Ocean/Wind Power Ecological Baseline Studies
4th Interested Party Group Meeting
NJDEP Public Hearing Room
401 E. State Street, Trenton
June 18, 2010

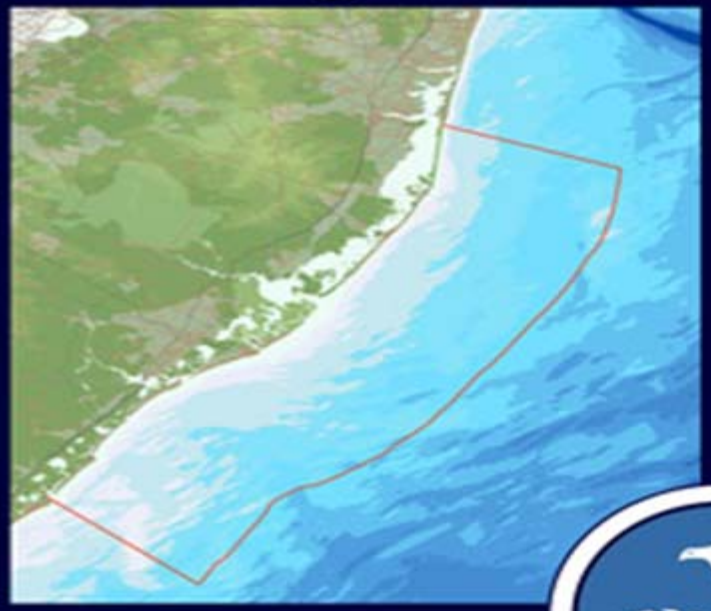
AGENDA

9:00 – 9:30 AM	**Introduction and Project Overview** *Gary A. Buchanan, Ph.D., NJDEP, Project Manager* *Office of Science*
9:30 – 11:00 AM	**Draft Final Report Results – Geo-Marine, Inc.**

- *Dan L. Wilkinson, Ph.D., GMI Project Manager, Introduction*
- *Jason See, Ph.D., Oceanography*
- *Jarrod Santora, Ph.D. & Chris Clark, Avian Results and Modeling*
- *Sid Gauthreaux, Ph.D., Radar Results*
- *Amy Whitt, M.S., Marine Mammal Results*
- *Kathleen Dudzinski, Ph.D., Underwater Acoustics*
- *Charles DeCurtis, Ph.D., Fisheries*
- *Suzanne Bates, M.S., Sensitivity Index & Potential Impacts*

11:00 - 11:20 AM	**Summary** – *Gary Buchanan*
11:20 – 12:00 AM	**Questions**

Ocean/Wind Power Ecological Baseline Studies



NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF SCIENCE, RESEARCH, & TECHNOLOGY

Ocean / Wind Power Ecological Baseline Studies

Draft Final Report

Interested Party Group Meeting
June 18, 2010

Gary A. Buchanan, Ph.D.
Project Manager
Manager, Office of Science
NJDEP

Project Significance and Issues

- DATA, DATA, DATA, DATA!!!!
- 1 project in state waters; 4 in federal waters
- $3-4^{+}$ Billion investment
- Data will help support the development of renewable energy projects
- Help assess potential impacts
- Inform NEPA & Federal Consultation process (e.g., ESA)

Project Objectives

- Address Natural Resource portion of Blue Ribbon Panel Recommendation No. 4:
  - "Baseline data should be collected regarding the distribution, abundance, and migratory patterns of avian species, fish, marine mammals and turtles in the offshore area where development may be feasible."

Specific Objectives – Fill Data Gaps

- In the Study Area, what are the abundance, distribution, and utilization of:
  - Bird Species (flight behavior)
  - Marine Mammals
  - Sea Turtles

Specific Objectives

- Using predictive modeling, mapping, and environmental assessment methodologies what portions of the study area are more or less suitable for wind/alternative energy power facilities based on potential ecological/environmental impacts?

STUDY AREA


New Jersey
Tom's River
Barnegat Bay
Barnegat Light
Little Egg Inlet
Mullica River
Great Bay
Great Egg Harbor River
Brigantine
Atlantic City
Great Egg Harbor Bay
Ocean City
Hereford Inlet
VT
NH
NY
MA
CT
RD
PA
NJ
MD
DE
Atlantic Ocean
VA
NC
Area of Enlargement


Ocean/Wind Power
Ecological Baseline Studies

Field Studies

- Three Primary Surveys:
  - Avian
  - Marine Mammal
  - Sea Turtle
- Supporting Studies:
  - Oceanographic

Activity conducted pursuant to NOAA Permit No. 10014-02

Photo by Tony Leukering, GMI


Sana Ana

Photo by Tony Leukering, GMI


GEO-MARINE INCORPORATED
Mobile Avian Radar System
972-423-5480 • www.geo-marine.com
• BIRD-AIRCRAFT STRIKE HAZARD (BASH) RISK MANAGEMENT
• REMOTE ENVIRONMENTAL MONITORING SERVICES
• REAL-TIME BIRD MIGRATION SURVEYS


R/V Robert E.


FURUNO
CAUTION
CAUTION
CAUTION
CAUTION

Other Tasks

- Literature Review
- Data Compilation-digital and historical
- Model Development
- Impact Assessment
- GIS
- Reporting

Schedule

- 24-month study
- Field Work: Jan 2008 – Dec 2009
- Interim Report – March 2009
- Draft Final Report – April 2010
- Final Report – Expected early July

Overall Process

- Technical Review Committee – State & Federal Agencies
- Peer Review Group – Independent Review
- Interested Party Group (stakeholders)
  - Periodic informational meetings

Draft Final Report Summary

- Four Volumes
  - Birds
  - Marine Mammals & Sea Turtles
  - Fisheries
- Modeling
- Sensitivity Index Map
- Data fulfilled Project Objectives!

Geo-Marine, Inc.

Dan Wilkinson, Ph.D.

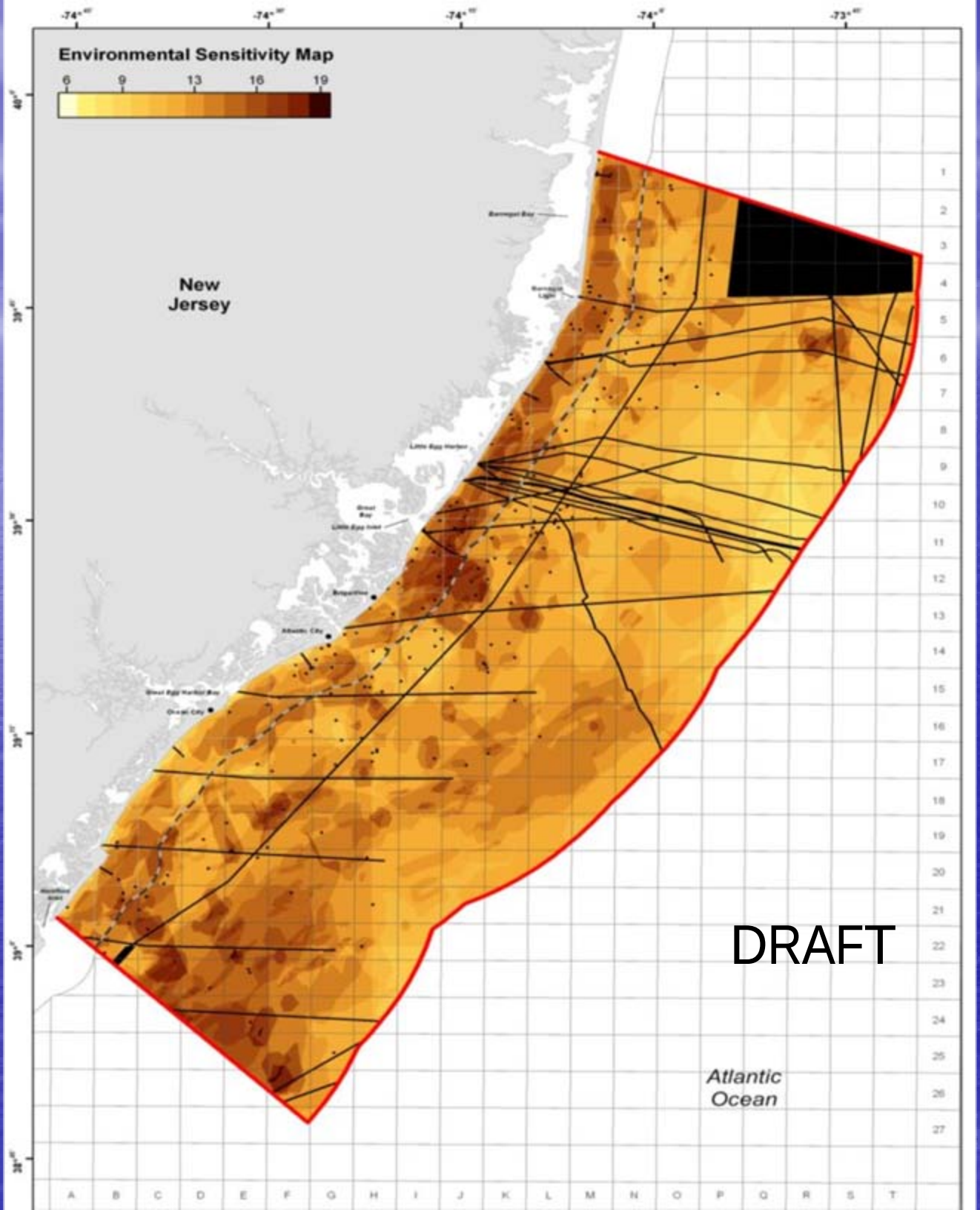
SUMMARY

Sensitivity Map – DRAFT

- Simple weighting of GIS layers by natural & physical resources
- More heavily shaded areas indicate greater potential
- Does not mean can not develop area, but may indicate greater mitigation &/or other costs (e.g., monitoring, construction $ due to avoidance).

Sensitivity Map (cont)

- Tabular listing of all GIS layers by grid block
- Easy ID of sensitive ‘layers’
- Additional site-specific information and risk assessment will be needed to better define risks and potential mitigation


Environmental Sensitivity Map
6
9
13
16
19
New Jersey
Atlantic Ocean
DRAFT


Ocean/Wind Power
Ecological Baseline Studies

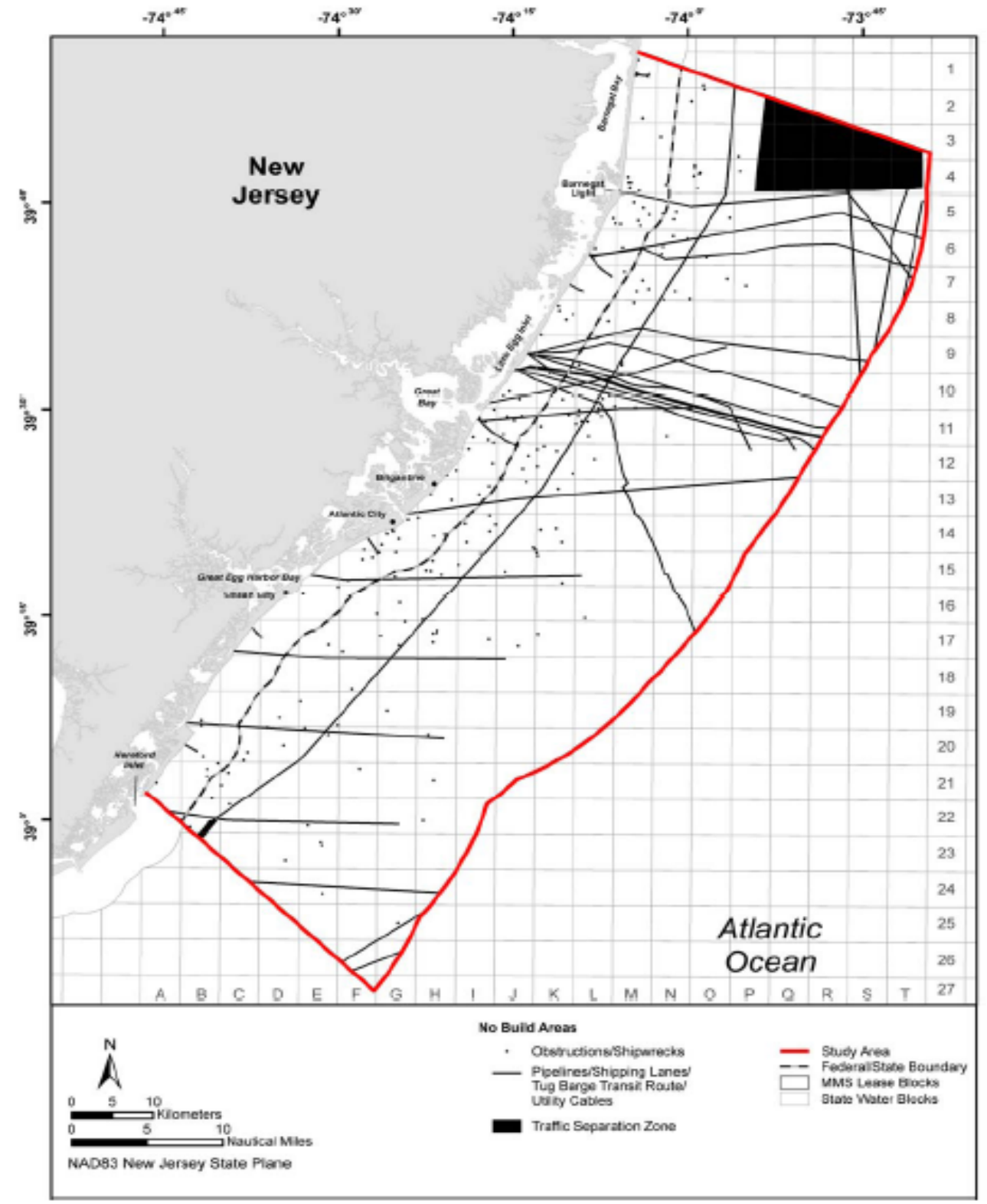


Figure C-1. Map showing the "no build areas" designated in the environmental sensitivity index.

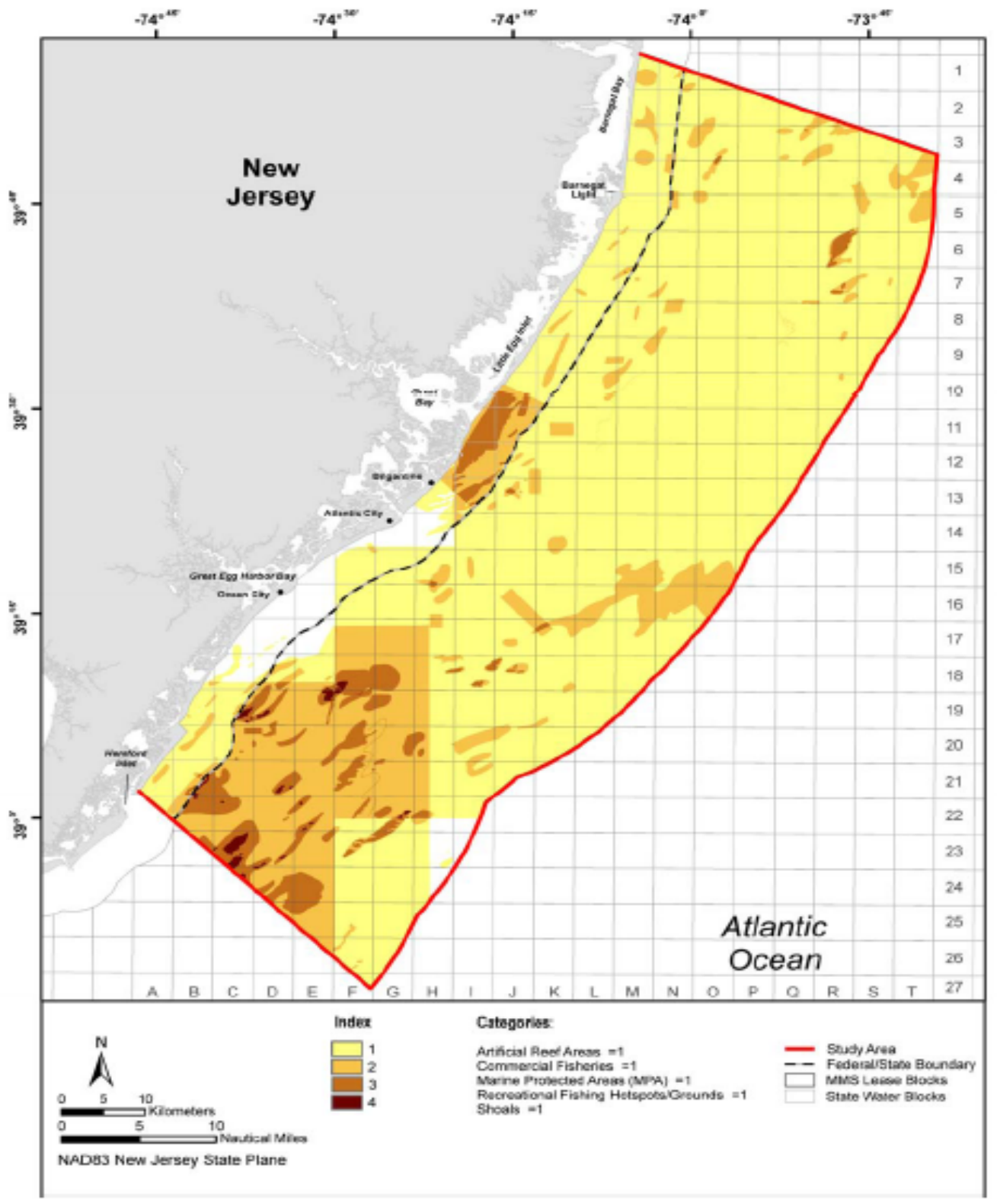
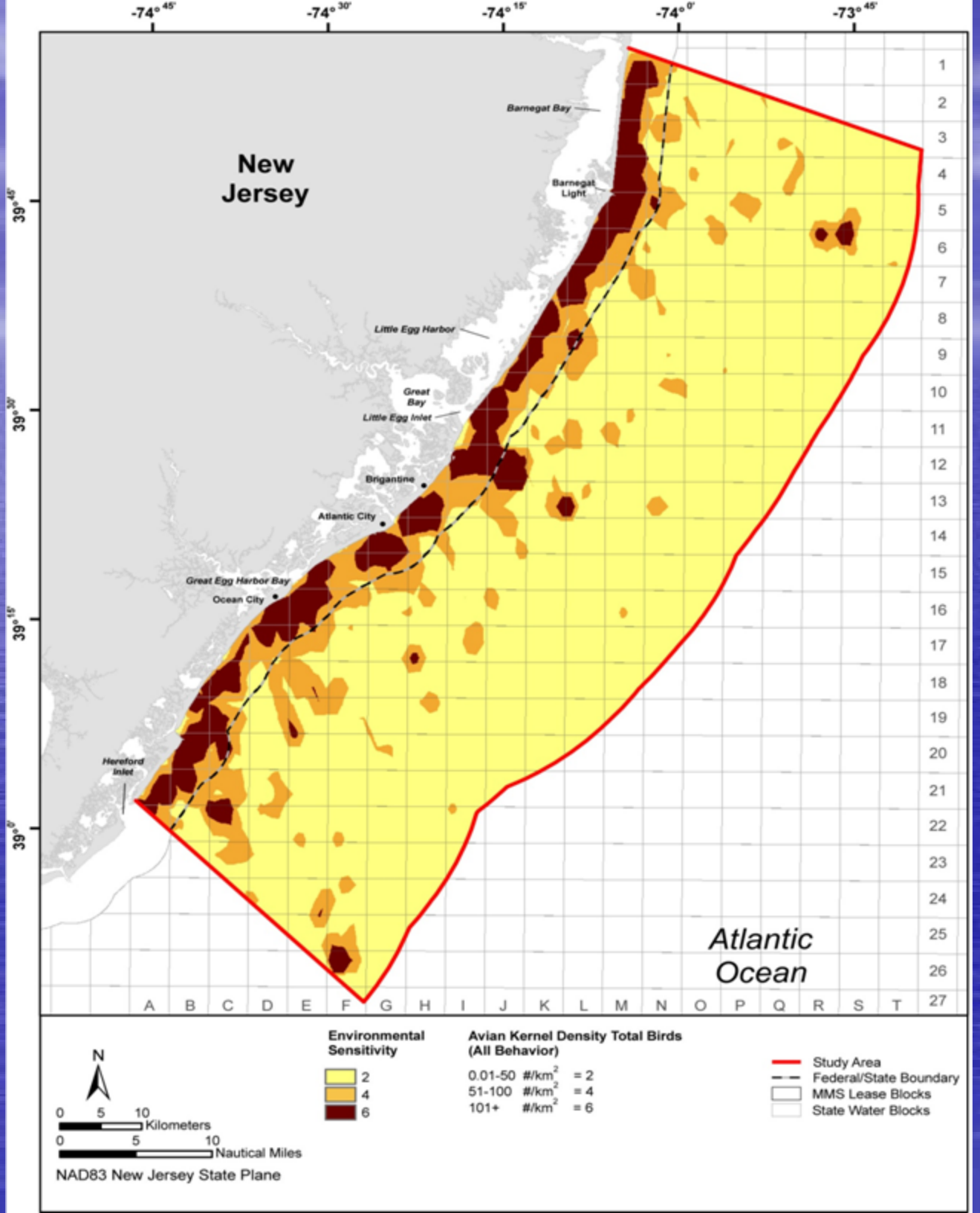


Figure C-2. Map showing the physical features used in the environmental sensitivity index.


Ocean/Wind Power
Ecological Baseline Studies


-74° 45'
-74° 30'
-74° 15'
-74° 0'
-73° 45'
39° 45'
39° 30'
39° 15'
39° 0'
New Jersey
Barnegat Bay
Barnegat Light
Little Egg Harbor
Great Bay
Little Egg Inlet
Brigantine
Atlantic City
Great Egg Harbor Bay
Ocean City
Hereford Inlet
Atlantic Ocean
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
A B C D E F G H I J K L M N O P Q R S T
N
0 5 10 Kilometers
0 5 10 Nautical Miles
NAD83 New Jersey State Plane
Environmental Sensitivity
2
4
6
Avian Kernel Density Total Birds (All Behavior)
0.01-50 #/km2 = 2
51-100 #/km2 = 4
101+ #/km2 = 6
Study Area
Federal/State Boundary
MMS Lease Blocks
State Water Blocks

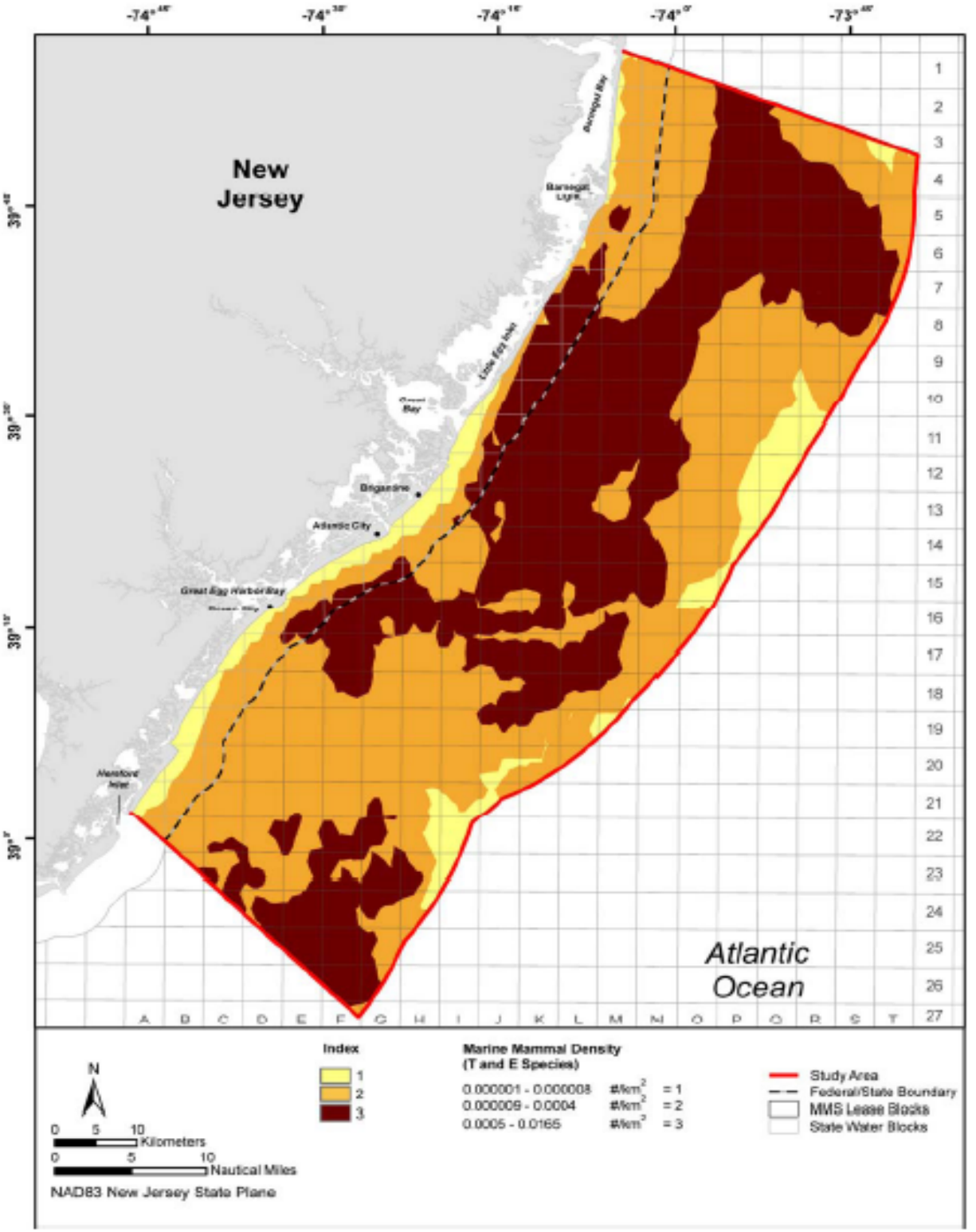
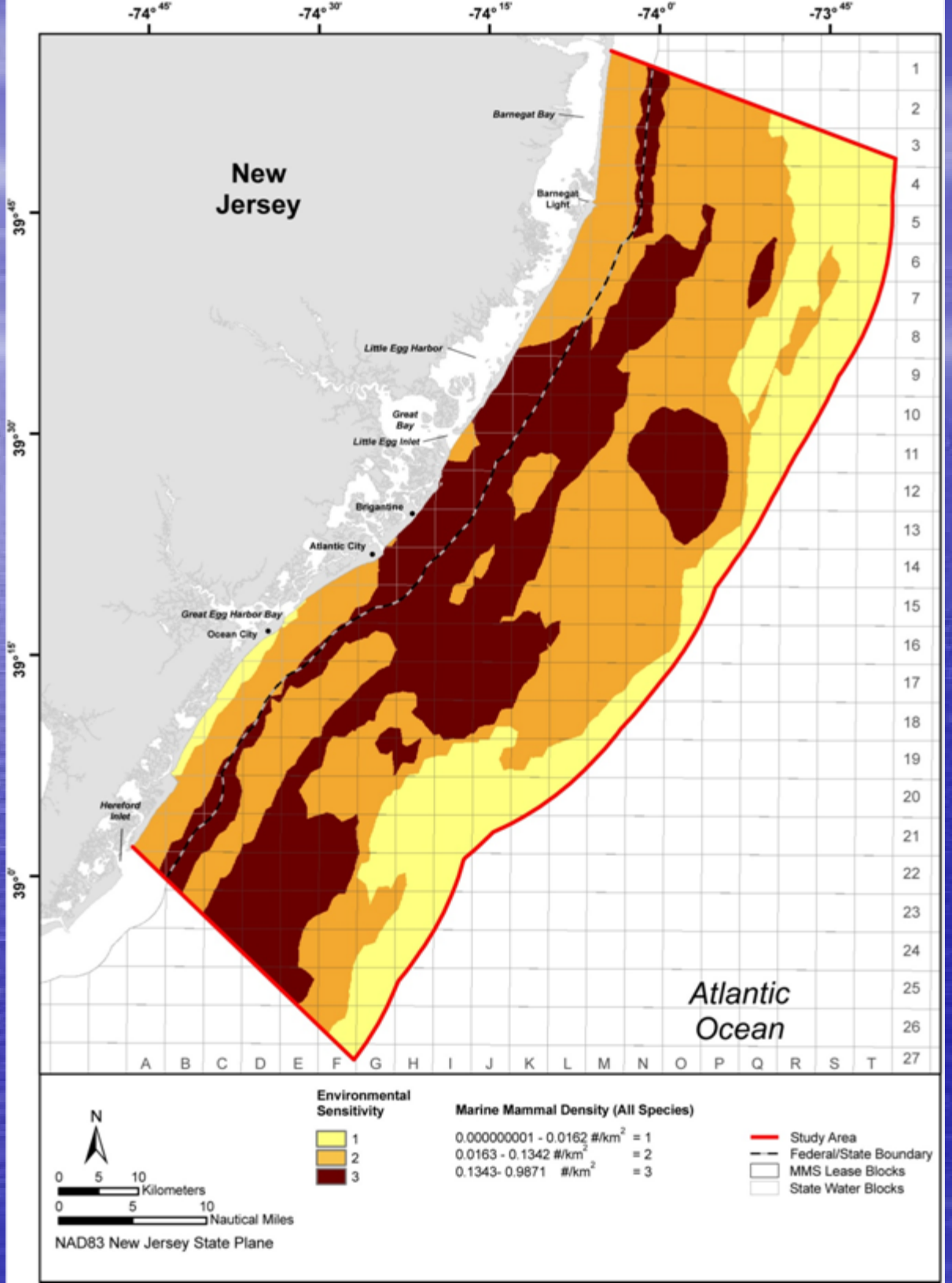


Figure C-5. Map showing the threatened and endangered marine mammal species data used in the environmental sensitivity index.


-74° 45'
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New Jersey
Barnegat Bay
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Hereford Inlet
39° 45'
39° 30'
39° 15'
39° 0'
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27
A B C D E F G H I J K L M N O P Q R S T
Atlantic Ocean
N
0 5 10 Kilometers
0 5 10 Nautical Miles
NAD83 New Jersey State Plane
Environmental Sensitivity
1
2
3
Marine Mammal Density (All Species)
0.000000001 - 0.0162 #/km2 = 1
0.0163 - 0.1342 #/km2 = 2
0.1343- 0.9871 #/km2 = 3
Study Area
Federal/State Boundary
MMS Lease Blocks
State Water Blocks


Ocean/Wind Power
Ecological Baseline Studies

Table C-1. Physical and biological features found within each grid cell in the environmental sensitivity index.

Column	Row	Avian Kernel Density - Rank 1	Avian Kernel Density - Rank 2	Avian Kernel Density - Rank 3	Marine Mammal Density (All Species) - Rank 1	Marine Mammal Density (All Species) - Rank 2	Marine Mammal Density (All Species) - Rank 3	Marine Mammal Density (T & E Species) - Rank 1	Marine Mammal Density (T & E Species) - Rank 2	Marine Mammal Density (T & E Species) - Rank 3	Sea Turtle – Rank 1	Sea Turtle – Rank 2	Sea Turtle – Rank 3	Essential Fish Habitat - Rank 1	Essential Fish Habitat - Rank 2	Essential Fish Habitat - Rank 3	Marine Protected Areas (MPA)	Shoals	Commercial Fisheries	Recreational Fishing Hotspots/Grounds	Shipping Lanes	Obstructions	Pipelines	Shipwrecks	Traffic Separation Zone	Tug Barge Transit Route	Utility Cables
A	20	√	√			√		√				√		√	√				√								
A	21	√	√	√		√	√	√	√			√		√	√				√	√		√					
A	22	√	√	√		√	√	√	√			√			√			√	√		√						
B	18		√	√	√	√		√				√		√	√				√	√							
B	19	√	√	√	√	√		√	√		√	√		√	√				√	√	√	√		√			
B	20	√	√	√		√		√	√			√		√	√				√	√		√	√				
B	21	√	√	√		√			√			√			√		√	√	√	√		√		√			
B	22	√	√	√		√	√		√			√			√		√	√	√	√	√			√	√	√	
B	23	√					√		√	√		√			√		√	√	√						√	√	
C	16		√		√			√				√		√													
C	17	√	√	√	√	√		√	√			√		√	√					√	√		√				
C	18	√	√	√	√	√		√	√			√		√	√			√	√	√							
C	19	√	√	√	√	√			√			√			√		√	√	√	√	√						
C	20	√	√	√		√			√			√			√		√		√	√	√			√			
C	21	√	√	√		√	√		√			√			√		√	√	√					√		√	
C	22	√	√	√		√	√		√	√		√			√	√	√	√	√	√	√			√		√	
C	23	√	√			√	√		√	√		√			√	√	√	√	√	√							
C	24	√	√				√		√	√		√	√			√	√	√	√	√	√						
D	16	√	√	√	√	√		√	√	√		√		√	√												
D	17	√	√	√	√	√	√		√	√		√		√	√					√	√		√				
D	18	√	√		√	√	√		√			√			√		√	√	√	√	√						
D	19	√	√	√	√	√			√			√			√		√	√	√	√				√			
D	20	√	√			√			√			√			√		√	√	√	√	√	√		√		√	
D	21	√	√			√	√		√			√			√	√	√	√	√	√						√	
D	22	√	√			√	√		√	√		√	√		√	√	√	√	√	√	√						
D	23	√	√			√	√		√	√		√	√			√	√	√	√	√		√					
D	24	√	√			√	√		√	√		√	√			√	√	√	√	√	√						
D	25	√				√	√		√	√			√			√	√		√	√							
E	15	√	√	√	√	√		√	√			√		√	√				√	√	√						
E	16		√	√	√	√			√	√		√		√	√				√			√		√			
E	17	√	√	√		√	√		√	√		√			√		√		√					√			
E	18	√	√	√		√	√		√			√			√	√	√	√	√	√	√						
E	19	√	√	√		√			√			√			√	√	√	√	√	√				√		√	

Final Report

- Information and data can be used for:
  - Baseline data for projects in study area (NEPA)
  - Design of future monitoring
  - Screening of potential sites
  - ID Areas for MMS ‘Request for Interest’
  - Planning for Phase II Wind Facilities

Final Report (cont)

- Estimate of potential impacts on natural resources
- Listing of species that may be impacted including T&E species
- Estimate of relative scale of potential mitigation

Final Report (cont)

- Indication of areas that have limited potential for impacts
- Areas that have greater potential for impacts
- Site-specific information
- Data, data, data, data!!!!

Acknowledgments –

Technical Review Committee - NJDEP

- Coastal Management – Kevin Hassel
- Fish & Wildlife – ENSP
  - Dave Golden
  - Sharon Petzinger
  - Jeanette Bowers
- Marine Fisheries - Don Byrne
- Wildlife Management - Ted Nichols
- NJGS – Jane Uptegrove
- Permit Coordination – Ken Koschek
- Land Use Management – Tom Micai
- DSRT/Office of Science
  - Joe Bilinski, Gail Carter, Joel Pecchioli (SRP)

Acknowledgements (cont)

- USFWS - Carlo Popolizio & Doug Forsell
- NOAA/NMFS
  - Gordon Waring, Ph.D.
  - Debra Palka, Ph.D.
  - Karen Greene
- Minerals Management Service - Will Waskes
- **Project Team: Geo-Marine, Inc.**
  - **Rutgers University**
  - **Aqua Survey Inc.**

Dedication to Gail Carter

In Memoriam

QUESTIONS?

Office of Science website:

http://www.state.nj.us/dep/dsr/

Activity conducted pursuant to NOAA Permit No. 10014-02
Photo by Tony Leukering, GMI

Ocean/Wind Power Ecological Baseline Studies

Draft Final Results

Interested Party Group Meeting

18 June 2010

New Jersey Department of Environmental Protection
Division of Science, Research, & Technology

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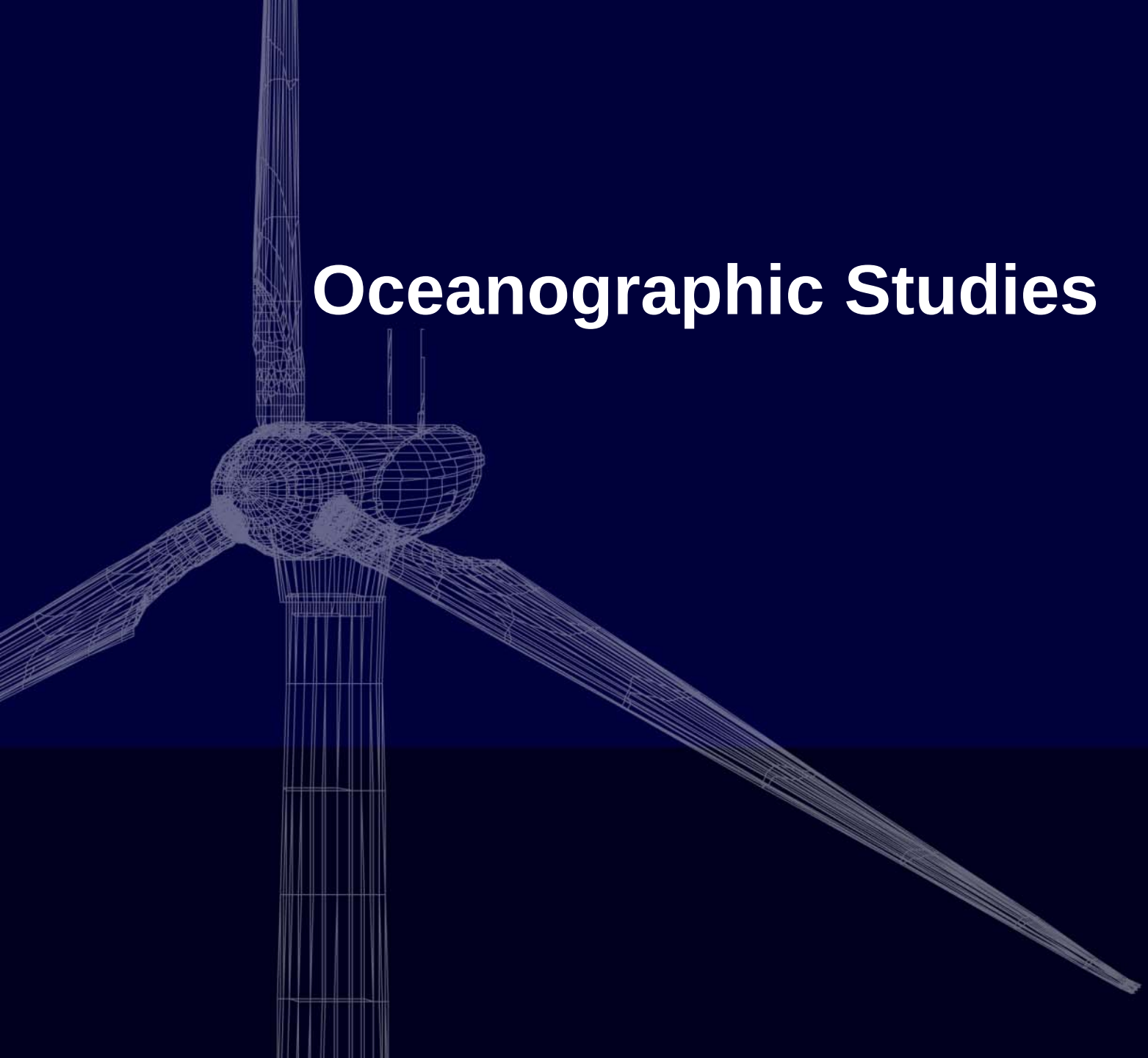
Oceanographic Studies



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Oceanographic Studies

- Surface Mapping System (SMS) – collected data from the bow of the *R/V Hugh R. Sharp* during shipboard surveys every 10 seconds in 2008 and 2009
- Conductivity, Temperature, and Depth (CTD) profiles – conducted during shipboard surveys in 2008 and 2009 at the beginning of the survey day, at noon, the end of the survey day, as well as the end of each trackline whenever possible
- Acoustic Doppler Current Profiler (ADCP) – data collected during shipboard surveys in 2008 and 2009
- Benthic Mapping: Side scan sonar and magnetometer – conducted from the *R/V Hugh R. Sharp* between August 2009 and December 2009 and from approximately 1900 to 0500 hours, 8.0 nautical miles off the shore and parallel to New Jersey

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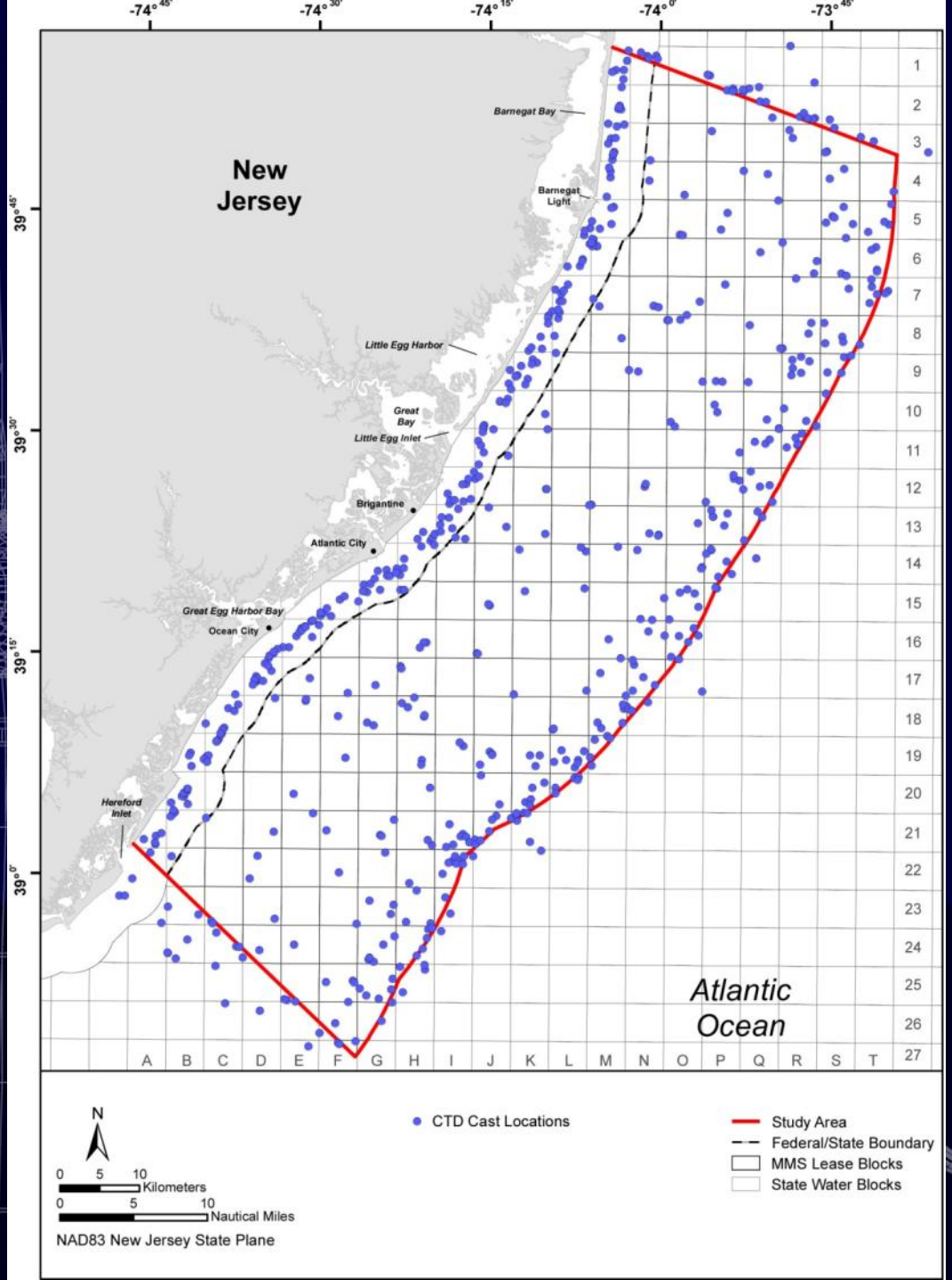
CTD Cast Locations



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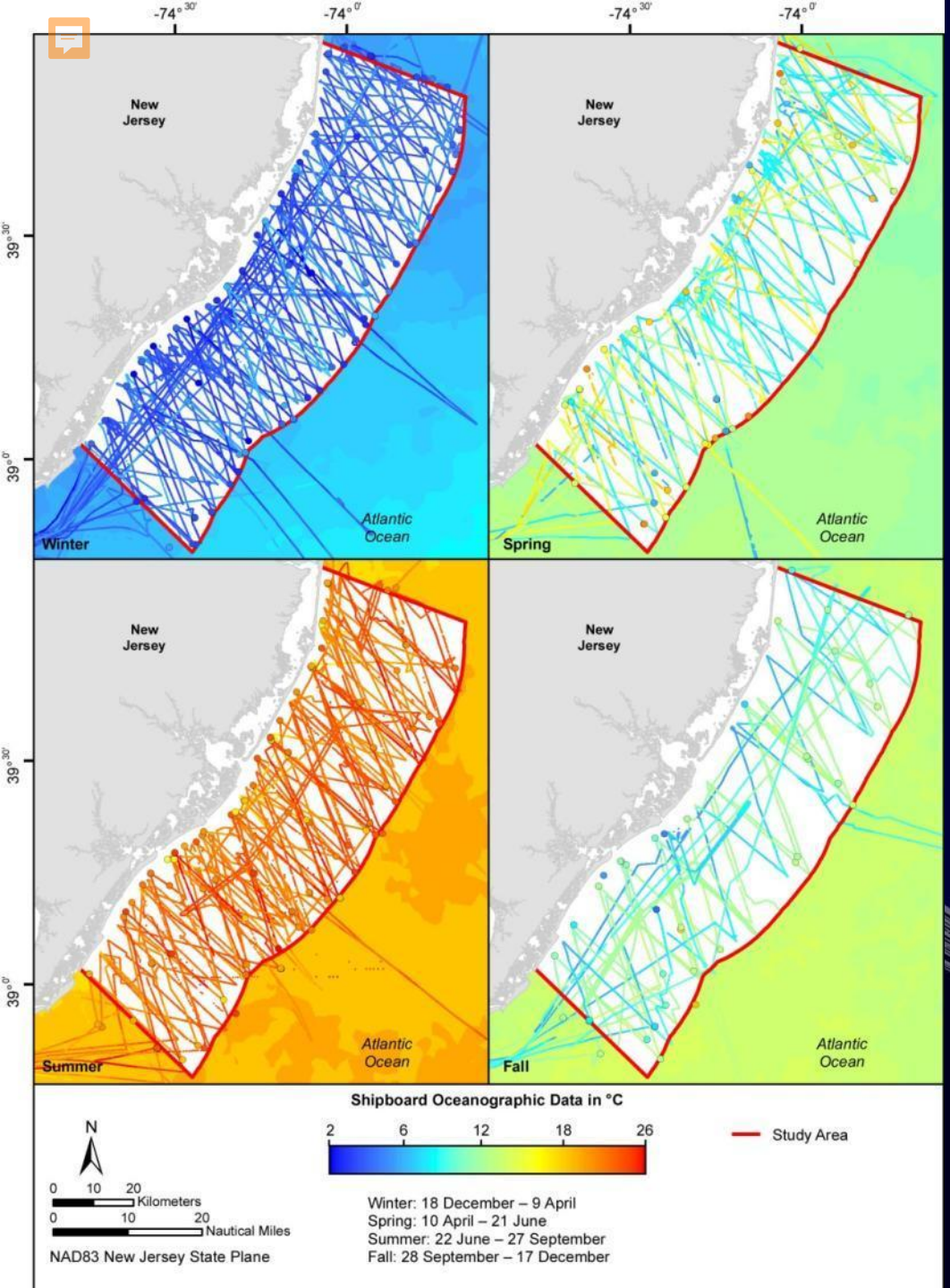

