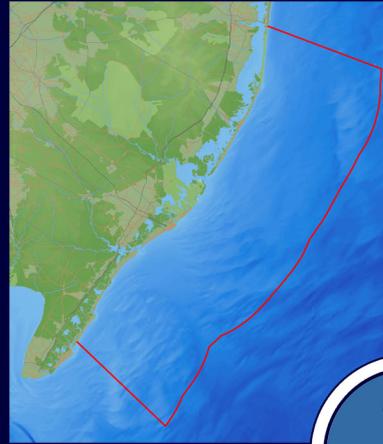


Ocean/Wind Power Ecological Baseline Studies

January 2008 – December 2009

Volume III: Marine Mammal and Sea Turtle Studies



NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION
OFFICE OF SCIENCE

FINAL REPORT

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July 2010



**New Jersey Department of Environmental Protection
Baseline Studies**

Final Report

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LIST OF ACRONYMS AND ABBREVIATIONS

°	Degree(s)
°F	Degree(s) Fahrenheit
°C	Degree(s) Celsius
AIC	Akaike's Information Criterion
BRP	Bioacoustics Research Program, Cornell Laboratory of Ornithology
BSS	Beaufort Sea State
CCL	Curved Carapace Length
CDS	Conventional Distance Sampling
CETAP	Cetacean and Turtle Assessment Program
chl <i>a</i>	Chlorophyll <i>a</i>
CI	Confidence Interval
cm	Centimeter(s)
CV	Coefficient of Variation
DF	Degrees of Freedom
DSM	Density Surface Modeling
DVD	Digital Video Disc
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
ESW	Effective Strip Half-width
ft	Foot (Feet)
GAM	Generalized Additive Model
GCV	Generalized Cross Validation
GIS	Global Information System
GMI	Geo-Marine, Inc.
GOF	Goodness-of-Fit
GPS	Global Positioning System
hr	Hour
Hz	Hertz
in.	Inch(es)
km	Kilometer
kHz	Kilohertz
kph	Kilometer(s) per Hour
kt	Knot(s)
MATS	Mid-Atlantic <i>Tursiops</i> Surveys
m	Meter(s)
mg/m ³	Milligram(s) per Cubic Meter
min	Minute(s)
MMPA	Marine Mammal Protection Act
MODIS	Moderate Resolution Imaging Spectroradiometer
mph	Mile(s) per hour
MRDS	Mark-Recapture Distance Sampling
NARWC	North Atlantic Right Whale Consortium
NASA	National Aeronautics and Space Administration
NJDEP	New Jersey Department of Environmental Protection
NM	Nautical Mile(s)
NMFS	National Marine Fisheries Service
NMFS-NEFSC	National Marine Fisheries Service-Northeast Fisheries Science Center
NMFS-SEFSC	National Marine Fisheries Service-Southeast Fisheries Science Center
NMFS-SWFSC	National Marine Fisheries Service-Southwest Fisheries Science Center
NOAA	National Oceanographic and Atmospheric Administration
OSA	Ocean Stock Assessment
PAM	Passive Acoustic Monitoring
PU	Pop-up
QA/QC	Quality Assurance/Quality Control

LIST OF ACRONYMS AND ABBREVIATIONS
(continued)

RU COOL	Rutgers Coastal Ocean Observation Lab
s	Second(s)
S	Station
SAS	Sighting Advisory System
SE	Standard Error
SST	Sea Surface Temperature
U.S.	United States
UBRE	Unbiased Risk Estimator
Var	Variance
VOR	Voice Operated Recording
χ^2	Chi-Square

