NEFSC data document

The Northeast Fisheries Science Center (NEFSC) has assembled ecological and fisheries related data from a number of different data sources pursuant to the request for information for various proposed off shore wind farm sites. The data has been disseminated via GIS maps produced in ArcGIS version 10.1. This document is intended as a supplement to those GIS products produced by NEFSC. A full list of the data sources can be found in Table 1.

Satellite Data

Satellite imagery provides biological and environmental measurements at high temporal and spatial resolution not attainable by ship board measurements alone.

Chlorophyll *a* (CHLa) images are a proxy for phytoplankton biomass and are derived from ocean color data collected by the SeaWiFS sensor (oceanocolor.gsfc.nasa.gov). Sea surface temperature data are merged from three different sensors, AVHRR-Pathfinder (www.nodc.noaa.gov), MODIS-Terra and MODIS-Aqua (oceanocolor.gsfc.nasa.gov). Primary productivity (PP), the rate of photosynthesis by phytoplankton, is modeled from satellite CHL, SST and photosynthetic active radiation (PAR) data. PP measures the amount carbon produced by phytoplankton and is used in fisheries production potential models.

Annual means and the span (the difference between the maximum and minimum values at each pixel location) represent the long-term (1998-2007) statistics for the region. Annual gradient (a depiction of frontal zones) are also provided for regions which are far enough offshore to avoid signal artifacts in the satellite data (Belkin and O'Reilley 2009).

An Inverse Distance Weighting (IDW) interpolation within ArcGIS version 10 is used to better visualize the data. Satellite data is provided by Kimberly Hyde (NEFSC-Narragansett Laboratory).

Sediment and Benthic Data

Sediment data was obtained from the Continental Margin Mapping Program (CONMAP) series produced by the US Geological Survey (USGS) and Woods Hole Oceanographic Institute (WHOI). The sediment is categorized by its grain-size distribution using the Wentworth grain-size scale and the Shepard scheme of sediment classification (USGS 2005).

Benthic data was obtained from NEFSC benthic survey that was conducted from 1956 to 1965. This was a systematic grid survey that used benthic grabs to classify the biota at each station (Theroux & Wigley 1998). The two metrics used from the survey were total biomass and species richness. Total biomass was calculated by summing all species weights at each station. Species Richness was calculated by counting the number of species present at each station. Data was interpolated using empirical Bayesian kriging.

Fishery Independent Data

Fall Bottom Trawl Survey

NEFSC has been conducting their Autumn Bottom Trawl Survey annually since 1963. Details of the survey can be found in Azarovitz (1981). In order to provide the most accurate portrayal of the areas in question, the most recent 5 years (2007-2011) of the survey were used. During this time

period, NEFSC transition from the NOAA Ship Albatross IV to the NOAA Ship Henry B. Bigelow. The two metrics used from the survey were total biomass and vertebrate richness. For total biomass, the expanded catch weights for all species were summed by station. Due to the transition between vessels, biomass from 2009-2011 were converted to levels consistent with 2007-2008 as appropriate (Miller et al. 2010). Vertebrate richness was derived by counting the number of vertebrate species present at each station. Because there is no conversion for the number of species caught, only data from the NOAA Ship Henry B. Bigelow were used. The bottom trawl survey does not sample invertebrate species uniformly however this data is captured in the benthic survey mentioned in the previous section. Because the survey is fairly comprehensive in its coverage of the shelf, it was appropriate to interpolate between stations using empirical Bayesian kriging.

In addition to overall survey metrics, several key forage species were examined. The three species examined were Atlantic herring, Atlantic mackerel, and sand lance. Data are represented with graduated symbols to indicate where the survey encountered larger numbers of the species.

Ecological Monitoring Survey

NEFSC conducts quarterly surveys of oceanographic properties of the shelf including lower trophic levels. Using data obtained in the fall we mapped several key zooplankton species. Data was interpolated using empirical Bayesian kriging.

Fishery Dependent Data

Commercial Fishery

Vessels operating in the Northeast US are required to report catch and effort information via Vessel Trip Reports (VTR) since 1994 (Rago et al. 2005). VTR data was segregated into commercial and recreational data. For commercial data, we further divided the data into 6 major gear categories. These gear categories were otter trawl, dredge, gillnet, pot, longline, and seine. We also used a seventh "other" gear category to encompass gears that did not fall into any of the six major categories. When data from a particular gear did not intersected with the proposed area, the maps were omitted from the submission. For landings we binned data into ten minute squares and took mean landings per year. We then interpolated the data using empirical Bayesian kriging. Effort data was collected for mobile gear as a yearly mean of tow durations within a ten minute square. Once again, the data was then interpolated using empirical Bayesian kriging.

Recreational Fishery

Recreational data was further divided into 2 major categories: party trips and charter trips. All gear categories were combined for recreational data (vast majority of gear was hand lines). Catch data is reported in pounds for commercial trips while recreational trips report catch as count (# fish). For recreational data, we measured effort by the number of trips. Data was interpolated using empirical Bayesian kriging.

Observer Data

Similar calculations were performed on the observer data from 2007-2011. For observer data we also mapped discards per gear category.