Sea Surface Temperature

Mean seasonal SST

- SST data collected via the Surface Mapping System (SMS) and CTD casts on-board the *R/V Hugh R. Sharp* between 2008 and 2009
- During winter, horizontal temperature gradients dominate; with colder water close to the coast and warmer water near the shelfbreak
- Temperature variations in the surface layer (the upper 30 m [98.4 ft]) are related to surface heating
- Thermal stratification begins in spring and persists until early fall when normal seasonal mixing occurs and homogenizes the water column

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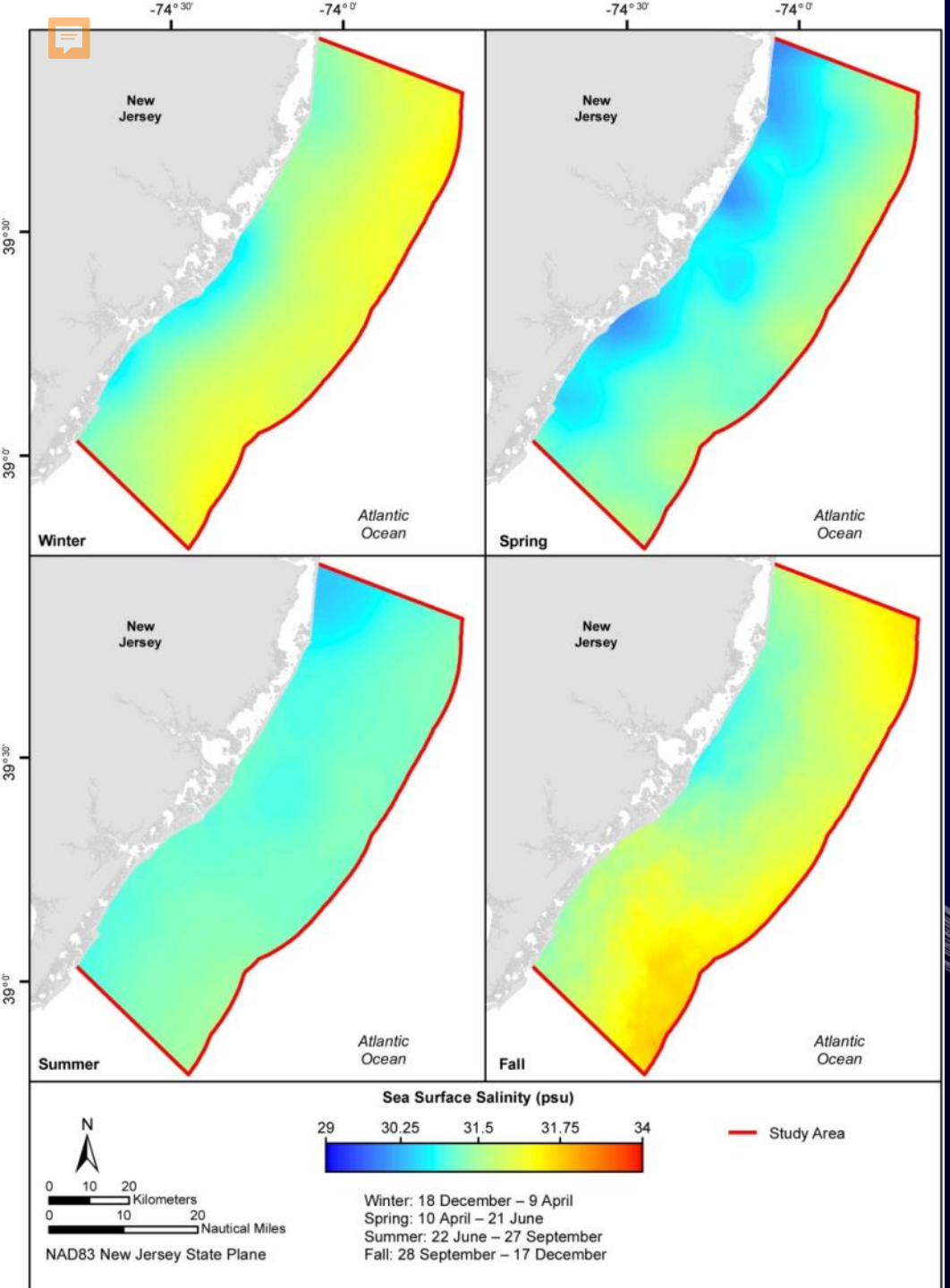

Sea Surface Salinity

Mean seasonal SSS

- In general, the average salinity increases in the offshore direction
- High seasonal variability due to the seasonal river discharge and wind variations.
- Offshore waters are more saline water due to the influence of the open ocean; waters closer to the coast are less saline due to the influence of the Hudson River outflow and coastal runoff
- a low salinity plume can span up to 100 km across the shelf during upwelling season
- In late summer/early fall, winds tend to compress the low-salinity waters against the coast

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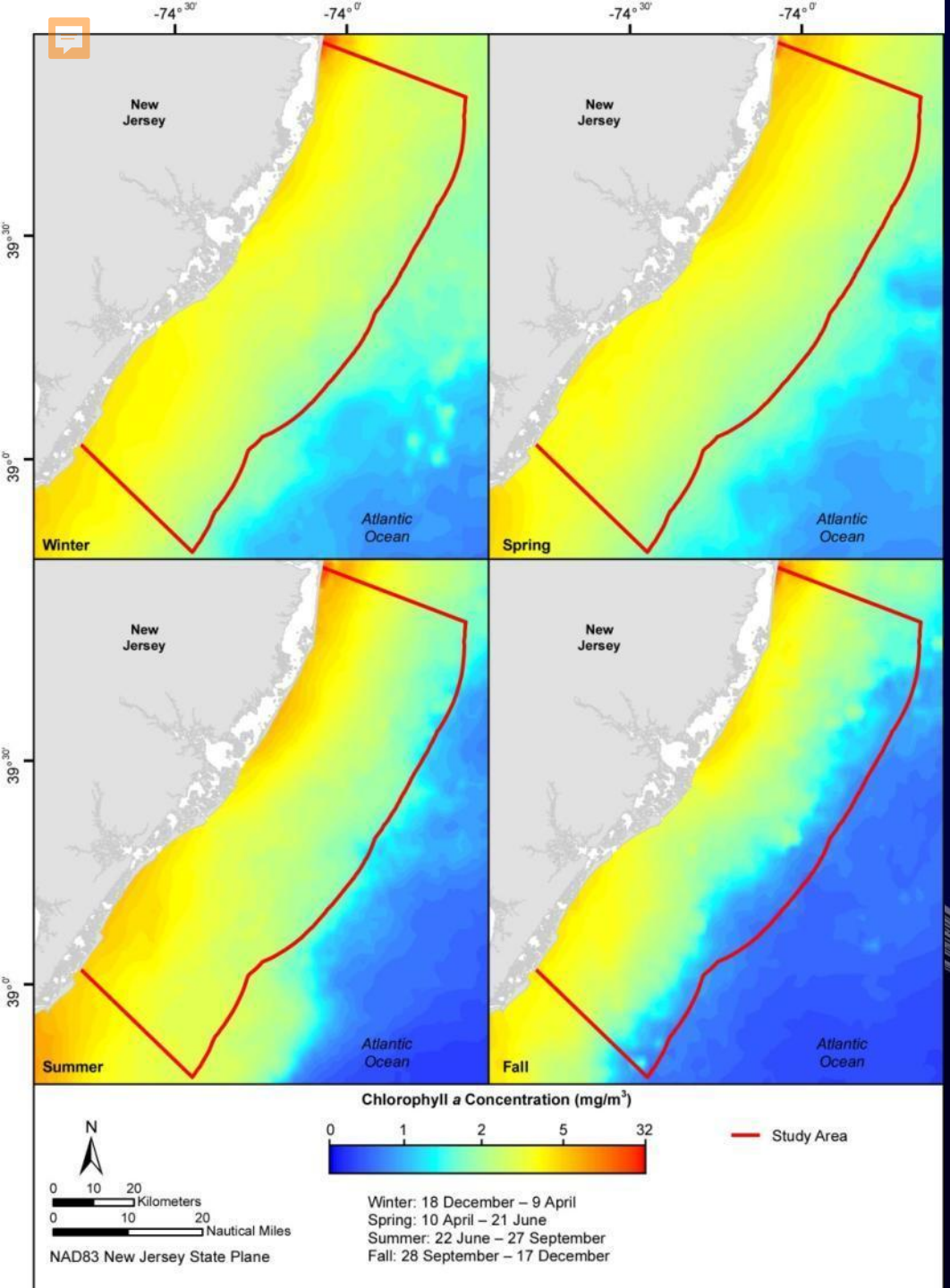
Surface Chlorophyll *a*



Mean seasonal surface chlorophyll *a* concentrations between 1 Jan 2007 and 31 Dec 2009

- Primary productivity is governed by the seasonal stratification of the shelf
- During summer, stratification is intense, primary production is low, except coastal areas near upwelling
- Mid and outer shelf, primary production is low as the shelf waters remain stratified
- Fall and winter blooms when stratification diminishes (due to seasonal convective overturn and frequent storms)

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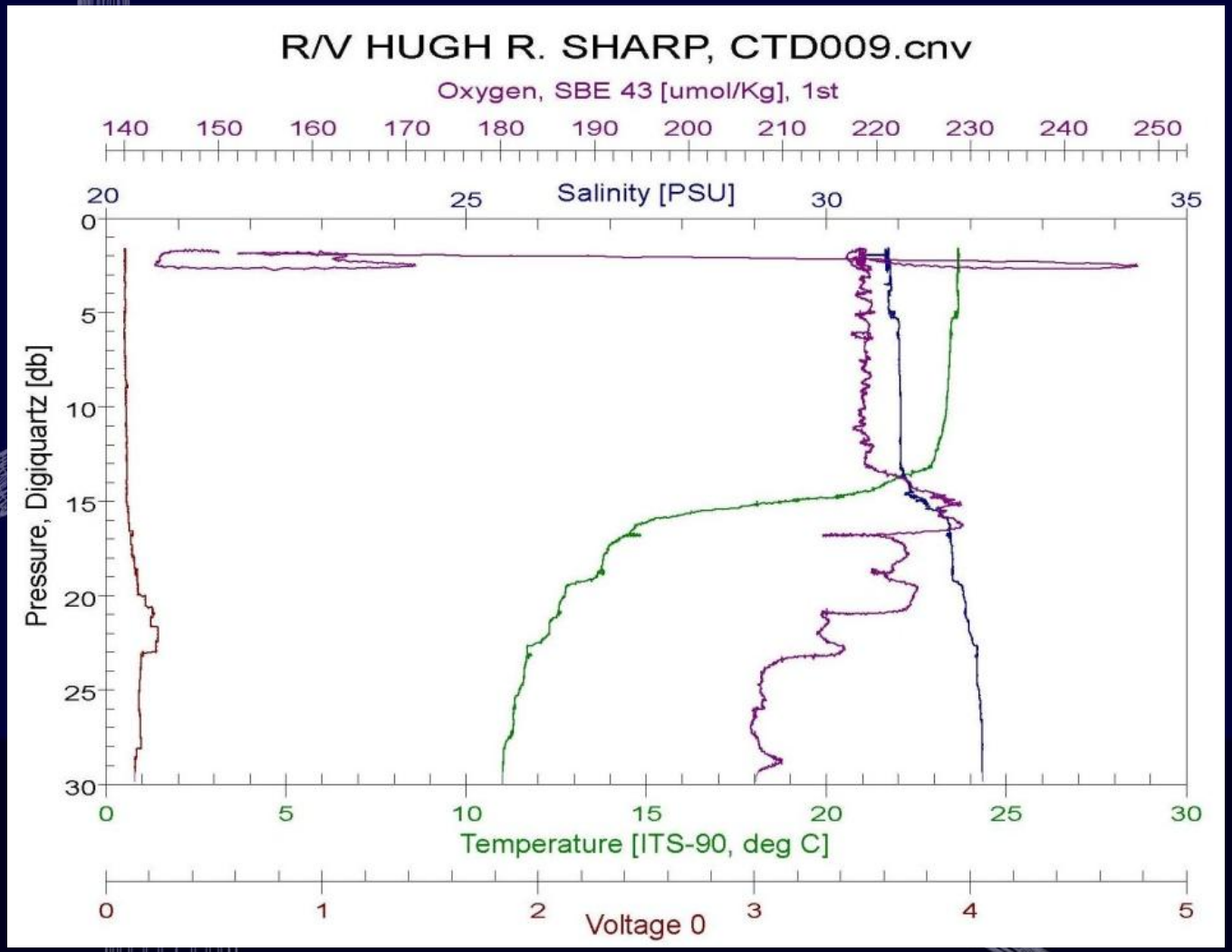
CTD Cast

Summer (2 August 2009)



This cast shows a well established stratified thermocline that is characteristic of the summer season in the Study Area

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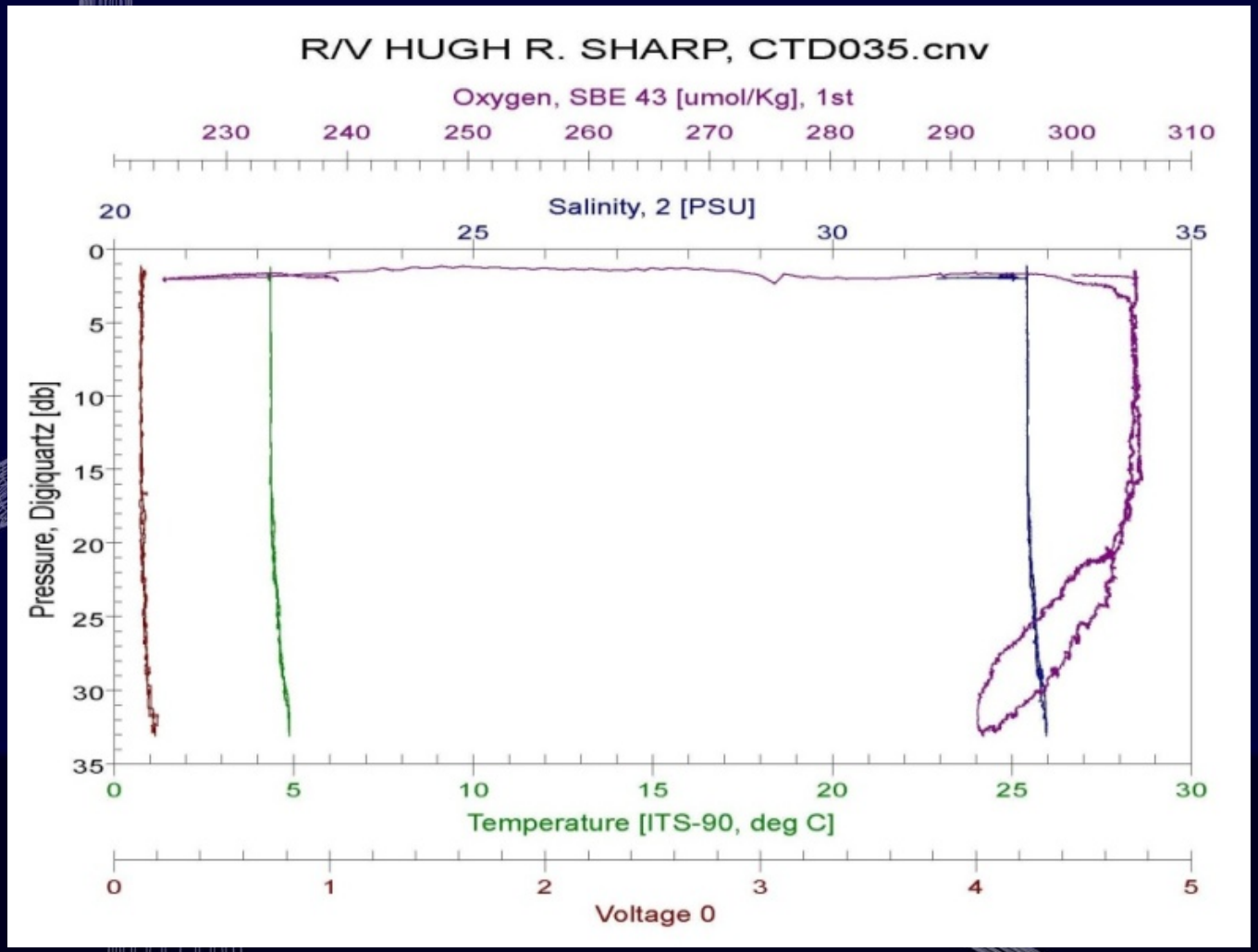
CTD Cast

Winter (15 February 2009)



This cast shows a well mixed water column with no thermal stratification and is characteristic of the winter season in the Study Area

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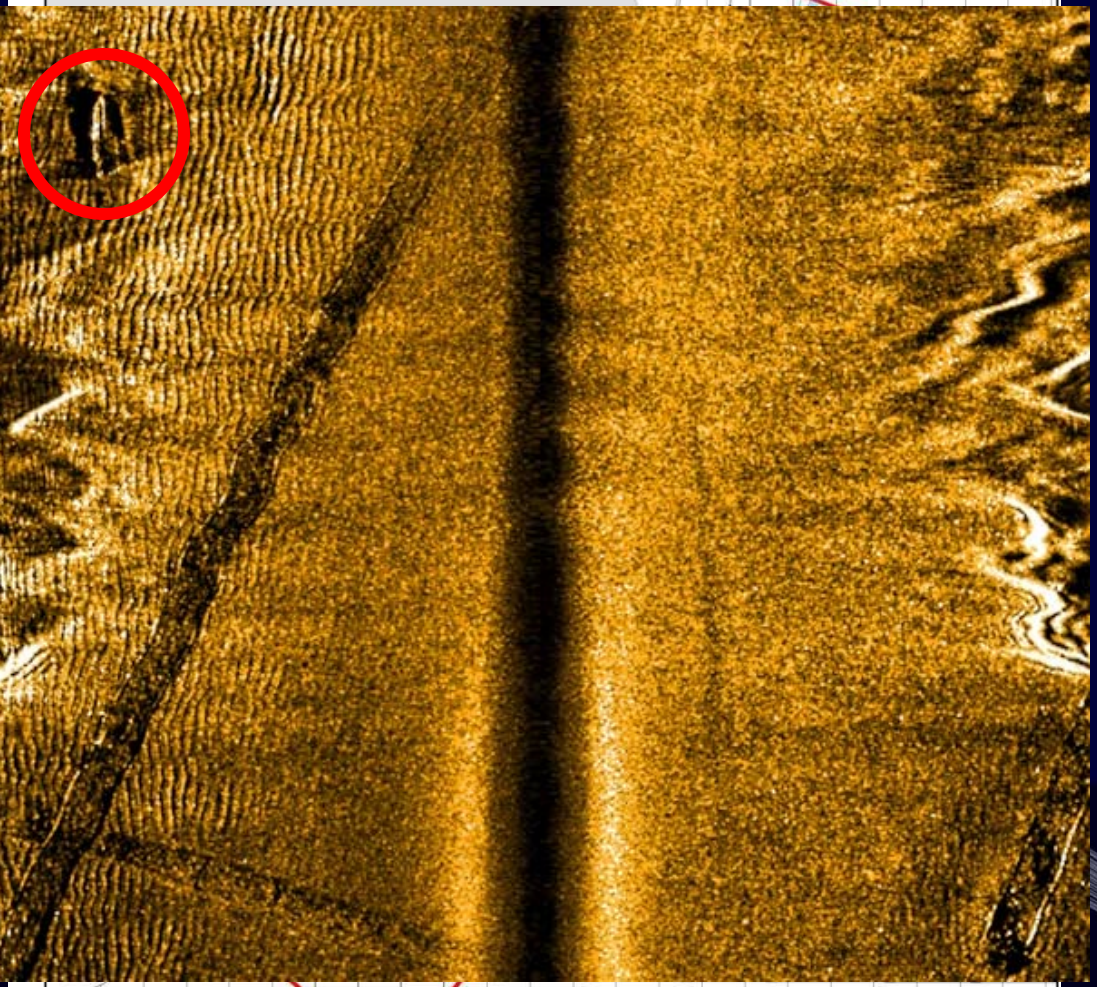
Benthic Mapping



- Two complementary tools: side scan sonar and magnetometer
- Relatively uniform sand bottom with four bottom types: sand plains, sand ripples, sand waves, and areas of mud and silt deposits
- Seabed morphology consists of relatively flat, migrating sand waves and ripples with occasional larger sand ridges
- Sonar targets include fish traps, debris probably associated with commercial shipping traffic, ship wrecks, and possibly cement structure debris.

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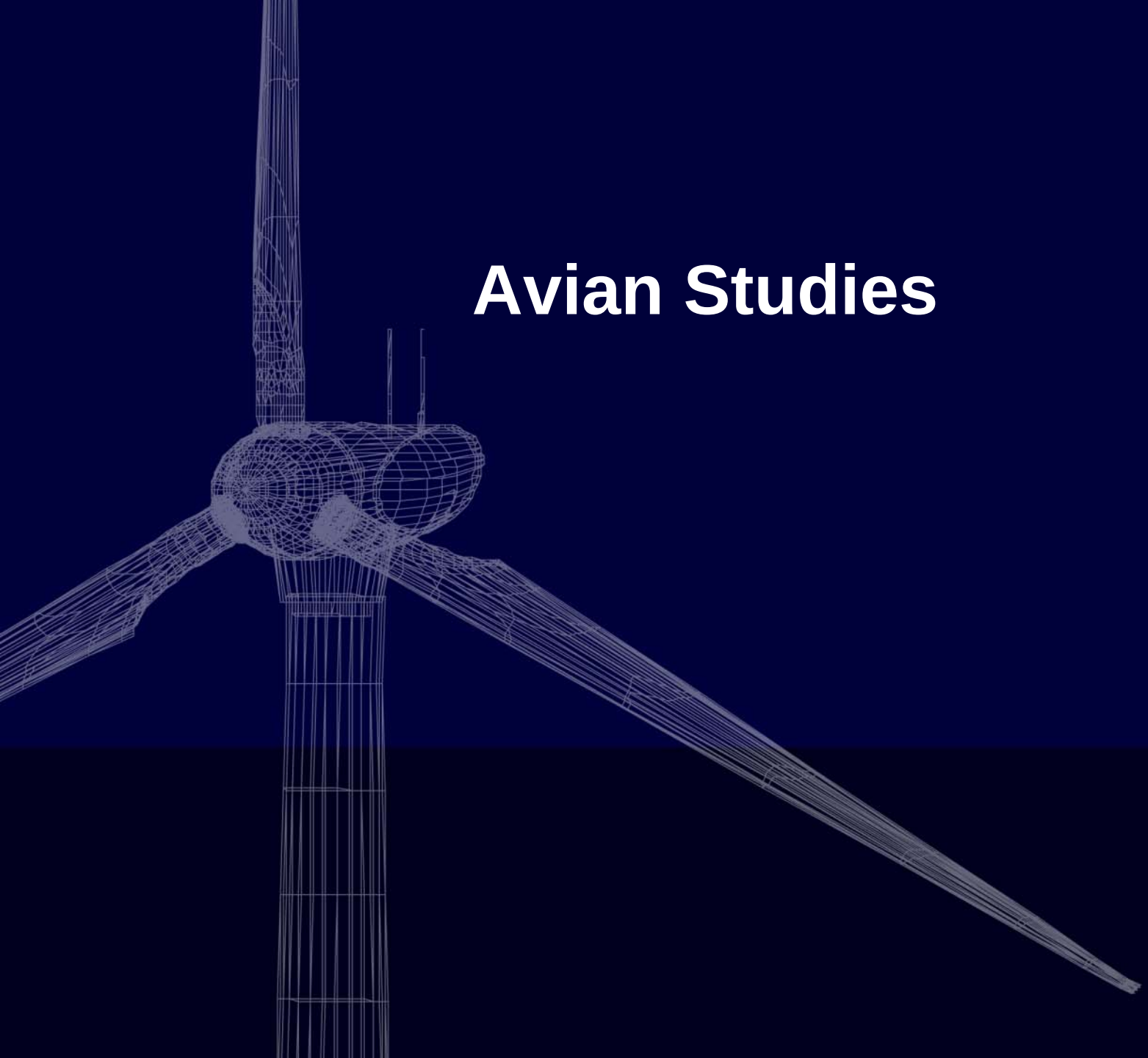
Avian Studies



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Avian Studies - Introduction

Visual Surveys

- Large Boat
- Small Boat
- Aerial

Avian Predictive Modeling

Remote Sensing

- Radar
  - Coastal
  - Offshore
- Radar Validation Surveys
- Thermal Imaging-Vertically Pointed Radar
- NEXRAD Study

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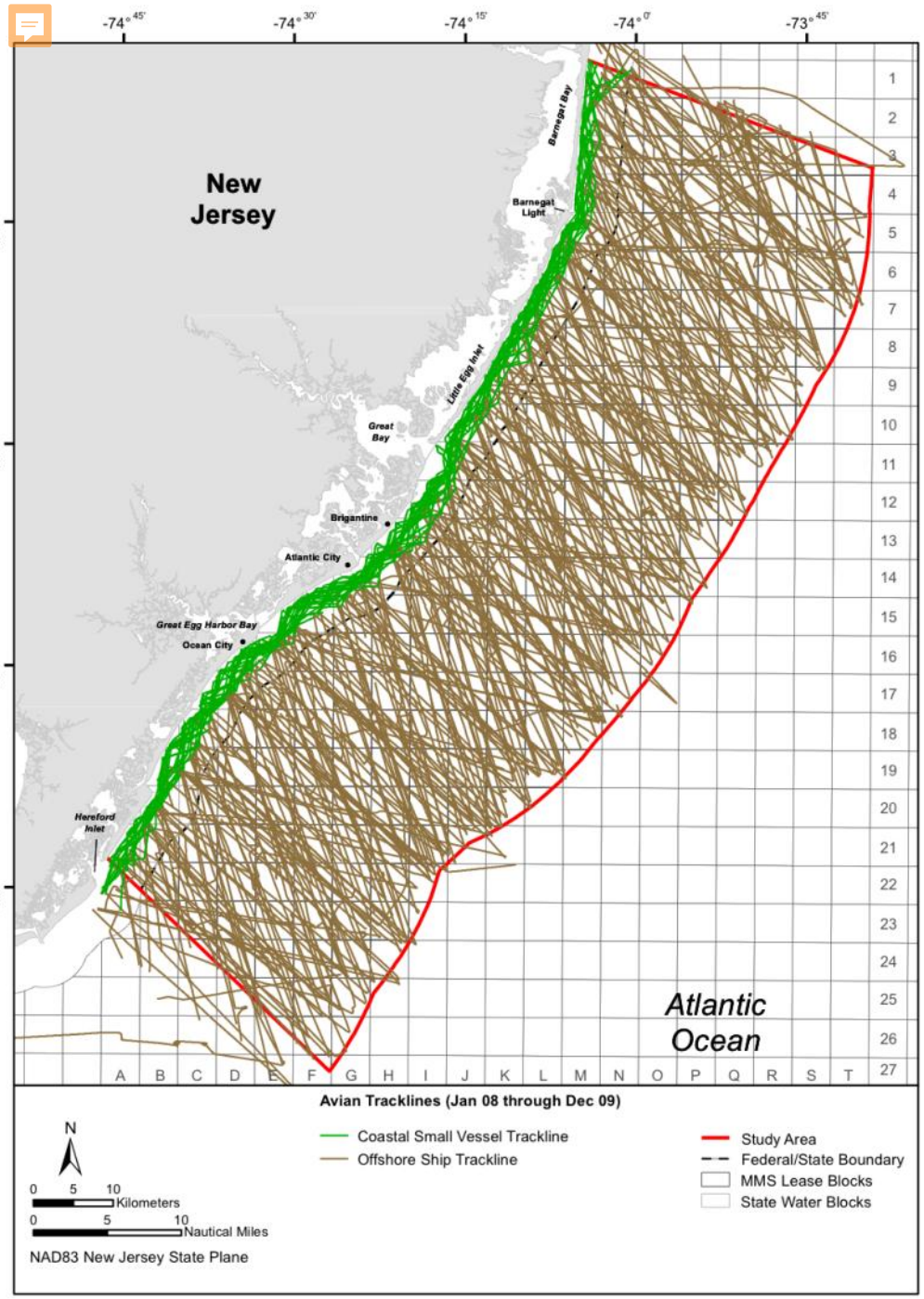
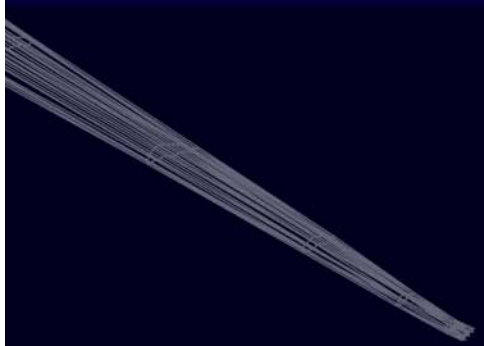
TOTAL SURVEY EFFORT 2008-2009

Bimonthly coastal and offshore surveys

Total km 18,183

Total species 153





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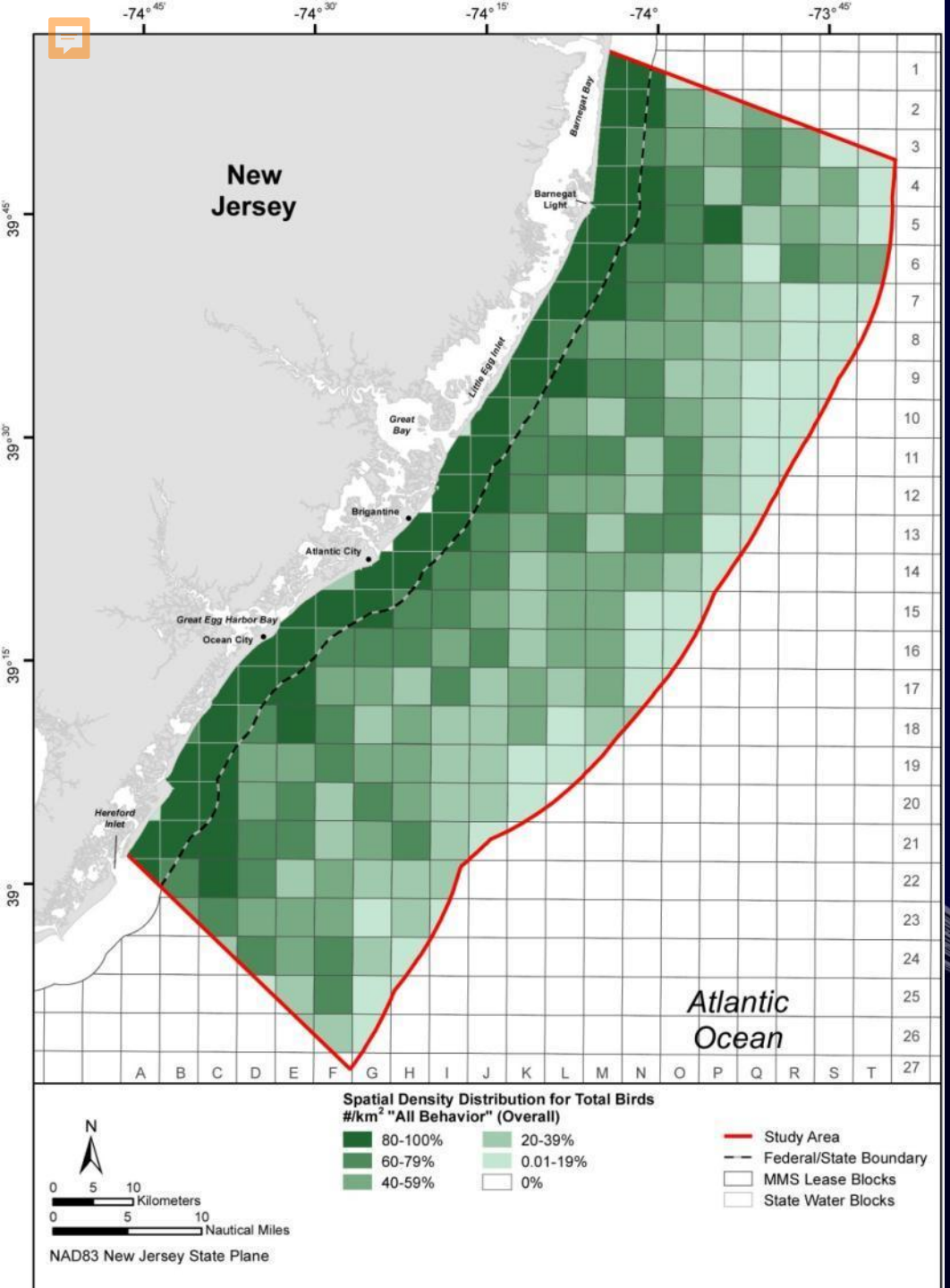
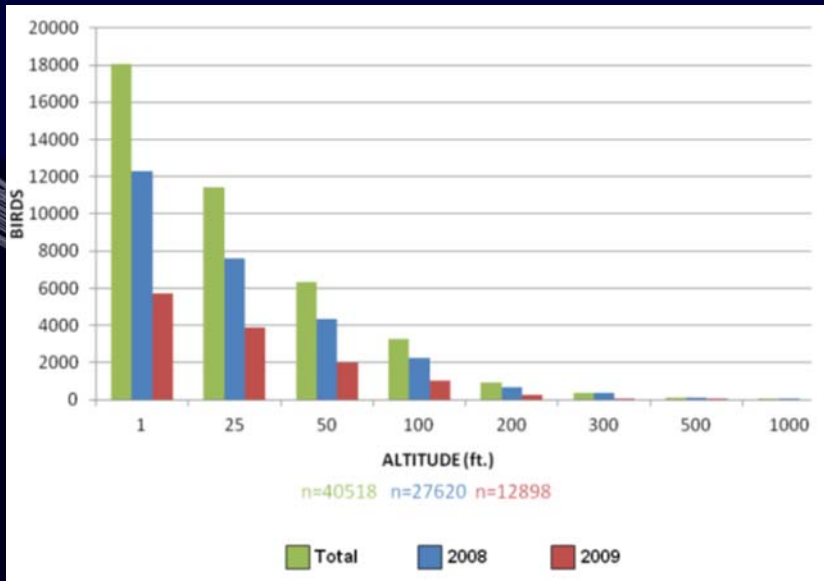
Avian Cumulative Daytime Abundance 2008-2009

Areas of highest avian abundance were mostly within state waters (3 NM from the coast)



Altitude Distribution



Objectives: Spatial ecology of birds in NJ coastal marine environment

Questions:

1. Where and when are birds (species) most likely to concentrate along the NJ coast?

2. Are birds more or less concentrated evenly along the coast, or do some species exhibit specific spatial gradients (i.e. latitude/longitude variation)?

3. What is the relationship between bird density/distribution and depth, distance to shoreline, distance to shoals, and slope?

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Modeling Overview

1) Bimonthly survey data are used to calculate density estimates (km^{-2}) of birds (e.g. total birds, by species).

2) Kernel density interpolation are used to grid bird density at seasonal scales.

3) GIS data management - Grid cells are integrated with spatial covariates.

4) Spatially-explicit regression models are fitted to test whether spatial variability of bird density and distribution may be related to spatial covariates.

5) The effect of each spatial covariate is assessed for predicting changes in bird density.

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Statistical Spatial Modeling:

Spatial Lag Regression Model

$$Y = \rho Wy + Xi\beta + \varepsilon$$

Generalized Additive Models (GAMs)

$$E[y] = g^{-1}(\beta_0 + \sum_k S_k(x_k))$$

Quantify spatial relationship between bird density and covariates:

- **Depth**
- **Slope**
- **Distance to shoreline**
- **Distance to nearest shoal**
- **Latitude**
- **Longitude**

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Modeling Results:

Synthesized 2 years of shipboard surveys to model and predict the spatial distribution of birds using kernel density interpolation and spatial regression.

- **Geographic Atlas**

- **Spatial distribution and abundance of birds varies by species and season.**

- **Depth, distance to shoreline and nearest shoal are significant predictors of bird spatial distribution.**

- **Birds are concentrated closer to shore during fall and winter than in spring or summer.**
  - **Community composition changes**
  - **Seasonal 'Hotspots' and spatial gradients are present**

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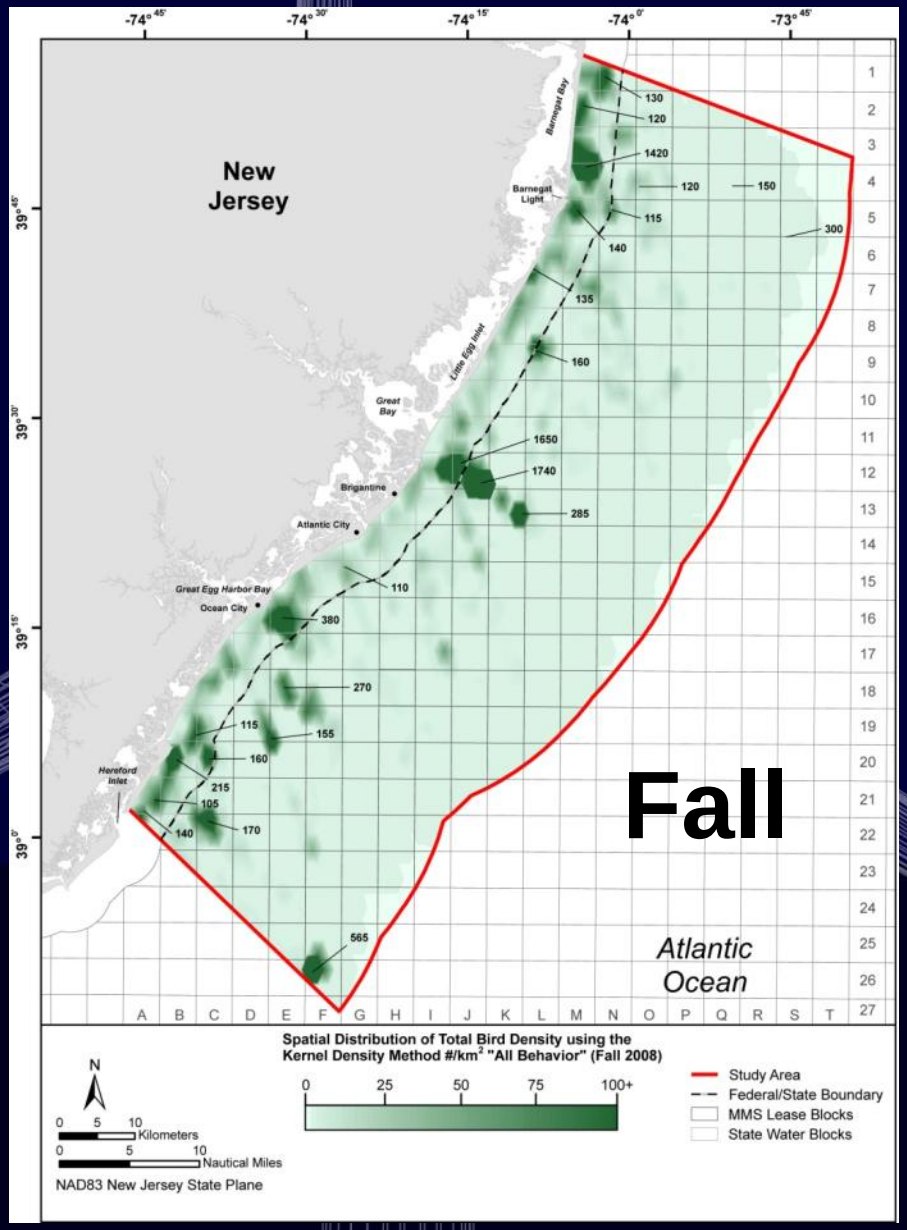
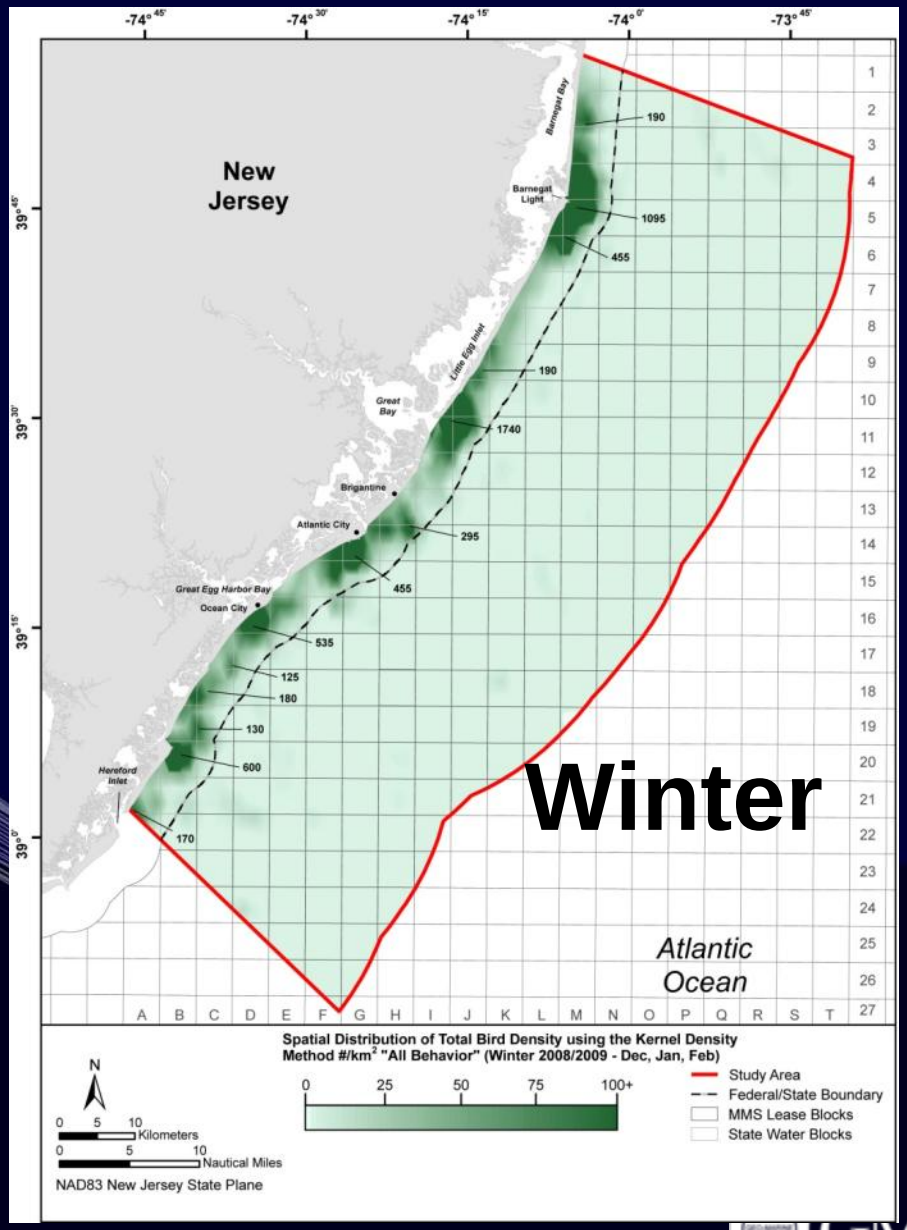
Seasonal Variability: Total bird density





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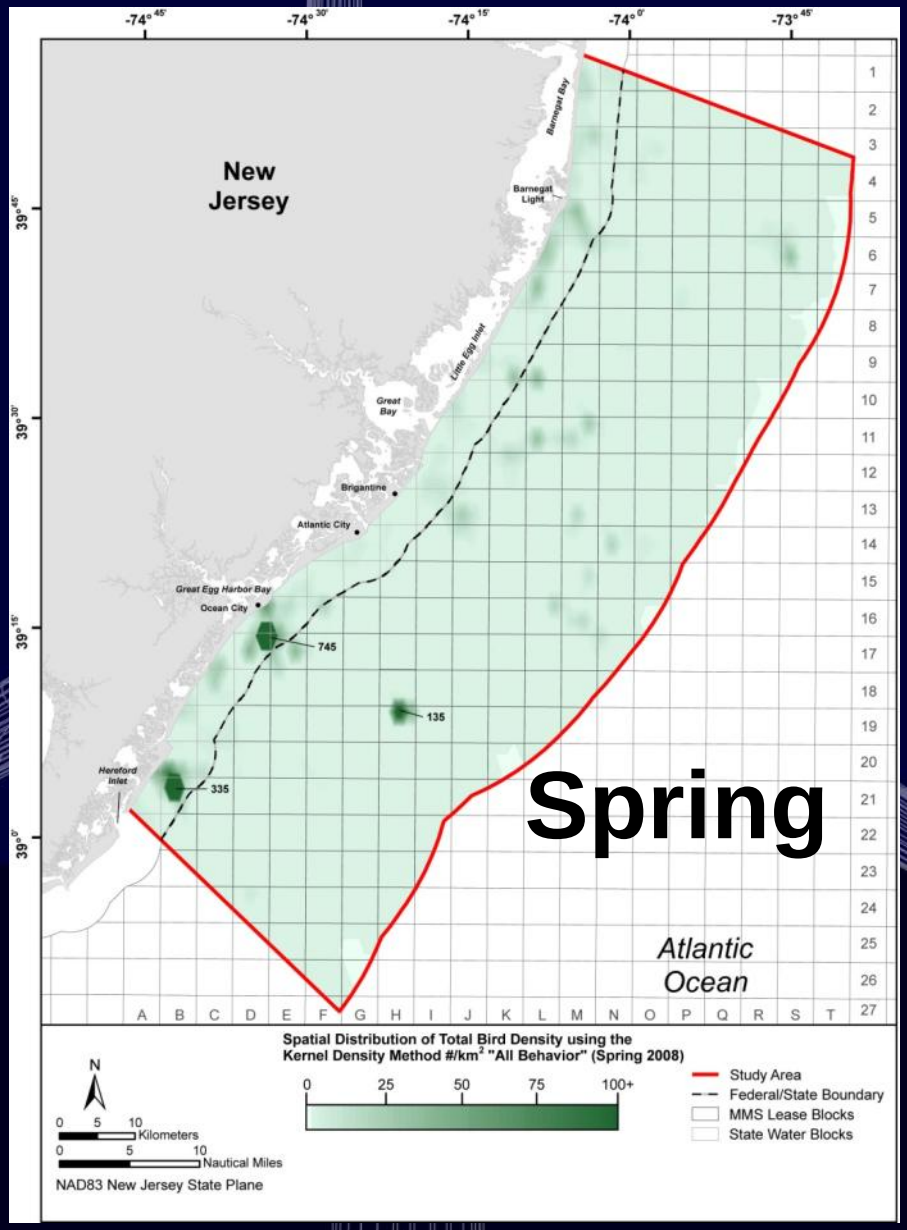
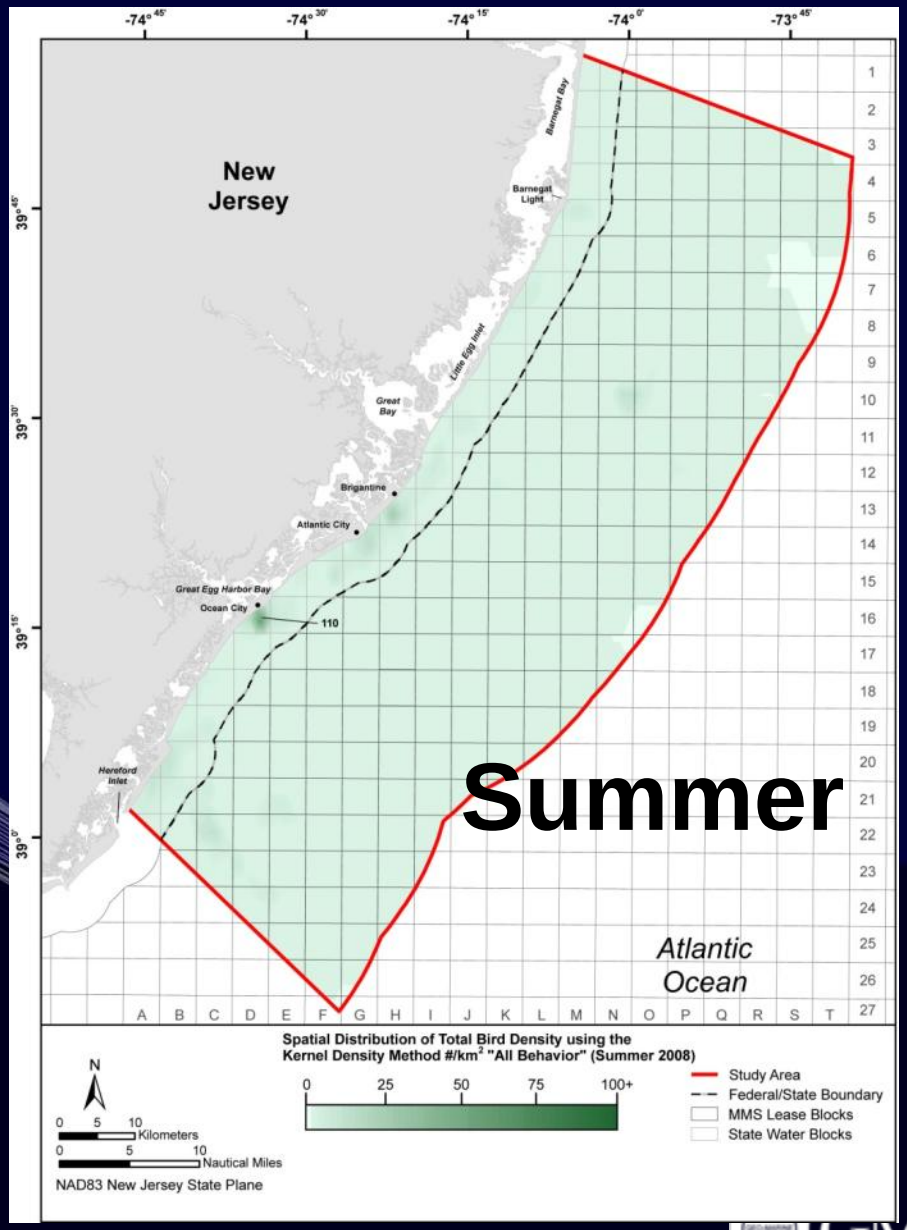
Seasonal Variability: Total bird density





