



**PADI FOUNDATION**



# USING DNA BARCODING TO IDENTIFY SEAFOOD FRAUD IN PUERTO RICO

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# Fish Fraud Concerns

## Public Health

- Food Poisoning
- Allergic Reactions
- Contaminant Exposure

## Environmental

- Illegal Fishing and Overexploitation
- Risk of Extinction of Threatened Species
  - Local extinctions
- Trophic Cascade
  - Reduction of a Predator Population
  - Increases in populations of intermediate components
  - Reduction in the populations of the mesopredators' prey

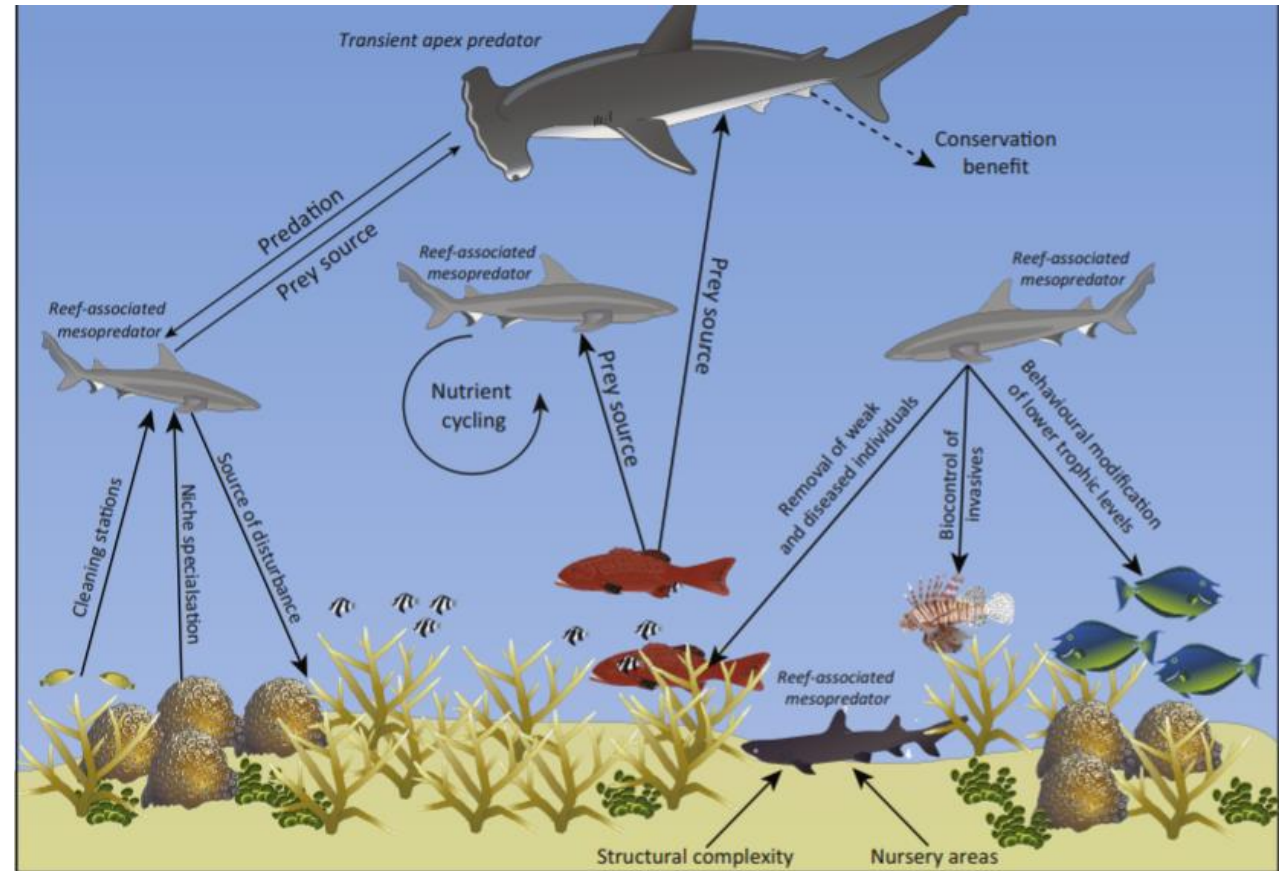


# Species Substitution and Mislabeling are Difficult to Detect

- Molecular identification methods
  - DNA barcoding
  - Next-generation sequencing
- Fish traceability is key to combating fish fraud
  - Enforcing food safety regulations
  - Ensuring high standards of sustainable fisheries management
  - Ensuring the quality of fish products
  - Minimizing health risks for consumers

# Importance of Elasmobranchs

- Some are apex predators
- Clean- up crew: Removal of weak and sick individuals
- Provide mass-balance
- Maintain structure in healthy ocean ecosystems
- Removal of invasive species
- Habitat disturbance
- Including nutrient cycling



# Boxfish (Ostraciidae)

## Size

- Maximum to about 45 cm; commonly to 25 cm.

## Fisheries importance

- Marketed fresh
- Highly prized in the Caribbean
- Considered excellent eating, although some species have been reported to have toxic skin (ostracitoxin) on occasion