Literature Cited

Azarovitz TR (1981) A brief historical review of the Woods Hole Laboratory trawl survey time series. Canadian Special Publication of Fisheries and Aquatic Sciences 58:62-67

Belkin IM, O'Reilly JE (2009) An algorithm for oceanic front detection in chlorophyll and SST satellite imagery. Journal of Marine Systems 78:319-326

Miller T, Das C, Politis P, Miller A, Lucey S, Legault C, Brown R, Rago P (2010) Estimation of Albatross IV to Henry B. Bigelow calibration factors. NEFSC Reference Document 10-05. National Marine Fisheries Service, Woods Hole, MA, p 233

Rago PJ, Wigley SE, Fogarty MJ (2005) NEFSC bycatch estimatiopn methodology: Allocation, precision, and accuracy. NEFSC Reference Document 05-09. National Marine Fisheries Service, Woods Hole, MA, p 233

Theroux RB, Wigley RL (1998) Quantitative composition and distribution of the macrobenthic invertebrate fauna of the Continental Shelf Ecosystems of the Northeastern United States. NOAA, Woods Hole, MA, p 240

U.S. Geological Survey (2005) CONMAPSG: Continental Margin Mapping (CONMAP) sediment grainsize distribution for the United States East Coast Contionental Margin: Open-File Report 2005-1001. USGS, Coastal and Marine Geology Program, Woods Hole, MA

Table 1 – Data sources used in GIS maps produced by NEFSC

Source	Variable	Units	Time Frame	Aggregation	Additional Information
Satellite Remote Sensing	Chlorophyll a mean	mg m^{-3}	1998-2007	Interpolated (IDW)	http://oceanocolor.gsfc.nasa.gov
Satellite Remote Sensing	Chlorophyll a gradient	unitless (ratio)	1998-2007	Interpolated (IDW)	http://oceanocolor.gsfc.nasa.gov Belkin and O'Reilly 2009
Satellite Remote Sensing	Chlorophyll a span	mg m^{-3}	1998-2007	Interpolated (IDW)	http://oceanocolor.gsfc.nasa.gov
Satellite Remote Sensing	PPD mean	gC m^{-2} d^{-1}	1998-2007	Interpolated (IDW)	http://oceancolor.gsfc.nasa.gov http://www.nodc.noaa.gov/SatelliteData/pathfinder4km/
Satellite Remote Sensing	PPD span	unitless (ratio)	1998-2007	Interpolated (IDW)	http://oceancolor.gsfc.nasa.gov/cgi/l3 http://www.nodc.noaa.gov/SatelliteData/pathfinder4km/
Satellite Remote Sensing	SST mean	^{o}C	1998-2007	Interpolated (IDW)	http://oceancolor.gsfc.nasa.gov/cgi/l3 http://www.nodc.noaa.gov/SatelliteData/pathfinder4km/
Satellite Remote Sensing	SST gradient	^{o}C km^{-1}	1998-2007	Interpolated (IDW)	http://oceancolor.gsfc.nasa.gov/cgi/l3 http://www.nodc.noaa.gov/SatelliteData/pathfinder4km/ Belkin and O'Reilly 2009
Satellite Remote Sensing	SST span	^{o}C	1998-2007	Interpolated (IDW)	http://oceancolor.gsfc.nasa.gov/cgi/l3 http://www.nodc.noaa.gov/SatelliteData/pathfinder4km/
USGS Sediment Data	Sediment Type		1982-1999		http://pubs.usgs.gov/of/2005/1001/data/conmapsg/conmapsg.zip
NOAA/USGS Cold-Water Coral Geographic Database (CoWCoG)	Cold Water Corals	Presence			
Eric Huepel, University of Connecticut	Terrain ruggedness index	slope			
NEFSC Benthic Data	Biomass	g	1956-1965	empirical Bayesian kriging	
NEFSC Benthic Data	Species Richness	# species	1956-1965	empirical Bayesian kriging	
NEFSC Autumn Bottom Trawl Survey	Biomass	kg	2006-2011	empirical Bayesian kriging	Catches from Bigelow converted to Albatross IV equivalent
NEFSC Autumn Bottom Trawl Survey	Vertebrate Richness	# species	2009-2011	empirical Bayesian kriging	Bigelow catches
NEFSC Autumn Bottom Trawl Survey	Abundance	# individuals	2007-2011		Ecologically important species
NEFSC Ecological Monitoring Survey	Abundance	# individuals	2007-2011		Ecologically important zooplankton

VTR Commercial Data	Landings	Log(lbs)	2007-2011	empirical Bayesian kriging	Divided by major gear categories (Otter Trawl, Dredge, Gillnet, Pot, Longline, Seine, and Other)
VTR Commercial Data	Effort	days fished	2007-2011	empirical Bayesian kriging	Divided by major gear categories (Otter Trawl, Dredge, Gillnet, Pot, Longline, Seine, and Other)
VTR Recreational Data	Landings	Log(# fish)	2007-2011	empirical Bayesian kriging	Divided by party trips and charter trips
VTR Recreational Data	Effort	Log(# trips)	2007-2011	empirical Bayesian kriging	Divided by party trips and charter trips
Observer Data	Landings	Log(lbs)	2007-2011	empirical Bayesian kriging	
Observer Data	Discards	Log(lbs)	2007-2011	empirical Bayesian kriging	
Nature Conservancy	Other human uses				Telecommunication lines, shipping lanes, and sand study sites