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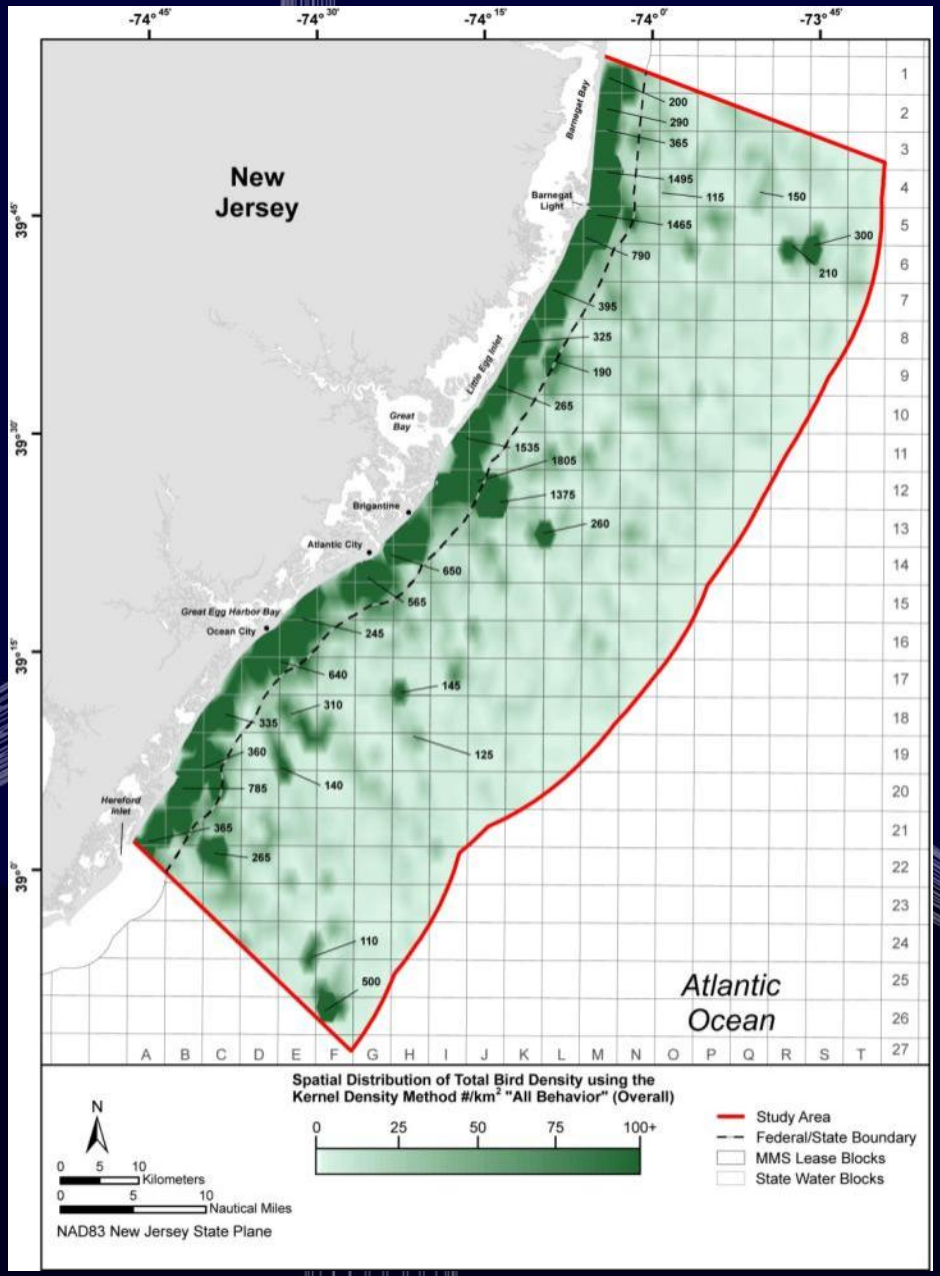
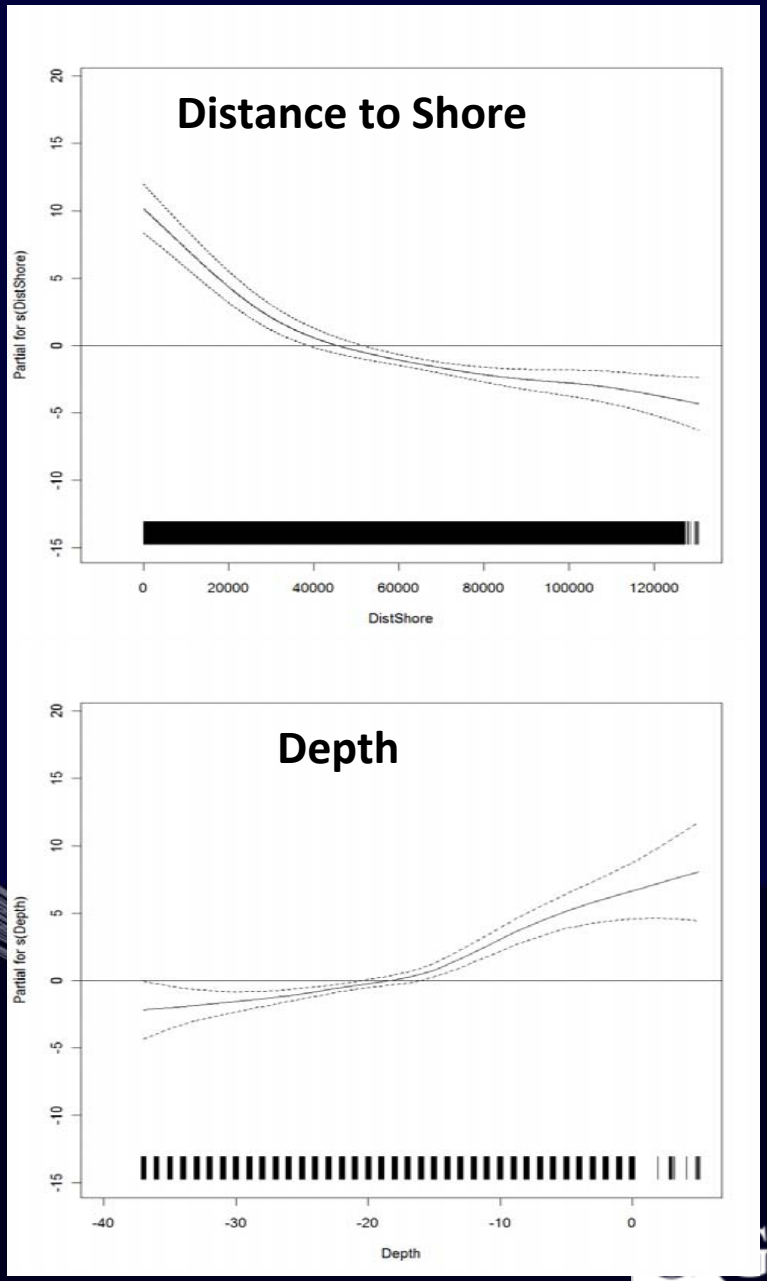
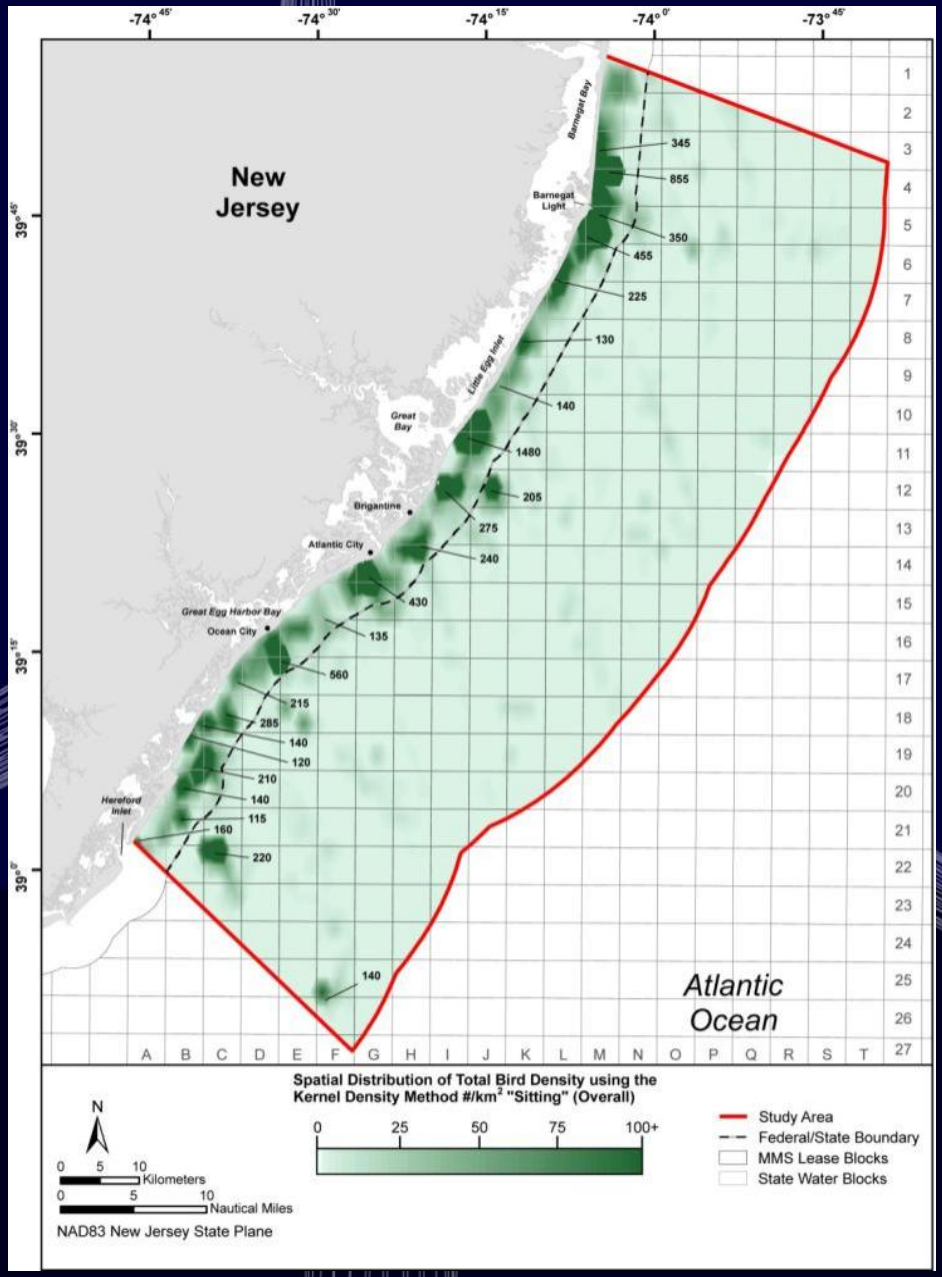
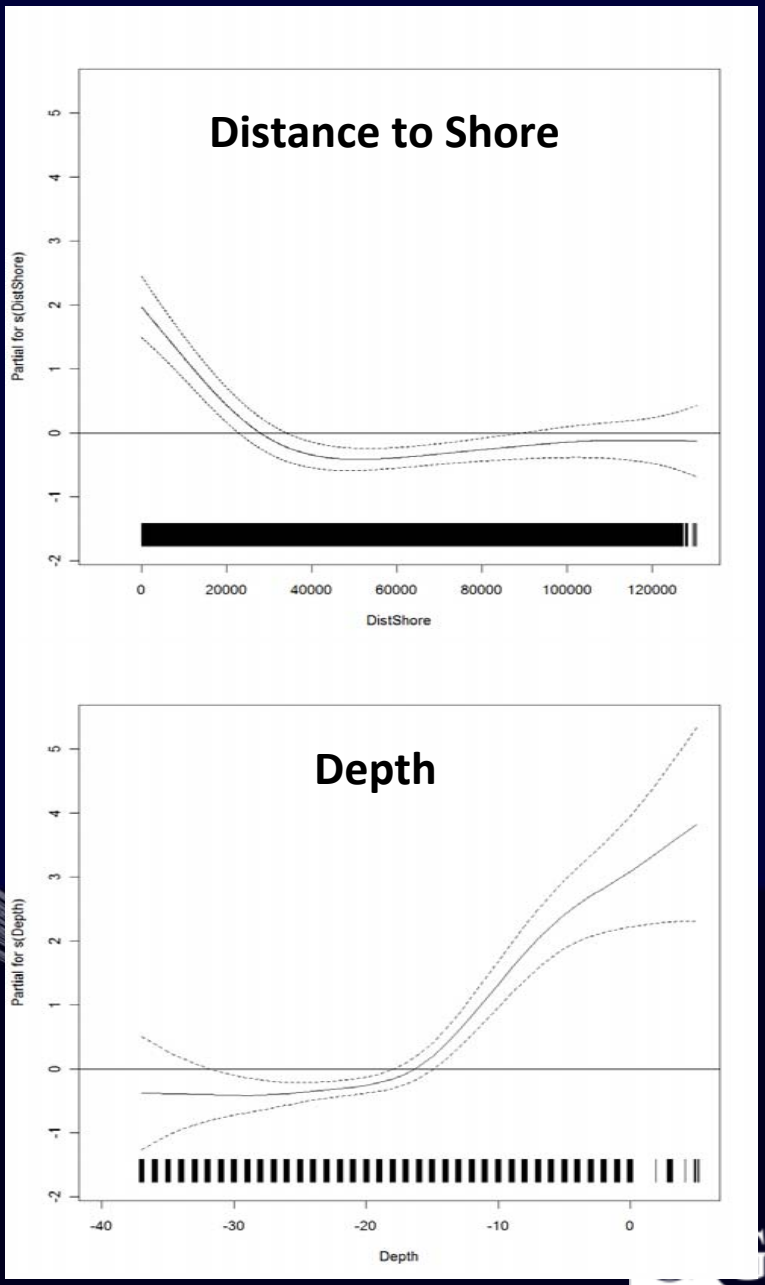
Total birds: relationship with covariates



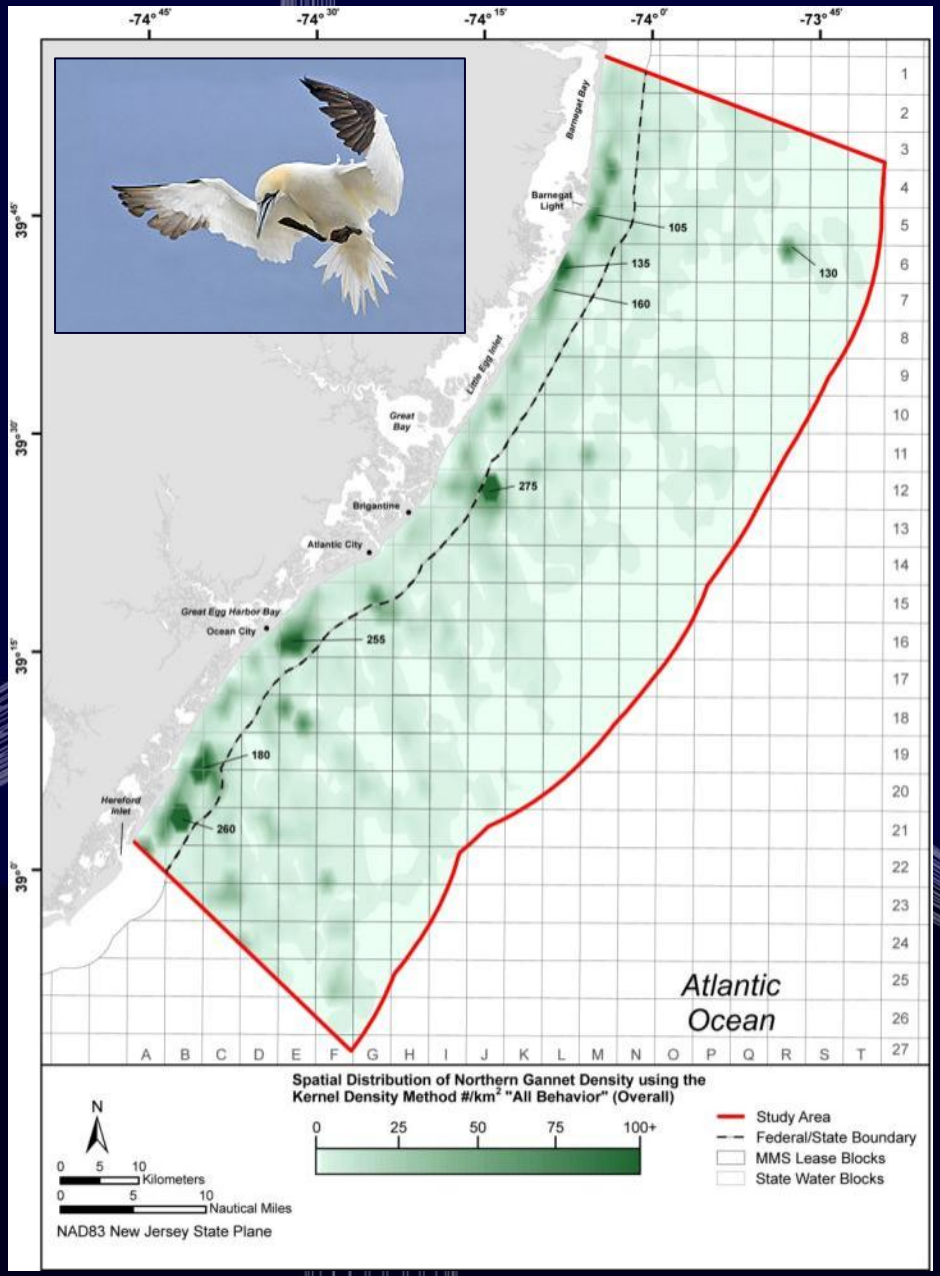


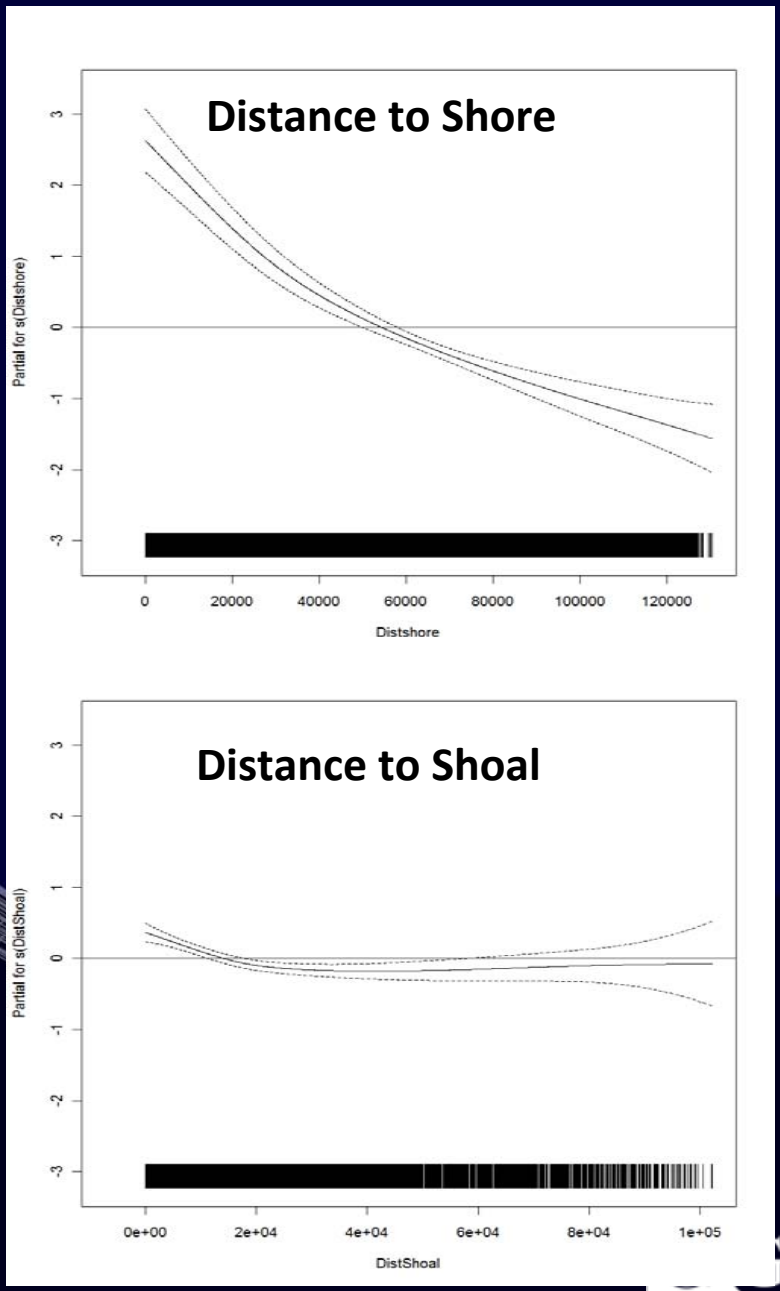
‘Sitting’ birds: relationship with covariates



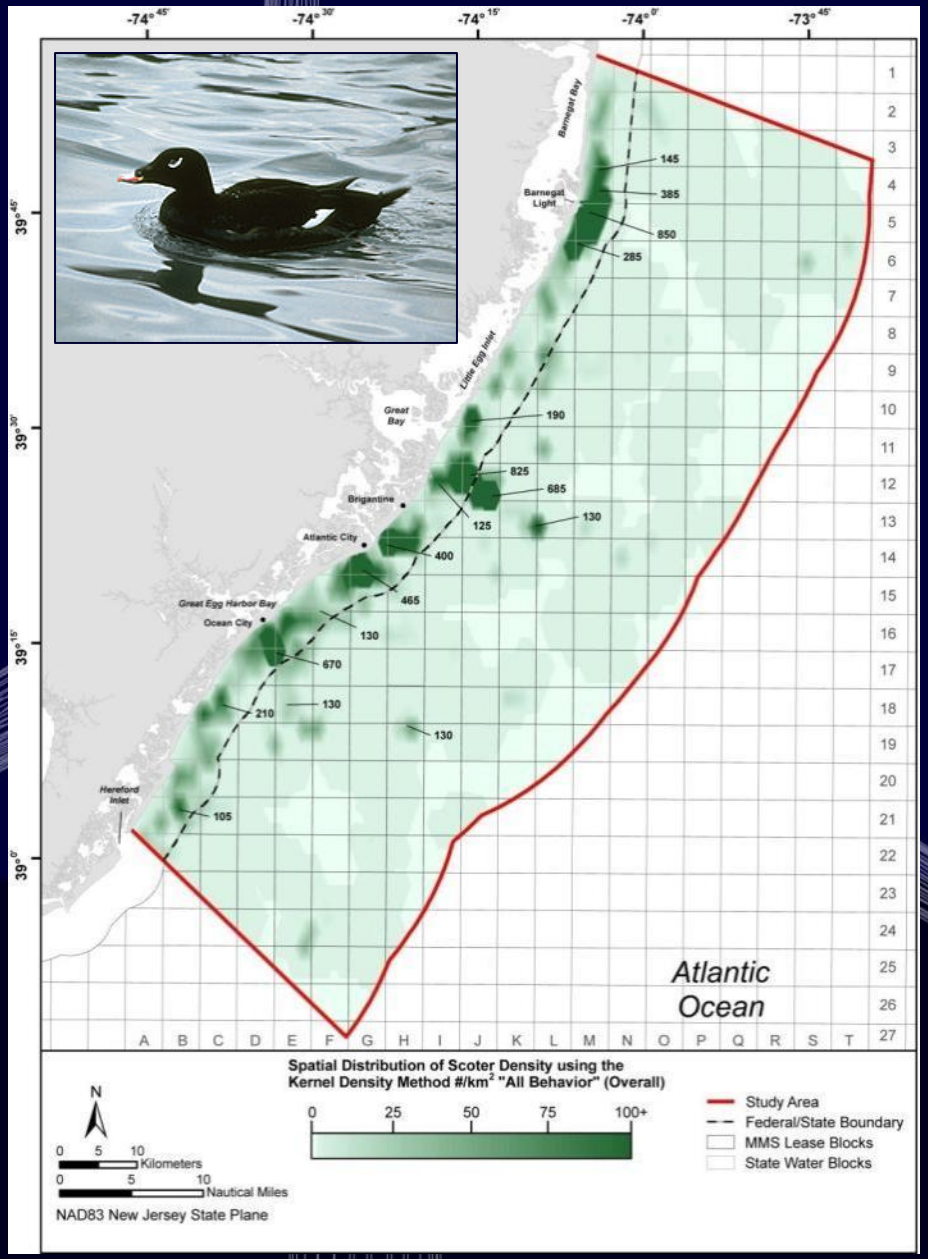


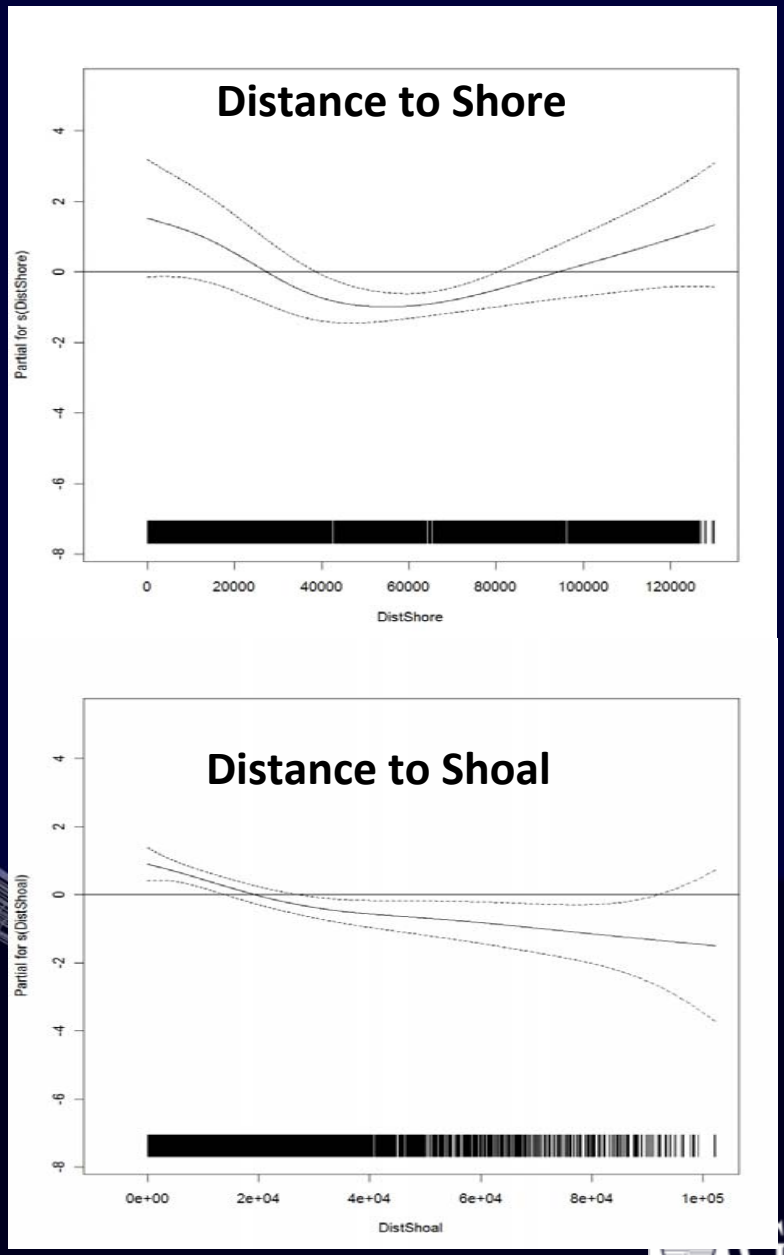
Northern Gannet: relationship with covariates





Scoter Species: relationship with covariates





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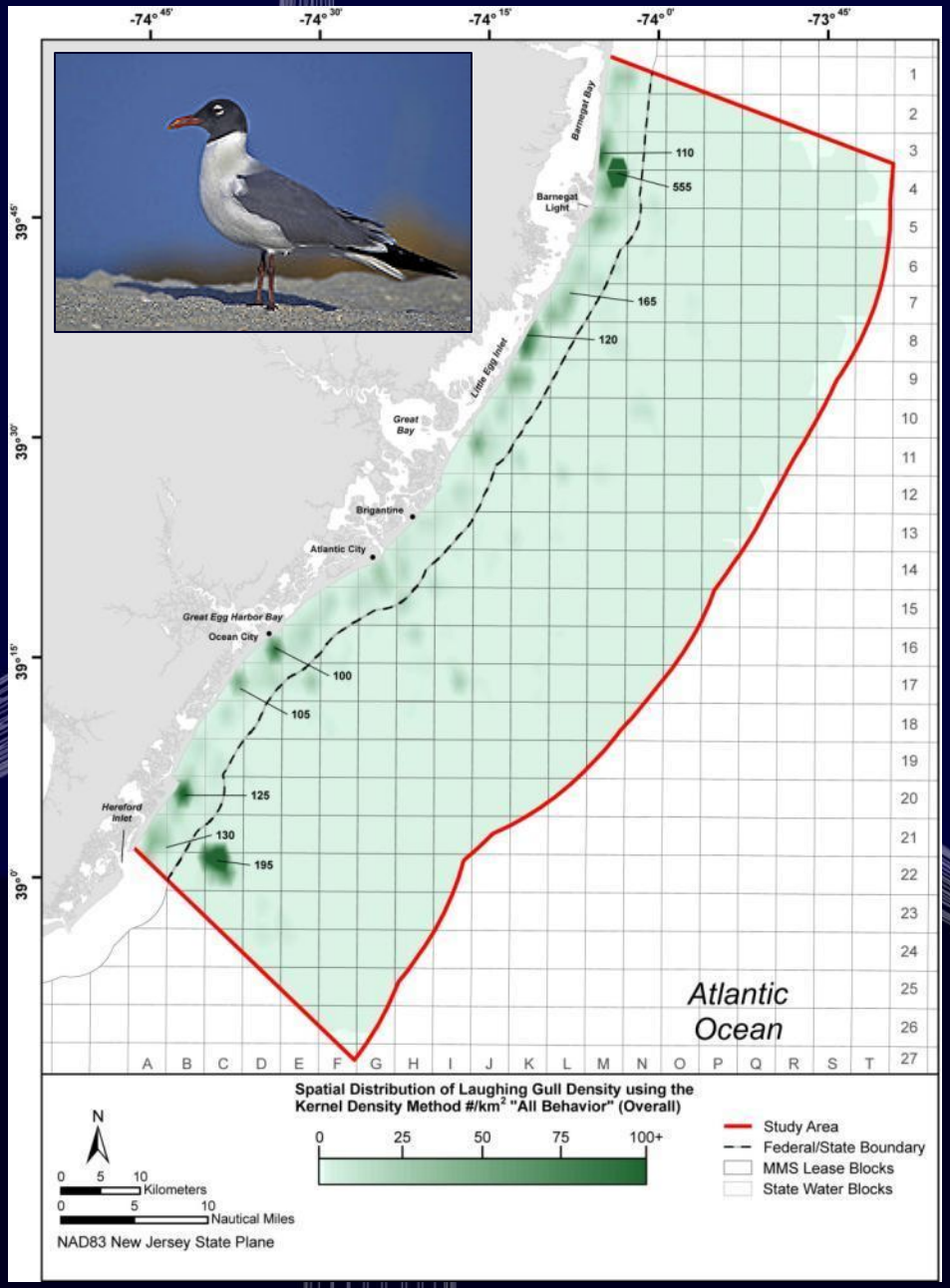
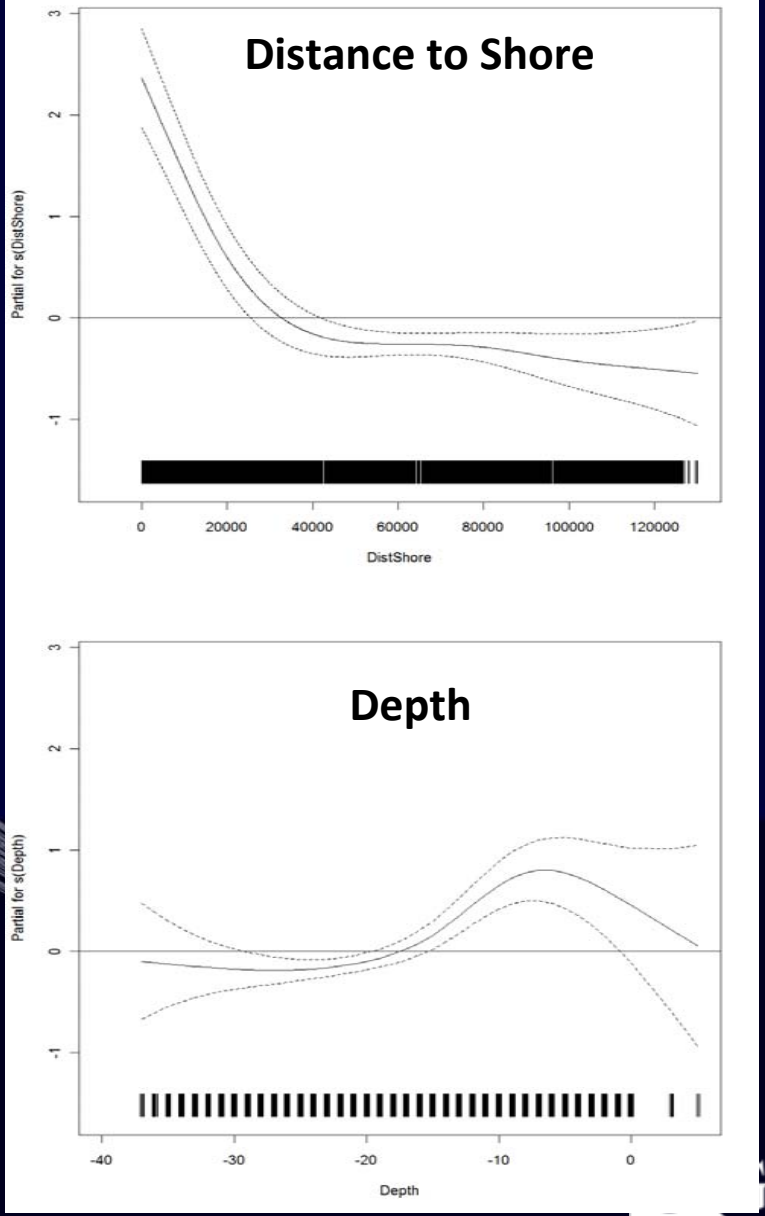
Laughing Gull: relationship with covariates





Conclusions:

- Geographic atlas of bird distribution and density
- concentration ‘hotspots’ are present

•dynamic with respect to seasonality and is driven by species specific responses

•changes in relation to depth, slope, distance to shoreline, distance to shoals

•Total bird density declined significantly in waters greater than 20m in depth and 7.6 miles from the coastline

•Sitting birds occurred in waters less than 15 m in depth and within 3.8 miles from the coastline

•These data are used to develop a semi-qualitative environmental sensitivity index

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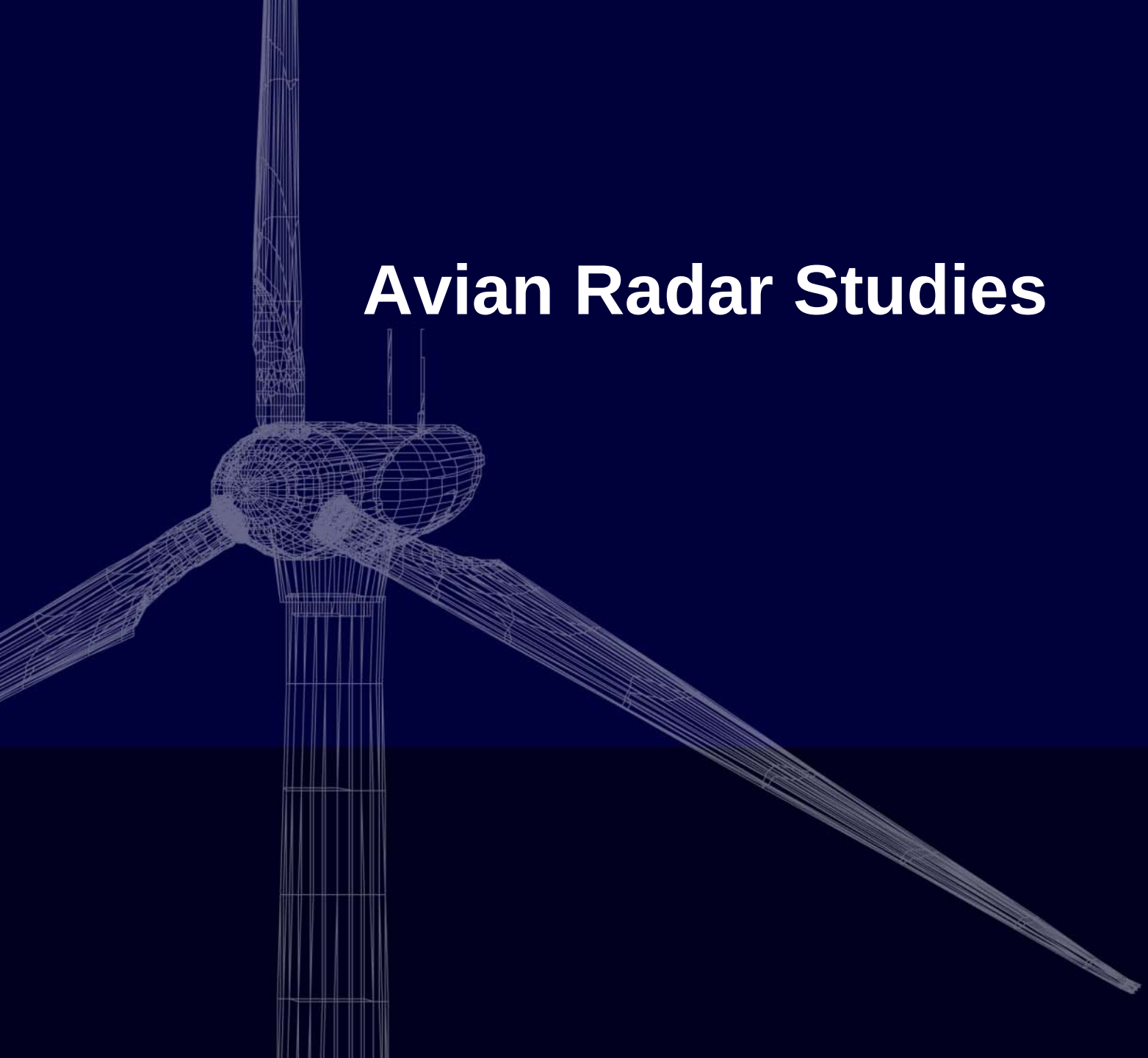
Avian Radar Studies



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Avian Radar Surveys

The primary goals and objectives of the offshore and onshore avian radar surveys were:

•To determine seasonal altitudinal distribution of birds over offshore, near shore, and onshore sites within the Study Area

•Determine the density of flight activity moving through the radar surveillance area over a specific time period.

