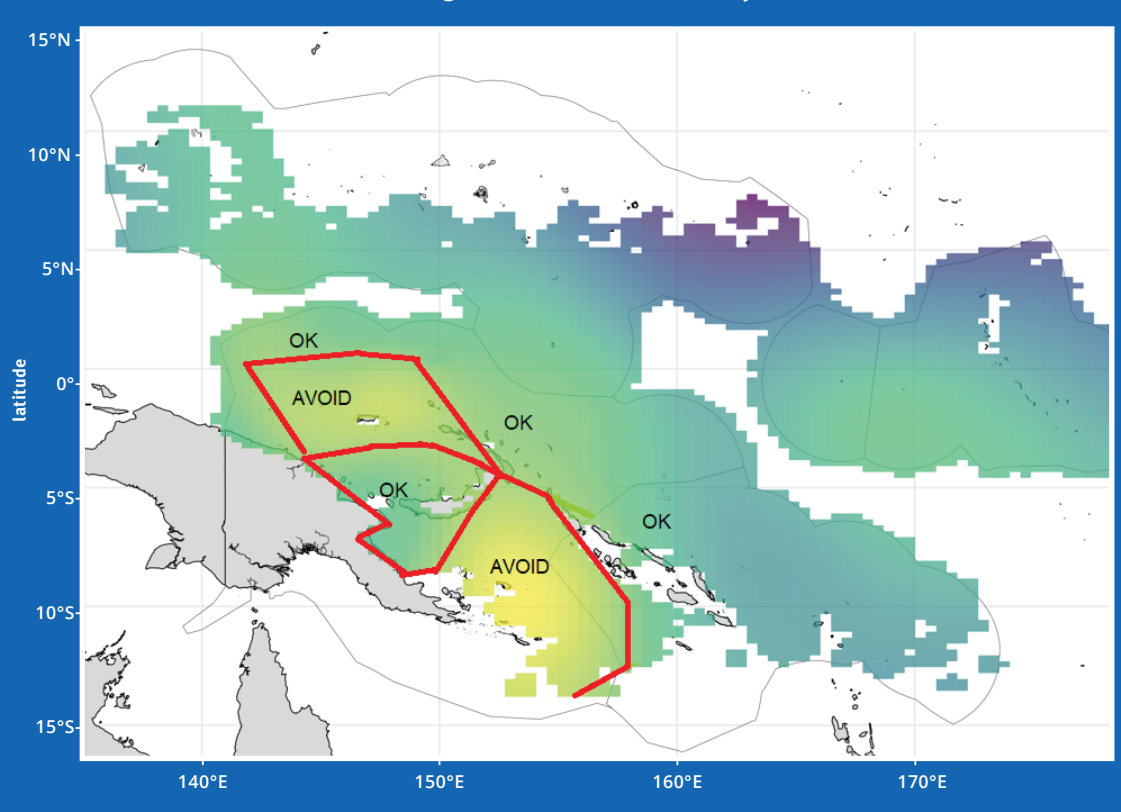
Effort could be focused in an area within core fishing grounds to reduce overlap with hotspots for silky sharks, rays and whale sharks without affecting catch rates of target tunas. Effort could also be shifted outside of core fishing grounds to zones with higher commercial tuna catch rates that reduce overlap with hotspots for at-risk species.







**Fishing Grounds to Reduce Silky Shark Catch**




## AREAS WHERE SPATIAL SEGREGATION MIGHT NOT BE FEASIBLE:

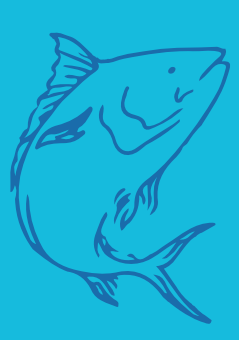
Two tuna catch rate warmspots overlapped with warmspots for whale sharks in the northwestern zone of the PNG EEZ, and for silky sharks, rays and whale sharks in the Coral Sea in the southeastern PNG EEZ. Here, spatial separation of target and at-risk catch may not be feasible.