LIST OF METRIC TO U.S. MEASUREMENT CONVERSIONS

To convert from	To	Multiply by
LENGTH		
Kilometer (km)	Mile, statute (mi)	0.6214
	Nautical mile (NM)	0.5400
Nautical Mile (NM)	Mile, statute (mi)	1.151
Meter (m)	Foot (ft)	3.281
	Inch (in.)	39.37
Centimeter (cm)	Inch (in.)	0.3937
Millimeter (mm)	Inch (in.)	0.03937
Micrometer or Micron (μm)	Microinch ($\mu\text{in.}$)	39.37
DISTANCE PER UNIT TIME		
Meter per second (m/s)	Mile per second (mi/s)	0.0006214
	Foot per second (ft/s)	3.281
Centimeter per second (cm/s)	Inches per second (in./s)	0.3937
Kilometers per hours (kph)	Mile per hour (mph)	0.6214
	Knot (nautical mile/hour)	0.5400
Knot (nautical mile/hour)	Mile per hour (mph)	1.151
AREA		
Square kilometer (km^2)	Square mile (mi^2)	0.3861
	Square nautical mile (NM^2)	0.2916
Square nautical mile (NM^2)	Square mile (mi^2)	1.324
Square meter (m^2)	Square foot (ft^2)	10.76
VOLUME		
Cubic meter (m^3)	Cubic foot (ft^3)	35.31
	Gallon (gal)	264.2
Liter (L)	Gallon (gal)	0.2642
VOLUME PER UNIT TIME		
Cubic meter per second (m^3/s)	Cubic foot per second (ft^3/s)	35.31
	Gallon per minute (gal/min)	15,850
Sverdrup (Sv) = $10^6 \text{ m}^3/\text{s}$	Gallon per second (gal/s)	264.2
WEIGHT		
Metric Ton (MT)	Ton, short (T)	1.102
Kilogram (kg)	Pound (lb)	2.205
DENSITY		
Kilograms per cubic meter (kg/m^3)	Pounds per cubic foot (lb/ft^3)	0.06243
CONCENTRATION		
Microgram per liter ($\mu\text{g}/\text{L}$)	Ounces per gallon (oz/gal)	1.336×10^{-7}
TEMPERATURE		
Degree Celsius ($^{\circ}\text{C}$)	Degree Fahrenheit ($^{\circ}\text{F}$)	$1.8*(^{\circ}\text{C} + 32)$

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1.0 INTRODUCTION

1.1 PREVIOUS STUDIES

Marine mammals and sea turtles are important marine resources found in the New Jersey Department of Environmental Protection (NJDEP) Study Area (hereafter referred to as Study Area); however, the distribution and abundance of these resources in New Jersey's nearshore waters are not well known. The National Marine Fisheries Service (NMFS) and other organizations have been conducting marine mammal and sea turtle surveys along the United States (U.S.) east coast for many years. Although several of these surveys have included waters of the Study Area, none have concentrated efforts specifically in New Jersey's nearshore waters, except a photo-identification survey that was conducted in coastal waters from the shoreline to 6 kilometers (km; 3 nautical miles [NM]) offshore. In addition, no year-round survey efforts have been conducted in this region. The following is a list of the main surveys that were conducted prior to the Ecological Baseline Study and that have effort which overlaps with at least part of the Study Area. Note that most of these surveys were conducted only during the summer months.