Mobile Avian Radar System (MARS)

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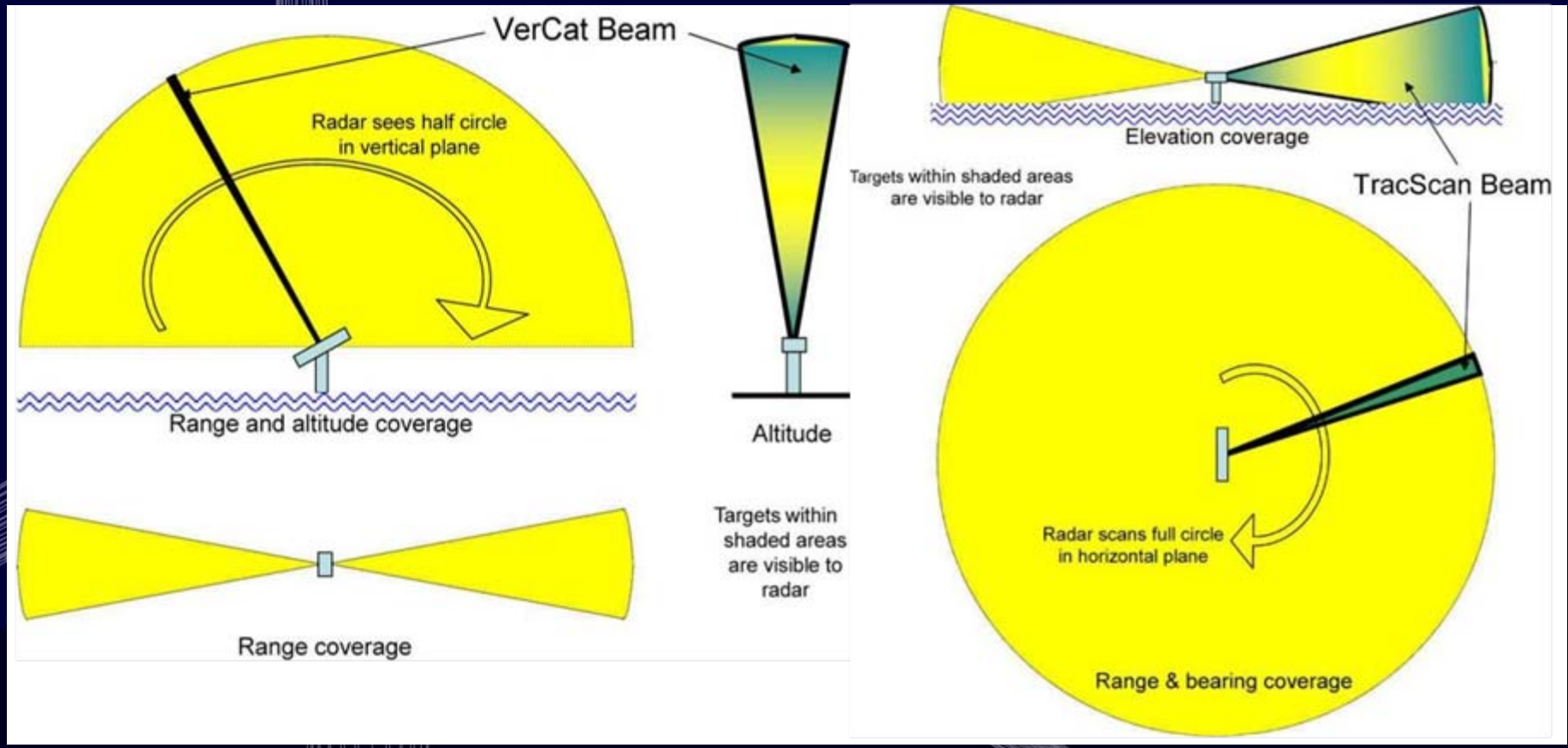
Radar Configurations



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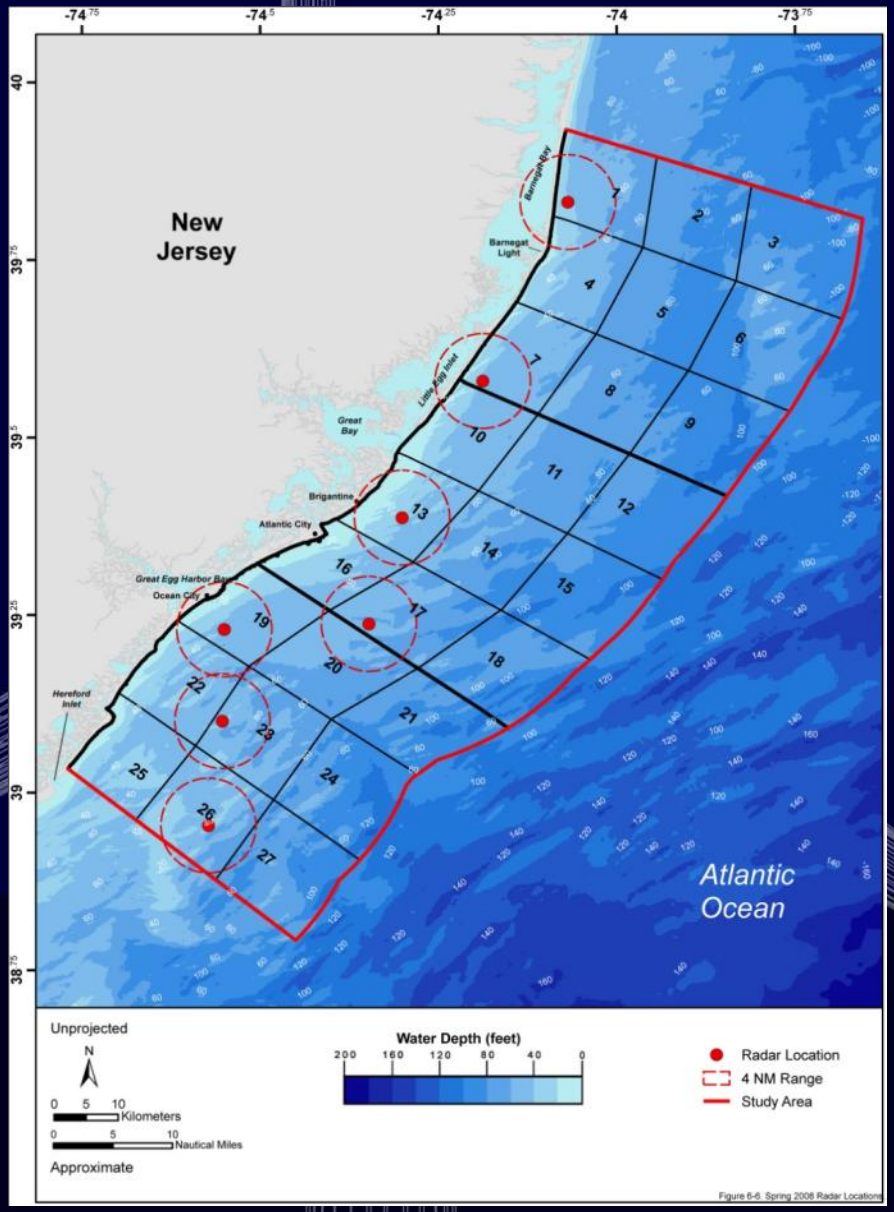
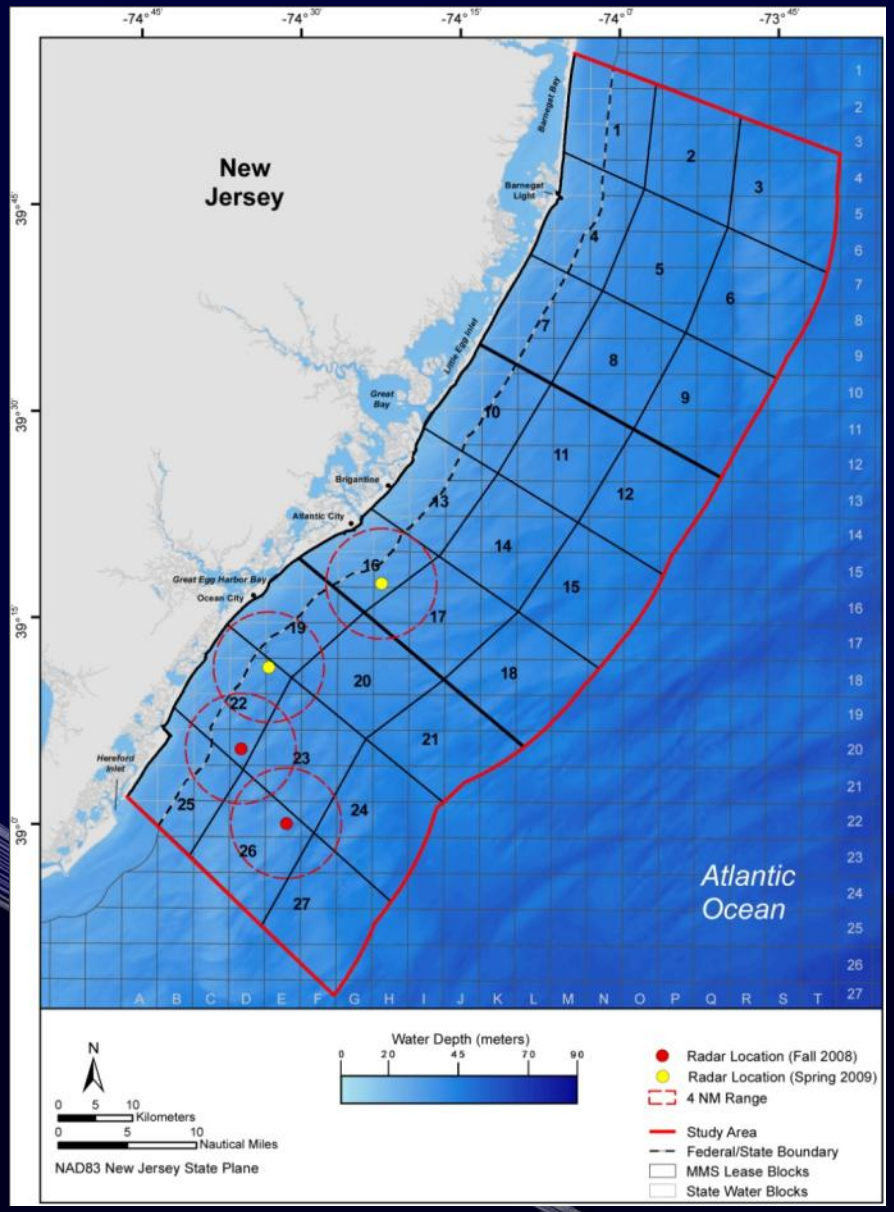
Offshore Radar Locations



Spring 2008



Fall 2008 and Spring 2009

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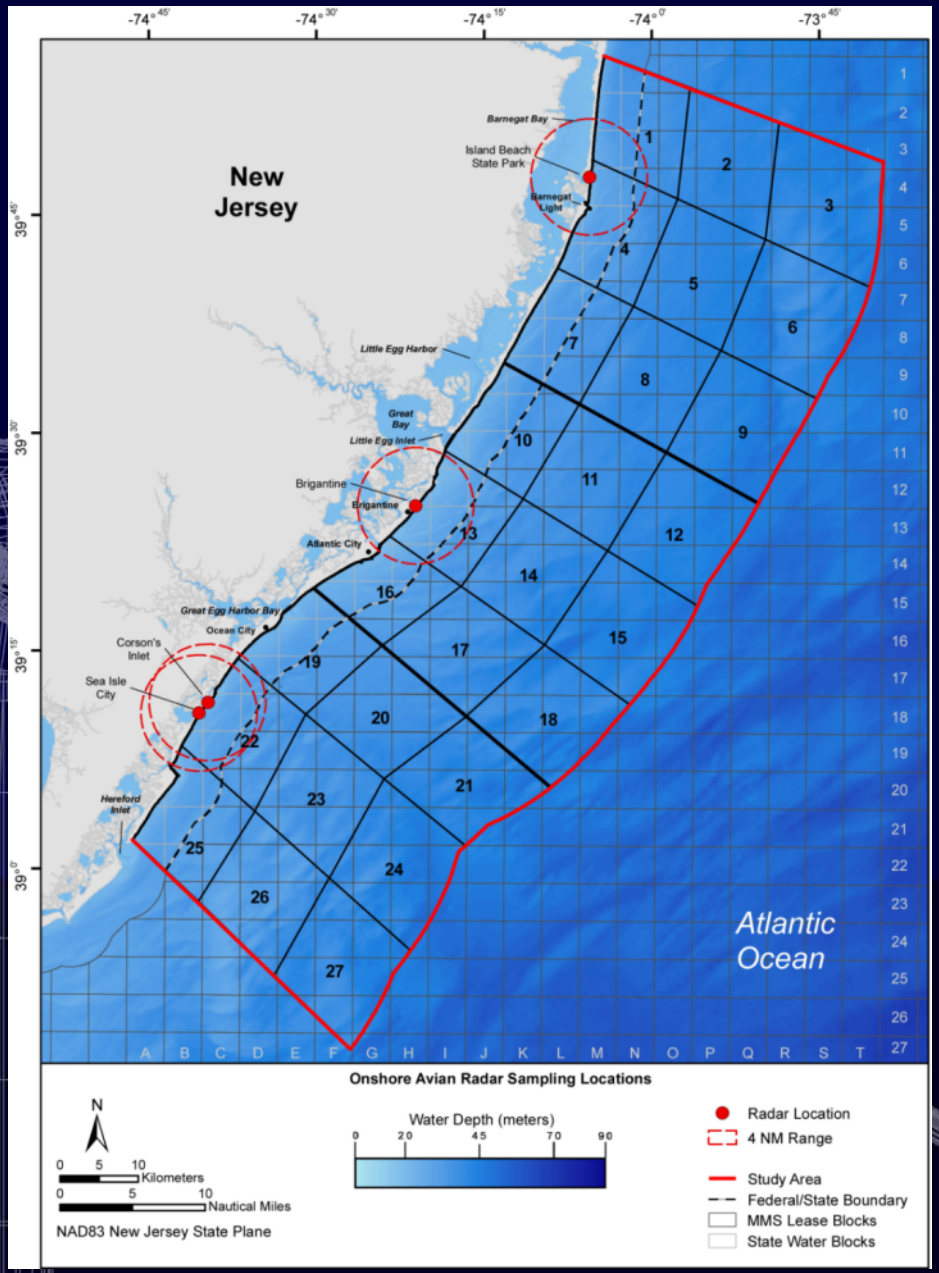
Onshore Radar Locations



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Radar Validation

- Avian radar validation surveys were conducted to identify the sources of radar echoes and to determine radar confirmation percentages of birds at varying distances and varying altitudes above mean sea level from the radar.

- Barge-based, boat-based and onshore-based validation surveys were conducted by observers throughout the study area.

- A TI-VPR system was also used to collect validation data.

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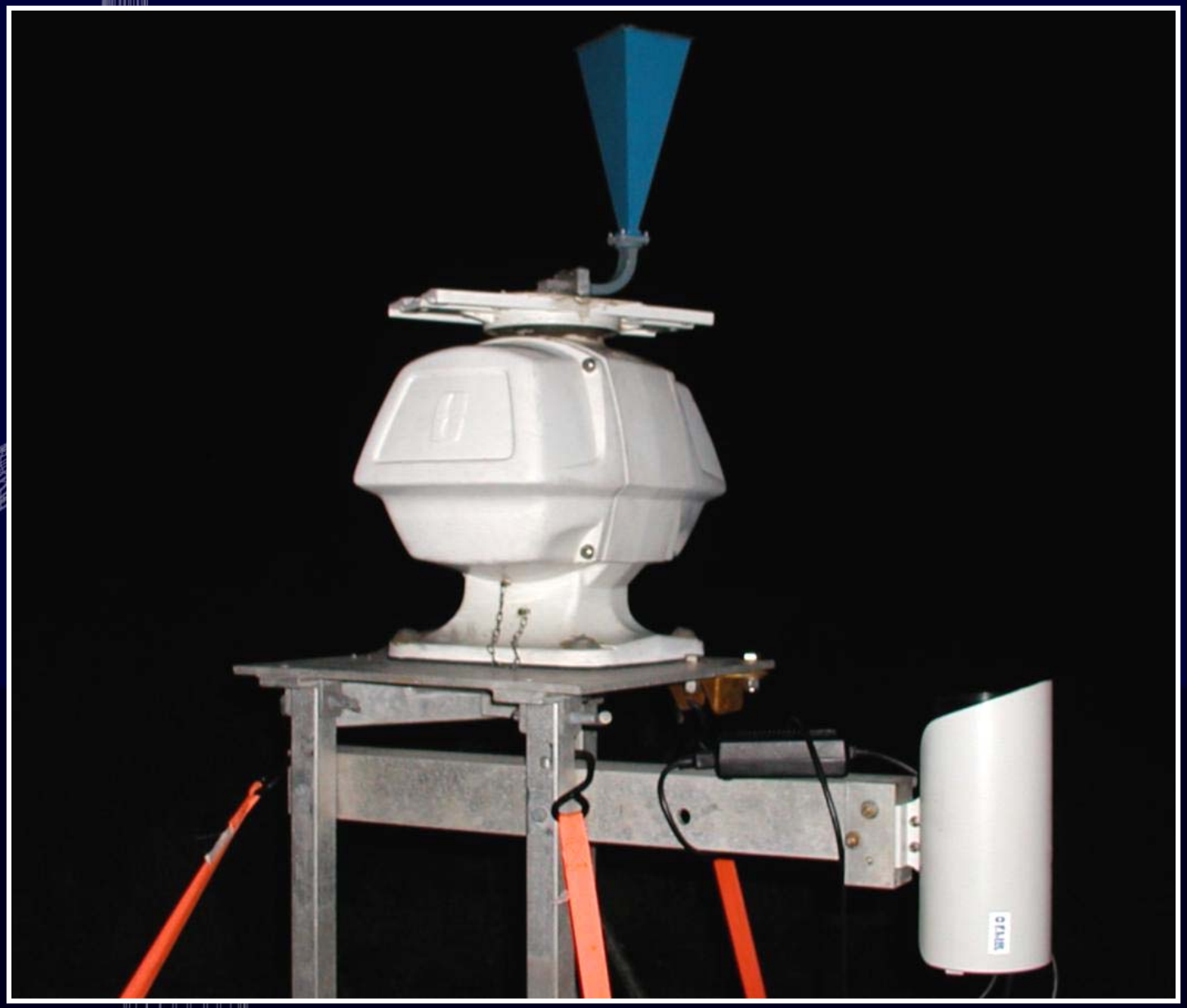
Thermal Imager-Vertically Pointing Radar (TI-VPR)



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Data Analysis

- Avian radar data were analyzed to identify false tracks generated by detections from:
  - rain (especially virga)
  - sea clutter
- Data filters and correction factors were developed to remove false tracks from radar data.
- The data were corrected for multiple tracks for a single target.
- The data were processed to eliminate insect targets.

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Radar Survey Results

The results of the studies with VerCat are expressed in terms of three metrics:

- **median altitude quartile** (the 50 % quartile containing the altitude at which half the total number of birds observed were flying below the median, and half were flying above the median)

- **adjusted migration traffic rate** (AMTR - number of bird tracks crossing over a km per hour)

- **flux** (adjusted bird tracks/km^3/hour)

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Radar Survey Results

- The flux value (adjusted bird tracks /km^3 / hr) is the primary metric used to estimate bird-turbine collision mortality.

- Cumulative diurnal and nocturnal flux data were sorted into three altitude bands with reference to the potential rotor swept zone (RSZ):
  - Below the RSZ (low altitude band, 1 to 99 ft AMSL),
  - Within the RSZ (middle altitude, 100 to 700 ft AMSL),
  - Above the RSZ (high altitude band, 701+ ft AMSL).

- Flux values were reported for time periods (e.g., weeks, daytime, nighttime) through the low, middle, and high altitude bands, and sorted into three wind categories: 0-8 mph, 9-16 mph, and above 16 mph.

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Offshore Flux (Spring – Fall 2008)

Diurnal

- Overall cumulative daytime flux was greater in the RSZ than the low altitude band from nearshore to offshore.

Nocturnal

- Overall cumulative nocturnal flux was greater in the RSZ than in the low altitude band, increased in quantity during nighttime, and increased in quantity as migration seasons progressed.
- The potential for bird turbine collision is greater during the fall because the majority of birds are within the RSZ.

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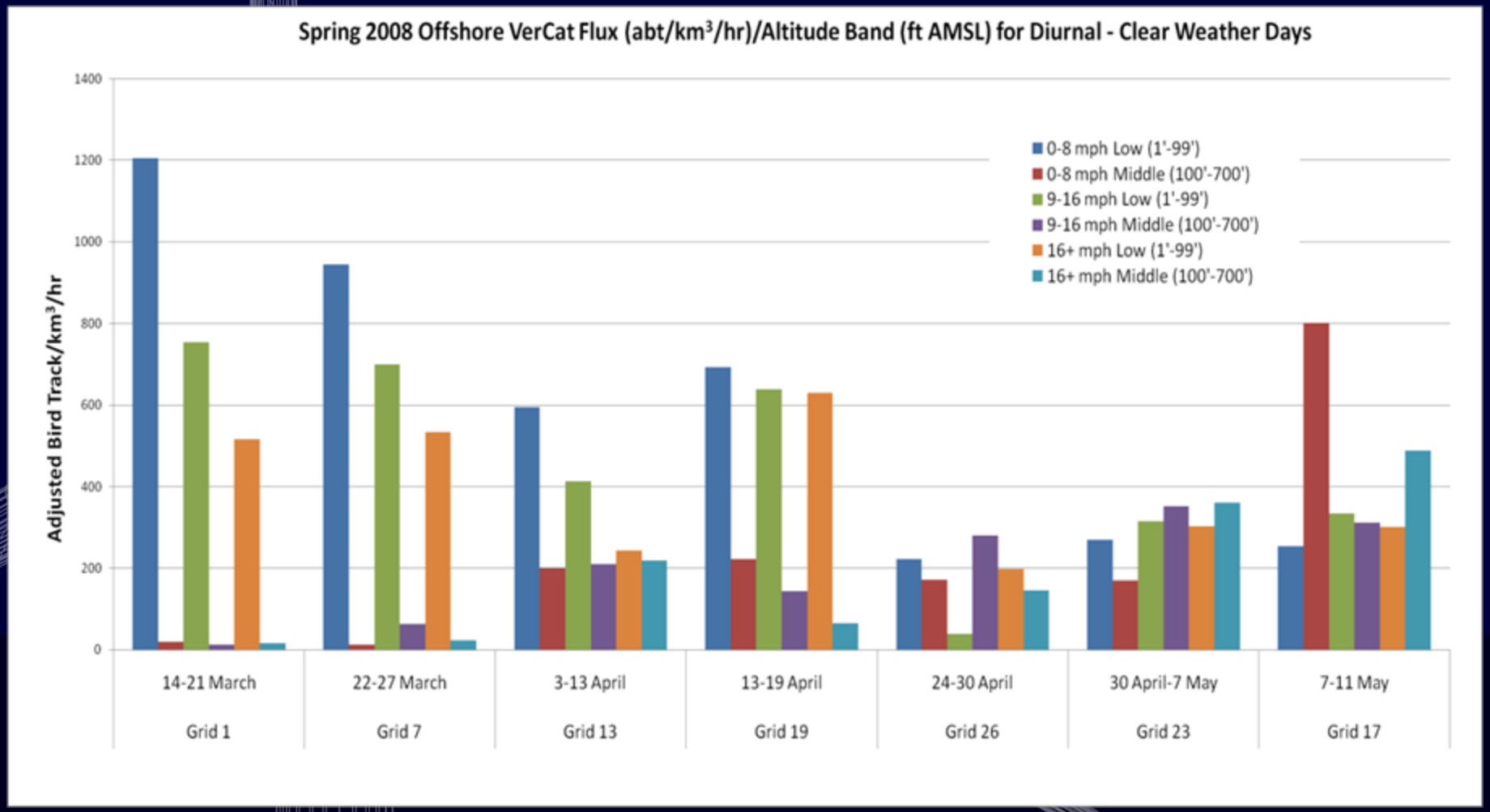
Offshore Flux--Diurnal Spring 2008



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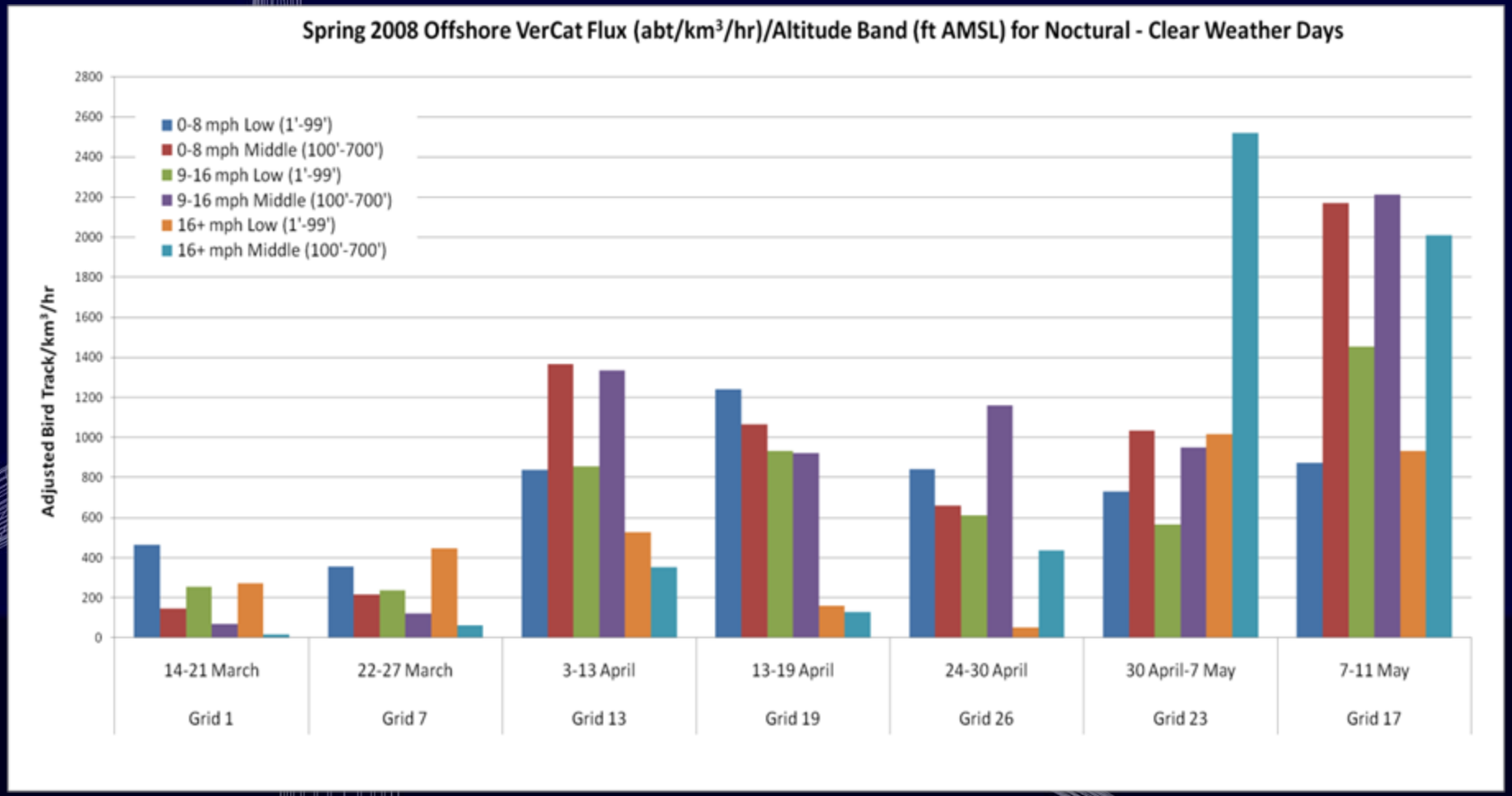
Offshore Flux--Nocturnal Spring 2008



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Onshore Flux:

Spring/Early Summer 2008, Fall/Early Winter 2008, Spring/Early Summer 2009, Fall 2009

Diurnal

- Although some flux occurred within the RSZ, most movements were below the RSZ.

Nocturnal

- The cumulative flux values were greater within the low altitude band than within the RSZ at all onshore sites when no migration occurred or when flux values were small.
- When migration occurred cumulative flux values increased within the RSZ and above the RSZ

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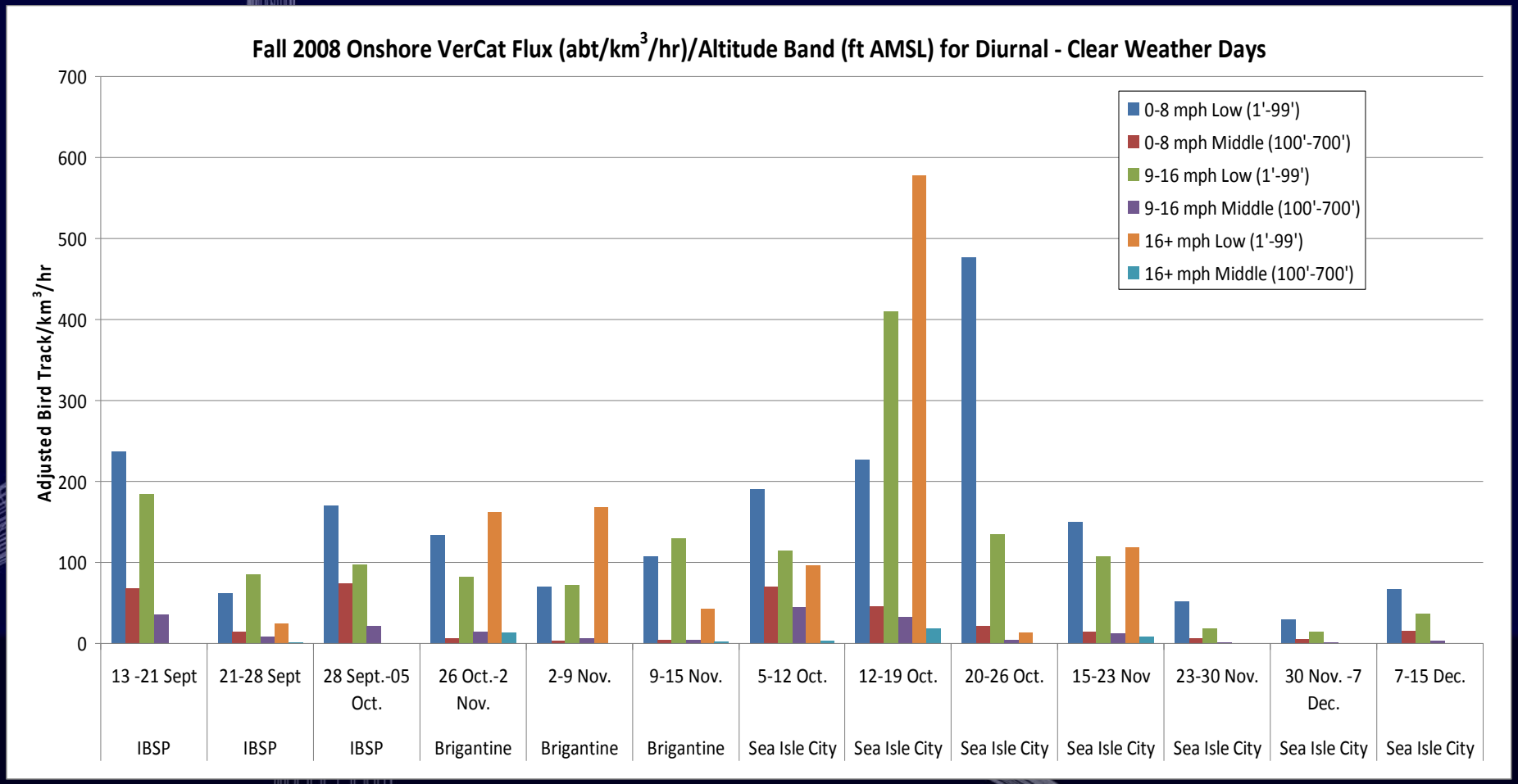
Onshore Flux-- Diurnal Fall 2008



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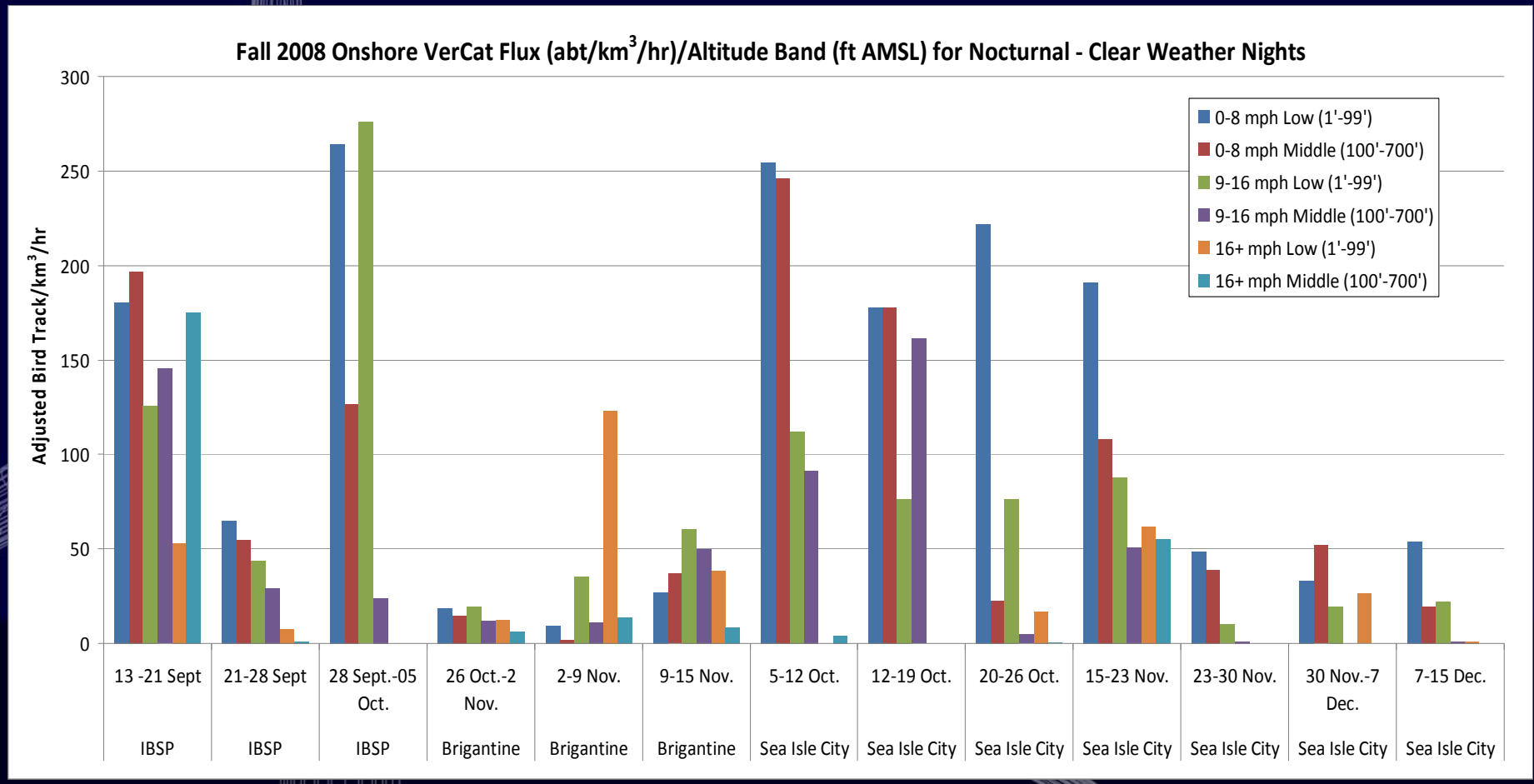
Nocturnal Fall 2008 Onshore Flux



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Thermal Imager-Vertically Pointed Radar

Offshore

Location	Total Count	Birds	Bats	Insects	When
Grid 23	783	570	9	204	Spring 2008
Grid 23	1,252	985	24	243	Fall 2008
Grid 26	249	192	0	57	Fall 2008
Grid 16	97	39	0	57	Spring 2009
Grid 22	57	39	0	18	Spring 2009

During spring 2008, 75+% of the bird movements aloft occurred within the RSZ.

During fall 2008, there were slightly more birds at altitudes within the RSZ (51%) than above (49%).

During spring 2009, 75+% of the bird movements aloft occurred within the RSZ.

Flight directions were towards the NNW-NE in spring.

Flight directions were towards the SW in fall and showed little variability.

Thermal Imager-Vertically Pointed Radar

Onshore

Location	Total Count	Birds	Bats	Insects	When
Sea Isle City	295	270	6	9	Fall 2008
Island Beach SP	54	21	0	33	Spring 2009
Sea Isle City	1,133	738	0	395	Fall 2009
Island Beach SP	219	144	6	69	Fall 2009
Brigantine NWR	138	39	0	99	Fall 2009

During fall 2008, 90% of the bird movements aloft occurred within the RSZ.

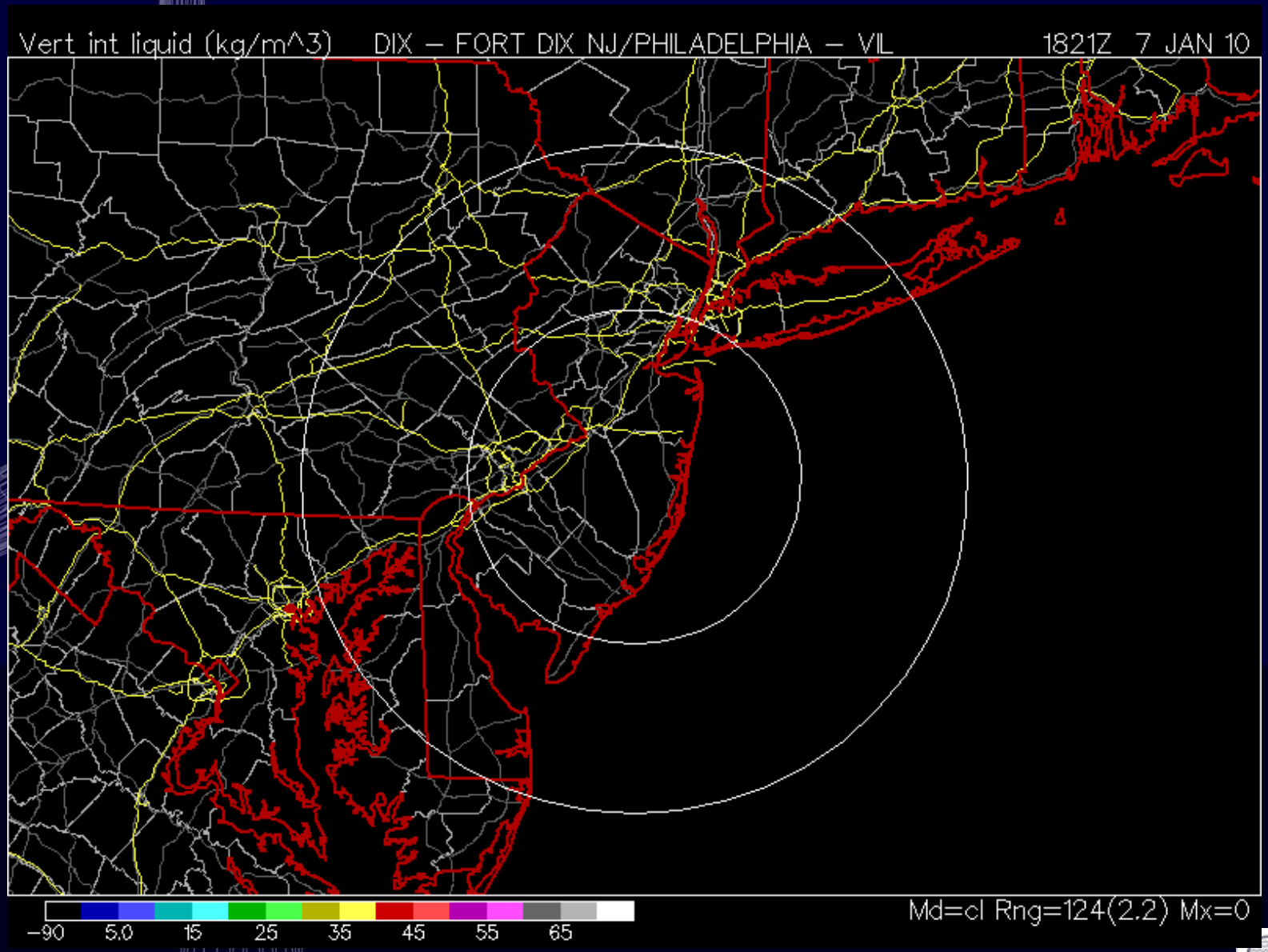
During spring 2009, 100% of the bird movements aloft occurred above the RSZ.

During fall 2009, 50-75% of the bird movements aloft occurred within the RSZ.

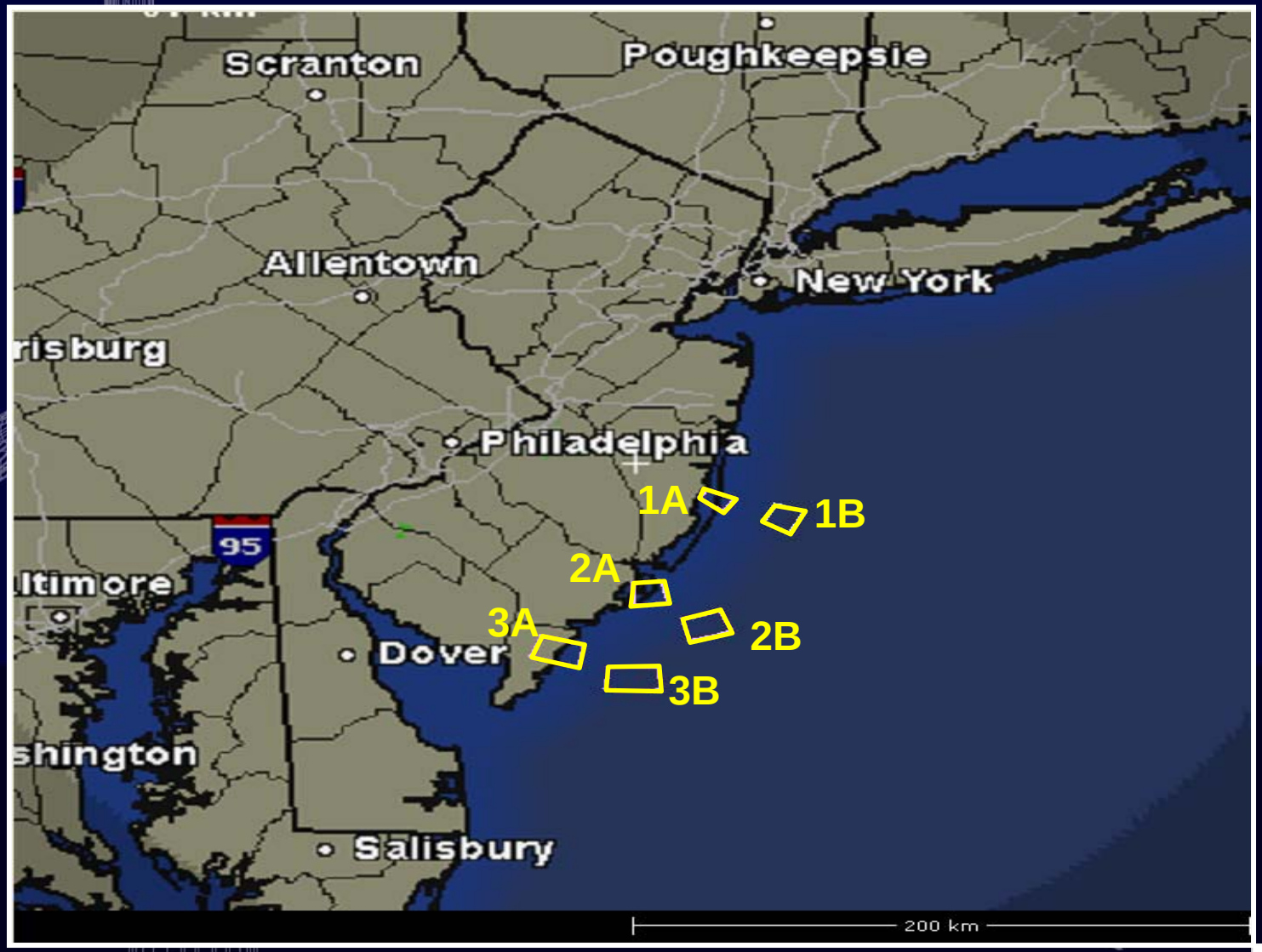
Flight directions in the spring were towards the NE.

Flight directions in the fall were towards SW to SE and more variable.

WSR-88D (NEXRAD)



Sample Areas



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Sample Area Specs

Area	Angle 1	Angle 2	Distance (km)	Base (m)	Center (m)	Top (m)	Width (m)
1A	117	127	27	63	282	501	438
			32	84	345	616	519
			37	111	411	711	600
2A	170	180	54	222	660	1098	876
			59	261	742	1221	957
			64	306	825	1344	1038
3A	191	201	83	495	1170	1845	1347
			88	555	1268	1983	1428
			93	618	1374	2130	1509
1B	112	122	50	192	597	1002	813
			55	228	675	1122	894
			60	270	756	1242	375
2B	157	167	72	381	966	1551	1170
			77	432	1056	1680	1251
			82	486	1152	1818	1332
3B	175	185	92	606	1353	2100	1494
			97	672	1458	2244	1575
			102	738	1566	2394	1656

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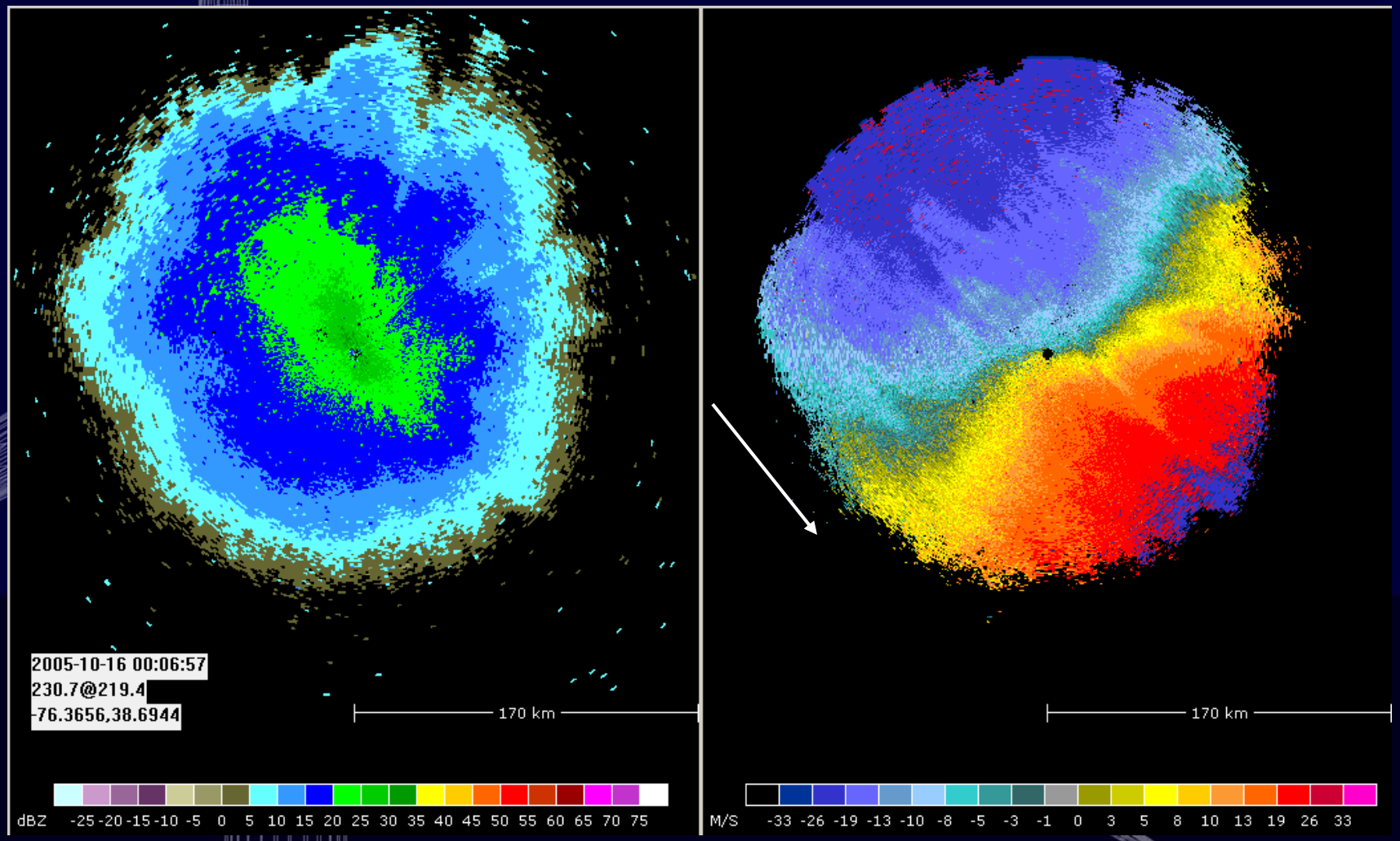
Base Reflectivity and Base Velocity: Night of 15 October 2005



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Data Analysis Products

- These data were then analyzed to measure the following:
  - Year-to-year patterns of migration
  - Night-to-night patterns of migration
  - Hour-to-hour patterns of migration
  - Direction of migratory movements
  - Migration, weather conditions, and collisions
    - Accomplished by comparing nights with decreased visibility (ceiling height > 1000-ft) and/or precipitation with migration densities from the same time.

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WSR-88D (NEXRAD)

- During the five-year study the amount of migration in spring and fall passing over the onshore sample areas was much higher than the amount of migration measured over the offshore sample areas, but the radar beam sampled higher altitudes as distance from the radar increased.

- Overall, the density of migration during the fall was on average two to three times greater than the density of migration observed during the spring.

- In spring the peak migration occurs in early to mid-May.

- In fall the peak migration occurs in early to mid-October.

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WSR-88D Weather Condition Analysis

Spring

- 79 of 365 nights had conditions that would cause birds to fly lower (overcast sky below 1000 ft, and sometimes with reduced visibility), and 29 of these nights had densities of 25 birds/km^3 or greater.

Fall

- 102 of 465 nights had weather conditions that might cause birds to migrate at low altitudes, and 24 of these nights had densities of 25 birds/km^3 or greater.

