Defining Ocean Migratory Corridors and Critical Habitats off North Carolina

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The Hatteras Bight: A Dynamic Place
North Carolina Concerns

- Wind farms
- Offshore exploration for natural gas
- Barrier Island development/inlet stabilization
- Wave and tidal energy
- Military uses – acoustics, bombing ranges, etc.
- Sustainability of commercial & sport fisheries
- Ocean transportation

A migratory fish
Locations of Proposed Wind Farms and Seismic Surveys
Seismic Surveys

Distance: 3-12 km (1.9 – 7.5 miles, OSPAR 2009)
Seismic Surveys and Animals

The X axis is frequency of sound:
- Top – frequencies of animal communication.
- Middle – hearing frequencies.
- Bottom – human-made noise frequencies.

The black rectangle shows those frequencies produced by seismic testing, and the overlap with fish and mammals.

Modified from: OSPAR 2009 (top) and Slabbekoorn et al. 2010 (middle, bottom)
Migratory Pathways

- Marine mammals
- Sea turtles
- Atlantic and shortnose sturgeons
- Coastal pelagic sharks, skates and rays
- Anadromous fishes (striped bass, shads, river herrings)

- What influences seasonal migrations along the coast?
- What role does Cape Hatteras play in influencing timing and continuance of coastal migratory pathways?
The Importance of Habitat

Factors Influencing Groundfish Assemblages (Langton et al. 1995)

But first you have to know where the animals are, where they go, and something about the environment...
Man bitten by shark off Outer Banks

The Associated Press
OCEAN SPRINGS, Miss. — A shark bit a 50-year-old man swimming in the waters off the coast of North Carolina.

The man was bitten on the left leg while swimming near the beach Tuesday night. Rescue workers said the man was taken to a hospital in nearby Beaufort, N.C., for treatment.

A shark attack is reported every year off the East Coast, but few are confirmed.

ECU researchers monitoring sharks

The man is the seventh person attacked along the North Carolina coast in three weeks.

Most of these attacks happen in shallow water. The injuries range from minor wounds to broken bones.

Shark experts said the recent rash of attacks along the coast of North Carolina is due to more people wading in the water.

The man suffered a minor wound to his left leg and ankle. He was treated for the bite and released from the hospital.

People surround a 70-year-old man who was bitten by a shark in the water near Oak Island on Monday. Two bites were confirmed.

Shark attacks rare but use caution

ECU doctoral student studies how warmer water attracts sharks to Pamlico Sound

Shark attacks are rare but can be deadly. Experts say there are about 125 shark attacks worldwide each year, with about 20 resulting in fatalities.

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Rulifson Lab Shark Research: Behavior, Distribution, Abundance

A juvenile blacktip shark is captured in Core Sound.
ECU Hatteras Acoustic Array
developed for a Spiny Dogfish shark study

- 12 VEMCO VR2W receivers, placed 2 m off bottom.
- Spacing about 1 mile apart (based on extensive range testing for these waters).
- “Listening Fence” extends out 12 miles perpendicular from shoreline off Hatteras Village, NC.
- Array includes acoustic doppler current profilers (ADCPs).

This ADCP fiberglass trawl shield was painted with red bottom paint when initially deployed – high energy, sand transport blasted paint off.
Hatteras Bight Acoustic Array

- Shallow ADCP: 30 ft
- Mid-site @ 45 ft, (not processed)
- Deep ADCP: 70 ft
Non-Acoustic Tagging Research, 1996-2010

Days at large (DAL) vs. Distance traveled (Km) for various release sites.

- Canadian Release Site
- U.S. Release Sites

47,000 Floy tags deployed
Acoustically Tagged Species Recorded by the Hatteras Acoustic Array

- American Shad
- Hickory Shad
- Atlantic Sturgeon
- Cownose Ray
- Spiny Butterfly Ray
- Sand Tiger Shark
- Sandbar Shark
- Spiny Dogfish (spurdog)
Acoustically Tagged Species Recorded by the Hatteras Acoustic Array

- Bull Shark
- White Shark
- Lemon Shark
- Green Sea Turtle

12 species to date.

The Hatteras Array has been pulled due to lack of funding.
Single Species

Atlantic sturgeon

Sandbar shark

Sand tiger shark

White shark
Shallow Water Dogfish Detections

- Currents at the deep and shallow site are very similar, indicating a relatively uniform along-shelf flow.
- Fish detections are generally more common under moderate currents (0.2-0.4 m/s) flowing eastward (+u component).
Cape Lookout Wind Speed, February 2009

Cape Lookout Wind Direction (Degrees from True North)
The East Carolina University Acoustic Wave Glider (AWG) "Blackbeard"

- Blackbeard is my homeboy.
- VEMCO VR2C
- Decimus® PAM Buoy
Acoustic Wave Glider “Blackbeard” by Liquid Robotics

- Moves by wave power
- Instruments powered by sun
- Weather station
- Water currents & velocity
- Depth
- Water temperature, salinity, dissolved oxygen
- Listen for animal noises
- Listen for animals tagged with pinging tags

Data stream = Oceanography + meteorology + predators + prey
Blackbeard has Arrived!!
ARRGH!
Wave Glider “Carey” used by Barbara Block

Purple = cooler water
Atlantic Sturgeons

Sand Tiger sharks
Red color = Gulf Stream
Questions, Mateys?
Shark Attacks in North Carolina (years 1975-2014)

Based on data from the 'Global Shark Attack File'

2015 so far