Drivers of Migration in Sand Tiger Sharks (*Carcharias taurus*)

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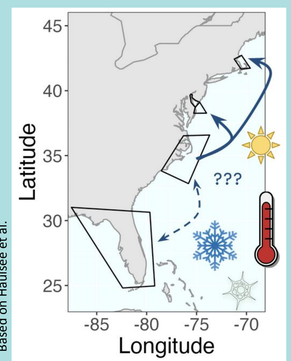
Background



Shark conservation

★ Important
- Apex predators
- Nutrient transfer

★ Difficult[4]
- Highly migratory
- Overlap with fisheries

Sand tiger sharks make long seasonal migrations in the Northwest Atlantic Ocean[1]

Understand where, when, and **why** sharks migrate

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Predict where sharks will be

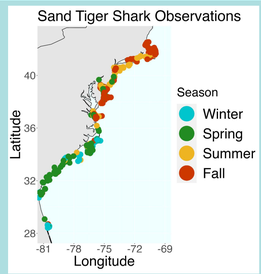
↓

Better informed management

What environmental cues prompt sand tiger migration?

Methods

Acoustic Tags
RStudio
`ggplot (graphs)`
`dplyr (data)`
`lubridate (time)`
`maps (land maps)`



Departure definition:
Leaving a known aggregation site boundary with **at least two observations** inside and outside the boundary

Clean tagging data and **bin into locations**, then identify start & end date in each location

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Identify departure dates as the last known date at an aggregation site (if detected elsewhere within 7 days)

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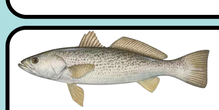

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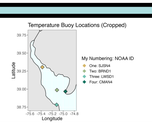
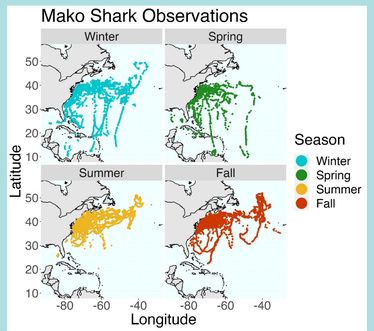
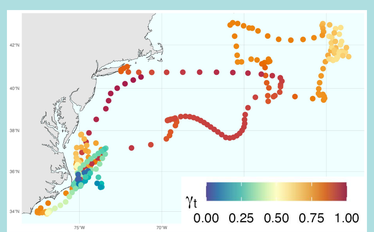
Combine departure dates with **environmental data**



Mako Sharks: Proposed Research





Clean satellite tag data and create a **movement persistence model**

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Identify **dates when migration begins** (spike in move persistence index)

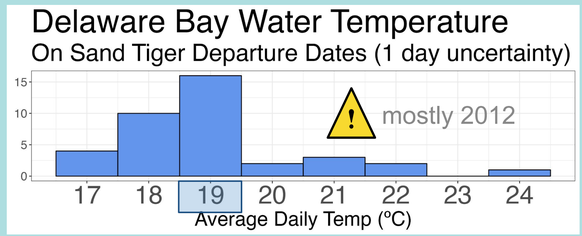
↓

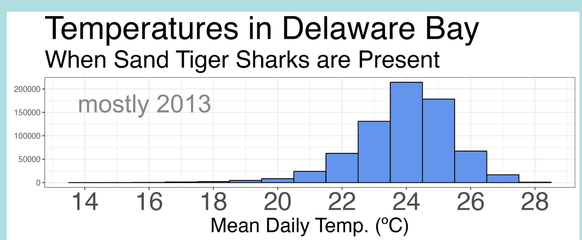
Combine departure dates with **environmental data from satellites**

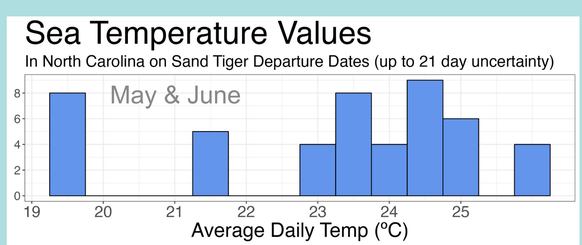
Results

Sand tiger sharks occur in Delaware Bay between 22-26ºC, and leave at the end of summer when temperatures drop below 19ºC

Higher uncertainty in North Carolina departures, but most sharks leave between 20-25ºC and tolerate temperatures from 10-20ºC.



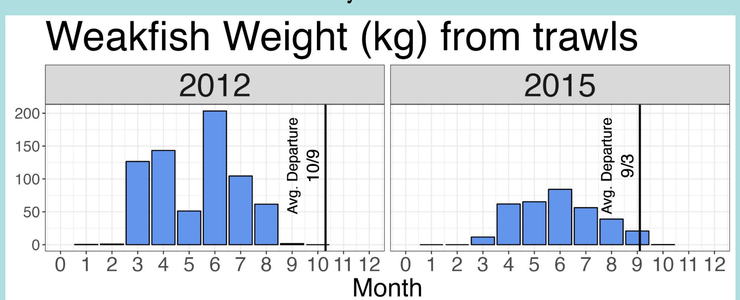




19 ºC is too cold for sand tiger sharks to remain up north

Also investigated:
Chlorophyll, salinity, day length, 7 day temperature change

Known prey items of sand tiger sharks from stomach content analysis + Delaware FWS trawl = Weakfish are likely the most prevalent prey option by weight in Delaware Bay in the summer



Weakfish biomass may be related to departure, but is not an immediate cue

Discussion

- Most likely cue for sand tiger shark migration is **temperature**
  - Thermal tolerance varies by season and aggregation site
  - Consistent with other studies on shark migratory cues[2]
  - **Does not explain interannual variability**
- **Code pipeline** can be used in similar studies
  - https://github.com/DolphinCoder/SharkTracking2023
- Future studies could combine a movement persistence model with satellite environmental data to examine drivers of mako shark migration

Acknowledgments

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