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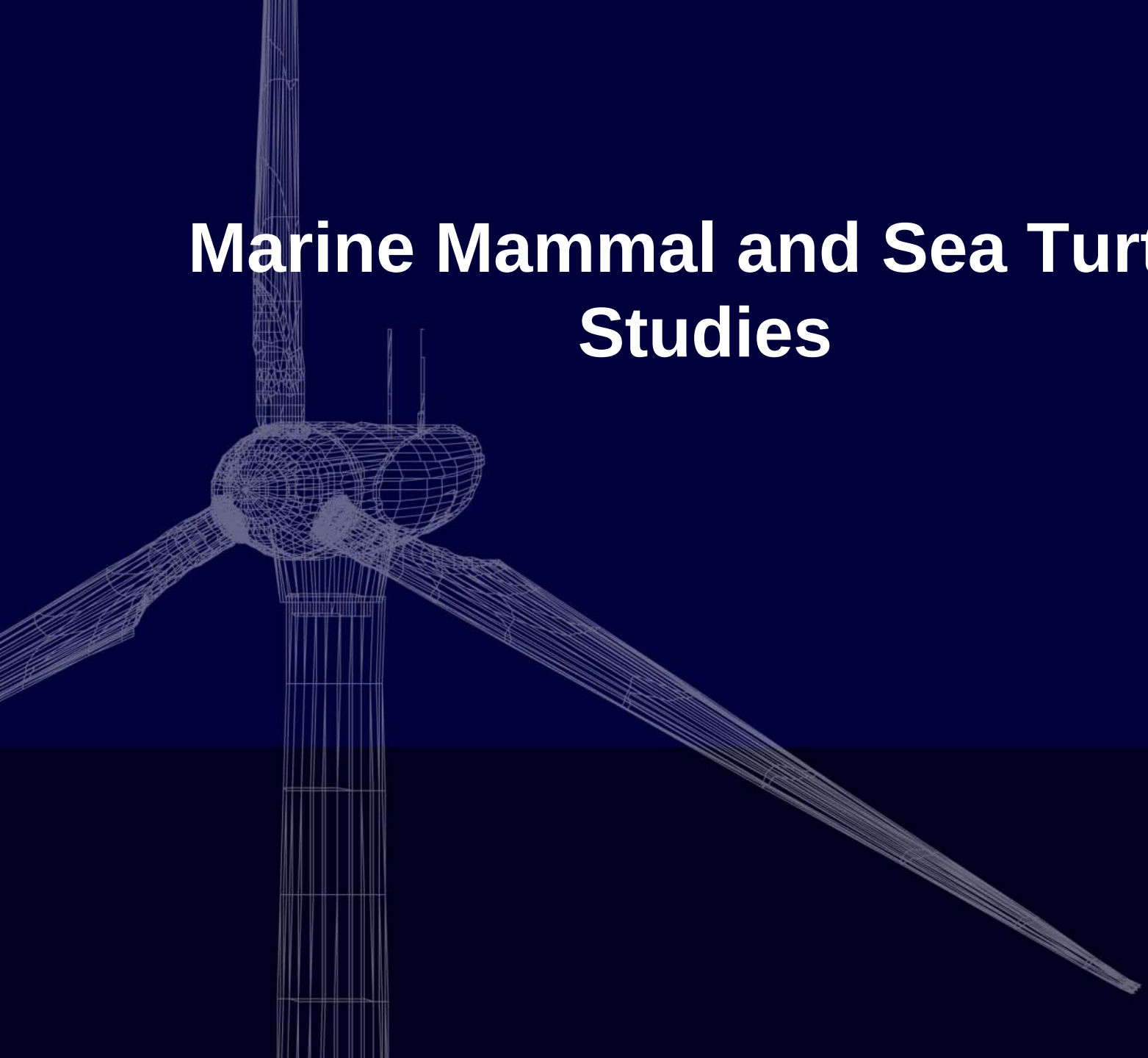
Marine Mammal and Sea Turtle Studies



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Results

- Ship Survey
  - Jan 2008 - Dec 2009
  - Effort = 7,086 NM
- Aerial Survey
  - Feb - May 2008; Jan - Jun 2009
  - Effort = 6,603 NM

TOTAL SURVEY SIGHTINGS = 615 (486 ON-EFFORT)

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Species Detected

- 8 Marine Mammal Species
- 2 Sea Turtle Species
- T&E Species = North Atlantic right whale
  Fin whale
  Humpback whale
  Loggerhead turtle
  Leatherback turtle
- Seasonality of Detections
  - Occurrence of dolphins, porpoises, & turtles is largely seasonal
  - Right whale, Fin whale, humpback whale, & bottlenose dolphin detected during all seasons

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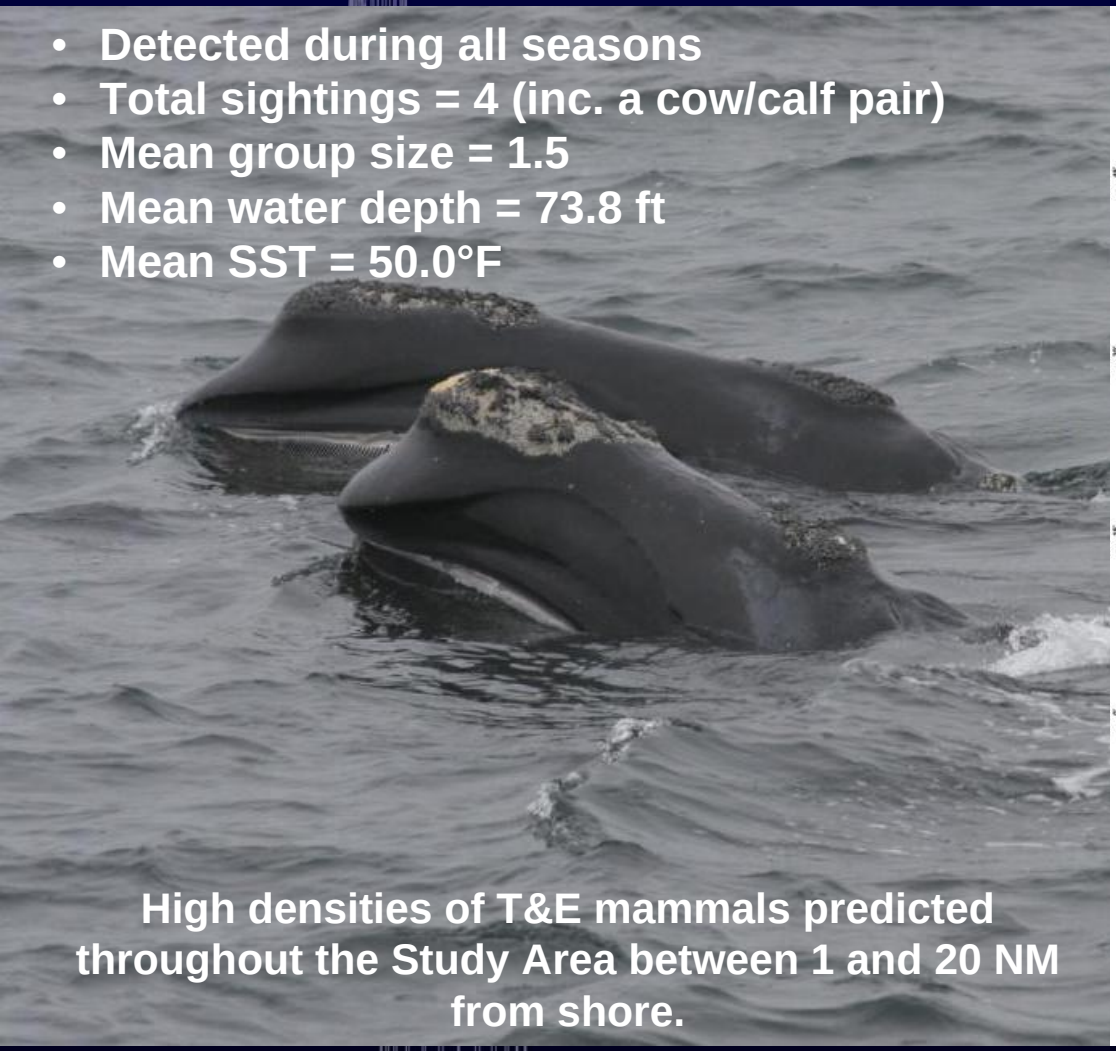
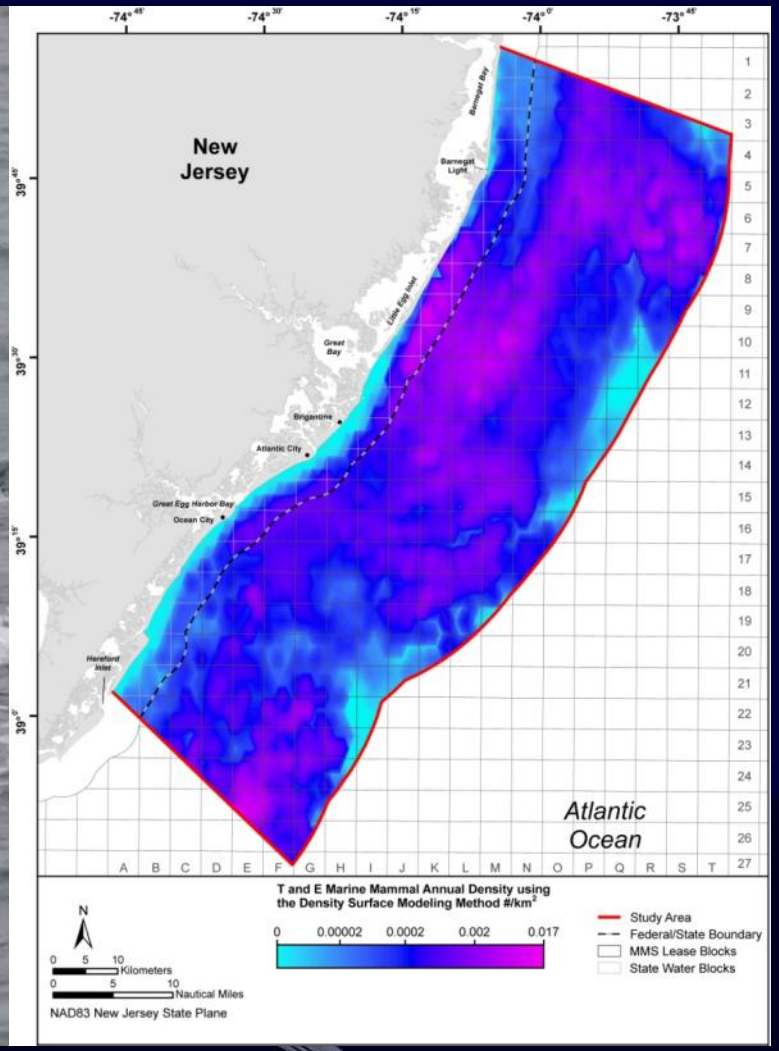
North Atlantic Right Whale

- Detected during all seasons
- Total sightings = 4 (inc. a cow/calf pair)
- Mean group size = 1.5
- Mean water depth = 73.8 ft
- Mean SST = 50.0°F



High densities of T&E mammals predicted throughout the Study Area between 1 and 20 NM from shore.



Study Area is part of the right whale migratory corridor.

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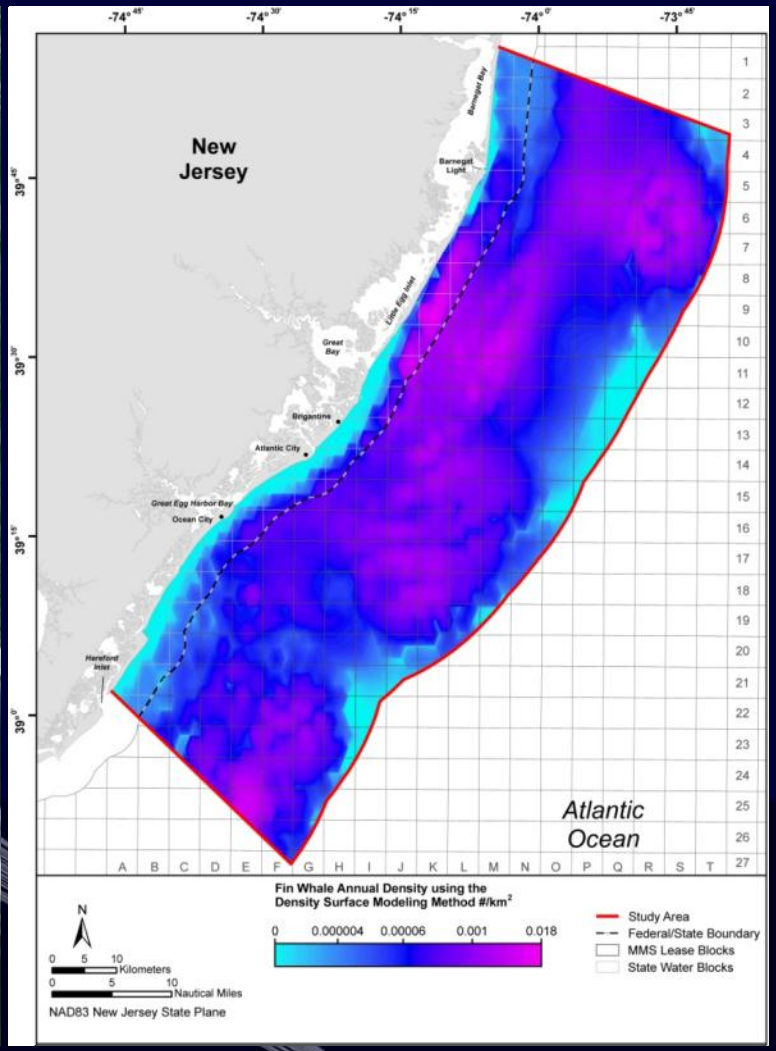
Fin Whale

- Detected during all seasons
- Total sightings = 37 (incl. a cow/calf pair)
- Mean group size = 1.5
- Mean water depth = 70.5 ft
- Mean SST = 49.3°F



High densities of fin whales were predicted throughout most of the Study Area, including in waters as shallow as 39 ft and within 1 NM from shore.

Year-round abundance = 2 animals

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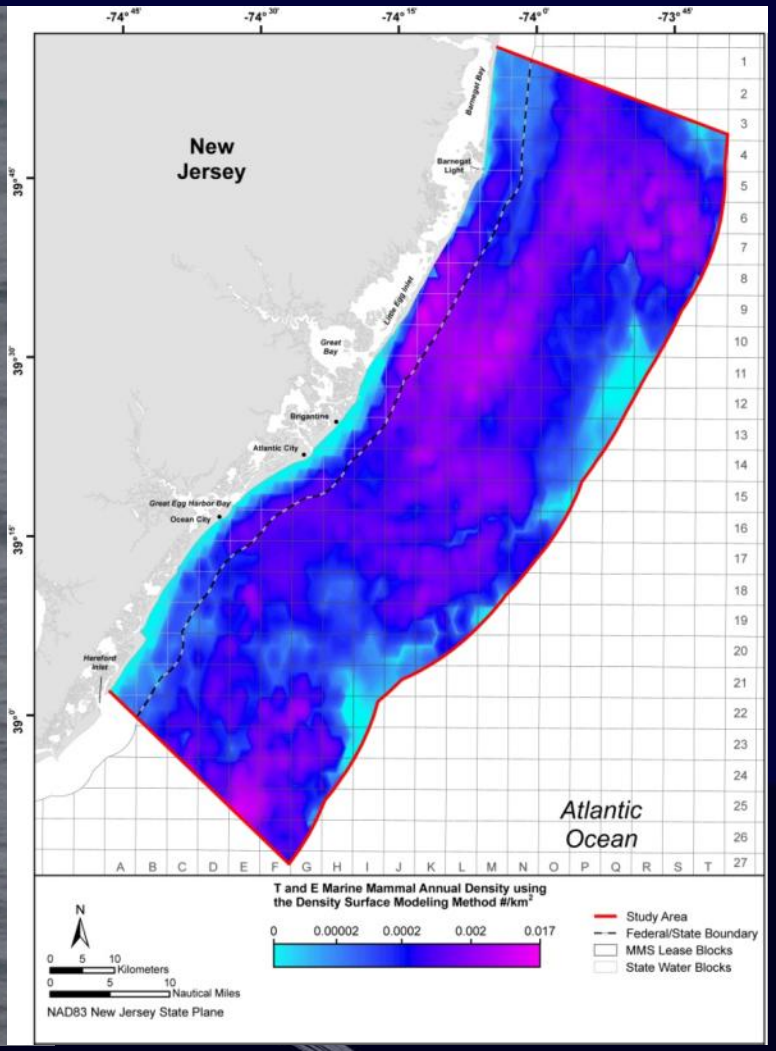
Humpback Whale

- Detected during all seasons
- Total sightings = 17 (incl. a cow/calf pair)
- Mean group size = 1.2
- Mean water depth = 67.3 ft
- Mean SST = 50.2°F



High densities of T&E mammals were predicted throughout the Study Area between 1 and 20 NM from shore.

Year-round abundance = 1 animal

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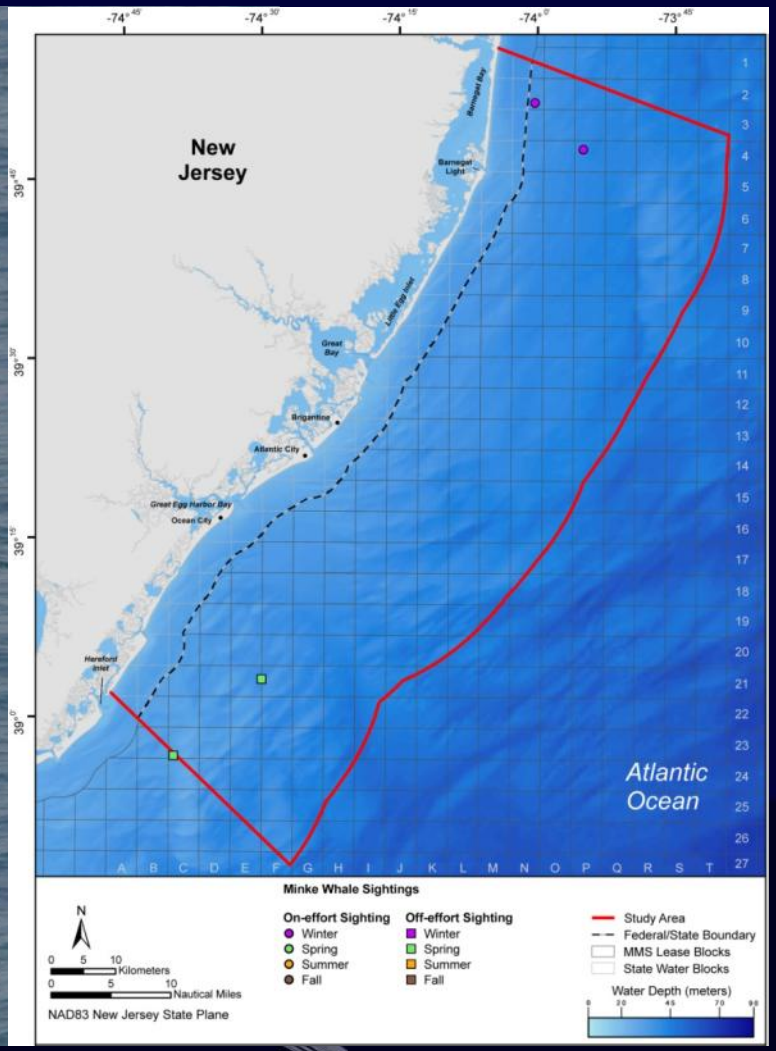
Minke Whale

- Detected during winter and spring
- Total sightings = 4
- Mean group size = 1
- Mean water depth = 59 ft
- Mean SST = 47.0°F



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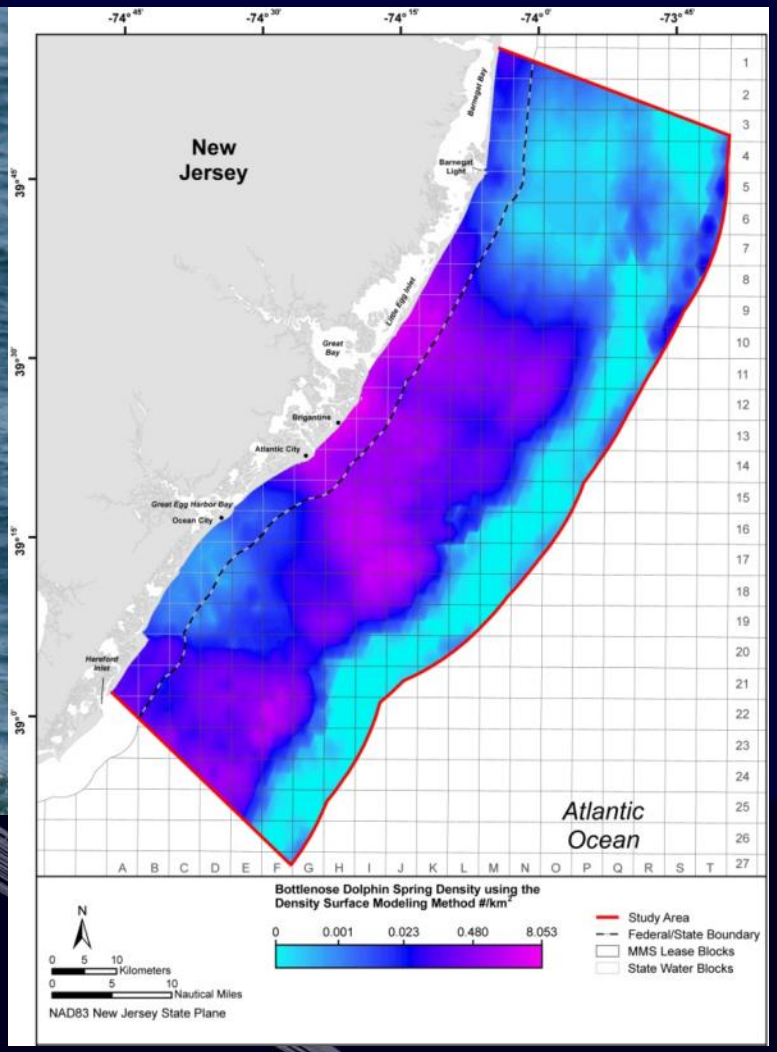
Bottlenose Dolphin

- Detected during all seasons (mostly during spring and summer)
- Total sightings = 319
- Mean group size = 15.3
- Mean water depth = 54.5 ft
- Mean SST = 61.3°F



High spring densities were predicted in portions of the Study Area up to 15 NM from shore. Peak densities were predicted in State waters off Atlantic City north to Brigantine and Little Egg Inlet.

Spring abundance = 722 animals

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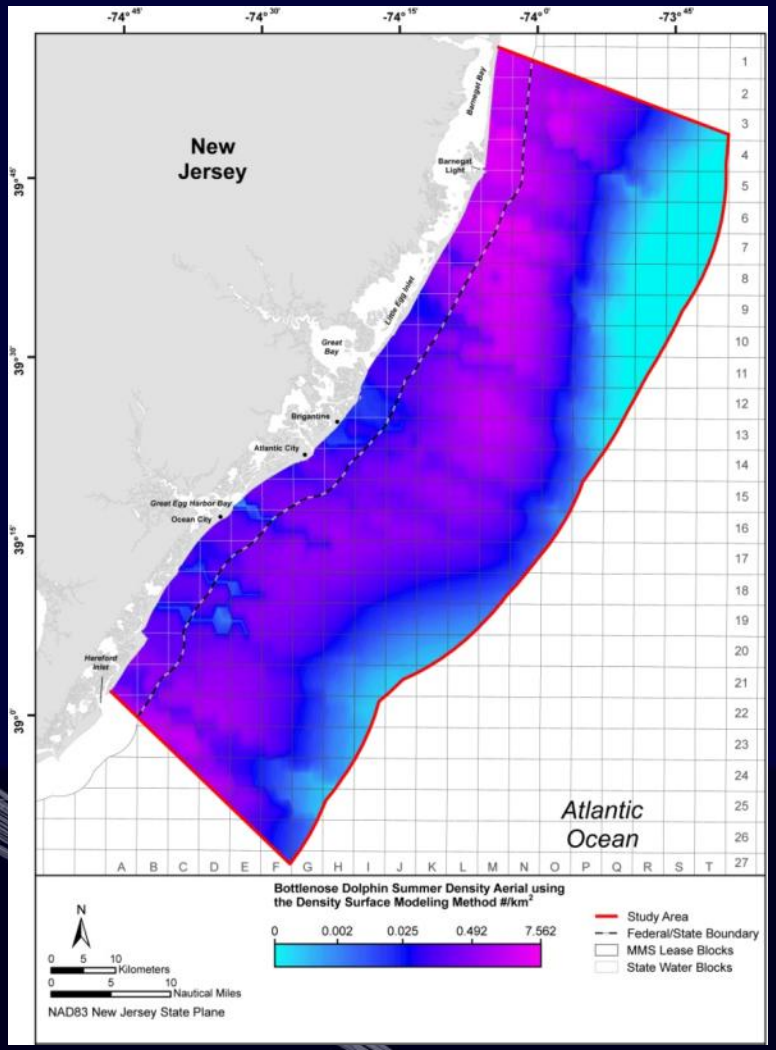
Bottlenose Dolphin

Summer Abundance & Density

Predicted densities spanned the Study Area during summer; higher densities of bottlenose dolphins extend into the northern portion of the Study Area during this time of year.
Peak densities were predicted from the shoreline to 19 NM offshore of Barnegat Bay and along the Federal/State boundary.



Summer abundance of bottlenose dolphins = 283 ship analysis
1,297 aerial analysis

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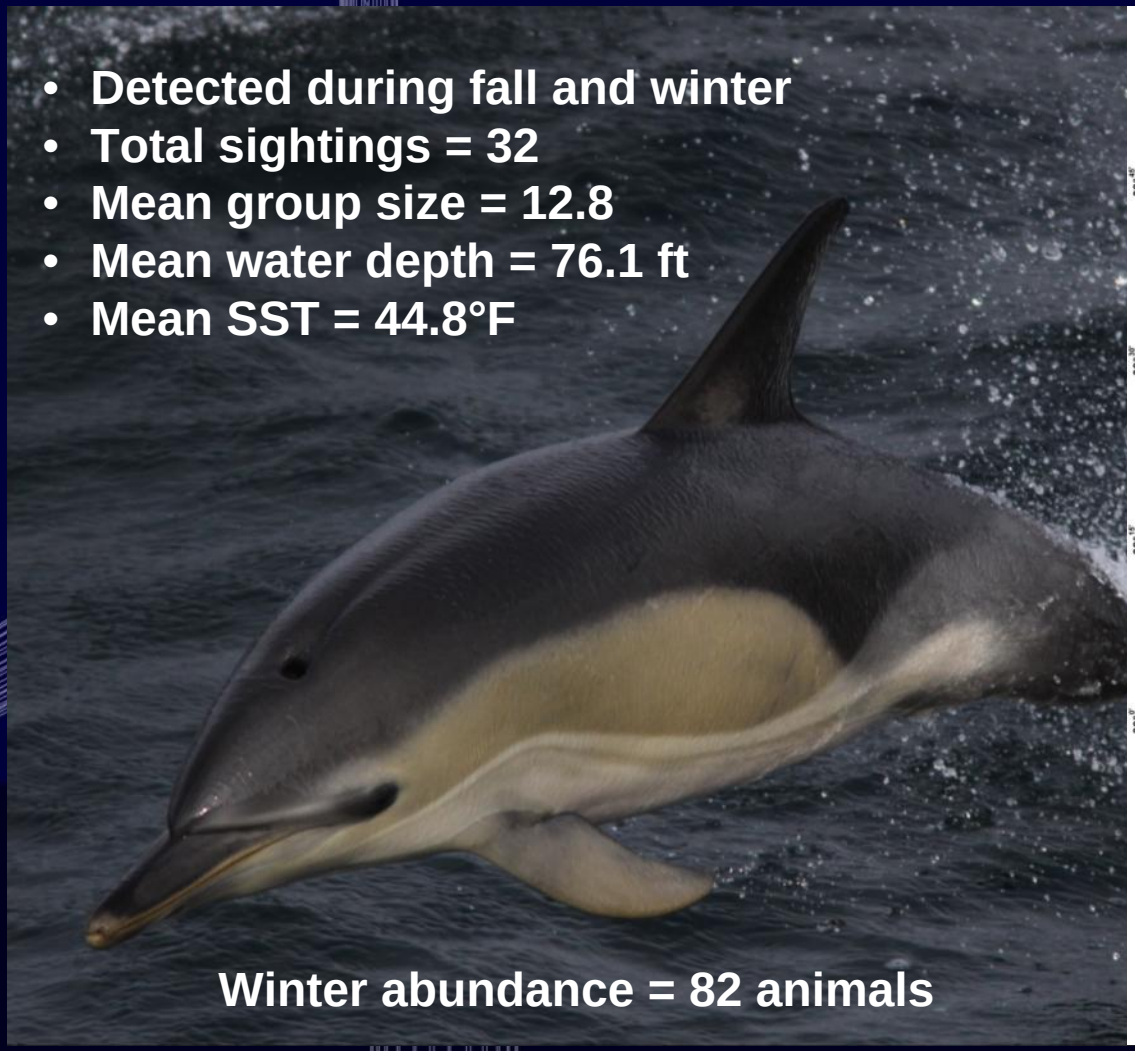
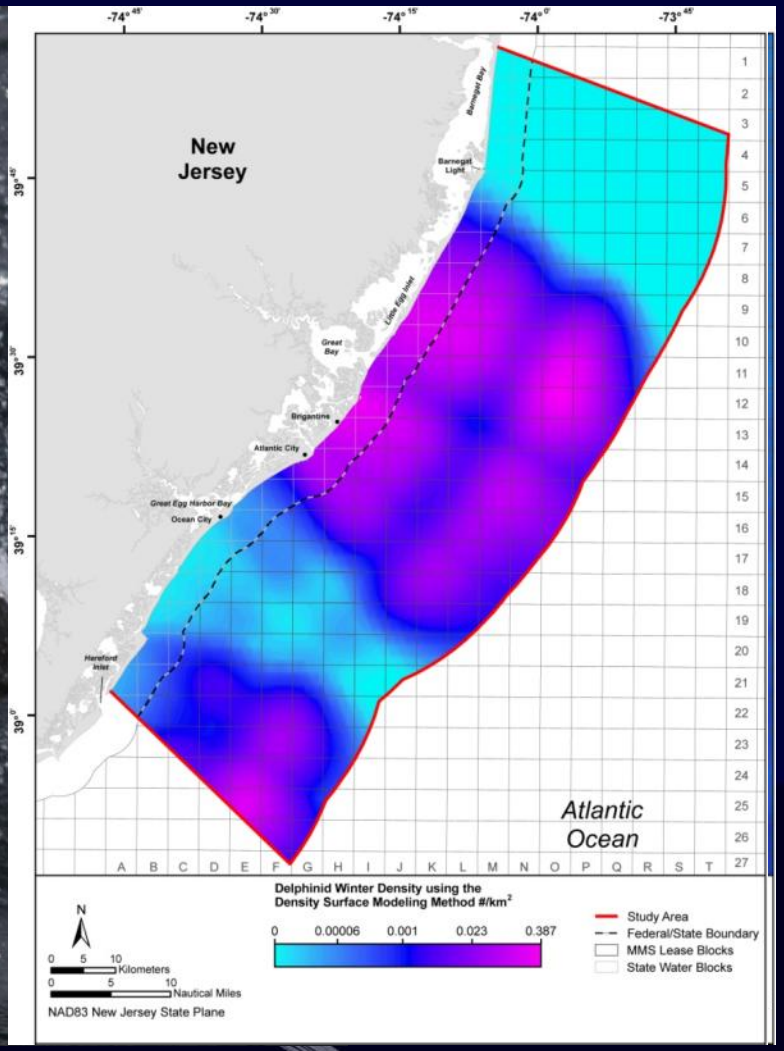
Short-beaked Common Dolphin

- Detected during fall and winter
- Total sightings = 32
- Mean group size = 12.8
- Mean water depth = 76.1 ft
- Mean SST = 44.8°F



Winter abundance = 82 animals



High densities of delphinids were predicted south of Barnegat Light during winter.

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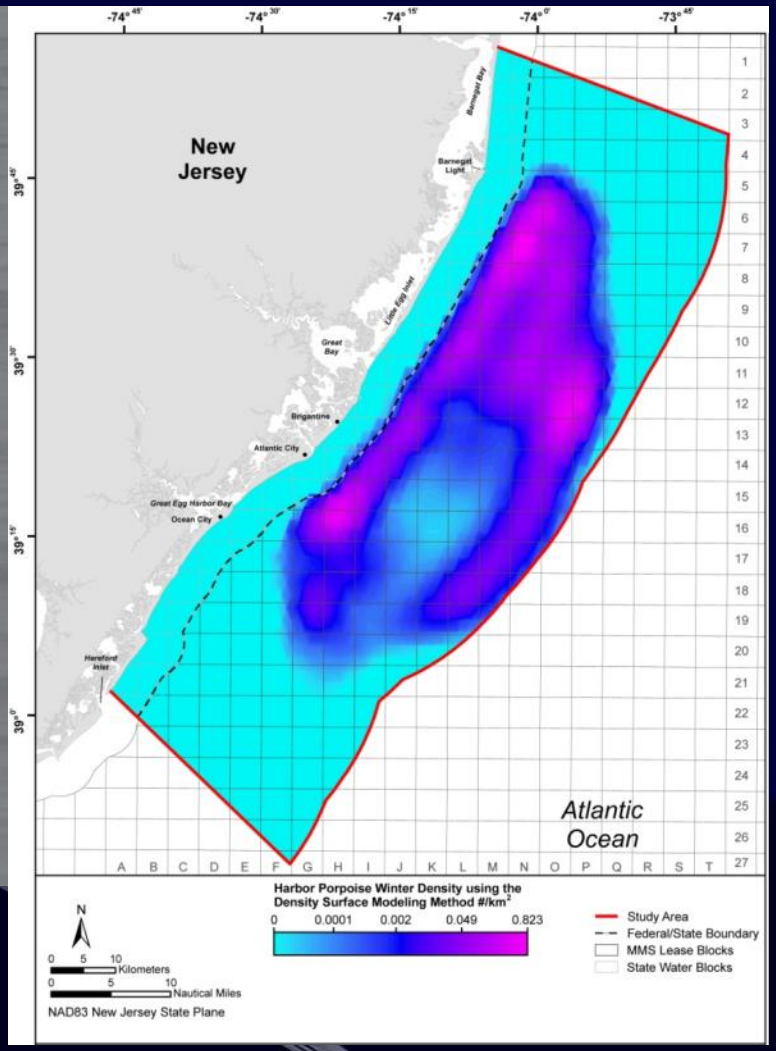
Harbor Porpoise

- Difficult to detect in BSS >2
- Over 90% of sightings recorded during winter
- Few sightings also recorded in spring and summer

- Total sightings = 51
- Mean group size = 1.7
- Mean water depth = 70.5 ft
- Mean SST = 42.4°F

Winter abundance = 98 animals



High densities of harbor porpoises were predicted in the center of the Study Area. Peak densities were predicted between 3 and 8 NM from shore and also 18 NM from shore north of Brigantine.

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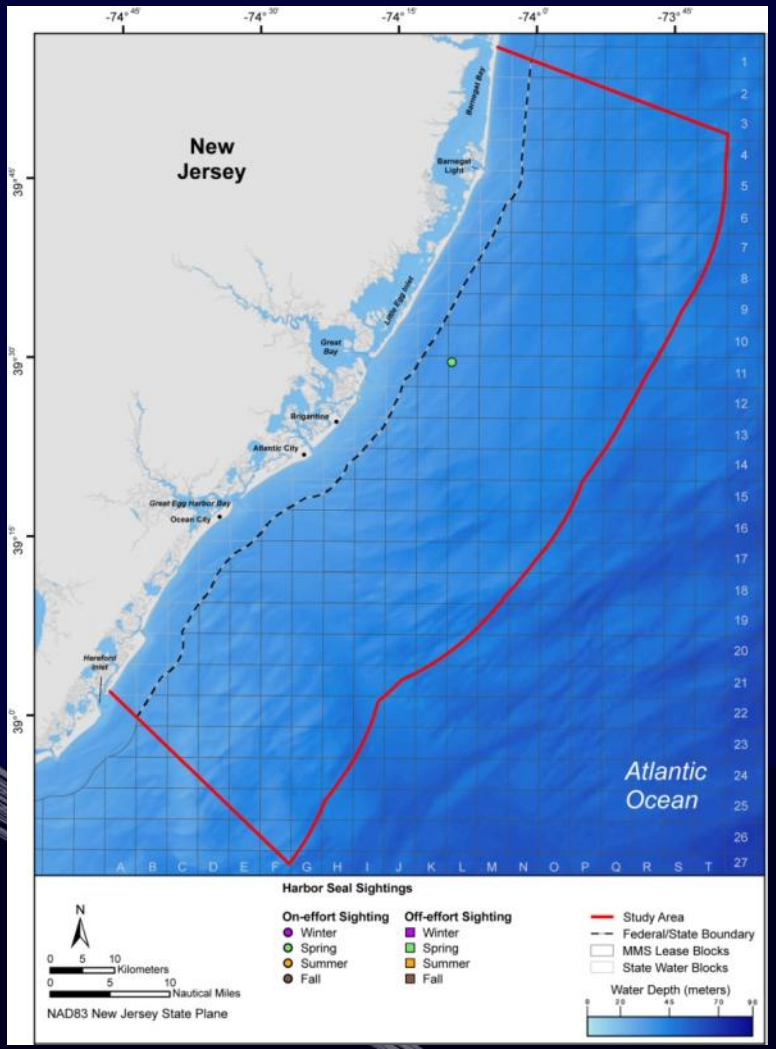
Harbor Seal

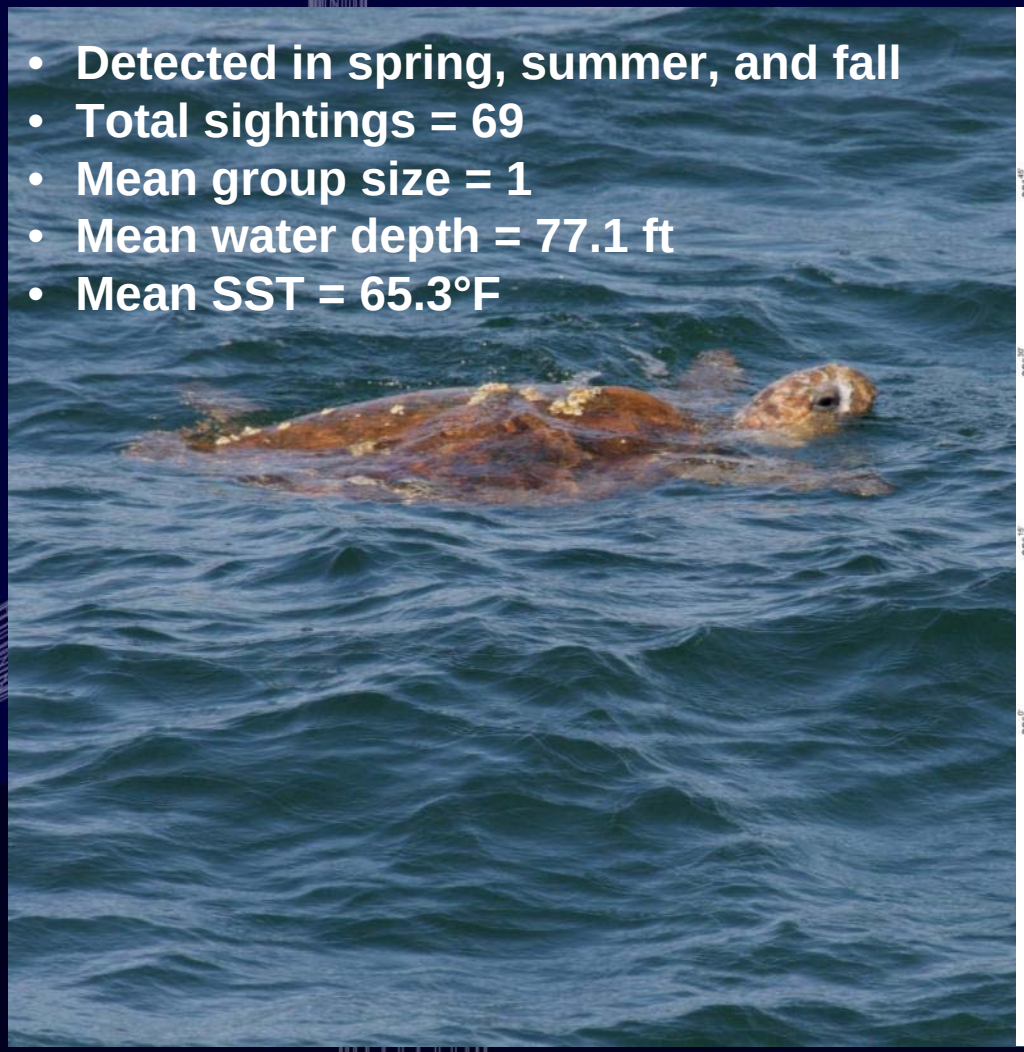
- Detected only in spring
- Total sightings = 1
- Mean group size = 1
- Mean water depth = 59 ft
- Mean SST = 52.5°F
- No haulout sites detected along shoreline

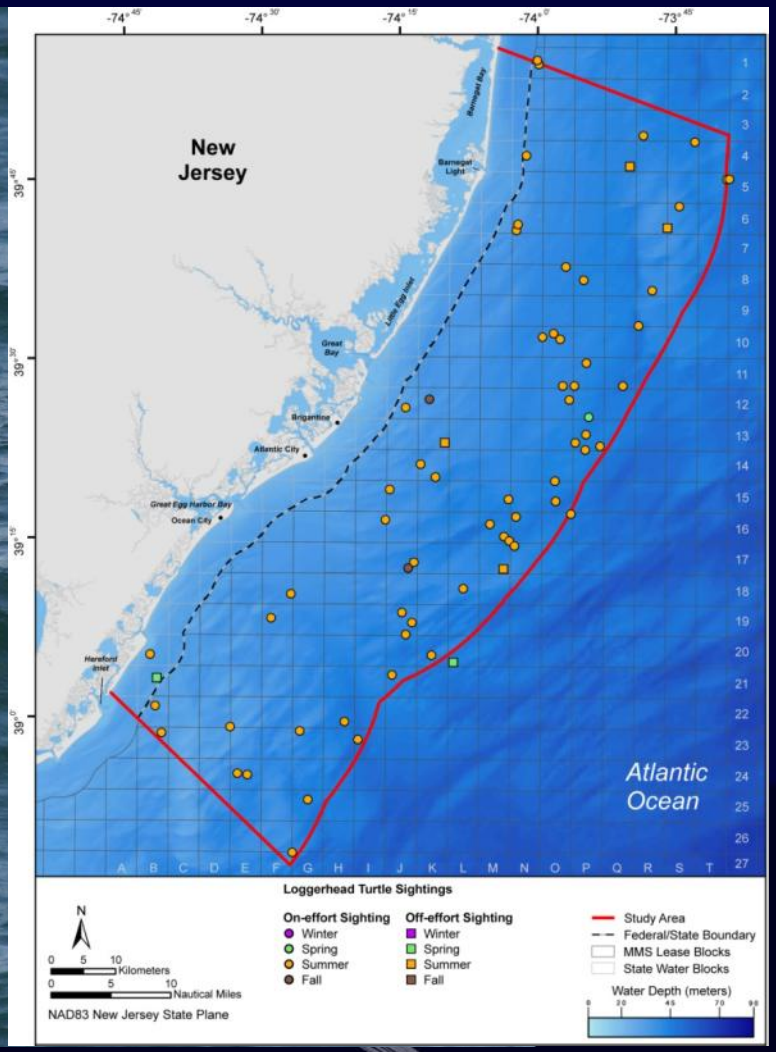
Other unidentified pinnipeds recorded near Ocean City in April 2008 were likely also harbor seals but could not be confirmed. Two possible harbor seals were sighted south of the Study Area near Lewes, Delaware during the study period.



Loggerhead Turtle

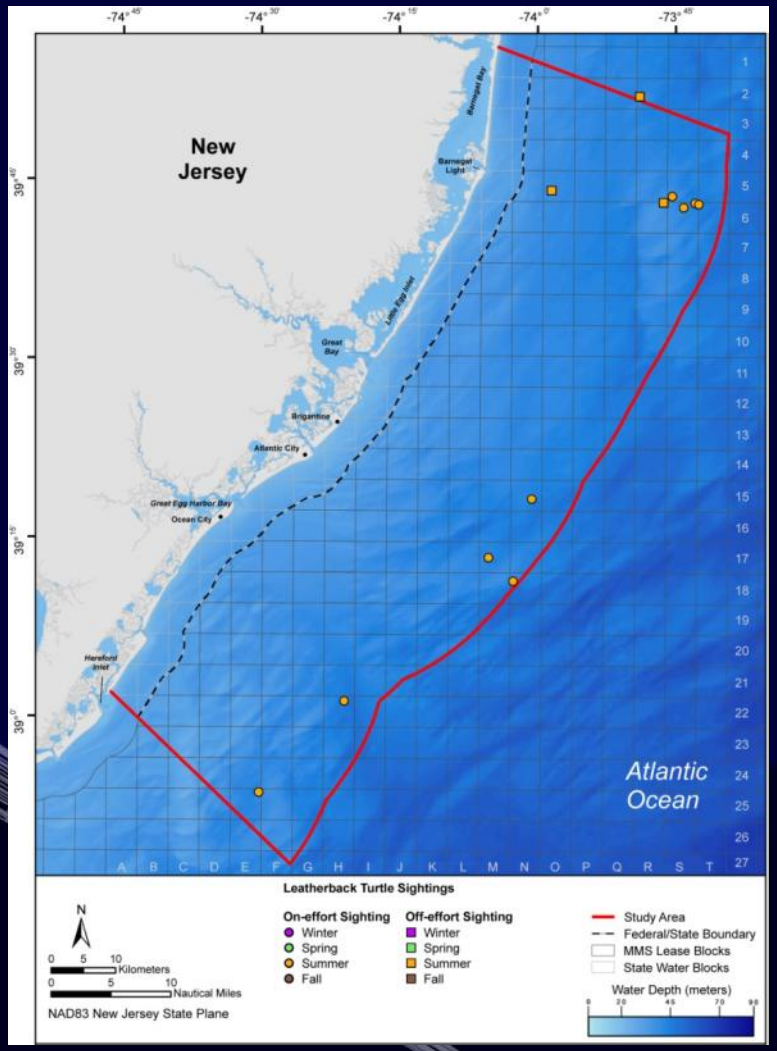
- Detected in spring, summer, and fall
- Total sightings = 69
- Mean group size = 1
- Mean water depth = 77.1 ft
- Mean SST = 65.3°F





Leatherback Turtle

- Detected during summer only
- Total sightings = 12
- Mean group size = 1
- Mean water depth = 79 ft
- Mean SST = 66.2°F



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Marine Mammal Acoustic Studies

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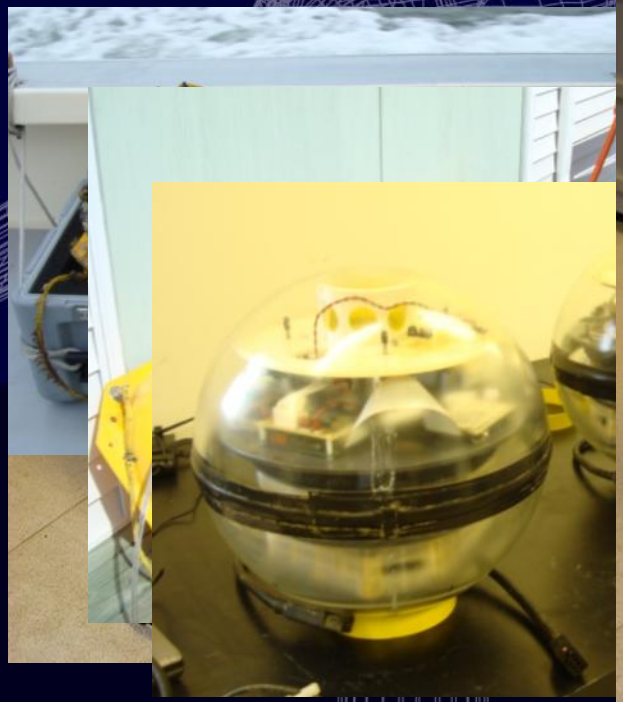
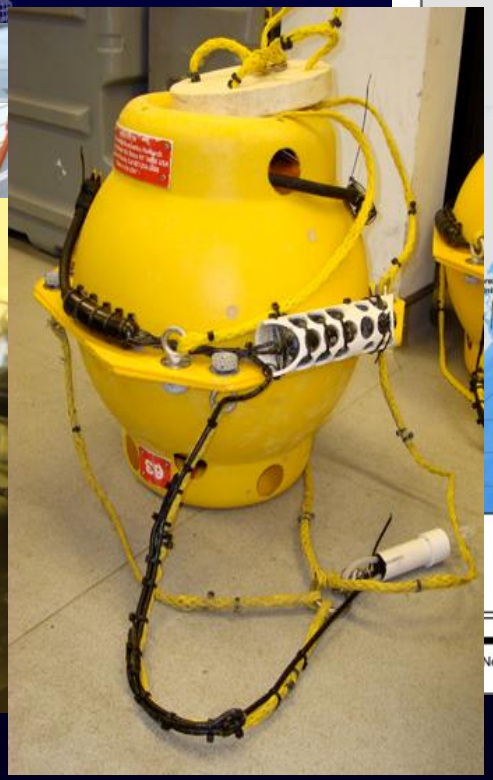
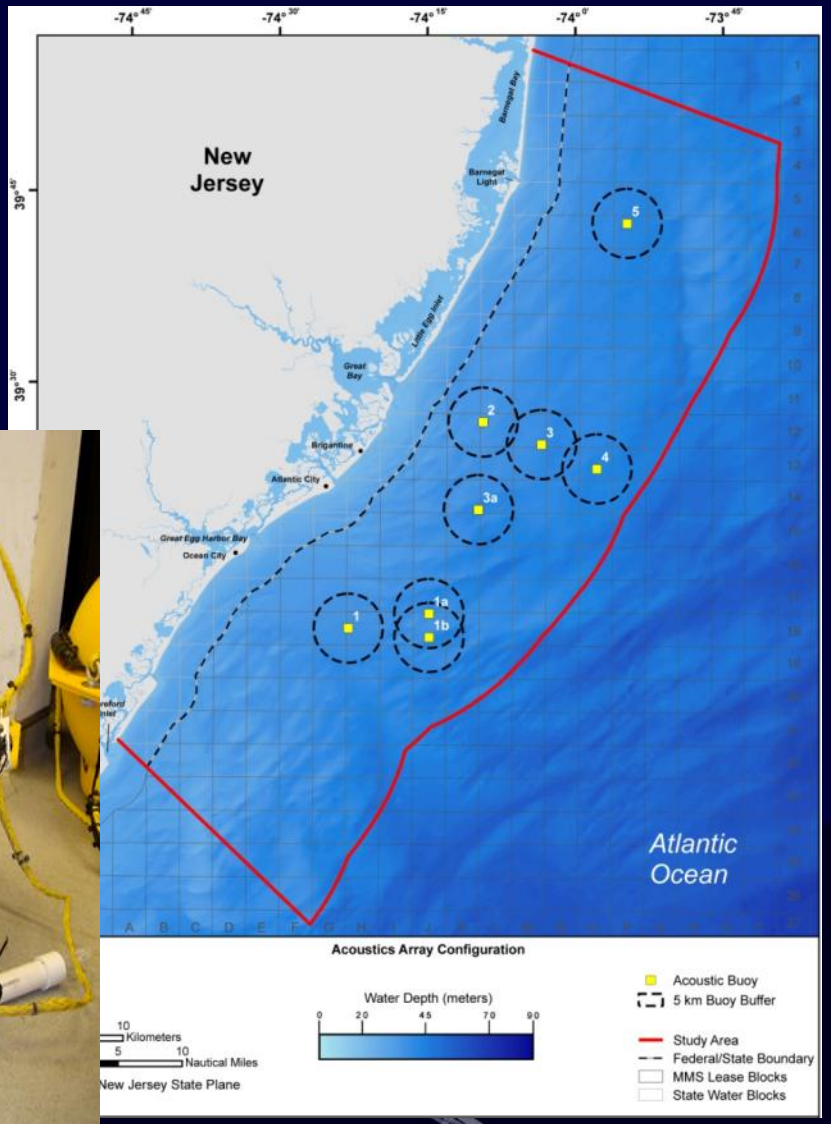
Underwater Acoustic Survey - Methods