## Species

- Scrawled Cowfish, *Acanthostracion quadricornis*
- Buffalo Trunkfish, *Lactophrys trigonus*
- Smooth Trunkfish, *Lactophrys triqueter*
- Spotted trunkfish, *Lactophrys bicaudalis*



# This Study

- There are unconfirmed speculations that rays are being used to replace *chapín* in turnovers.
- Detect the presence of Nurse Shark, as protected from fishing, possession, and sale, in shark fillets and shark processed products
  - A recent study found that nurse sharks were sold to local fish markets (Franqui-Rivera, 2020)
  - Demonstrates seafood fraud as the prohibited take and sale of a protected species



Conosco a alguien que trabajaba en un restaurante en Cabo Rojo y Me decía que las empanadillas que "supuestamente" eran de Chapín, SIEMPRE eran de "Rayas" y al dueño se las vendían bien baratas y les sacaba un montón. Según El cuenta, ellos tenían 2 "Chapines" viejos con los ojos bien hundidos en el congelador que a veces se lo mostraban a los clientes tenían dudas y preguntaban si las empanadillas en si eran de Chapín.. Yo he comido bastante Chapín y bastante Rayas preparadas de la misma manera(guisá) y son igual de ricas.

19h Like Reply



# OBJECTIVES:

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- Use DNA barcoding to detect the prevalence of seafood fraud in turnovers and shark meat
  - Determine if chapin is being substituted with other fish species
  - Determine if nurse sharks are being sold for consumption

