Comisión Interamericana del Atún Tropical Inter-American Tropical Tuna Commission

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Estimation of the Order of Magnitude of Silky and Hammerhead Shark Catches in Coastal Artisinal Fisheries

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Estimating Shark Catches

- Silky (*Carcharhinus falciformis*) and hammerhead (*Sphyrnidae spp.*) sharks identified as vulnerable species in the EPO (<u>SAC-11-13-MTG</u>)
 - Targeted and bycatch
- Limited comprehensive and consistent data on catches from targeted "panga" fisheries from CA but reason to believe they are substantial
- Field program sampling catch of sharks per trip per panga throughout coastal Central American EPO ran 2020-2021

Can we estimate total catch of silky and hammerhead sharks in CA panga fisheries based on survey data?



Background



Goals Long-term sampling Program (2020-2021)

Field test the IATTC-OSPESCA sampling design





Provide guidance and a field-tested protocol sampling program Replace preliminary orderof-magnitude estimates from fisher interviews



Data



Survey Program 2019 (See SAC-11-13-MTG)





Distribution of Sampling Sites

Not Sampled
 Sampled



Figure 1: Map of identified landing sites marked as "Sampled" (visited at least once by a surveyor) or "Not Sampled"



Temporal Coverage of Sampling



Figure 2: Number of sampling events per year-week



Country Samples



Figure 3: Number of sampling events per year-month and country



Temporal Coverage of Sampling



Figure 4: Number of samples per site and year week. Blank indicates no samples taken.





Figure 5: Mean catch per week per panga from surveys



Cut Types



Figure 6: Proportion of cut types reported in the survey data.



Raising Factors



Figure 7: Net raising factor per country and species



Models



Random Forests

This project uses a type of model called *random forests*

- A type of *machine learning* good for **prediction** but not **understanding**
- Can "learn" complex interactions in the data on their own
- No estimates of uncertainty or "significance"



Measuring Performance

- Models are usually measured by how well they predict the kinds of data points they
 were fit to
- We care more about the accuracy of the **total catch prediction** than we do individual points

To test this for each model...

- 1. Randomly(ish) split the data into a "training" and "testing" split (mirroring sampling bias)
- 2. Train model on training, use to predict testing
- 3. Calculate observed and predicted total catch
- 4. Repeat process many times



Interpolation

- As seen in Figure 4, coverage at sampled sites varies
- We know catch occurred when samplers were not present
- We trained a model to predict the average catch per week per panga at **un-surveyed weeks** at **surveyed sites**
 - Uses site traits + time + most recently observed catch rates



Interpolation



Figure 8: Observed vs. predicted total interpolated catch for 20 bootstrapped testing datasets



Extrapolation

- As seen in Figure 1, only 5% of landing sites surveyed
- We know catch occured at at least some of these un-surveyed sites
- We trained a model to predict the average catch per week per panga at **un-surveyed sites** based **surveyed sites**
 - Uses site traits + time



Extrapolation



Figure 9: Observed vs. predicted total extrapolated catch for 20 bootstrapped testing datasets



Results



Catch Estimates



Catch Over Time

Α



Figure 10: Total catch in metric tons (t) by species, year week, and model type



Total Catch

В



Figure 11: Total catch in metric tons (t) by species, year, and model type



Silky Catches





silky



Figure 12: Total catch in metric tons (t) by country and model type



В



Figure 13: Total catch in metric tons (t) by country and model type



Discussion



Panga Catches are Meaningful

- Survey data confirms and expands on prior research suggesting CA panga fishery catches meaningful amounts of sharks
 - An additional 5,000t of silky
 - CA panga hammerhead catches of 12,500t ~75% of total silky estimate
- Catch appears to be concentrated in some locations
- Panga catches need to be considered in monitoring, assessment, and management



Key Uncertainties

- Catches of sharks are not very predictable
- How similar are sampled sites to un-sampled sites?
- Raising factors for converting processed to whole weight in space and time
- Tracking active pangas in space and time
- COVID-19!



Potential Next Steps

- Harmonizing existing shark catch databases throughout region
- Targeted study on raising factors provides an easy improvement
- Consider new technologies for counting pangas
- Refining sampling design in line with objectives
- Expanding to additional countries
- Estimate relative impact of catch-at-age



Gracias por su atención - Thanks for your attention

Special thanks to all the technicians that made this analysis possible