- Methods
  - Study area
  - Pop-up locations
  - Sampling rates







Photos: GMI

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Underwater Acoustic Survey - Results

Deployment (#days deployed)	S#	Pop-up ID	Sample Rate (kHz)	Status
March 2008 (84)	1	PU039	2	Lost
	2	PU086	2	analyzed
	3	PU063	2	analyzed
	4	PU081	2	analyzed
	5	PU134	2	analyzed
June 2008 (85)	1	PU063	2	analyzed
	2	PU081	32	analyzed
	4	PU086	32	analyzed
	5	PU134	2	analyzed
September 2008 (64)	1	PU063	2	Lost
	2	PU081	32	Lost
	3	PU202	2	analyzed
	4	PU086	32	analyzed
	5	PU203	2	analyzed

Deployment (#days deployed)	S#	Pop-up ID	Sample Rate (kHz)	Status
December 2008 (97)	1a	PU179	2	Lost
	2	PU134	32	analyzed
	3	PU202	2	analyzed
	4	PU086	32	Lost
	5	PU203	2	Lost
March 2009 (76)	1a	PU002	2	analyzed
	2	PU171	32	Malfunctioned
	4	PU182	2	analyzed
August 2009 (78, 114) **none deployed in July 09*	1b	PU145	2	analyzed
	2	PU134	32	Under analysis
	2	PU182	2	analyzed
	3a	PU160	2	analyzed
	4	PU153	32	analyzed
	5	PU162	2	analyzed

Total hours collected: 38,700 hrs
Total GB of data: ~2.5 TB

Photos: GMI

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Underwater Acoustic Survey - Results

Deployment	Station #	Species ID Confirmed (# days detected)	Delphinid Calls Confirmed (# days detected)
March 2008	1	NA	\
	2	RW(19), FW(16)	\
	3	RW(21), FW(5)	\
	4	RW(24), FW(16)	\
	5	RW(14), FW(17)	\
June 2008	1	RW(0), FW(18)	\
	2	\	(68)
	4	\	(42)
	5	RW(12), FW(56)	\
September 2008	1	NA	\
	2	\	NA
	3	RW(5), FW(18)	\
	4	\	(16)
	5	RW(3), FW(6)	\

Deployment	Station #	Species ID Confirmed (# days detected)	Delphinid Calls Confirmed (# days detected)
December 2008	1a	NA	NA
	2	\	(30)
	3	RW(9), FW(64)	\
	4	NA	NA
	5	NA	NA
March 2009	1a	RW(0), FW(10)	\
	2	\	Malfunctioned
	4	RW(7), FW(14)	\
August 2009	1b	RW (6), FW (27)	\
	2	\	under analysis
	2	RW (ua), FW (29)	\
	3a	RW (2), FW (37)	\
	4	\	(6)
	5	RW(1), FW(30)	\

\ = data in other sample rate
NA = not available to analysis (lost)
RW = North Atlantic right whale
FW = fin whale

Photos: GMI

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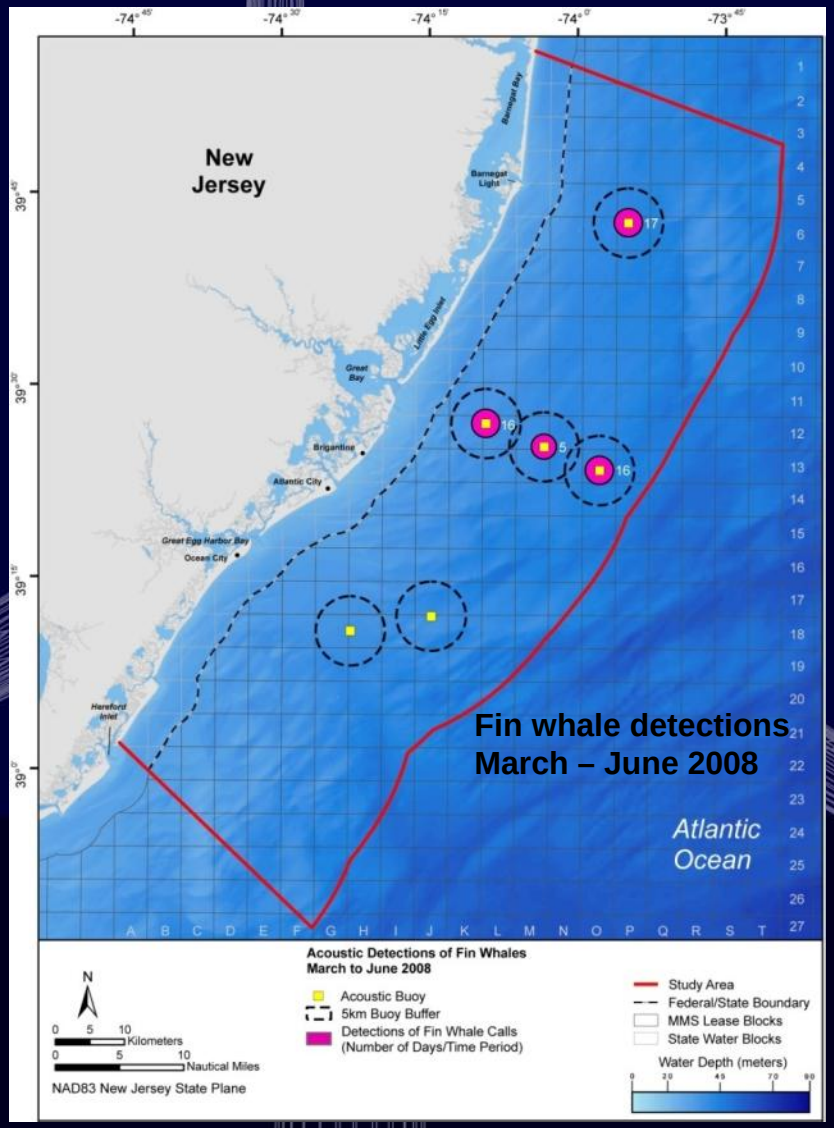
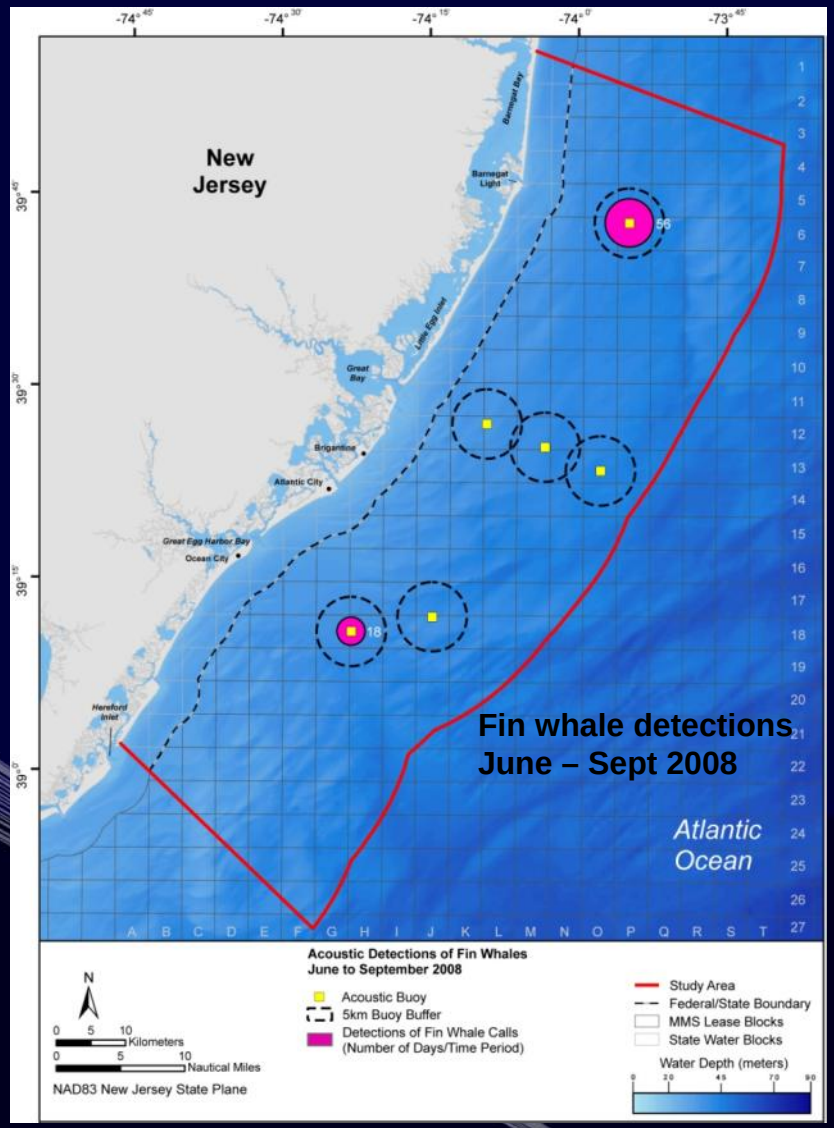
Underwater Acoustic Survey - Results





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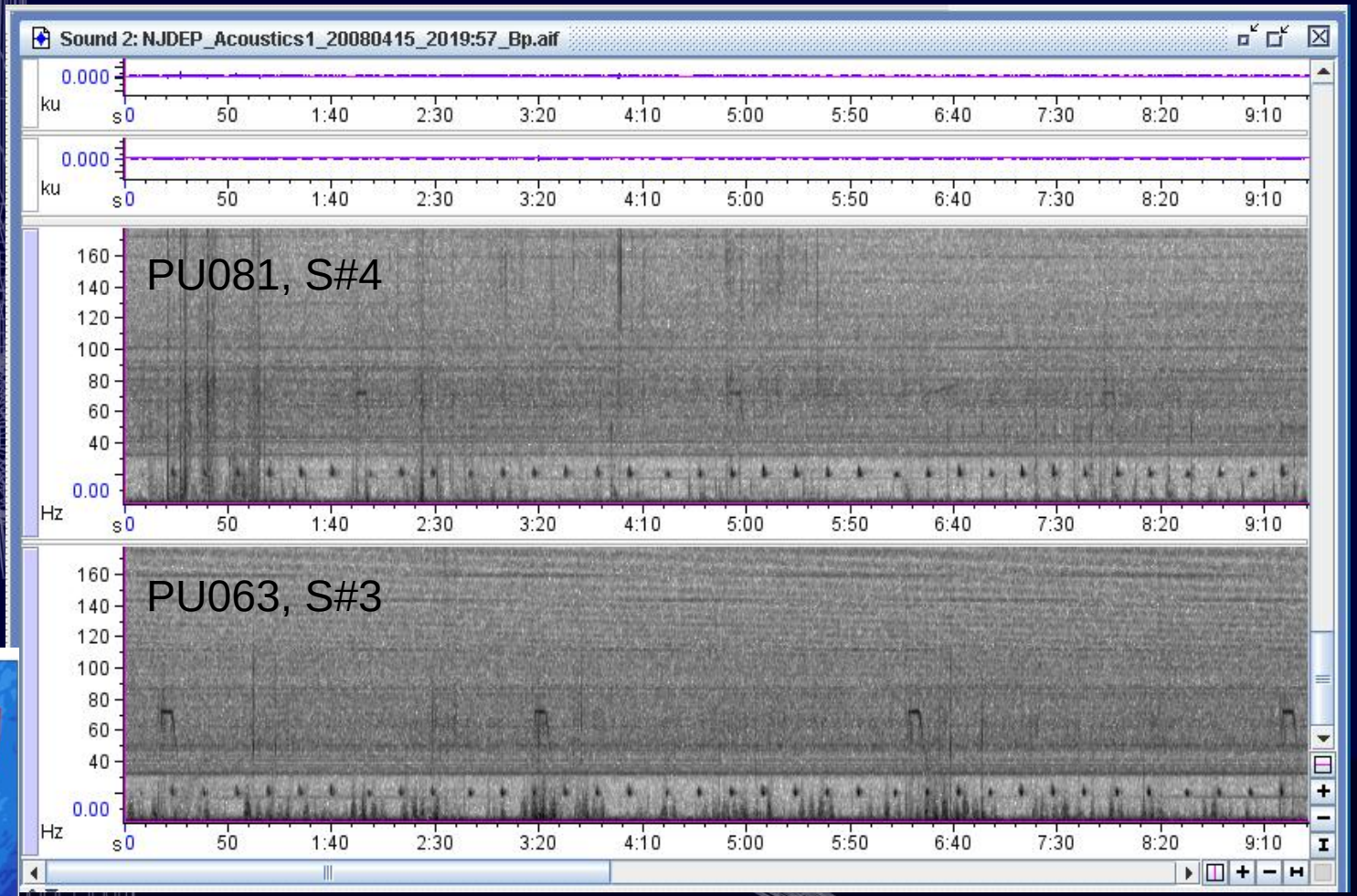
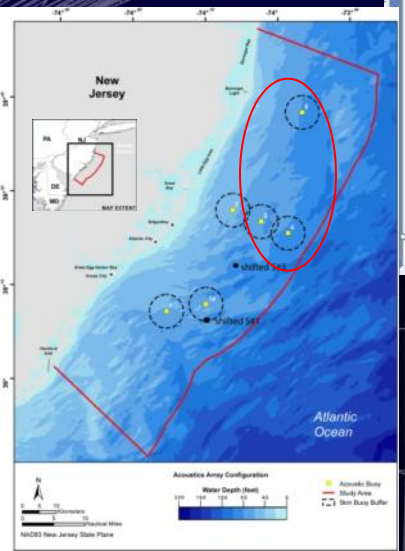
Underwater Acoustic Survey - Results

Fin whale pulses

15 Apr 08





S# 3, 4, 5 presented fin pulses

Ch 2

Ch1 (amp)

Photos: GMI

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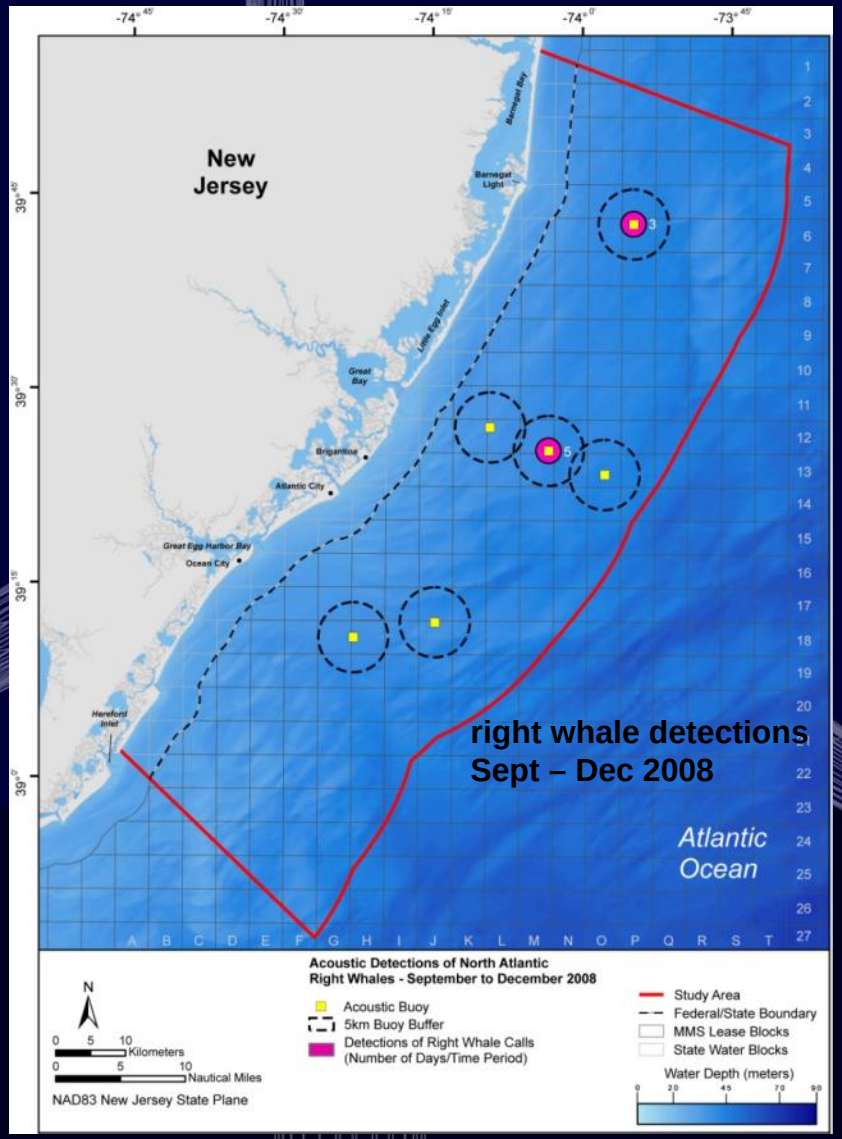
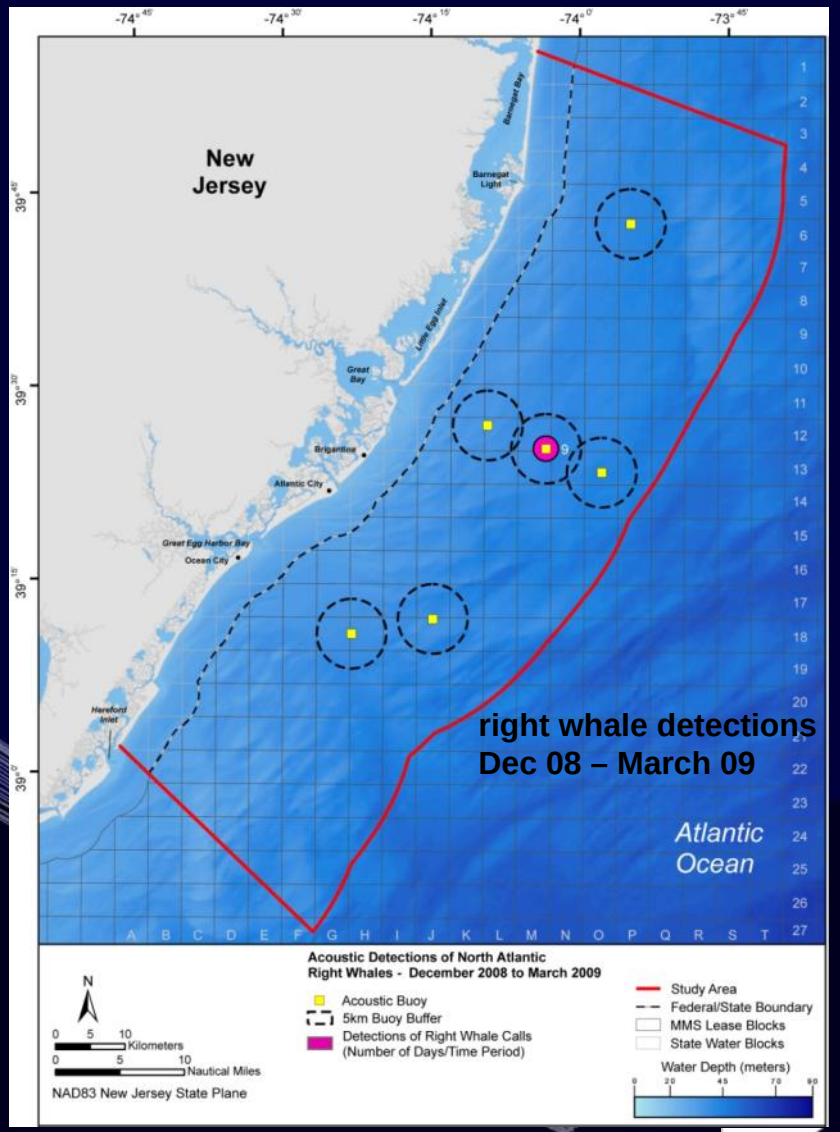
Underwater Acoustic Survey - Results





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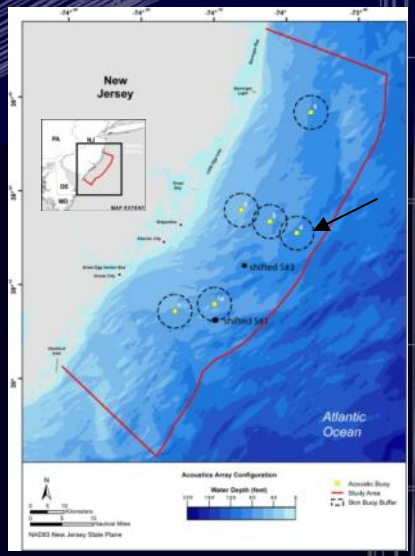
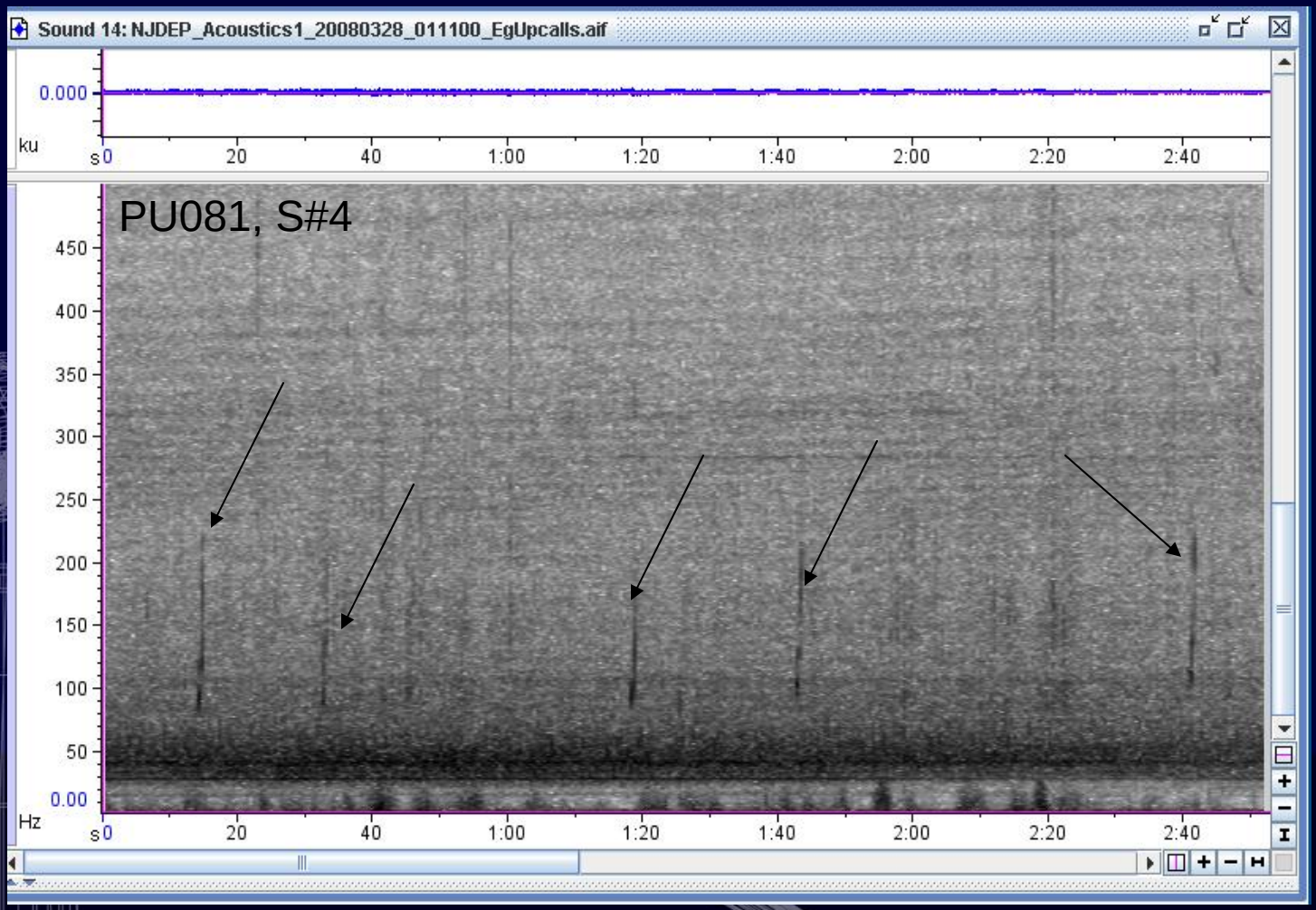
Underwater Acoustic Survey - Results

North Atlantic right whale upcalls

15 Apr 08





March 28, 2008 @ ~1:11 AM unamplified, normal speed

2x rate, amplified 4x

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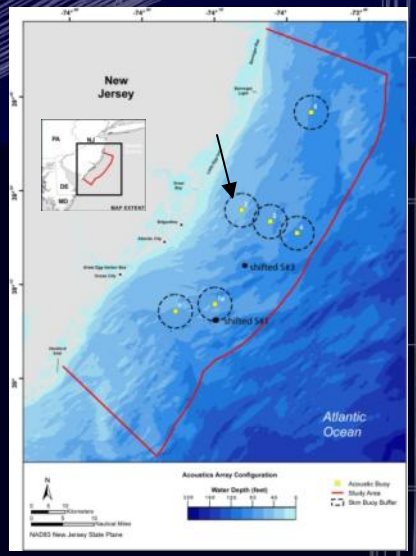
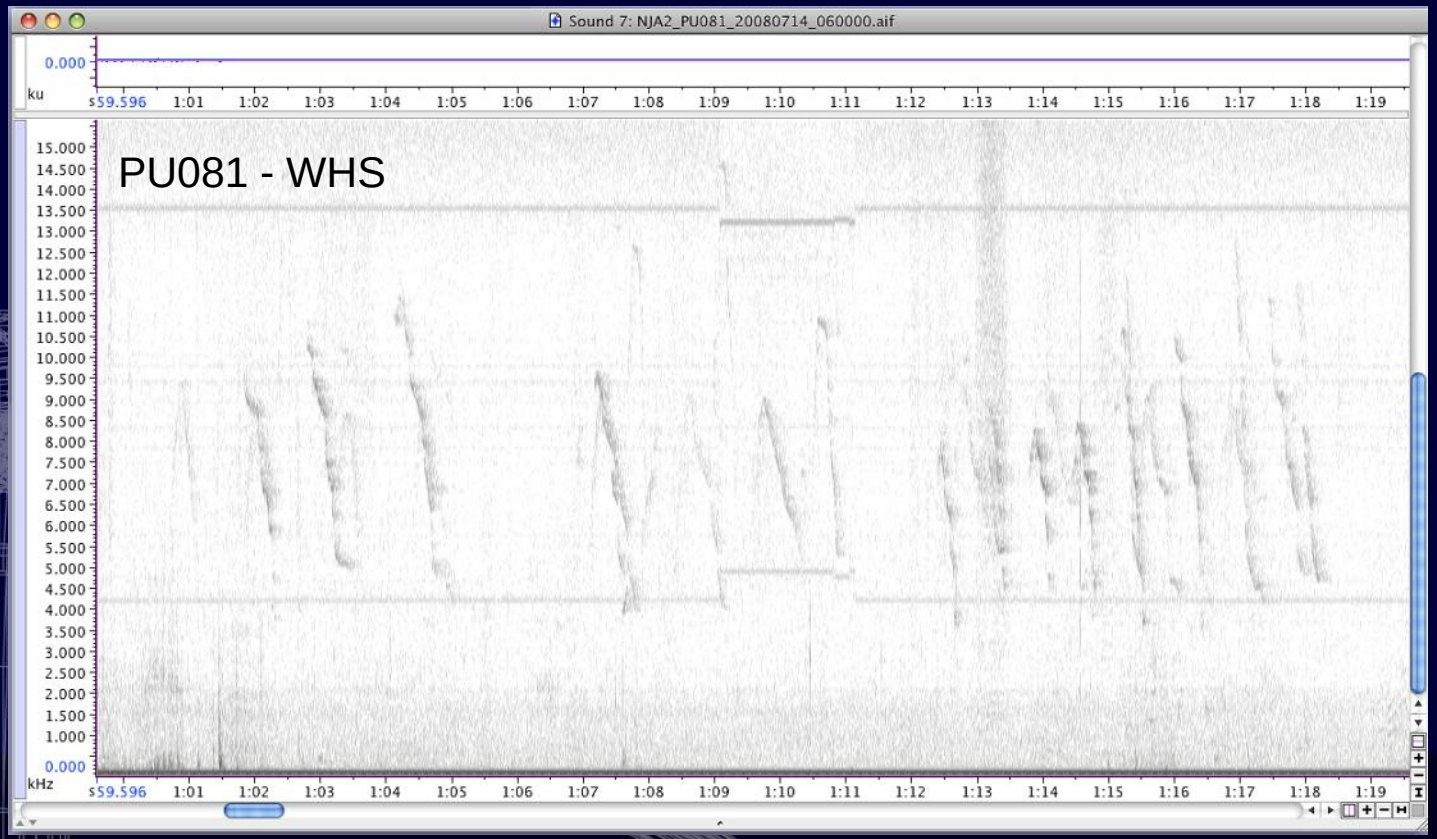
Underwater Acoustic Survey - Results

dolphin whistles

clicks, claps, pulses, squawks, etc, too

14 July 08





July 14, 2008 @ ~6:00 AM

Underwater Acoustic Survey - Summary

- Baleen whales detected
  - Call detectors only for species with stereotypical calls
  - North Atlantic right whales – spring, fall, winter
  - Fin whales – every month, sometimes chorusing
  - Both offshore & near-shore detections
- Toothed whales detected
  - Manual review for variable calls
  - Whistles, squawks, pulsed calls detected
  - Jaw claps, too
  - Species differences … not yet

Photos: GMI

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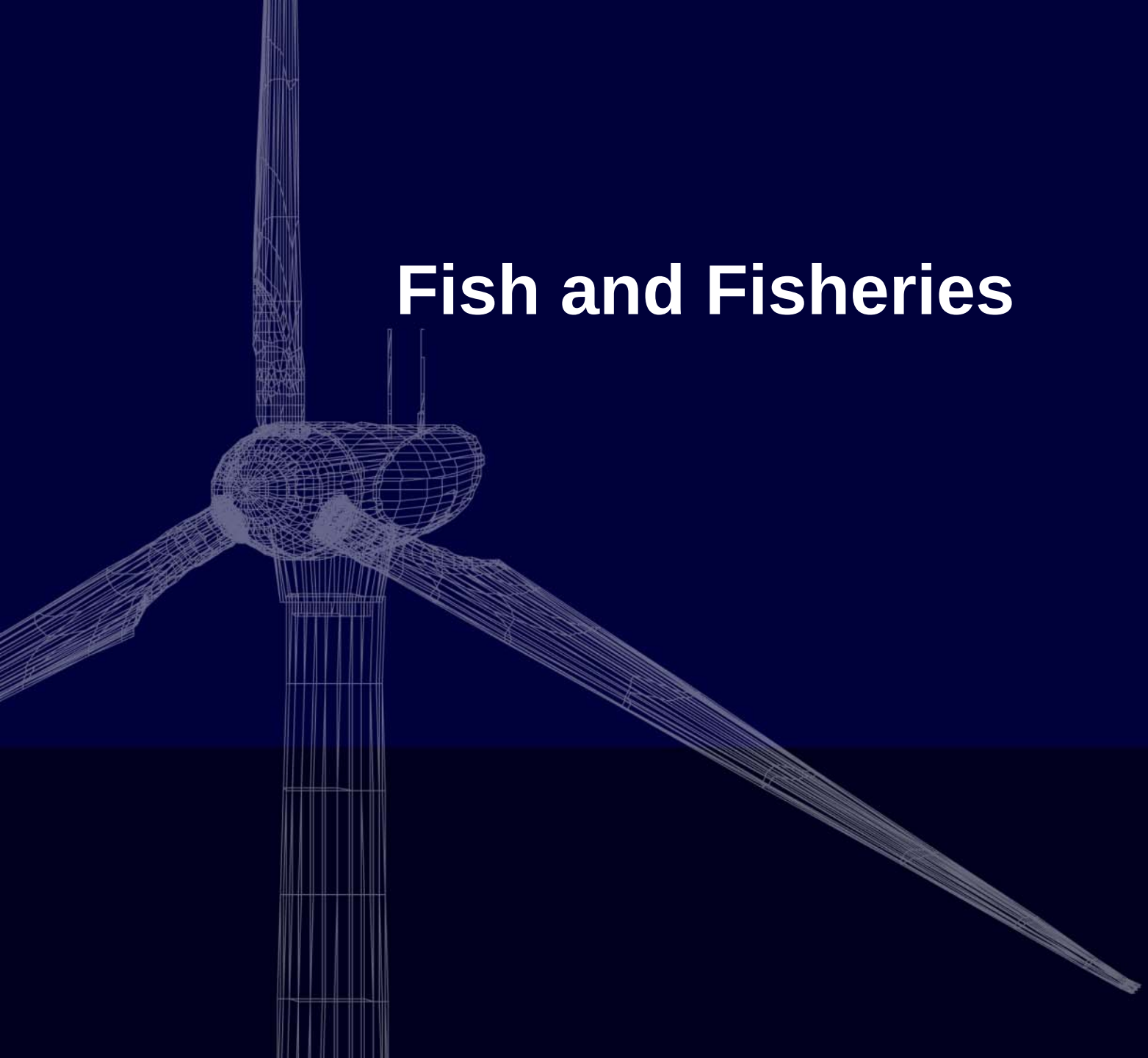
Fish and Fisheries



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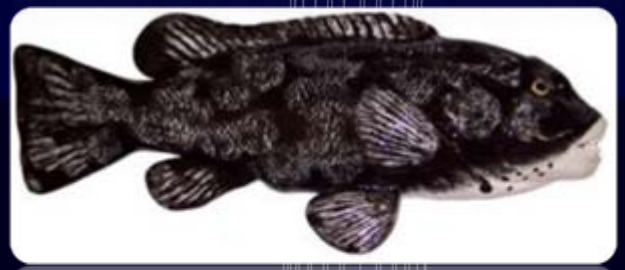
Fish and Fisheries

- **Fish Habitats**
  - Inshore
    - Coastal Beaches (surf zone): Anchovy, Silverside, Bluefish, Northern Kingfish
  - Offshore
    - Pelagic zone (water column): Bluefish, Striped Bass, Atlantic Mackerel
    - Benthic zone (bottom substrate):
      - Sand-mud Plain: Yellowtail Flounder, Silver Hake, Sand Lance, Atlantic Surfclam
      - Shoreface Sand Ridges: Butterfish, Bay Anchovy, Atlantic Surfclam, Decapod crustaceans (e.g., Atlantic Rock Crab and American Lobster)
    - Artificial Structures (*~ 150 different marine species*) : Tautog, Black Sea Bass, Red Hake



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Fish and Fisheries

One of New Jersey's most valuable natural resources

The economic impact of commercial fisheries, recreational fisheries, and aquaculture in New Jersey is approximately $4.5 billion annually.

- **Fisheries Management**
  1. **Atlantic States Marine Fisheries Commission (ASMFC)**
     - A. **19 Coastal Fish Species**
     - B. **Shad/River Herring Group and 20 Coastal Sharks**
  2. **Fishery Management Councils (NEFMC, MAFMC, SAFMC)**
     - A. **26 Essential Fish Habitat (EFH) Species**
     - B. **1 Habitat Areas of Particular Concern (HAPC): Summer Flounder**
  3. **National Marine Fisheries Service (NMFS)**
     - A. **14 Highly Migratory Species (HMS)**
     - B. **1 HAPC: Sandbar Shark**
     - C. **1 *Proposed* (Threatened/Endangered) D**istinct Population Segments (**DPS): Atlantic Sturgeon**

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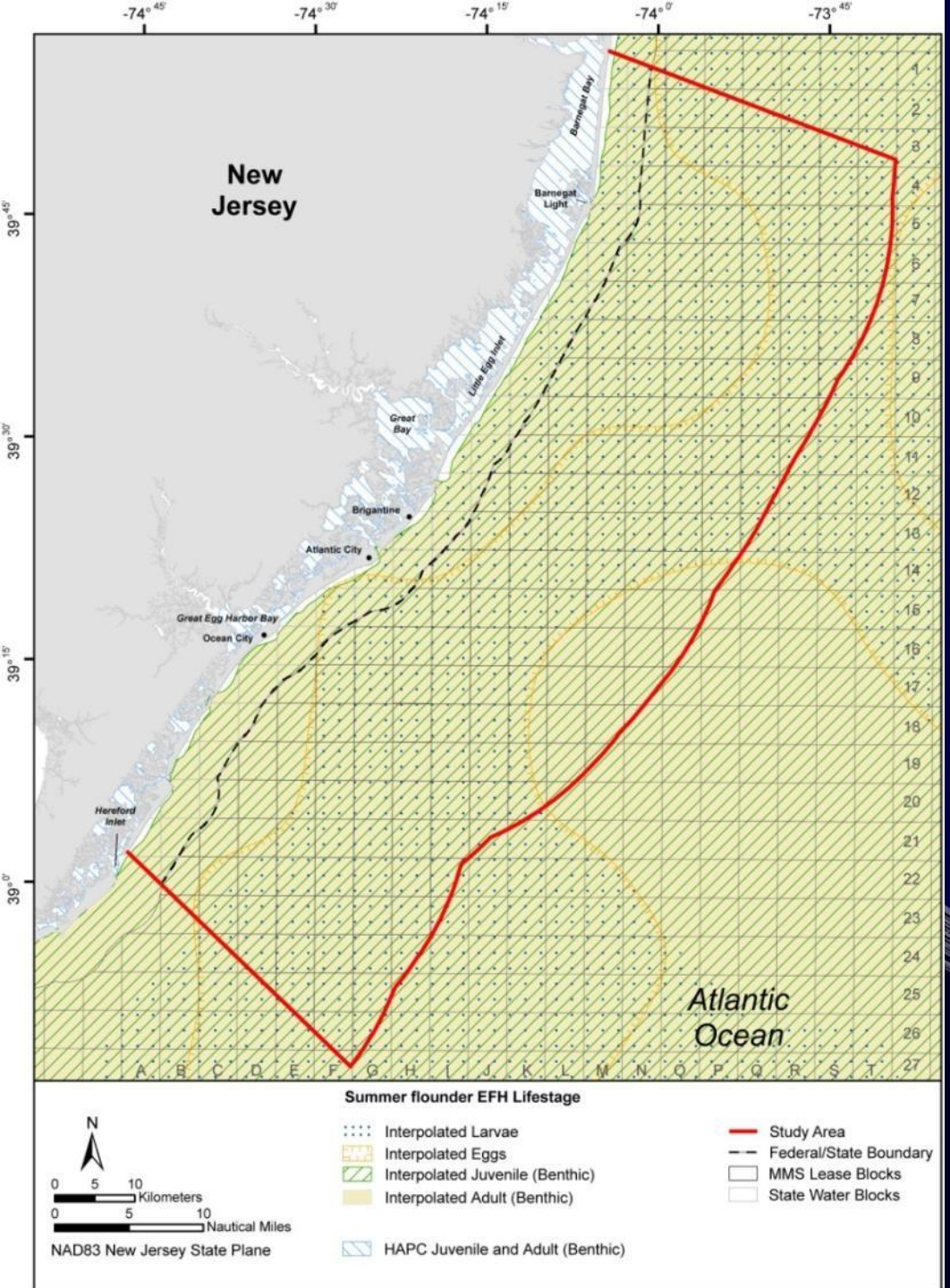
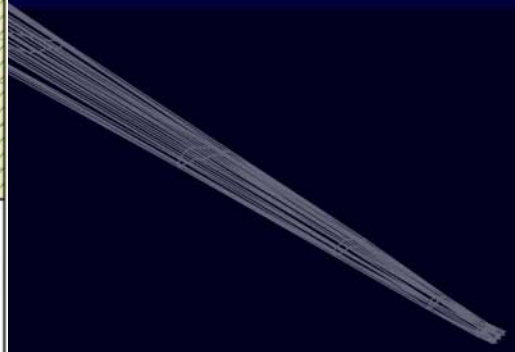
Fish and Fisheries

Essential Fish Habitat

- 38 species have EFH within the study area
- Most includes multiple life stages





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Fish and Fisheries

- **Commercial Fisheries (2003-2007)**
  - Total value $700 Million
  - Annual mean value $178 Million
  - In 2007, NJ Ranked 8th in value and 10th in landings
  - Fishing Gear
    - New Jersey:
      - Dredges, Trawls, Purse Seine, Hook-and-Line, Gillnets, Pots/Traps
    - Study Area:
      - Clam Dredge

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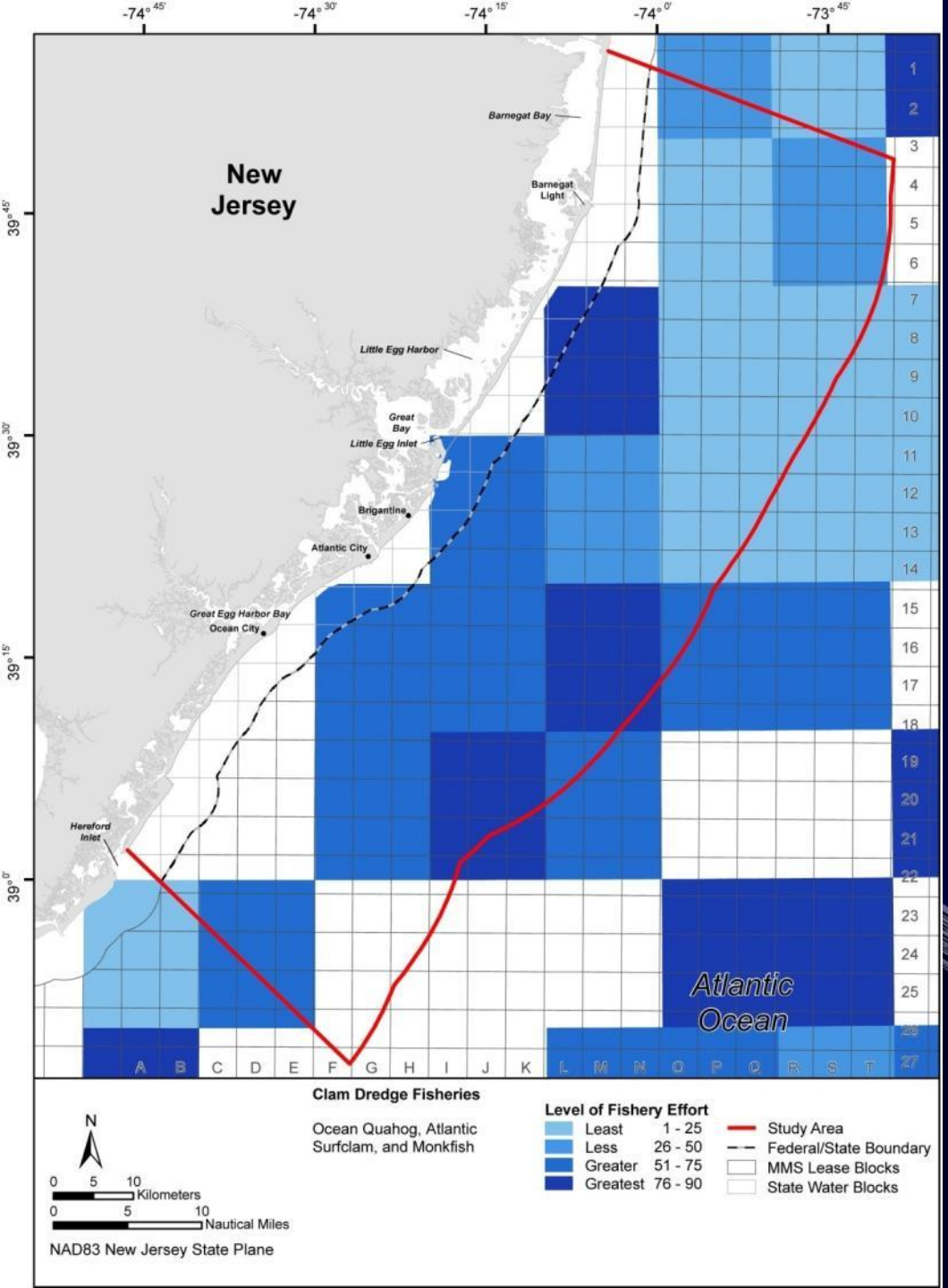
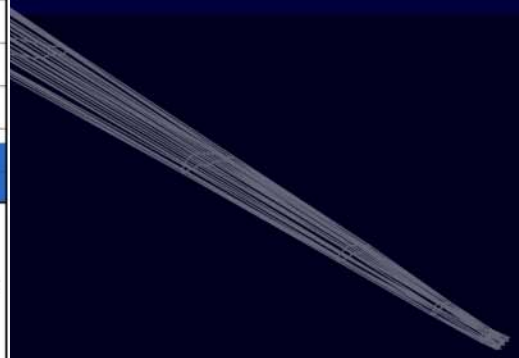
Fish and Fisheries

