Fishing Effects Model
Sediment Data Density
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Prepared for*:*
Northeast Regional Ocean Council (NROC)
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1 INTRODUCTION

The Northeast Fishing Effects Model combines seafloor data (sediment type, energy regime) with fishing effort data and parameters related to the interactions between fishing gear and seafloor habitats to generate percent habitat disturbance estimates in space and time. Fishing gear interacts with both living (biological) and non-living (geological) seafloor features. Diverse seabed types comprised of various combinations of biological and geological features occur in the Northwest Atlantic Ocean off the northeastern United States. These seabed structures constitute merely one element of complex fish habitats that also include the overlying water column and its features. Because sediment type data were available at a reasonable spatial resolution and representativeness across the model domain, sediments were used as a proxy for the diverse array of seabed types occurring in the region, with biological habitat elements inferred on the basis of sediment and energy classifications. This allows appropriate habitat/gear interaction parameters to be applied when the model is run.

Generally, the model domain extends north to south from the U.S./Canadian border to the N.C./S.C. border, and inshore to offshore from the coastline to the Exclusive Economic Zone boundary. The sediment grid covers this entire domain. Data inputs and outputs to Fishing Effects are gridded at a 5 km by 5 km resolution, except for cells along the edge of the domain which are clipped to the coastline or Exclusive Economic Zone boundary and are therefore smaller.

This dataset indicates the number of data points occurring within each 5x5 grid cell (data density). Each record in the dataset represents a unique grid cell with corresponding grid identification number. In areas where there were existing polygon interpretations of sediments, these are used instead of the point-based interpolations to determine the percent sediment values in the final sediment dataset. The polygon data are not included in this sediment data density product, only points. The methods for generating the percent sediment grid, including the use of polygon vs. point data in specific locations, are explained in the metadata document for that dataset.

Additional information about the model can be found in NEFMC (2019) and in the report for the precursor to Fishing Effects, the Swept Area Seabed Impact (SASI) Model (NEFMC 2011). Smeltz et al. (2019) details the North Pacific implementation of the model and provides additional background.

2 PURPOSE

The primary purpose of this dataset is to indicate data density associated with the percent sediment base layer for the Northeast Fishing Effects Model. Percent sediment values in cells with fewer observations may be less reliable than values calculated for grids with multiple grain size observations. The associated map of sediment grain sizes (percent sediment map) can be used to inform various spatial planning issues where seabed type is a consideration for decision making. It is important to understand caveats and limitations associated with both the underlying source data and this compilation when using the data for spatial planning. These limitations and caveats influence the Fishing Effects Model percent habitat disturbance results as well.

3 SOURCES AND AUTHORITIES

Various sources and types of sediment data were combined to generate this product. See percent sediment metadata for details.

4 COLLABORATORS

The Fishing Effects Model was developed collaboratively by the New England Fishery Management Council's Habitat Plan Development Team and the Fisheries, Aquatic Science, and Technology Laboratory at Alaska Pacific University. Team members included:

- Michelle Bachman, NEFMC staff
- Peter Auster, University of Connecticut/Mystic Aquarium
- Jessica Coakley, Mid-Atlantic Fishery Management Council
- Geret DePiper, NMFS/Northeast Fisheries Science Center
- Kathryn Ford, Massachusetts Division of Marine Fisheries
- Bradley Harris, Alaska Pacific University
- Julia Livermore, Rhode Island Division of Marine Fisheries
- Dave Packer, NMFS/ Northeast Fisheries Science Center
- Chris Quartararo, NEFMC staff
- Felipe Restrepo, Alaska Pacific University
- T. Scott Smeltz, Alaska Pacific University
- David Stevenson, NMFS Greater Atlantic Regional Fisheries Office
- Page Valentine, U.S. Geological Survey
- Alison Verkade, NMFS Greater Atlantic Regional Fisheries Office

5 DATABASE DESIGN AND CONTENT

- Feature Class Name: Fishing Effects Sediment
- Total Number of Unique Features: 13,157 (corresponds with the percent disturbance results)
- Dataset Status: Complete
- Native storage format: ArcGIS feature class
- Feature Type: Polygon

Table 1. Data dictionary.