## SPECIES FOR WHICH SPATIAL SEGREGATION MIGHT NOT BE FEASIBLE:

There were sparse hard-shelled marine turtle and whale shark catch rate hotspots generally scattered across the fishing grounds.

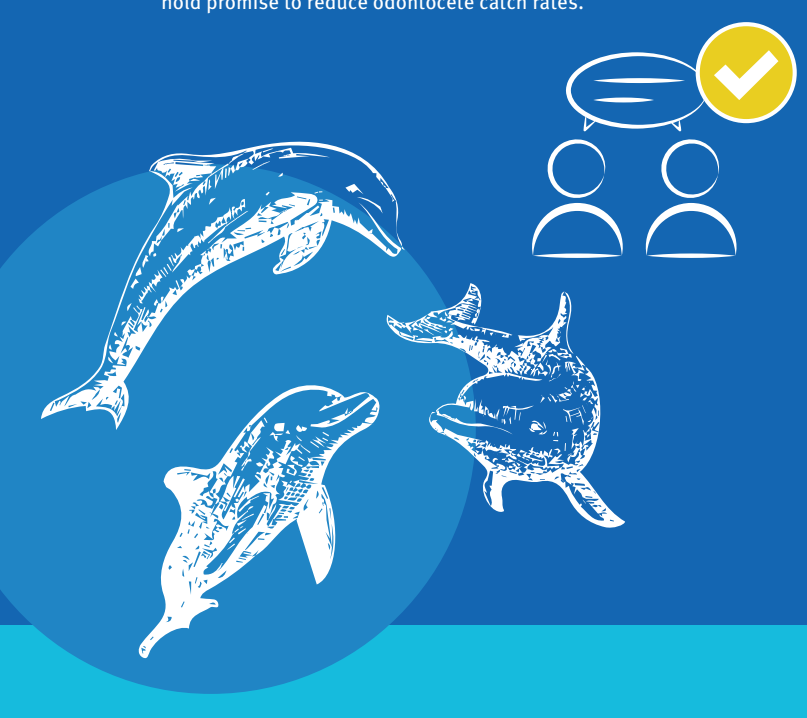
## ADDITIONAL RESEARCH ON SOCIOECONOMIC EFFECTS OF ALTERNATIVE STATIC AREA-BASED MANAGEMENT STRATEGIES

is a priority, such as accounting for costs including from fuel efficiency and operational constraints of adjusting fishing grounds. Additional research could also assess the spatial distribution of the size frequency distribution of the principal market tuna catch.



## OTHER OPPORTUNITIES TO REDUCE DOLPHIN BYCATCH:

Unlike for silky shark, whale shark, rays and turtles, a small subset of sets had disproportionately large numbers of odontocete captures. Real time fleet communication and move-on rules, and avoiding sets on dolphin schools, might hold promise to reduce odontocete catch rates.



## MANAGEMENT OF SIGNIFICANT OPERATIONAL PREDICTORS

**SET TYPE:** Silky shark catch was lowest in sets on anchored fish aggregating devices (FADs), and highest in drifting FAD and in other associated sets compared to sets on free swimming schools. The fishery has increasingly conducted free school sets, making up over 80% of sets during the past 5 years.

**MESH SIZE:** Sets using nets with a smaller mesh size were more likely to have no silky shark or ray catch. Mesh size did not affect tuna catch rates.

## NO TEMPORALLY DYNAMIC AREA-BASED MANAGEMENT METHODS IDENTIFIED

Results did not identify opportunities for temporally dynamic area-based management of target and bycatch catch rates. Time of day of initiating sets was an important predictor for tuna catch rate, but not for at-risk bycatch species. Previous studies that explored time of day effects on attendance at drifting FADs found that target tunas and silky sharks unfortunately make excursions away from the FADs, likely to forage, at similar times (mainly during the night time). Temporal predictors at scales of within a month (moon phase), season, and interannual El Nino Southern Oscillation phase also did not explain any species-specific catch rates.

## CONCLUSION:

Findings inform the design of a bycatch management strategy that incorporates area-based management to avoid catch rate hotspots of at-risk species without compromising the catch of principal market species.