- **Clam Dredge Fishery**





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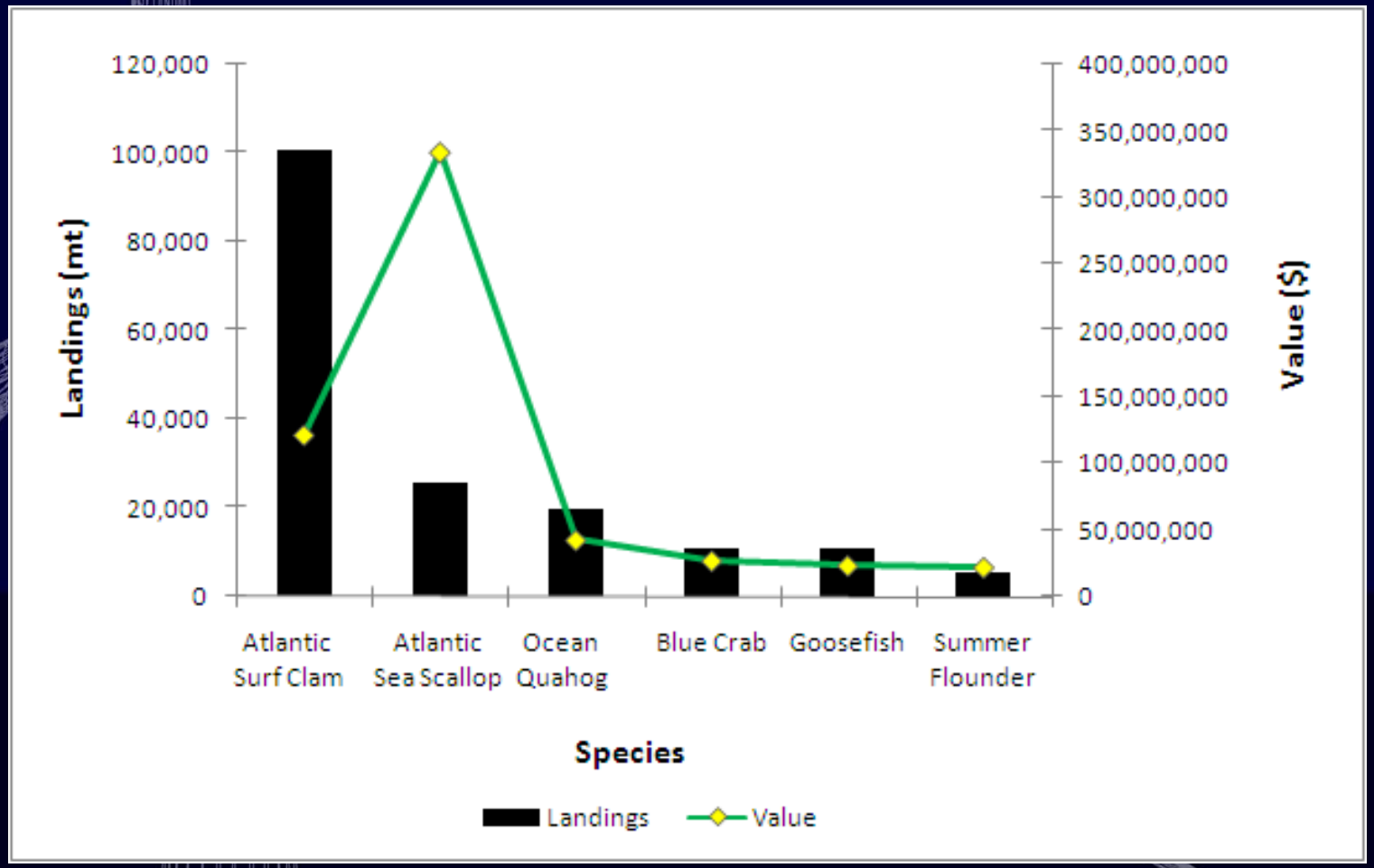
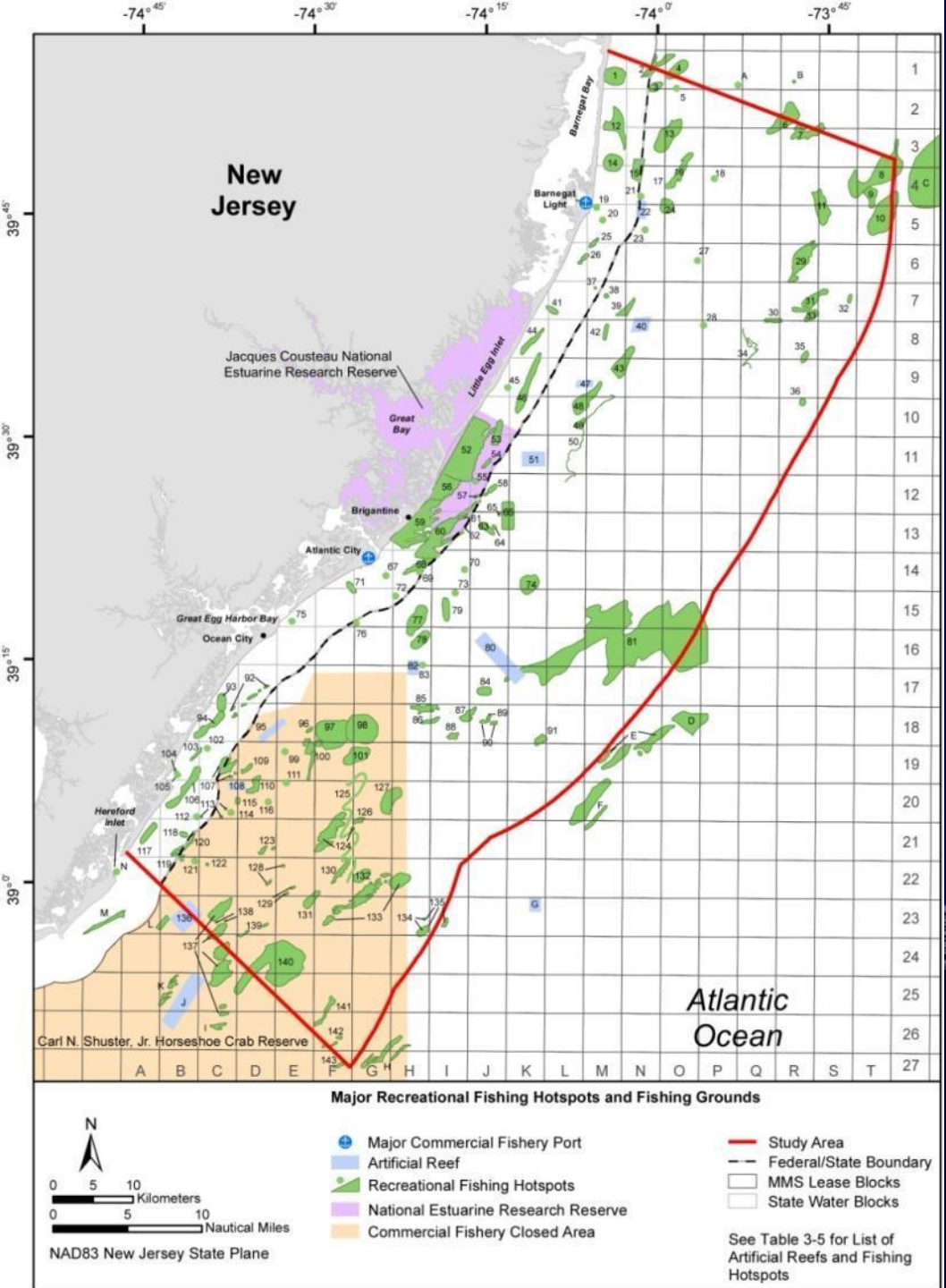
Fish and Fisheries

Commercial Fisheries (2003-2007)



Fish and Fisheries

- Two Major Commercial Fishery Ports (Barnegat Light and Atlantic City)
- Carl N. Shuster Jr. Horseshoe Crab Reserve
- Jacques Cousteau National Estuarine Research Reserve



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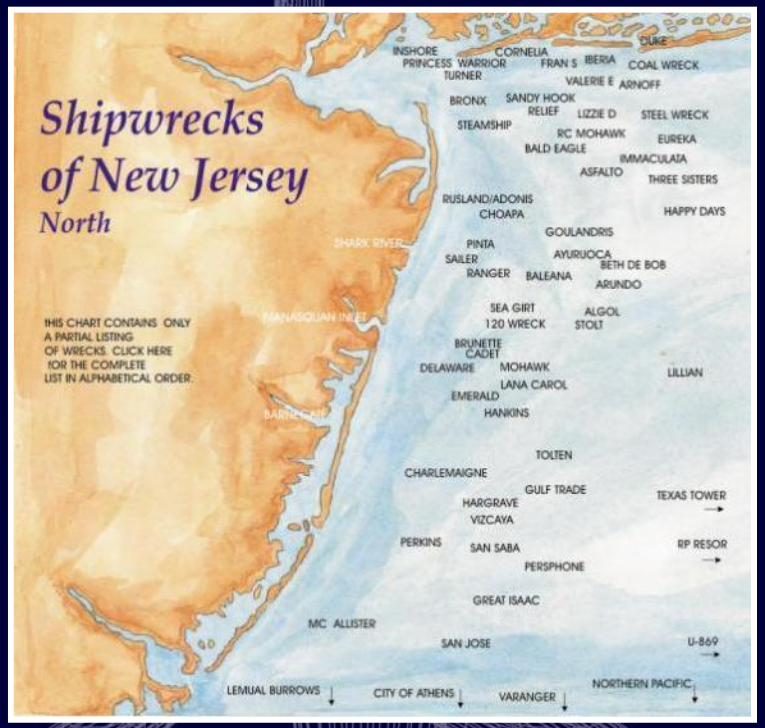
Fish and Fisheries



- **Recreational Fisheries**
  - **Fishing Hotspots:**
    1. **Shipwrecks (~ 102)**
    2. **Artificial Reef Complexes (~ 9)**
    3. **Shoals/Lumps (~ 40)**
  - **Common Species:**
    - **Black Sea Bass**
    - **Tautog**
    - **Striped Bass**
    - **Bluefish**
    - **Winter Flounder**
    - **Atlantic Mackerel**
    - **Atlantic Bonito**

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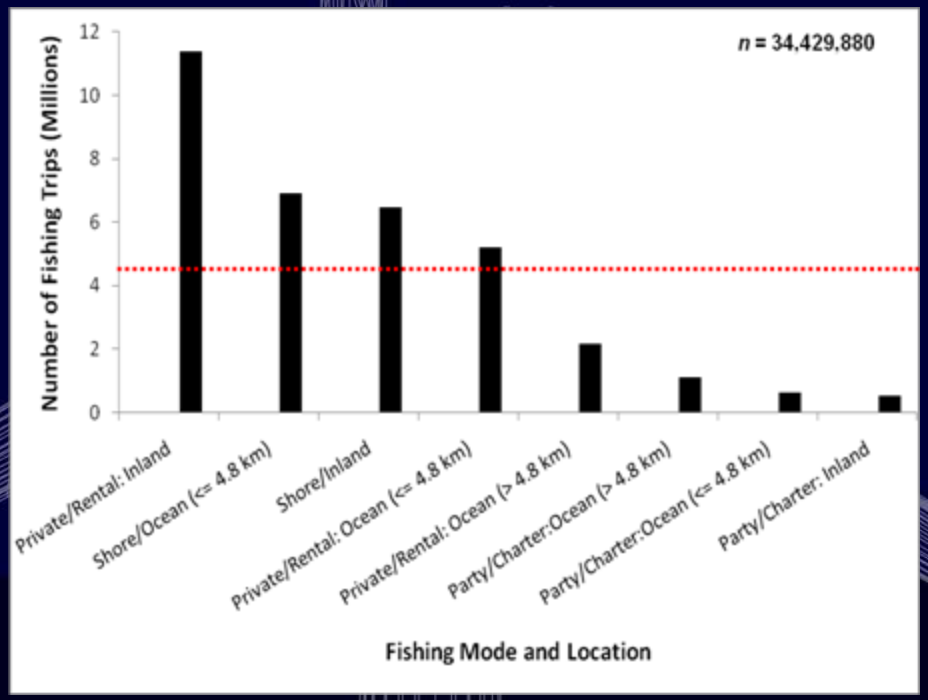
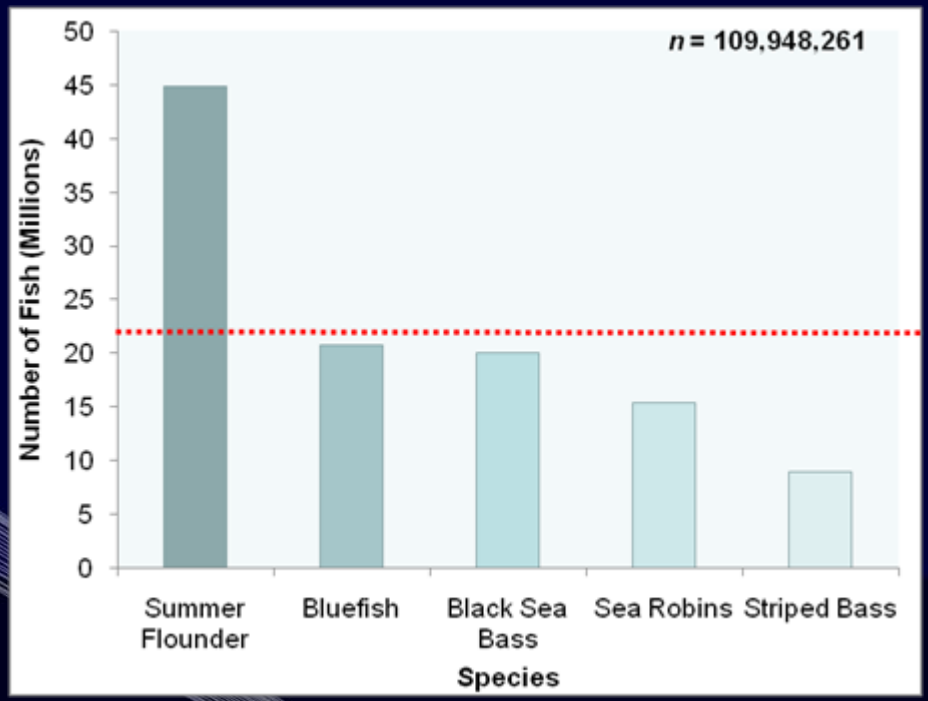
Fish and Fisheries

Recreational Fisheries (2003-2007)





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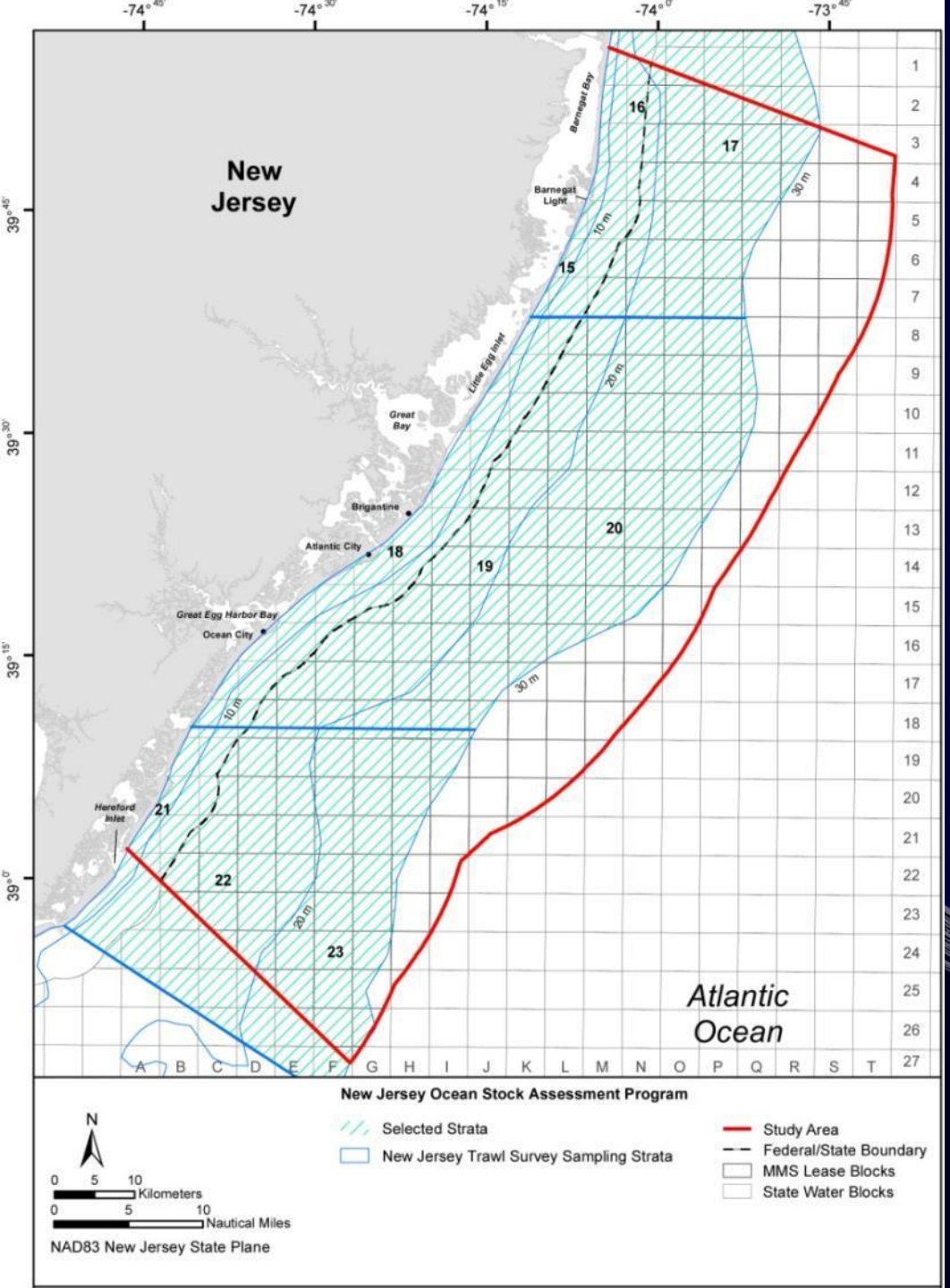
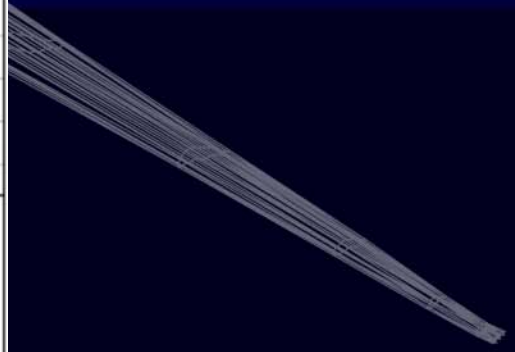
Fish and Fisheries

- New Jersey Ocean Stock Assessment (OSA) Program (2003-2008)





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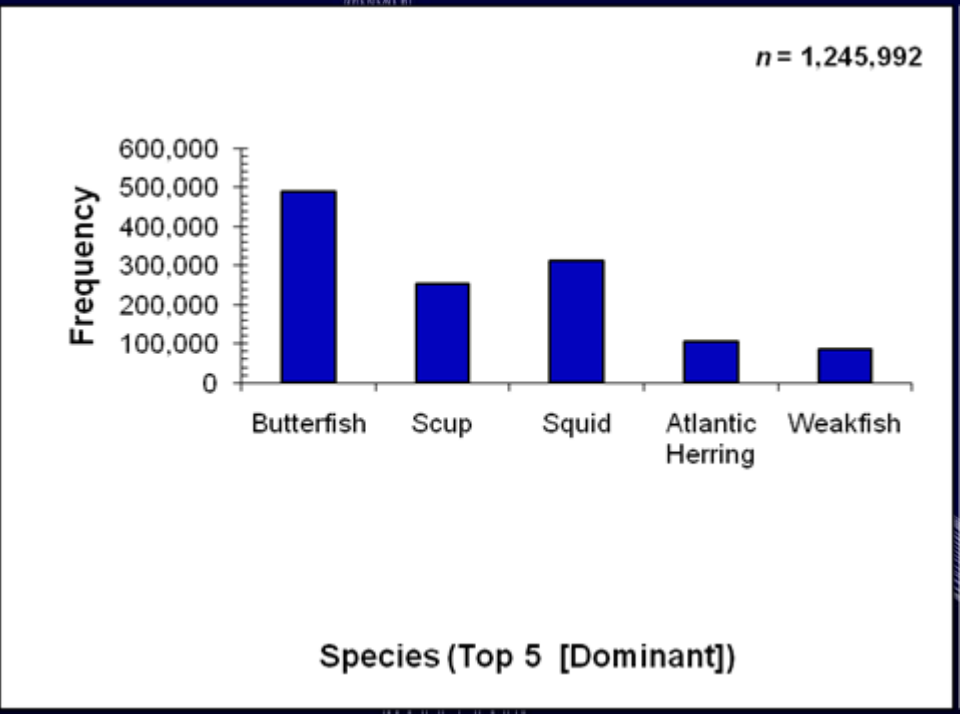
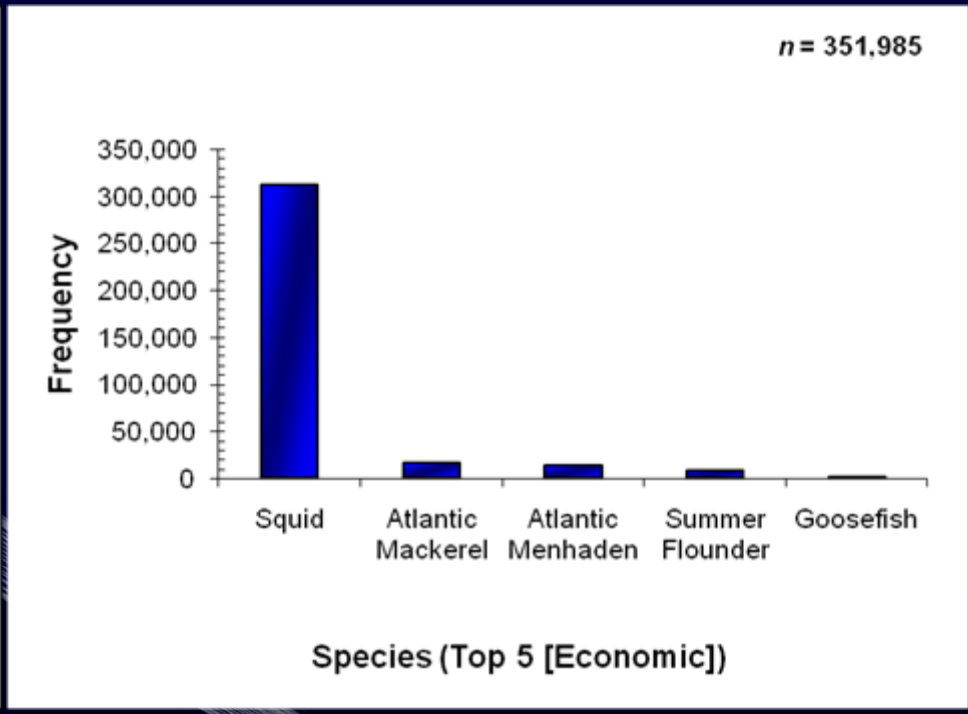
Fish and Fisheries

- **OSA Program (2003-2008)**





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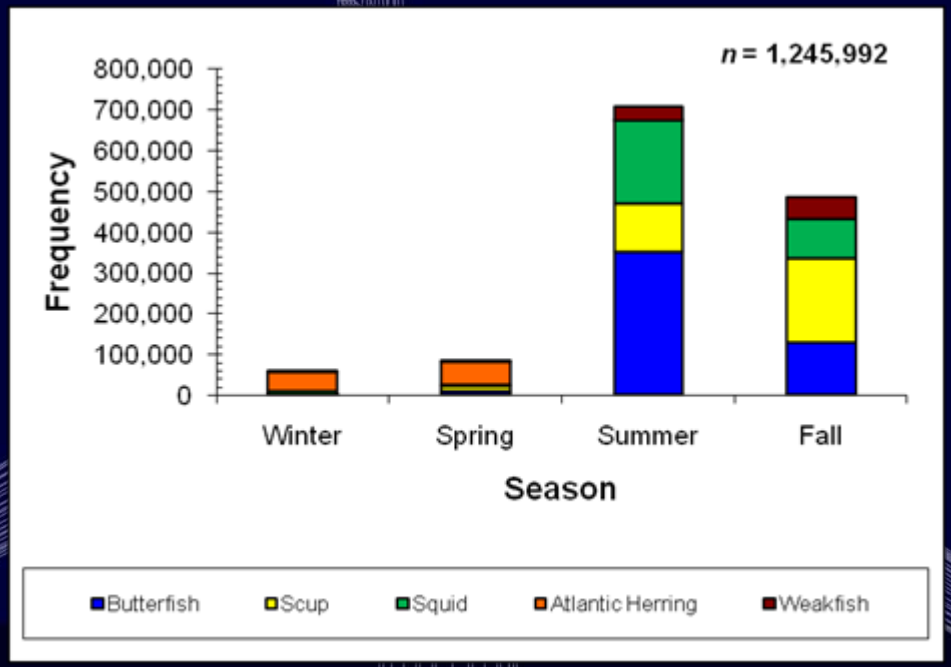
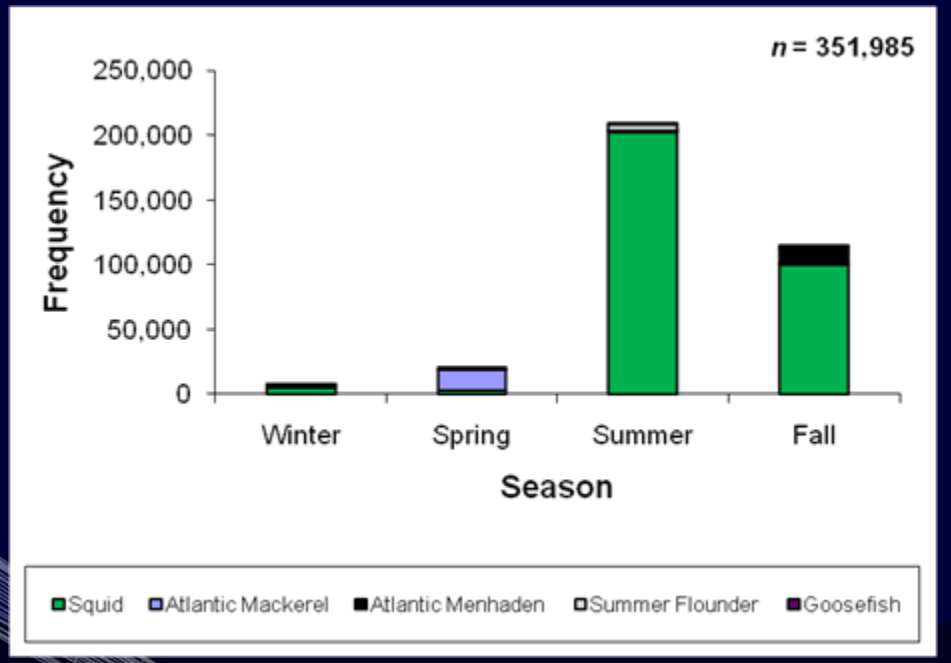
Fish and Fisheries

- **OSA Program (2003-2008)**





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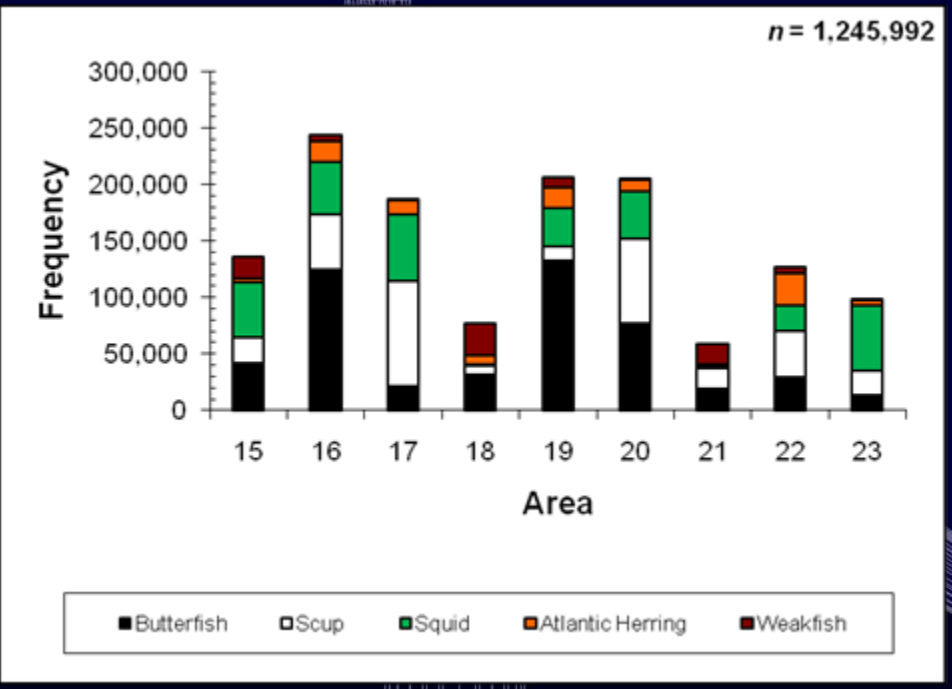
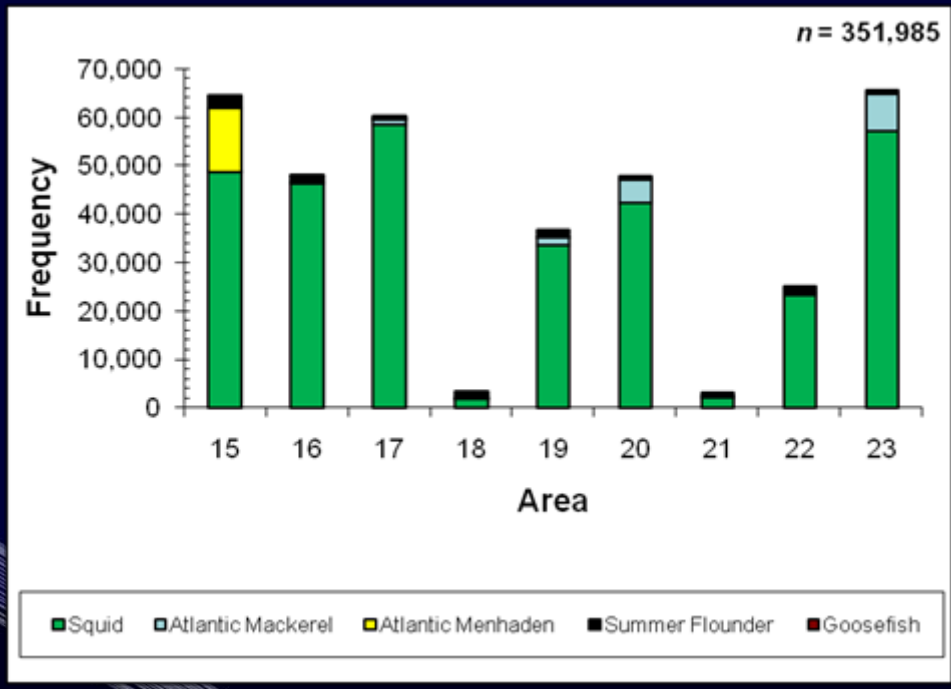
Fish and Fisheries

- **OSA Program (2003-2008)**





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Fish and Fisheries

- **OSA Program (2003-2008)**
- **Dominant Species by Area**

Species	Area								
	15	16	17	18	19	20	21	22	23
Butterfish	**41,328**	**124,528**	21,337	**31,614**	**131,960**	**76,678**	**19,253**	**29,152**	13,526
Scup	23,211	48,759	**92,885**	7,037	12,645	**74,916**	**17,758**	**40,574**	21,516
Squid	**48,566**	46,123	58,324	1,659	33,547	42,104	1,875	**23,168**	**56,933**
Atlantic Herring	3,724	17,791	13,120	7,694	18,129	9,656	1,662	**27,793**	5,484
Weakfish	18,478	6,139	62	**28,562**	9,444	20	**17,549**	5,737	244
Little Skate	16,333	10,380	8,547	9,872	6,960	4,666	5,267	2,953	4,472
Atlantic Croaker	821	2,343	14	9,879	11,769	13	4,032	7,214	73
Clearnose Skate	14,217	2,187	99	4,863	1,468	146	4,250	1,900	347
Spot	6,071	321	0	11,060	137	0	10,408	116	4
Windowpane Flounder	4,933	2,522	549	3,758	2,935	612	3,171	1,632	785
Total	177,682	261,093	194,937	115,998	228,994	208,811	85,225	140,239	103,384
Percent of Total by Area	11.7	17.2	12.9	7.7	15.1	13.8	5.6	9.2	6.8

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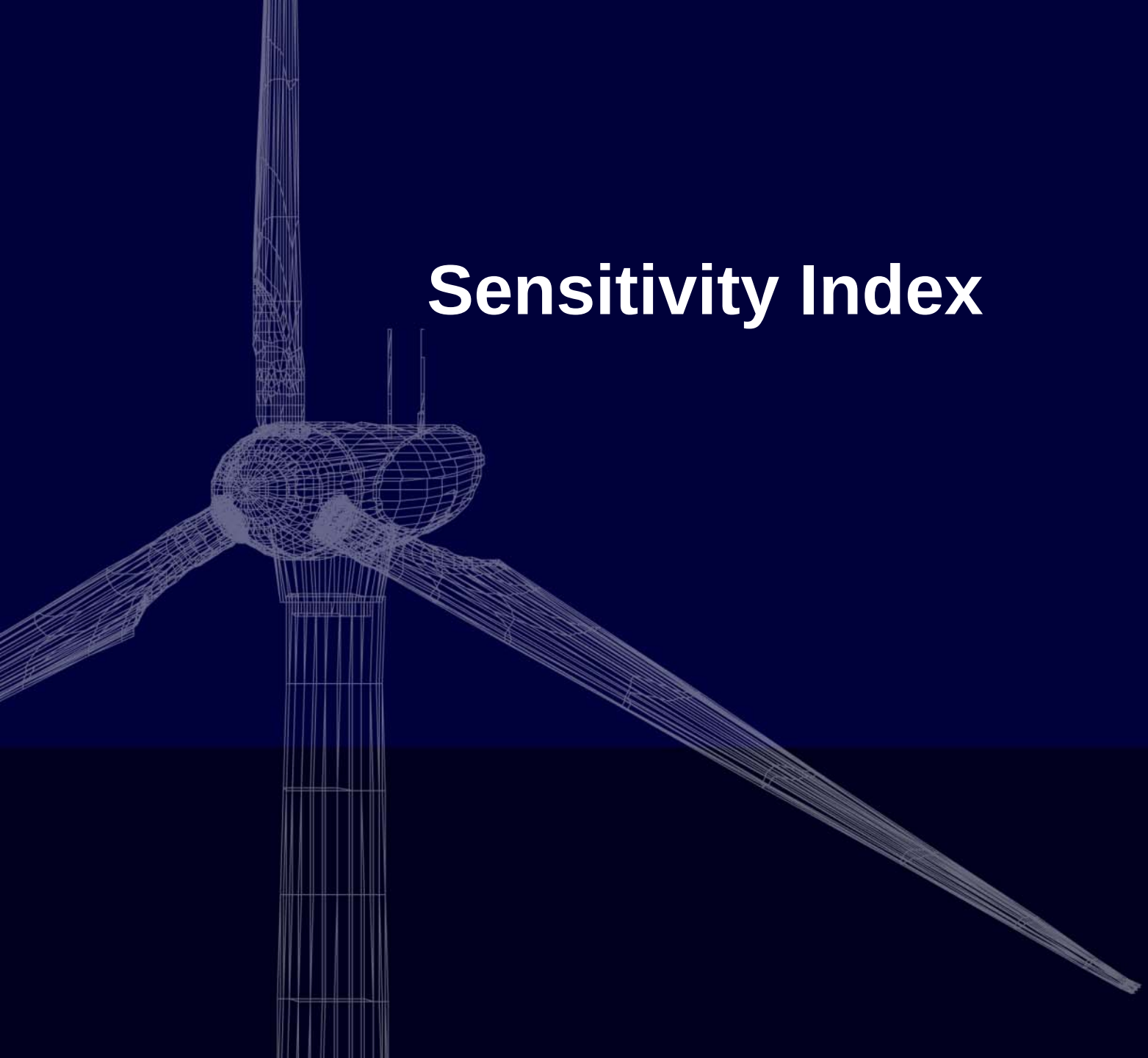
Sensitivity Index



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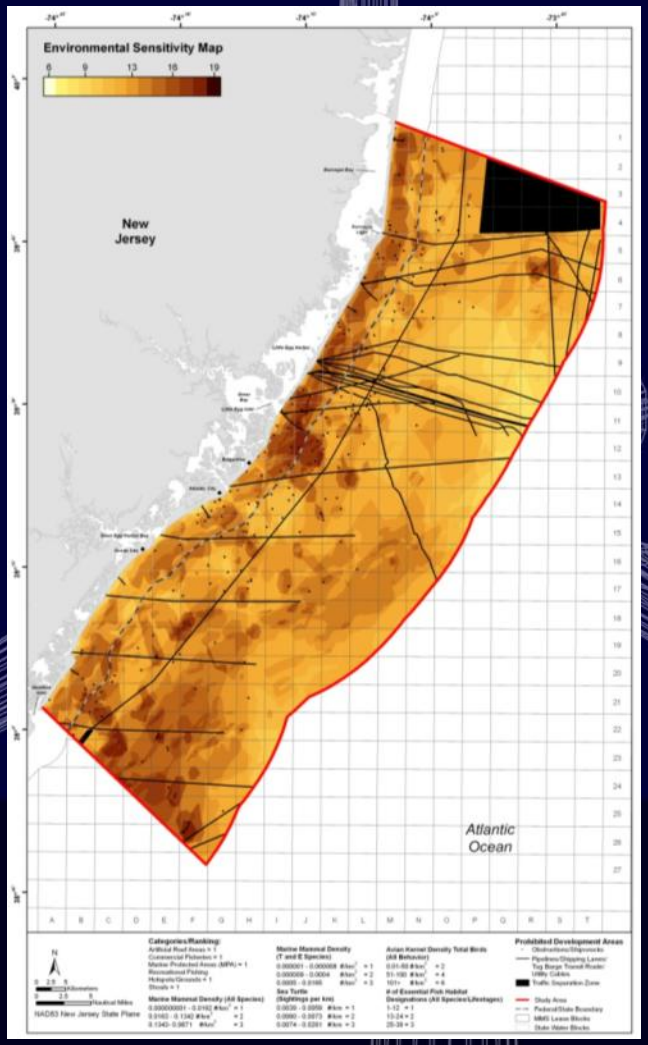
Index Development



- Includes physical, biological and socio-economic features
- Data collected through
  - field studies
  - review of published literature
  - resource agencies such as NJDEP, NOAA, NMFS, and MMS
- Resources considered for the index include:
  - artificial reefs
  - marine protected areas (MPA)
  - shoals
  - habitat areas of particular concern (HAPC)
  - essential fish habitat (EFH)
  - commercial fishing grounds
  - recreational fishing grounds
  - modeled avian, marine mammal, and sea turtle data
- “Prohibited Development Areas”
  - Shipping lanes, utility cables, obstructions, shipwrecks, and UXO
- Every layer is ranked, and the cumulative score of the layers provides the index value

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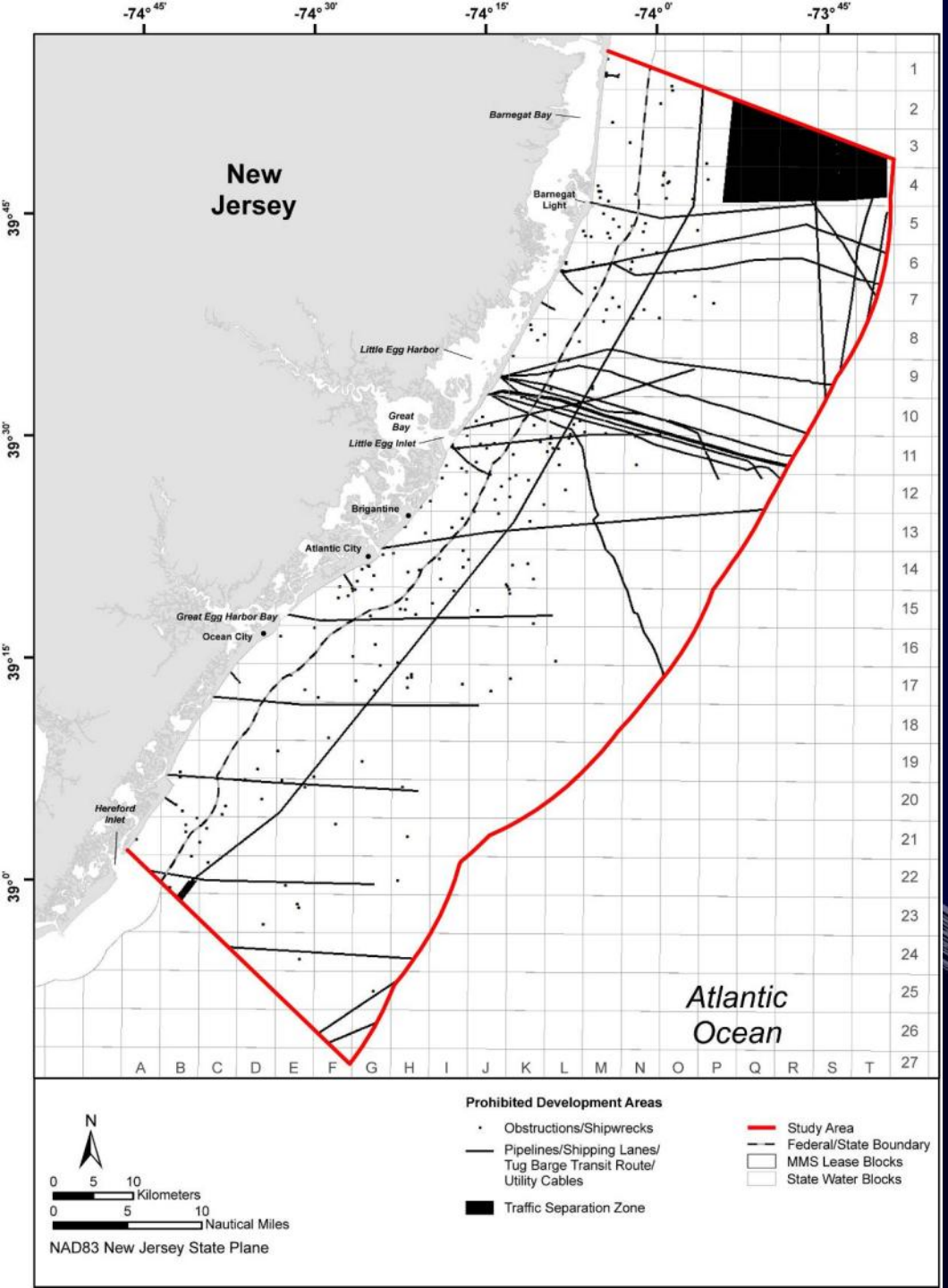
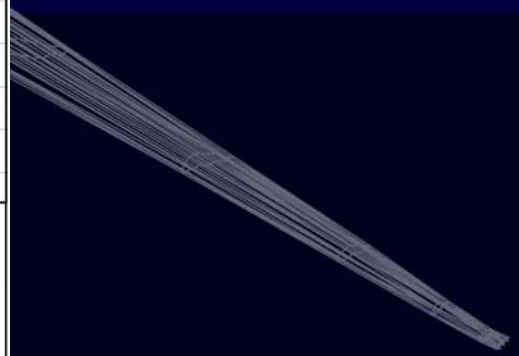
Prohibited Development Areas

Data Includes:

- shipping lanes
- known obstructions
- Shipwrecks
- traffic separation zones
- utility cables





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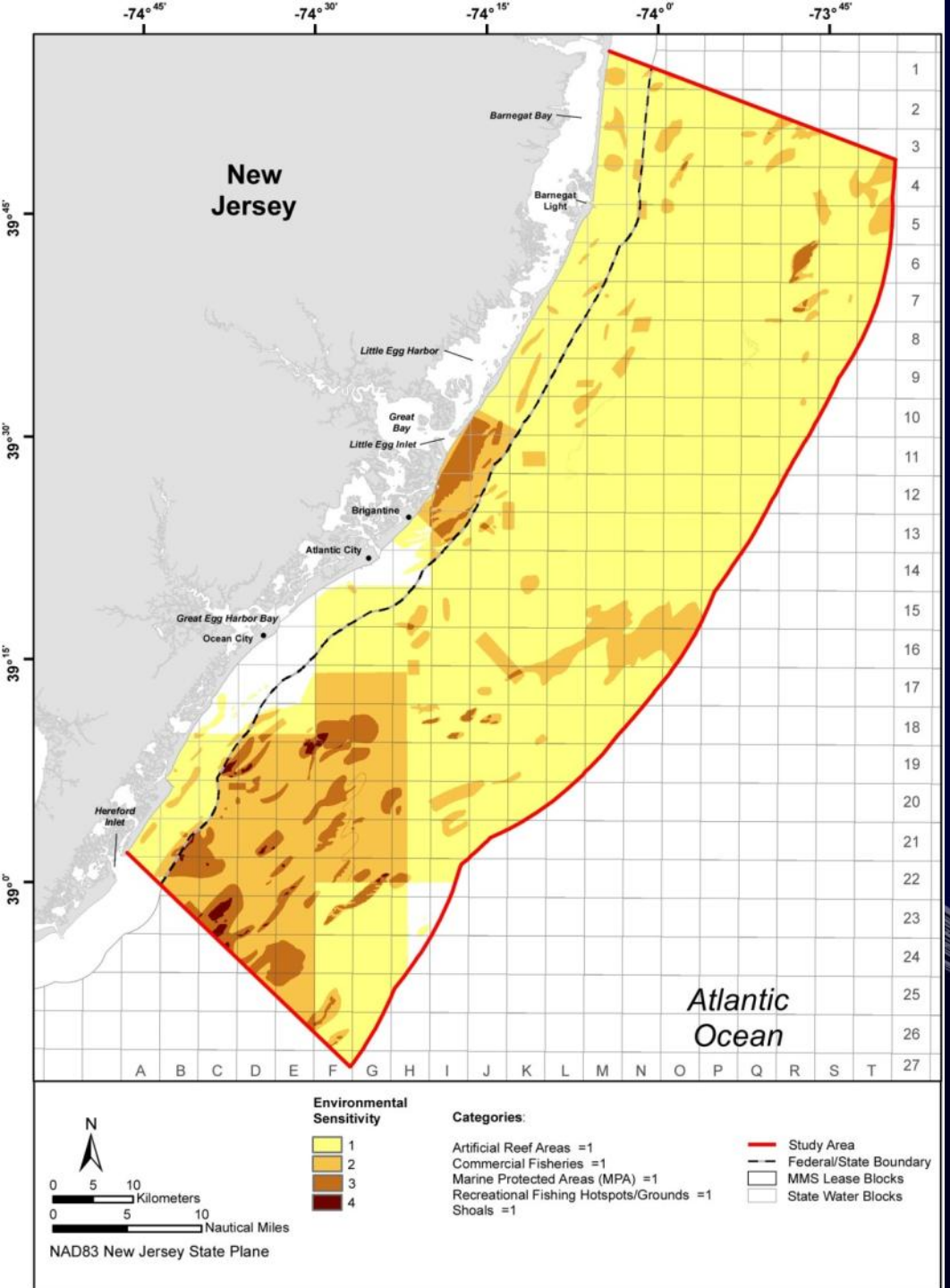

General Features

Data Includes:

- **Shoals**
- **Recreational fishing areas**
- **Commercial fishing areas/grounds**
- **Marine protected areas**
- **Artificial reefs**

All equally ranked at 1

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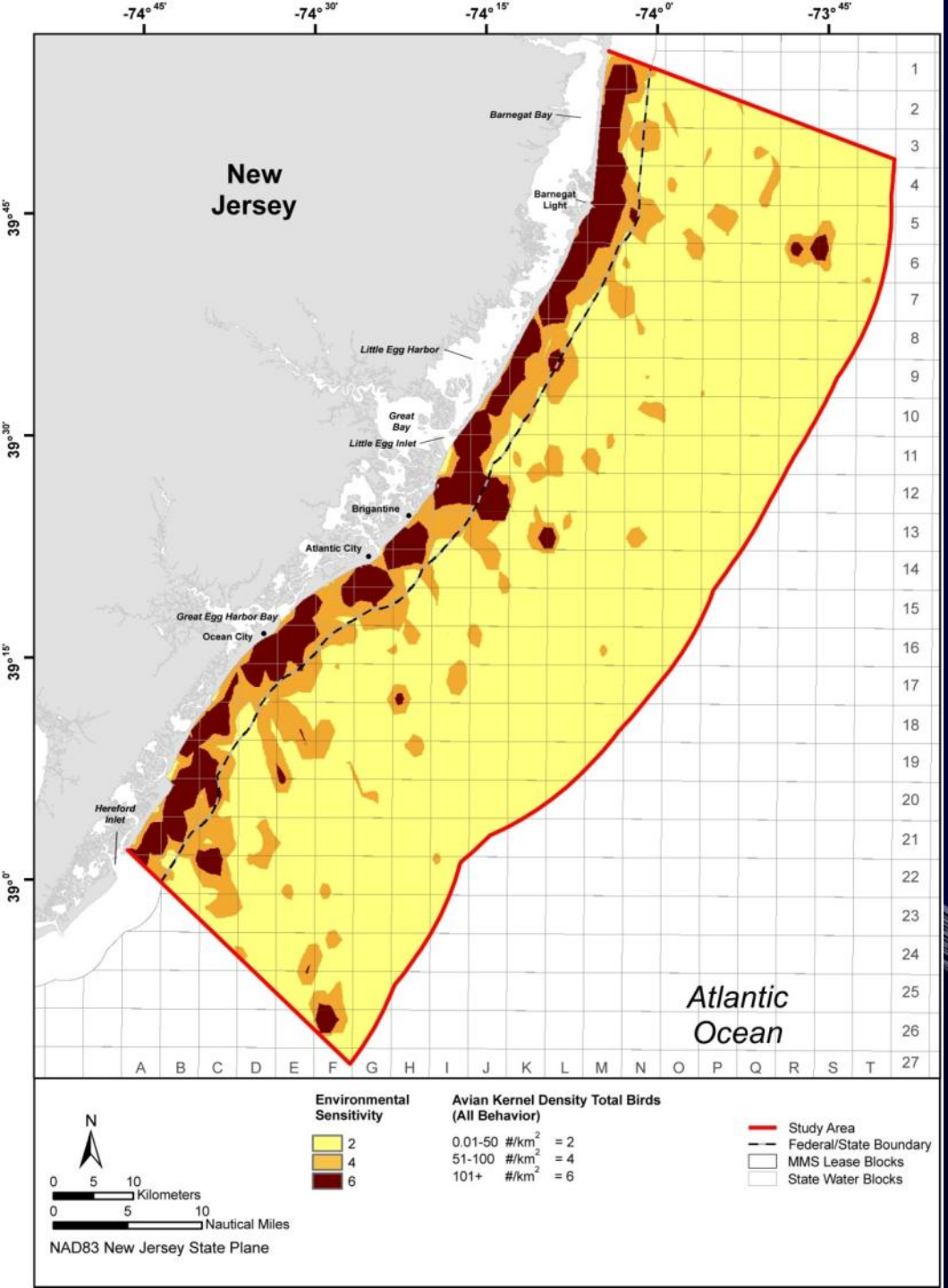