# Sample Collection



## ***Chapín Turnover***

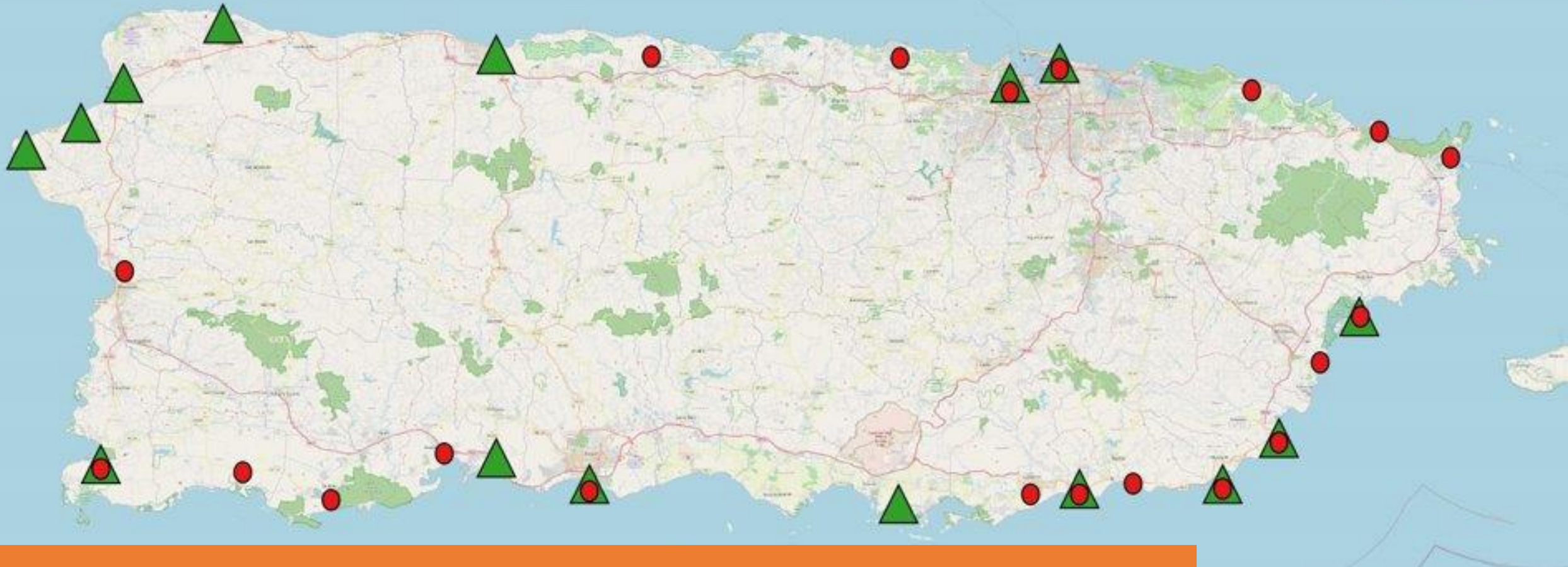
Restaurants  
Local Business  
Chinchorro





## **Shark Meat**

Restaurants  
Fish markets





## Locations

- Shark meat 
- Chapin Turnovers 

# Methodology

## DNA Extraction

- Chapín Turnovers
  - 63 turnovers were collected
  - Three subsamples of meat from each sample (n=189)
- Shark Meat
  - 100 samples were collected
  - 59 fillets
  - 33 turnovers
  - 8 pinchos

## PCR

- Mini Primers
- Universal Fish Primers
- Specific Primers for *G. cirratum*

# Results

## *Chapín* turnovers

- 15 species were identified
  - Four species of boxfish were identified
  - Elasmobranchs
  - Imported freshwater species
  - Other marine fish

## Shark meat

- Nine shark species
  - Near Threatened, Vulnerable, Endangered, and Critically Endangered state
- Imported freshwater species
- Other marine fish

# Results

## Chapín Turnovers

Only eight of all 62 samples contained *chapín*

- Only three were 100% boxfish

The only species of ray identified

- *Hypanus americanus* (NT), n=7 samples

Shark species

- *Isurus oxyrinchus*, Shortfin Mako (EN)
- CITES listing : Appx II.
- *Galeocerdo cuvier*, Tiger Shark (NT)

The most common substitutes were

- Tilapia (n=40 subsamples)
- Striped catfish (n=27 subsamples)- EN
- Bocourt's catfish (n=19 subsamples)
- Queen triggerfish (n=23 subsamples) - NT

# Results

## Shark Meat

### Nurse Shark

- was not detected in the samples during the collection period

### Nine species identified in this study

- Caribbean reef shark (EN)
- Blacktip shark (VU)
- Atlantic sharpnose shark (LC)
- Great hammerhead (CR)- Appx. II
- Tiger shark (NT)
- Shortfin mako (EN)
- Blacknose shark (EN)
- Silky shark (VU)- Appx. II
- *Mustelus sp.* (NT)

### Imported freshwater species

- Striped Catfish
  - Pinchos (n=5)
- Tilapia
  - Turnovers (n=1)

### Other marine fish

- Common Snook
  - Turnovers (n=9)