Line	Name	Definition	Type	Size[1]
1	OBJECTID	Uniquely identifies a feature	OBJECTID	*
2	Shape	Geometric representation of the feature	geometry	*
3	GridID	Unique GridID field used to link across model datasets	Long	9
4	Mud	Proportion of grid cell classified as mud grain size	Double	18, 15
5	Sand	Proportion of grid cell classified as sand grain size	Double	18, 15
6	GrPe	Proportion of grid cell classified as granule or pebble grain size	Double	18, 15
7	Cobble	Proportion of grid cell classified as cobble grain size	Double	18, 15
8	Boulder	Proportion of grid cell classified as boulder grain size	Double	18, 15
9	StDeep	Proportion of grid cell classified as steep and deep	Double	18, 15
10	Diversity	Number of distinct sediment classes (mud-boulder)	Long	10
11	Density	Number of sediment points (does not account for polygon data inputs)	Long	10

6 SPATIAL REPRESENTATION

- Geometry Type: vector polygon
- Projection
    - Reference System: GCS_North_American_1983
    - Horizontal Datum: North American Datum 1983
    - Ellipsoid: Geodetic Reference System 1980
- XY Resolution: n/a
- Tolerance: n/a
- Geographic extent: -82.87 to -63.95, 22.14 to 47.13
- IS0 19115 Topic Category: environment, oceans, geoscientificInformation
- Place Names: Cape Cod Bay, Georges Bank, Gulf of Maine, Maine Inner Continental Shelf, Massachusetts Bay, New Jersey Continental Shelf, New York Bight, North Atlantic Ocean, Southern New England Shelf
- Recommended Cartographic Properties:
    - (Using ArcGIS ArcMap nomenclature)
    - Classified, Manual classification, 9 classes, color model R-G-B
        - 0: no color
        - 1: 217-217-217
        - 2: 204-204-204
        - 3: 191-191-191

        - 4: 179-179-179
        - 5: 166-166-166
        - 6: 153-153-153
        - 7: 140-140-140
        - 8-1916: 52-52-52
- Scale range for optimal visualization:1,000,000 to 13,000,000

7 METHODS AND DATA PROCESSING

The number of points in each grid cell was determined by summing the number of points falling inside each grid in ArcGIS.

8 QUALITY PROCESS

- Attribute Accuracy: Attribute values are derived from authoritative metadata sources.
- Logical Consistency: These data are believed to be logically consistent.
- Completeness: The completeness of the data reflects the feature content of the data sources, and their associated metadata.
- Positional Accuracy: Positional accuracy may vary according to positioning methodology in the underlying data sources. Results are aggregated by Fishing Effects Model grid cell, with each cell having a resolution of 5 kilometers.
- Timeliness: Based on samples collected between 1934 and 2018.
- Use restrictions: Data are presented as is. Users are responsible for understanding the metadata prior to use. The New England Fishery Management Council shall be acknowledged as data contributors to any reports or other products derived from these data.
- Distribution Liability: All parties receiving these data must be informed of all caveats and limitations.

9 CAVEATS AND DISCUSSION

As described in the metadata document for the Percent Sediment Type layer, percent sediment for each grid was calculated using one of three methods: (1) a modified area-weighted approach for cells with polygonal sediment data, (2) a similar approach but based on counts instead of areas for cells without polygon data but with 8 or more point data values, or (3) an Ordinary Kriging spatial interpolation for cells with less than 8 point data values.

Data density alone is not necessarily and indicator of data quality. A major qualifier is that the methods used to generate the sediment data compiled by USGS often do not have the ability to sample the largest grain sizes, cobble and boulder. Therefore, even in areas of high point data density, these larger grain sizes may be under-represented. This could be occurring in Long Island Sound, Buzzards Bay, and Massachusetts Bay. While in general sediments are finer in the Mid-Atlantic Bight as compared to New England, there are localized areas of high data density (>7 points) associated with data from the USGS database along the coast of NJ, DE, MD, and NC as well. Other than these areas, locations with greater than 7 points per grid were surveyed with drop camera, capable of detecting the larger grain sizes.