Avian Density

- Total kernel density abundance for all birds, behaviors, and years
- Ranked 2 to 6 depending on density
- Insufficient quantity of T&E data to model

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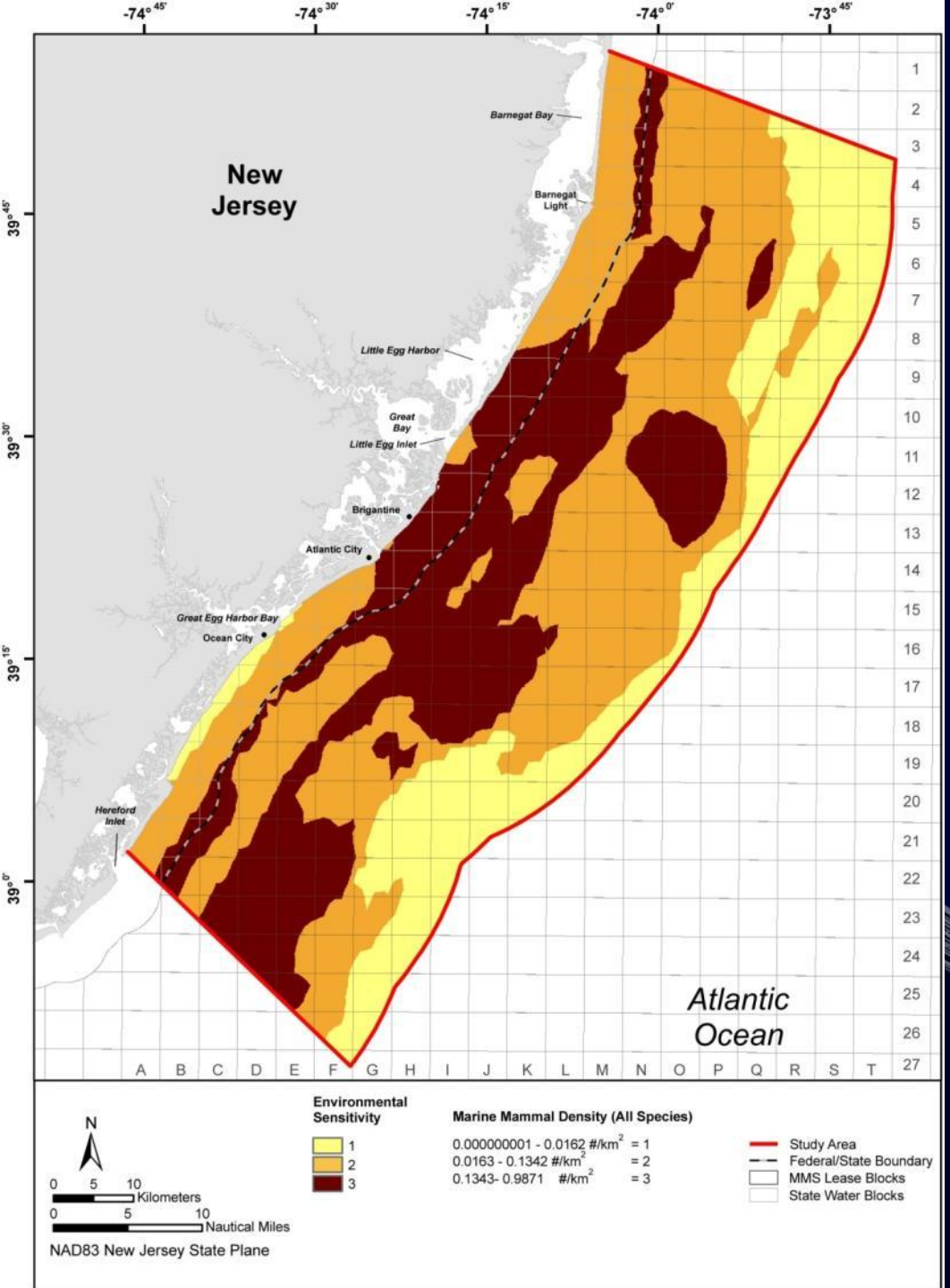
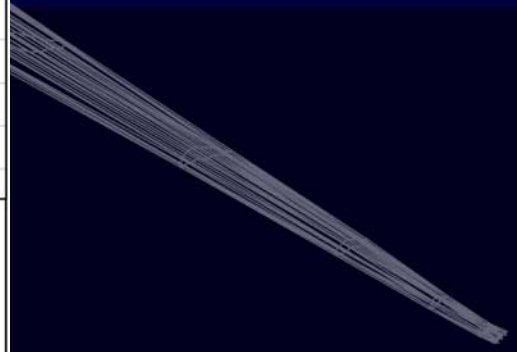
Marine Mammal Density

- All Distance modeling output for non-listed species were combined to create this layer
- Ranked 1 to 3 depending on density





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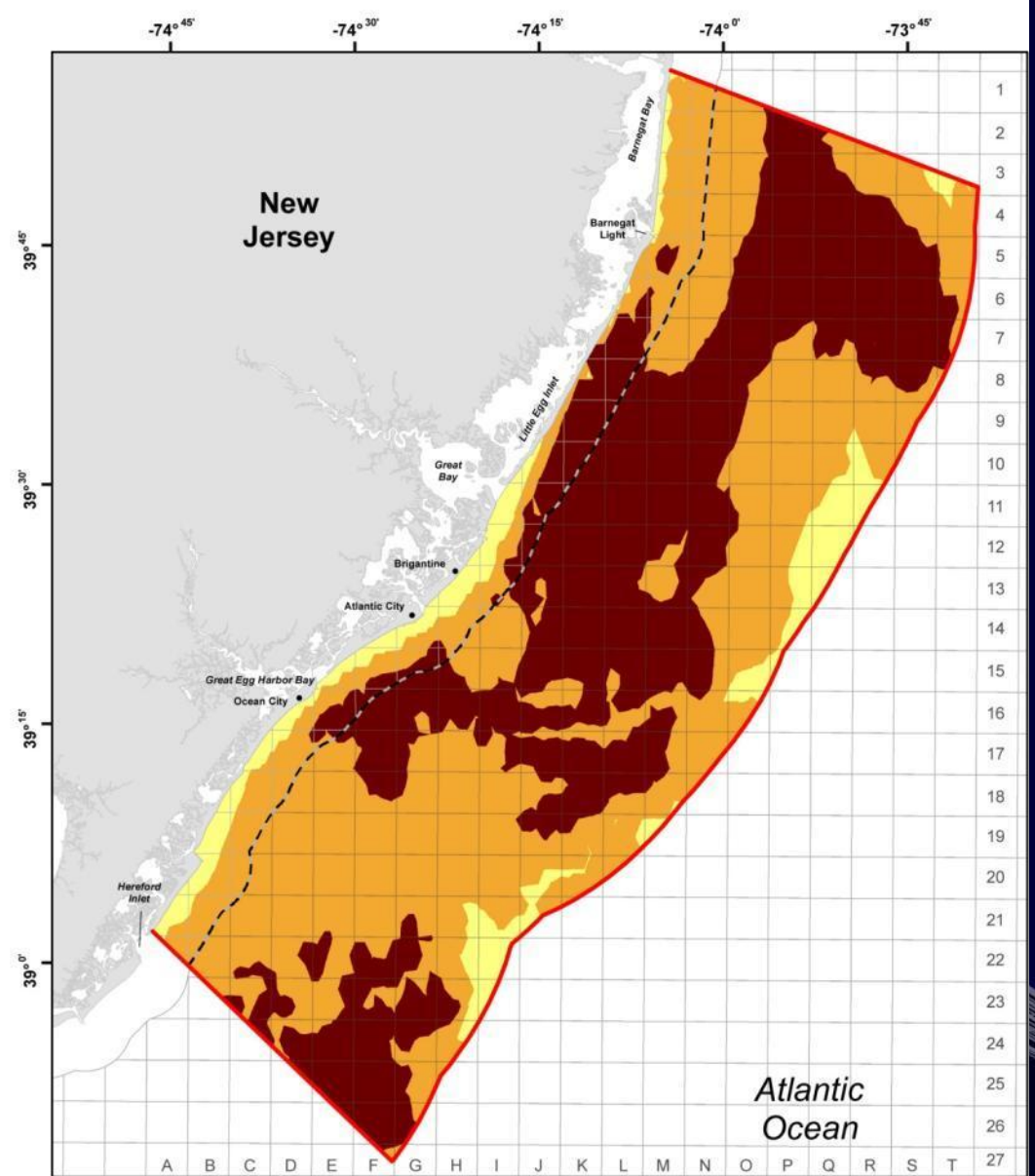
Marine Mammal T&E Density

- Includes only Distance modeling for T&E species
- Ranked 1 to 3 depending on density



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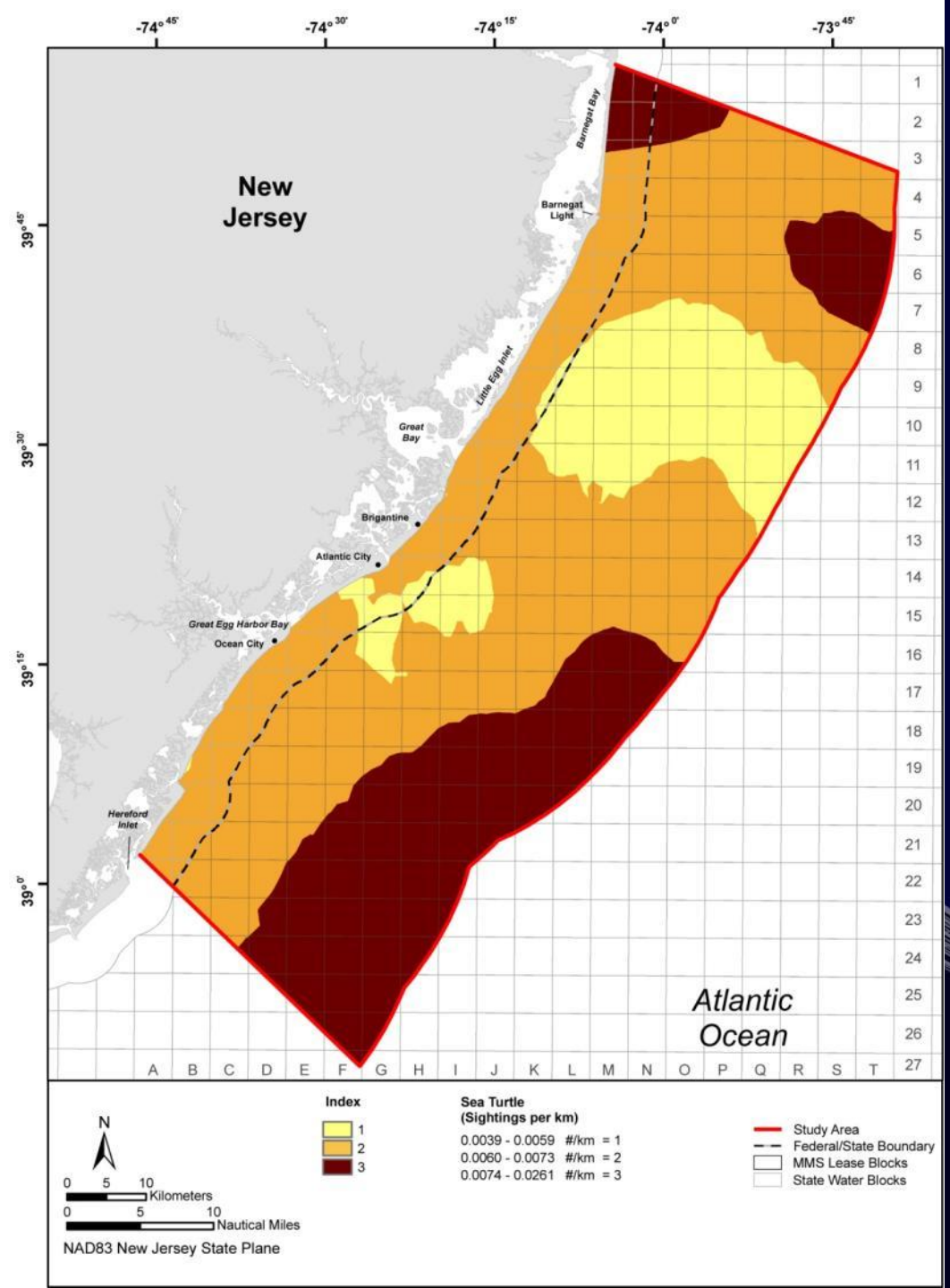

Sea Turtle
Sightings per Unit Effort

- Developed from a sightings per unit effort (#/km) & Kriging method due to insufficient data for density modeling
- Ranked 1 to 3 depending on number of sightings per km

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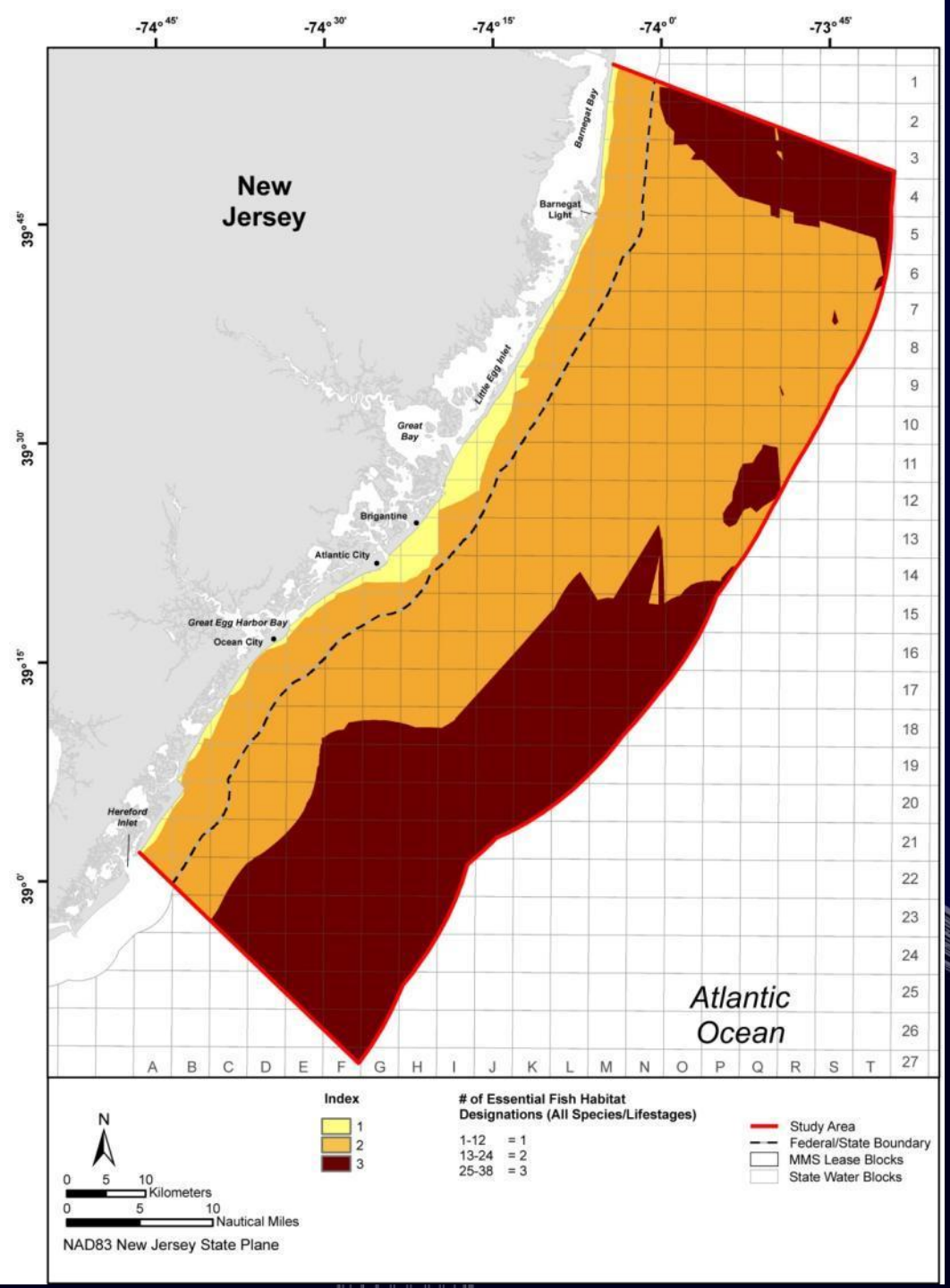
Essential Fish Habitat

- All EFH within the Study Area was layered to create this data
- Ranked 1 to 3 depending on number of overlapping EFH



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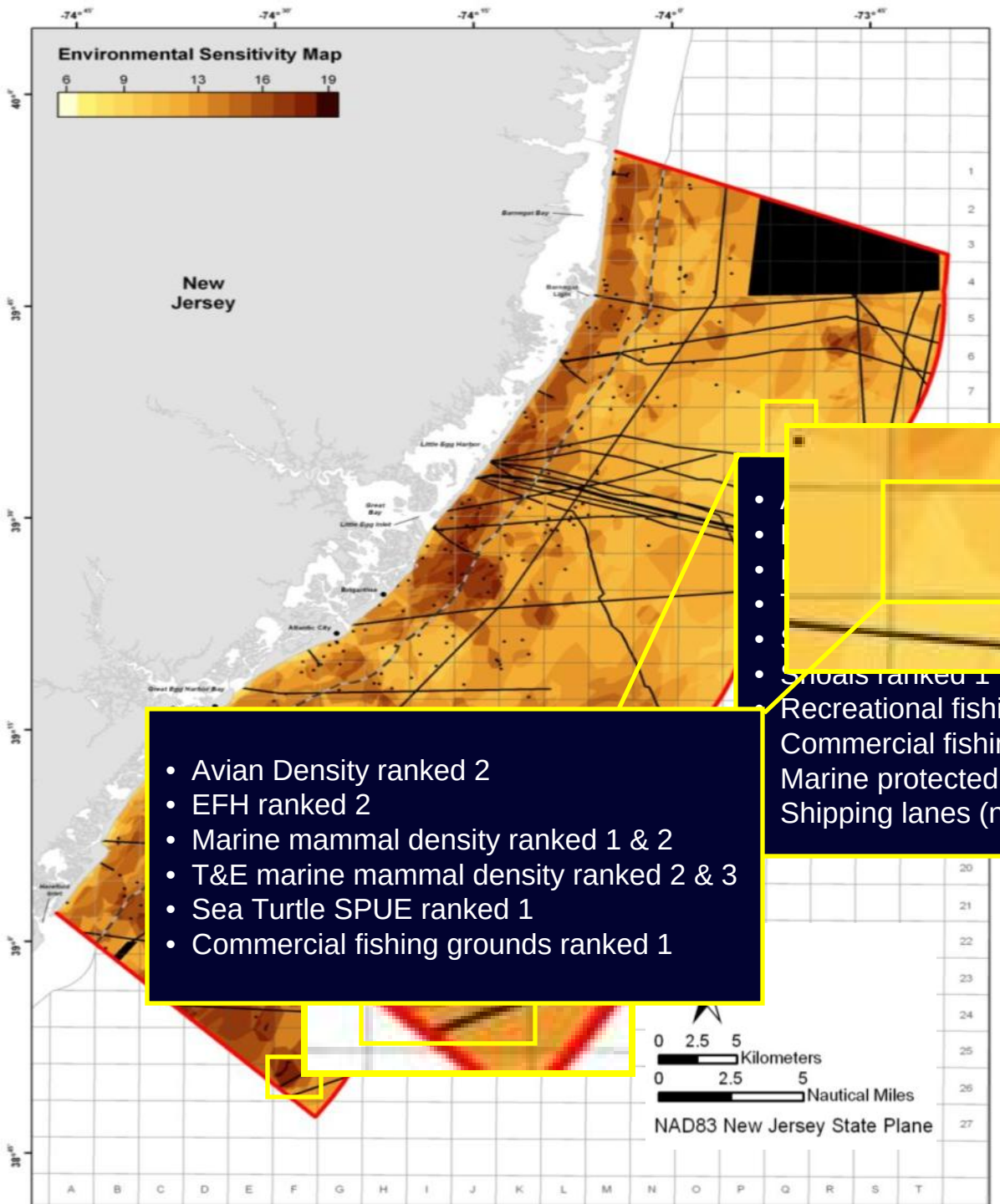


- Avian Density ranked 2
- EFH ranked 2
- Marine mammal density ranked 1 & 2
- T&E marine mammal density ranked 2 & 3
- Sea Turtle SPUE ranked 1
- Commercial fishing grounds ranked 1

- 2, 4, & 6
- anked 2
- sity ranked 3
- Recreational fishing grounds ranked 1
- Commercial fishing grounds ranked 1
- Marine protected area ranked 1
- Shipping lanes (no rank)

Categories/Ranking:
Artificial Reef Areas = 1
Commercial Fisheries = 1
Marine Protected Areas (MPA) = 1
Recreational Fishing
Hotspots/Grounds = 1
Shoals = 1

Marine Mammal Density (All Species)
0.000000001 - 0.0162 #/km^2 = 1
0.0163 - 0.1342 #/km^2 = 2
0.1343- 0.9871 #/km^2 = 3

Marine Mammal Density (T and E Species)
0.000001 - 0.000008 #/km^2 = 1
0.000009 - 0.0004 #/km^2 = 2
#/km^2 = 3

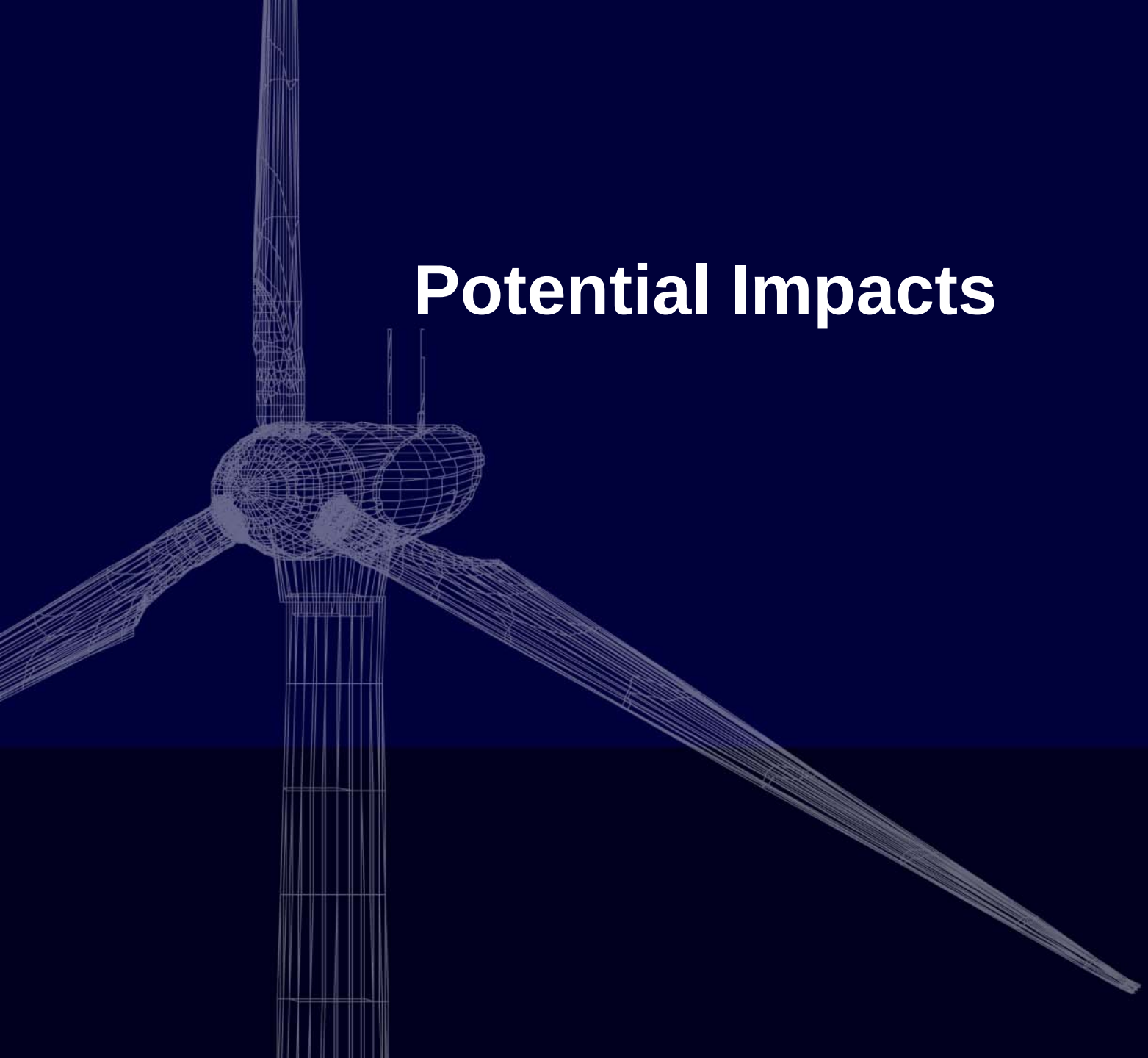
n)
#/km = 1
#/km = 2
#/km = 3

nsity Total Birds
2
4
6
h Habitat
Species/Lifestages)
25-38 = 3

Prohibited Development Areas
Obstructions/Shipwrecks
Pipelines/Shipping Lanes/ Tug Barge Transit Route/ Utility Cables
Traffic Separation Zone

Study Area
Federal/State Boundary
MMS Lease Blocks
State Water Blocks

Potential Impacts



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Life Cycle of an Offshore Windfarm

~30 Years			
Preconstruction	**Construction**	**Operational**	**Decommissioning**
1 to 5 Years	1 Year	20 to 25 Years	1 Year
• Site investigation, geophysical and geotechnical surveys • Meteorological tower installation • Vessel traffic	• Vessel traffic • Foundation preparation and installation • Tower and turbine installation • Cable laying	• Physical presence and operation of turbines • Vessel traffic • Electromagnetic field emissions	• Vessel traffic • Turbine removal • Foundation removal • Cable removal

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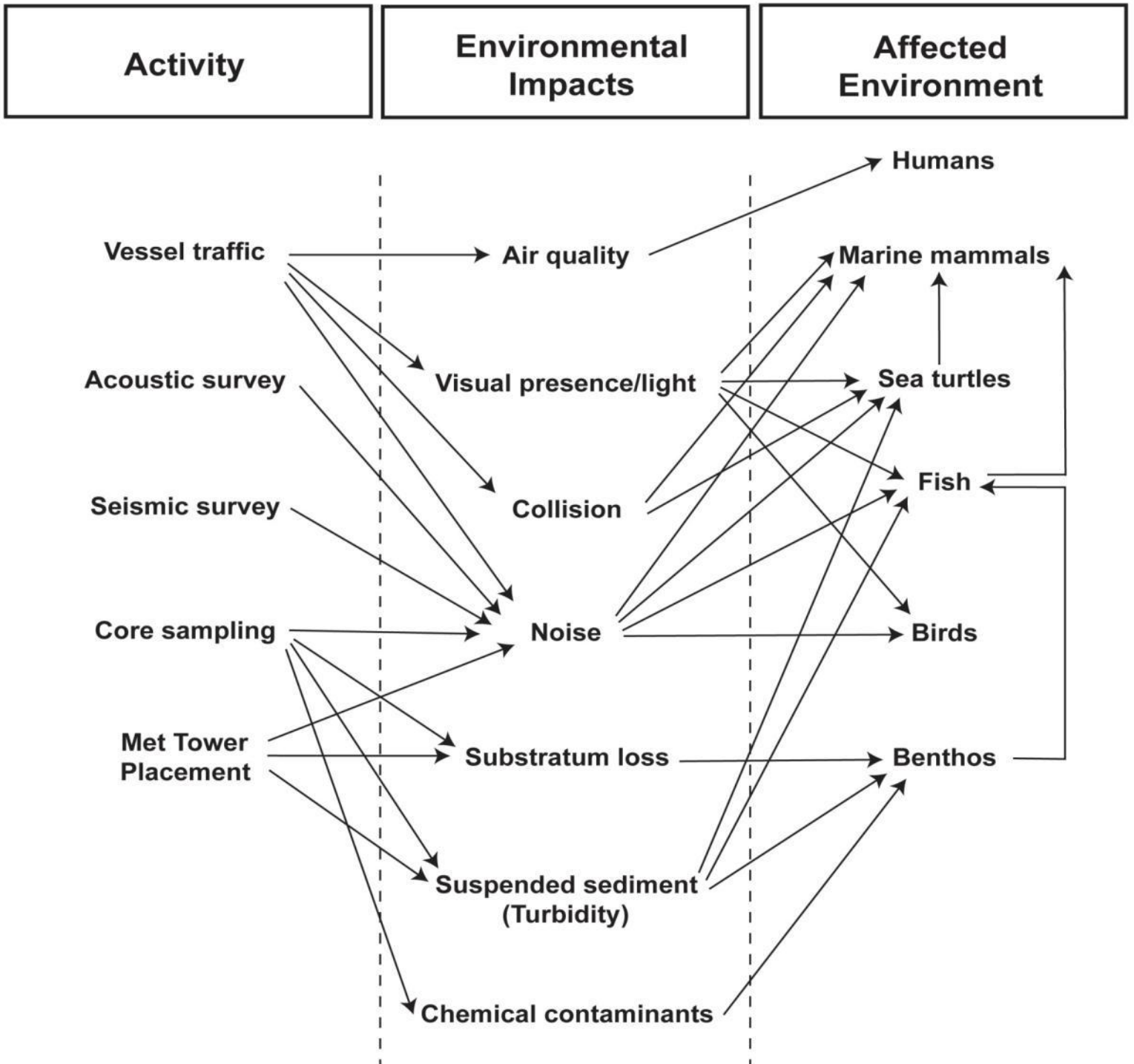
Preconstruction Impacts



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	POTENTIAL IMPACTS – PRECONSTRUCTION/EXPLORATION								
	Artificial Habitat	Lighting	Disturbance	Ship Traffic*	Noise	Substrate Loss	Turbidity	Contaminants	Turbine Collision
Avian Guilds									
Scoters				X	X	X	X	X	
Loons				X	X	X	X	X	
Gannets					X	X	X	X	
Gulls					X	X	X	X	
Terns					X	X	X	X	
Passerines									
Marine Mammals & Sea Turtles									
N. Atlantic Right Whale			X	X	X		X	X	
Humpback Whale			X	X	X		X	X	
Minke Whale			X	X	X		X	X	
Fin Whale			X	X	X		X	X	
Bottlenose Dolphin			X	X	X		X	X	
Short-beaked Common Dolphin			X	X	X		X	X	
Harbor Porpoise			X	X	X		X	X	
Harbor Seal			X	X	X		X	X	
Leatherback Sea Turtle			X	X	X	X	X	X	
Loggerhead Sea Turtle			X	X	X	X	X	X	
Fisheries Groups									
Benthic Nearshore					X	X	X	X	
Benthic Offshore					X	X	X	X	
Pelagic Nearshore					X	X	X	X	
Pelagic Offshore					X	X	X	X	

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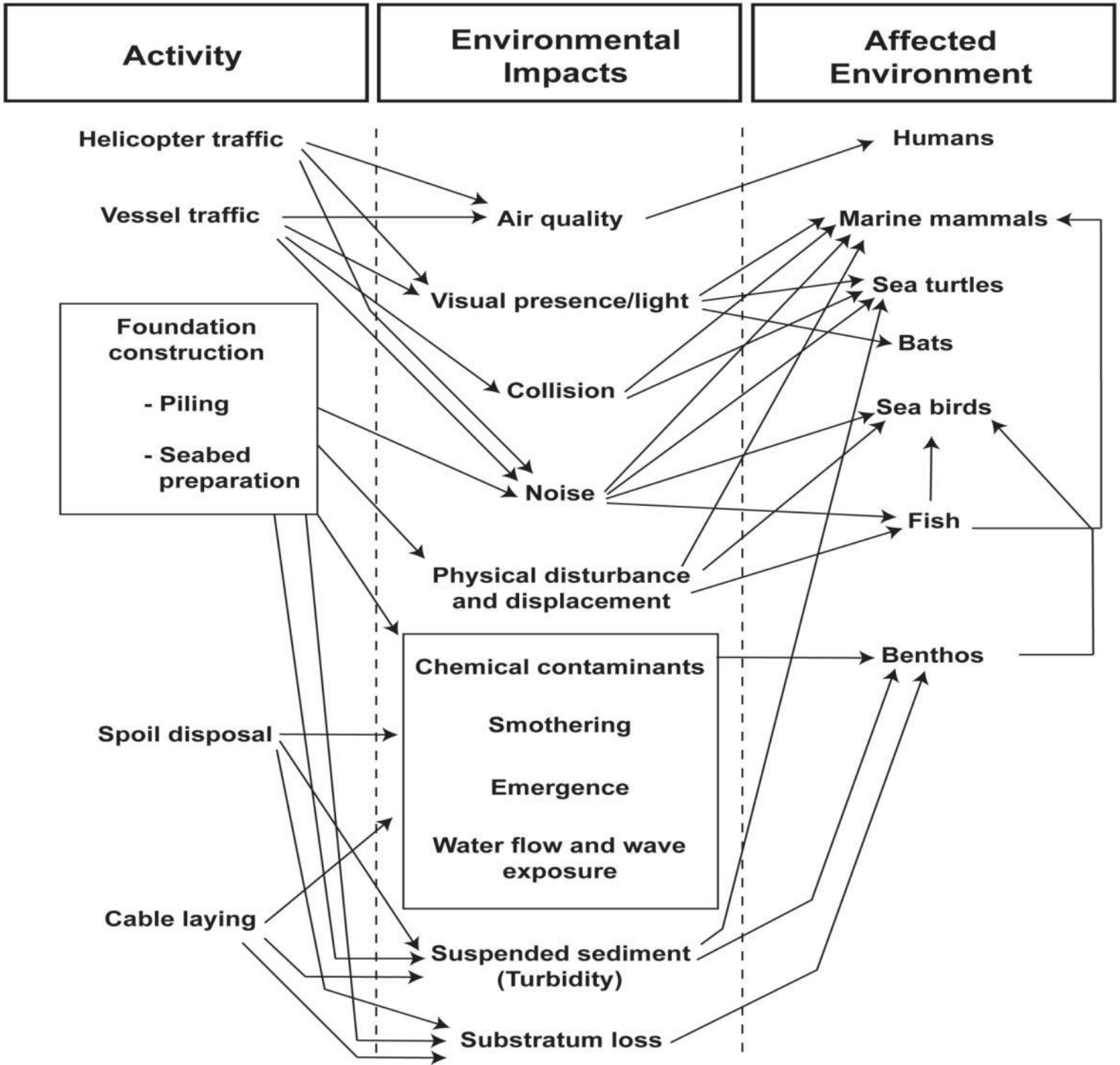
Construction Impacts



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	POTENTIAL IMPACTS -CONSTRUCTION								
	Artificial Habitat	Lighting	Disturbance	Ship Traffic*	Noise	Substrate Loss	Turbidity	Contaminants	Turbine Collision
Avian Guilds									
Scoters				X	X	X	X	X	X
Loons				X	X	X	X	X	X
Gannets					X	X	X	X	X
Gulls					X	X	X	X	X
Terns					X	X	X	X	X
Passerines		X							X
Marine Mammals & Sea Turtles									
N. Atlantic Right Whale			X	X	X		X	X	
Humpback Whale			X	X	X		X	X	
Minke Whale			X	X	X		X	X	
Fin Whale			X	X	X		X	X	
Bottlenose Dolphin			X	X	X		X	X	
Short-beaked Common Dolphin			X	X	X		X	X	
Harbor Porpoise			X	X	X		X	X	
Harbor Seal			X	X	X		X	X	
Leatherback Sea Turtle			X	X	X	X	X	X	
Loggerhead Sea Turtle			X	X	X	X	X	X	
Fisheries Groups									
Benthic Nearshore					X	X	X	X	
Benthic Offshore					X	X	X	X	
Pelagic Nearshore					X	X	X	X	
Pelagic Offshore					X	X	X	X	

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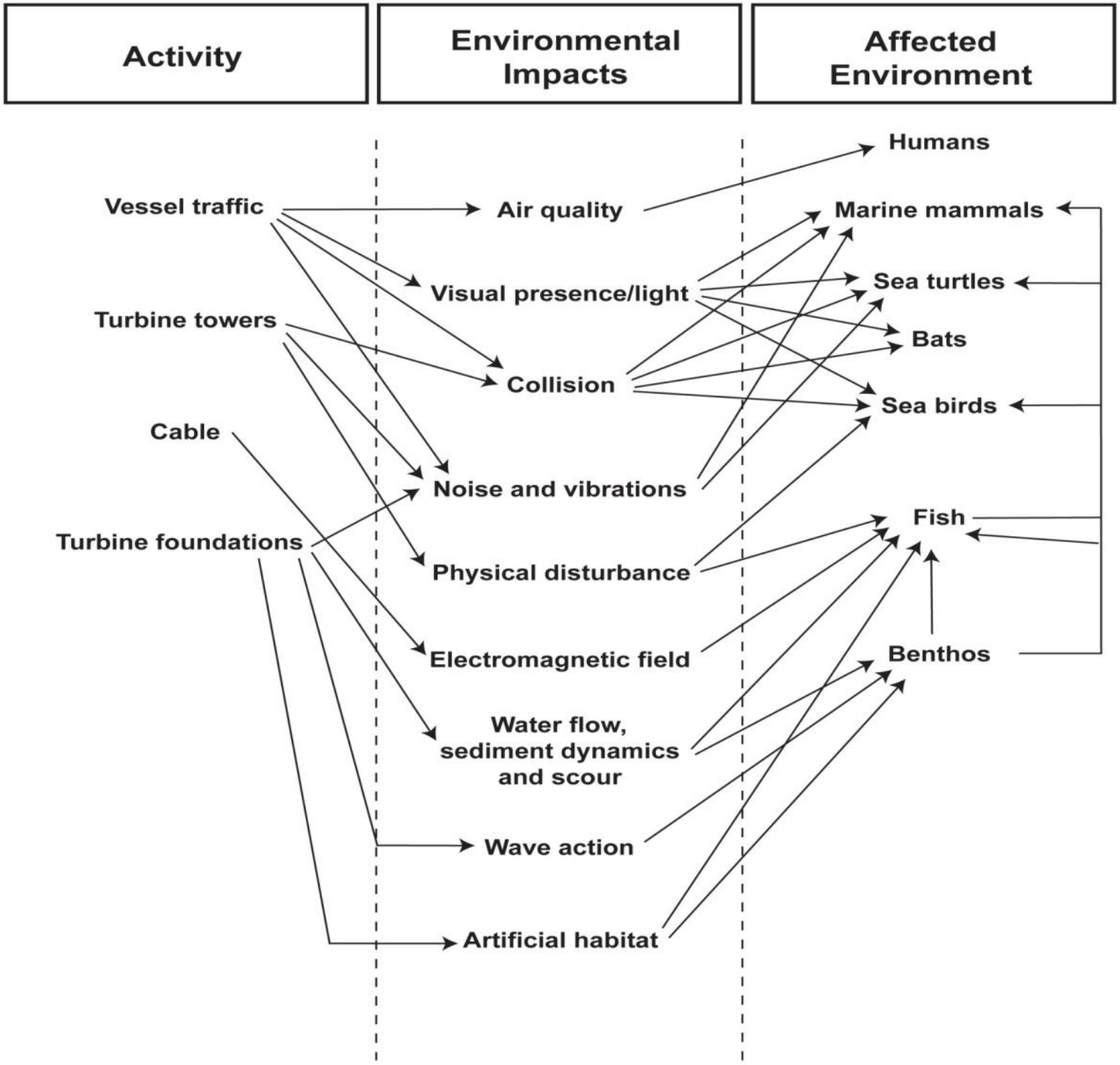
Operational Impacts



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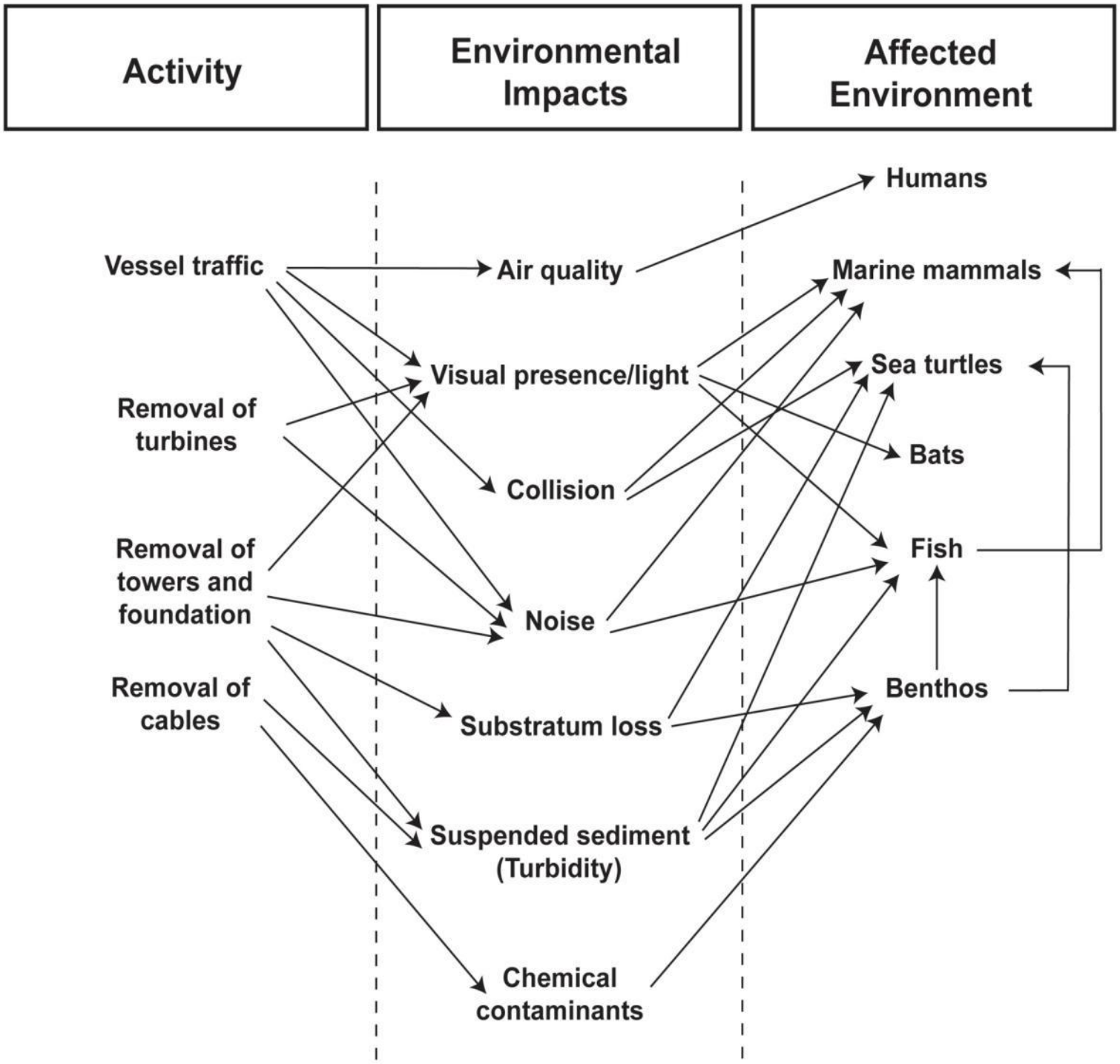
	POTENTIAL IMPACTS – OPERATIONS & MAINTENANCE								
	Artificial Habitat	Lighting	Disturbance	Ship Traffic*	Noise	Substrate Loss	EMF	Current Alteration	Turbine Collision
Avian Guilds									
Scoters		X		X	X	X			X
Loons		X		X	X	X			X
Gannets	X	X			X	X			X
Gulls	X	X			X	X			X
Terns	X	X			X	X			X
Passerines		X							X
Marine Mammals & Sea Turtles									
N. Atlantic Right Whale	X		X	X	X				
Humpback Whale	X		X	X	X				
Minke Whale	X		X	X	X				
Fin Whale	X		X	X	X				
Bottlenose Dolphin	X		X	X	X				
Short-beaked Common Dolphin	X		X	X	X				
Harbor Porpoise	X		X	X	X				
Harbor Seal	X		X	X	X				
Leatherback Sea Turtle	X		X	X	X				
Loggerhead Sea Turtle	X		X	X	X				
Fisheries Groups									
Benthic Nearshore	X				X		X	X	
Benthic Offshore	X				X		X	X	
Pelagic Nearshore	X				X		X	X	
Pelagic Offshore	X				X		X	X	

Decommissioning Impacts



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	POTENTIAL IMPACTS - DECOMMISSIONING								
	Artificial Habitat	Lighting	Disturbance	Ship Traffic*	Noise	Substrate Loss	Turbidity	Contaminants	Turbine Collision
Avian Guilds									
Scoters		X		X	X	X	X	X	X
Loons		X		X	X	X	X	X	X
Gannets	X	X			X	X	X	X	X
Gulls	X	X			X	X	X	X	X
Terns	X	X			X	X	X	X	X
Passerines		X							X
Marine Mammals & Sea Turtles									
N. Atlantic Right Whale	X		X	X	X		X	X	
Humpback Whale	X		X	X	X		X	X	
Minke Whale	X		X	X	X		X	X	
Fin Whale	X		X	X	X		X	X	
Bottlenose Dolphin	X		X	X	X		X	X	
Short-beaked Common Dolphin	X		X	X	X		X	X	
Harbor Porpoise	X		X	X	X		X	X	
Harbor Seal	X		X	X	X		X	X	
Leatherback Sea Turtle	X		X	X	X	X	X	X	
Loggerhead Sea Turtle	X		X	X	X	X	X	X	
Fisheries Groups									
Benthic Nearshore	X				X		X	X	
Benthic Offshore	X				X		X	X	
Pelagic Nearshore	X				X		X	X	
Pelagic Offshore	X				X		X	X	

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Ocean/Wind Power
Ecological Baseline Studies

New Jersey Department of Environmental Protection
Division of Science, Research, & Technology

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