# COVID-19 Pandemic Impacts in Puerto Rico

- A recent assessment of the seafood industry contacted 139 small-scale commercial fishers to understand the COVID-19 pandemic impacts in Puerto Rico
  - 79% reduction on numbers of fishing trips
  - 71% decrease in prices or lack of markets (dealers, buyers, clients)
  - 48% reduction in their operational activities due to government restrictions

# Conclusion

This study provided evidence of seafood fraud in the form of species substitution and mislabeling among fishmongers and restaurants in Puerto Rico

This is the first time that the possible use of rays as a substitute in *chapín* turnovers was studied and ultimately verified

Most species that were detected are in a Near Threatened, Vulnerable, Endangered, and Critically Endangered state

Nurse sharks were not detected in any of the shark samples collected (n=100 samples)

- But in previous study were detected their fish in Puerto Rico

# What can we do ?

- Promote local education to fisher community, restaurants and general public
  - Shark ID
  - Elasmobranchs importance in our ecosystem
  - Potential health risk of species substitution
- Improve knowledge of regulations
- Monitor the sell of sharks to observe if protected species (nurse sharks) are being sold.
- Consider to adopt Federal regulations for sharks to local water or find alternatives with fishers specially with those species under IUCN red list category such as:
  - Near Threatened
  - Vulnerable
  - Endangered
  - Critically Endangered





Thank you

# Regulations

| SCIENTIFIC NAME                     | SPANISH COMMON NAME                    | ENGLISH COMMON NAME | REGULATION   | STATE/<br>FEDERAL |
|-------------------------------------|--|---------------------|--|-------------------|
| <i>Acanthostracion quadricornis</i> | Chapín veteadado                       | Scrawled cowfish    | FL 7" (17.8cm)   | S                 |
| <i>Scomberomorus cavalla</i>        | Carite, Sierra carite                  | King mackerel       | Commercial: FL 16" (40.6cm) Recreational: FL 16" (40.6cm); Recreational quota: 5 per person/day or 10 per boat/day | S                 |
| <i>Centropomus undecimalis</i>      | Róbalo común, Róbalo blanco, Róbalo    | Snook, Common snook | FL 22" (55.9cm)  | S                 |
| <b>HIGHLY MIGRATORY SPECIES</b>     |  |                     |  |                   |
| <i>Coryphaena hippurus</i>          | Dorado, Pez Delfín, Mahi-Mahi, Lampuga | Dolphinfish         | Recreational quota: 5 per person per day or 10 per boat/day  | S                 |
| <i>Acanthocybium solandri</i>       | Peto, Barracuda de mar                 | Wahoo               | Recreational quota: 5 per person per day or 10 per boat/day  | S                 |
| <i>Isurus oxyrinchus</i>            | Mako                                   | Shortfin Mako       | Federal permit required  | F                 |
| <i>Galeocerdo cuvier</i>            | Tiburón tigre                          | Tiger shark         | Federal permit required  | F                 |

# Regulations

| Scientific Name             | Spanish Common Name              | English Common Name         | Regulation               | State/ Federal |
|-----------------------------|----------------------------------|-----------------------------|--------------------------|----------------|
| Galeocerdo cuvier           | Tiburón tigre                    | Tiger shark                 | Federal permit required  | F              |
| Carcharhinus falciformis    | Tiburón jaquetón                 | Silky shark                 | Federal permit required  | F              |
| Sphyrna mokarran            | Cornuda                          | Great hammerhead            | Federal permit required  | F              |
| Carcharhinus acronotus      | Tintorera hicico prieto          | Blacknose shark             | Federal permit required  | F              |
| Isurus oxyrinchus           | Mako                             | Shortfin Mako               | Federal permit required  | F              |
| <b>Carcharhinus perezii</b> | <b>Tintorera de arrecifes</b>    | <b>Caribbean reef shark</b> | <b>Permanent closure</b> | <b>F</b>       |
| Rhizoprionodon terraenovae  | Tintorera hocicuda del Atlántico | Atlantic sharpnose shark    | Federal permit required  | F              |
| Carcharhinus limbatus       | Caconeta punta prieta            | Blacktip shark              | Federal permit required  | F              |