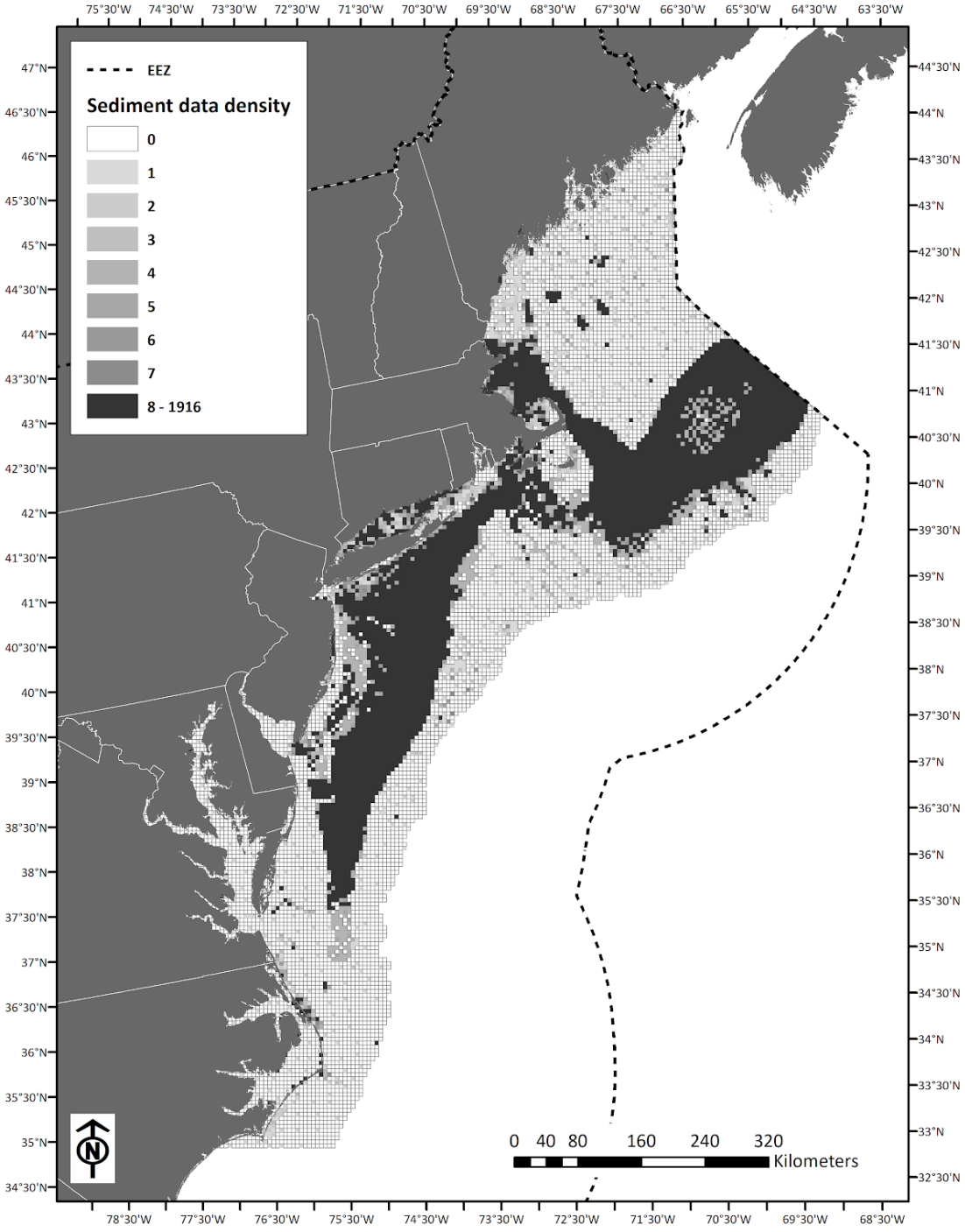
10 REFERENCES

NEFMC (2011). Omnibus Essential Fish Habitat Amendment 2 Final Environmental Impact Statement. Appendix D: The Swept Area Seabed Impact (SASI) approach: a tool for analyzing the effects of fishing on Essential Fish Habitat. Newburyport, MA, New England Fishery Management Council: 257p.

NEFMC (2019). Fishing Effects Model Northeast Region. Newburyport, MA, New England Fishery Management Council: 109p.

Smeltz, T. S., B. P. Harris, J. V. Olson and S. A. Sethi (2019). "A seascape-scale habitat model to support management of fishing impacts on benthic ecosystems." Canadian Journal of Fisheries and Aquatic Sciences: 76(10): 1836-1844.

11 FIGURES


EEZ
Sediment data density
0
1
2
3
4
5
6
7
8 - 1916
0 40 80 160 240 320
Kilometers
75°30'W 74°30'W 73°30'W 72°30'W 71°30'W 70°30'W 69°30'W 68°30'W 67°30'W 66°30'W 65°30'W 64°30'W 63°30'W
47°N 46°30'N 46°N 45°30'N 45°N 44°30'N 44°N 43°30'N 43°N 42°30'N 42°N 41°30'N 41°N 40°30'N 40°N 39°30'N 39°N 38°30'N 38°N 37°30'N 37°N 36°30'N 36°N 35°30'N 35°N 34°30'N
44°30'N 44°N 43°30'N 43°N 42°30'N 42°N 41°30'N 41°N 40°30'N 40°N 39°30'N 39°N 38°30'N 38°N 37°30'N 37°N 36°30'N 36°N 35°30'N 35°N 34°30'N 34°N 33°30'N 33°N 32°30'N
78°30'W 77°30'W 76°30'W 75°30'W 74°30'W 73°30'W 72°30'W 71°30'W 70°30'W 69°30'W 68°30'W