Aerial Surveys

- The National Marine Fisheries Service-Southeast Fisheries Science Center (NMFS-SEFSC) conducted the Mid-Atlantic *Tursiops* Surveys (MATS) to determine the distribution and abundance of bottlenose dolphins (*Tursiops truncatus*) in nearshore waters of the U.S. east coast. During the summer of 1994, NMFS-SEFSC conducted a pilot study which consisted of an aerial survey to count the bottlenose dolphins along the shoreline and a line transect aerial survey from Long Island, New York, to Vero Beach, Florida (Blaylock 1995). During the following summer, a line transect aerial survey from Sandy Hook, New Jersey, to Cape Hatteras, North Carolina from the shoreline to the 25-meter (m; 82-foot [ft]) isobath (around 0 to 81 km [0 to 44 NM] from shore; Garrison and Yeung 2001). The MATS surveys flown during the summer (June through July) of 2002 covered coastal waters between Sandy Hook, New Jersey, and Ft. Pierce, Florida (Waring et al. 2009). Additional surveys were flown in the summer of 2004 between Atlantic City, New Jersey, and Fort Myers, Florida (Fertl and Fulling 2007).
- The National Marine Fisheries Service-Northeast Fisheries Science Center (NMFS-NEFSC) conducted aerial (DeHavilland Twin Otter) line transect surveys to estimate cetacean and sea turtle abundance off the mid-Atlantic and northeast coasts. These surveys were flown during the summer in 1995, 1998, and 2004 from the Gulf of St. Lawrence to Virginia (NMFS-NEFSC 1998b; Quintal and Smith 1999; Palka et al. 2001).
- Right Whale Sighting Advisory System (SAS) aerial surveys are currently being flown over a broad region of the western North Atlantic Ocean from just south of Long Island, New York, to the U.S./Canada border and out to the 370 km (200 NM) Exclusive Economic Zone (EEZ).¹ Although the primary focus of these surveys is North Atlantic right whales, other species of marine mammals and also sea turtles are documented. Opportunistic sighting information is also provided to the SAS by other organizations, including state, federal, and non-profit organizations (NMFS-NEFSC 2008).

Shipboard Surveys

- The NMFS-NEFSC conducted a two-week shipboard survey (*Delaware II* 97-05 cruise) in March 1997 to determine the spatial distribution and relative abundance of cetaceans in mid-Atlantic waters between Long Island, New York, and just south of Cape Hatteras, North Carolina (NMFS-NEFSC 1997). Additional surveys (*Delaware II* 98-04 cruise) in this same region were conducted in March 1998 (NMFS-NEFSC 1998a).

- The NMFS-SEFSC conducted a shipboard marine mammal survey (*Oregon II* 99-05 cruise) in August and September 1999 from the 10-m (33-ft) isobath to 185 km (100 NM) offshore from Cape Canaveral, Florida, to just north of Delaware Bay (NMFS-SEFSC 1999).

Small Boat Surveys

- The NMFS-SEFSC and the Rutgers University Marine Field Station funded boat-based photo-identification surveys in southern New Jersey. Surveys were conducted from May through October in 2003, 2004, and 2005 along 70 km (38 NM) of coastline from the northern tip of Long Beach Island to southern Longport, New Jersey. The study area extended from the shoreline to 6 km (3 NM) offshore. The purpose of this study was to determine the occurrence, structure, and characteristics of two bottlenose dolphin population subunits in coastal New Jersey (Toth-Brown 2007).

Aerial/Shipboard Surveys

- The University of Rhode Island conducted systematic seasonal surveys (aerial and shipboard) during the Cetacean and Turtle Assessment Program (CETAP) from October 1978 through January 1982. These surveys covered waters of the U.S. continental shelf (from the coast to 9.26 km [5 NM] seaward of the 2,000-m [6,562-ft] isobath) from Cape Hatteras, North Carolina, to the northern Gulf of Maine (CETAP 1982).

1.2 BASELINE STUDY OBJECTIVES

This Ecological Baseline Study includes the first year-round, systematic survey effort in nearshore waters of New Jersey between Stone Harbor and Seaside Park. The objective of this study was to determine the spatial distribution and to estimate the abundance/density of marine mammals and sea turtles in the Study Area (shoreline to around 37 km [20 NM] offshore). This baseline study was conducted over a 24-month period between January 2008 and December 2009. The three sampling techniques conducted during this study included aerial line transect surveys, shipboard line transect surveys, and passive acoustic monitoring (PAM). Shipboard and aerial line transect surveys are a type of distance sampling method and were used to collect data on marine mammal and sea turtle species found in the Study Area. PAM was conducted to determine the presence of cetaceans in the Study Area.

The survey design, data recording methods, and safety guidelines were prepared in consultation with the NJDEP, NMFS-NEFSC personnel, acousticians from the Bioacoustics Research Program, Cornell Laboratory of Ornithology (BRP), and other experts in distance sampling and acoustic monitoring. The shipboard and aerial surveys were conducted under National Oceanographic and Atmospheric Administration (NOAA) Permit No. 10014.