Fishing Effects Model
Sediment Diversity
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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, with the exception of 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 different sediment types associated with each cell in the percent sediment grid used as an input to Fishing Effects. Five different sediment grain sizes are represented in this dataset, mud, sand, granule/pebble, cobble, and boulder. Each record in the dataset represents a unique grid cell with corresponding grid identification number.

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 the number of sediment categories associated with each grid cell in the percent sediment base layer for the Northeast Fishing Effects Model. This provides a rough indication of the diversity of sediment types occurring across different portions of the domain. The associated map of sediment grain sizes 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
- 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

[1] Size for type double fields refers to precision and scale

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
- 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, 5 classes, color model R-G-B
      5: 0-0-0
      4: 78-78-78
      3: 130-130-130
      2: 178-178-178
      1: 225-225-225

- Scale range for optimal visualization: 1,000,000 to 13,000,000

7 METHODS AND DATA PROCESSING

The number of sediment types in each cell was calculated by summing the number of classes (mud, sand, granule/pebble, cobble, and boulder) with non-zero percentages.

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

All five sediment classes occur in three primary locations: (1) grids directly offshore RI; (2) on the back side of Cape Cod, continuing along the Great South Channel, and east along the northern flank of Georges Bank; and (3) in various shallow banks and ledges in the Gulf of Maine, including Jeffreys Bank, Stellwagen Bank, Fippennies Ledge, Cashes Ledge, and Platts Bank. Occasional grids in the Mid-Atlantic Bight include all five sediments but boulder and cobble are rare in that region.

The spatial distribution of grids with four sediment classes is generally similar, but also includes much of the inshore Gulf of Maine. One reason for this is that the Maine Bottom Type (Barnhardt et al 1998) and Massachusetts Office of Coastal Zone Management data sets only have four classes, mud, sand, gravel (coded as granule-pebble) and rock outcrop (coded as boulder). The Fishing Effects cobble and boulder categories fall within Barnhardt's/MA CZM's gravel categories, such that there is not an ideal correspondence between the Fishing Effects classification and these sources. Rock outcrops are not identified in other data sets contributing to the sediment grid.

Other locations in the domain that are classified as having two or three of the five sediment grain sizes may be classified this way because only three sediment types are present, but the source data documents all five, or because the source data only document three classes. This is the case with the USGS database, where sampling gears contributing information to this data set are generally not capable of sampling cobble and boulder sizes, so these two types cannot be mapped using the USGS data. Also, the Narragansett Bay Estuary Program data classifies sediments as mud, sand, or gravel, and gravel was mapped to the granule pebble sediment type in Fishing Effects. That being said, large areas of Georges

Bank and the Mid-Atlantic Bight mapped with drop camera (which is expected to provide a complete picture of the grain sizes occurring in these areas) only have mud, sand, and/or granule-pebble classes.

Locations with a single sediment type are rare, but there is a large area in the center of Georges Bank that is mapped as 100% sand.

10 REFERENCES

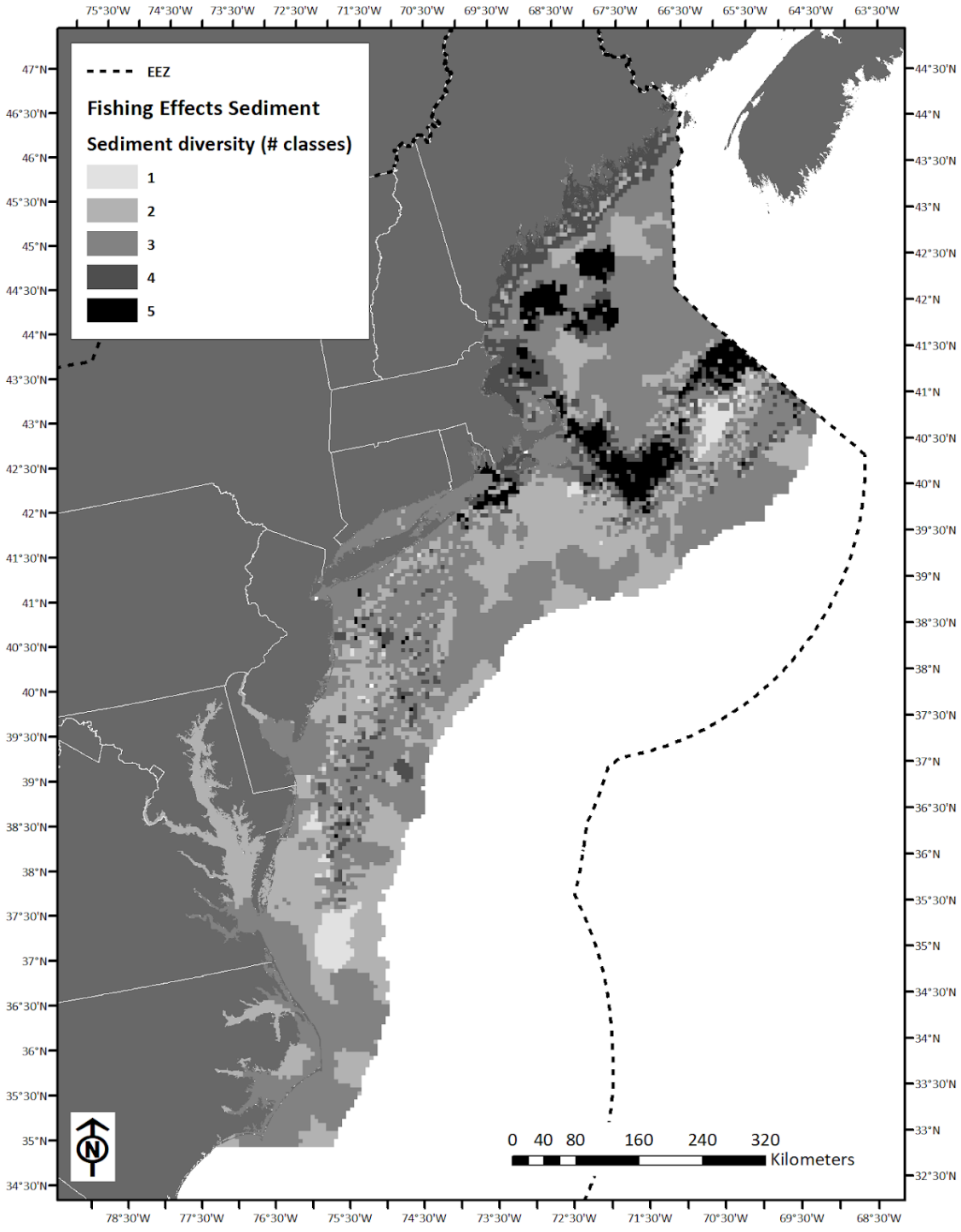
NEFMC (2011). Omnibus Essential Fish Habitat Amendment 2 Final Environmental Impact Statement. Appendix D: The Swept Area Seabed Impact (SASI) approach: a tool for analyzing the effects of fishing on Essential Fish Habitat. Newburyport, MA, New England Fishery Management Council: 257p.

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.

12 FIGURES

Figure 1. Sediment diversity, i.e. number of classes present in each grid, considering mud, sand, granule/pebble, cobble, and boulder classes.


EEZ
Fishing Effects Sediment
Sediment diversity (# classes)
1
2
3
4
5
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