

Northeast Recreational Boater Route Density
Northeast United States
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Prepared for:
SeaPlan
89 South Street, Suite 202
Boston, MA 02111

Prepared by:
Kate Longley
SeaPlan
89 South Street, Suite 202
Boston, MA 02111

1. INTRODUCTION

The Northeast Recreational Boating Density Layer was created based on results of the 2012 Northeast Recreational Boater Survey, which was conducted by SeaPlan, the Northeast Regional Ocean Council (NROC), states' coastal agencies, marine trade associations composed of many private industry representatives, and the First Coast Guard District. The methodology for the 2012 Northeast Recreational Boater Survey follows a protocol similar to the [2010 Massachusetts Survey](#) with modifications based on the lessons learned and recommendations suggested in the [Massachusetts Survey Final Report](#).

The methodology consists of surveying a random sample of selected boat owners throughout the Northeast through a series of monthly online surveys. The surveying period lasted throughout the 2012 boating season (May 1 through October 31, 2012), which was identified by the advisory committee (consisting of NROC and representatives from the recreational boating industry).

The project team decided to use a random sample survey approach because it successfully gathered statistically robust economic and spatial data on recreational boating activity by Massachusetts registered boaters during the 2010 boating season. This was also the only approach that would allow for the calculation of statistically robust economic impact estimates for both the states and the region, which was identified as a priority (along with spatial data) by both NROC and the boating industry.

Survey Sampling Methodology

The sample for this survey came from seven databases, including the U.S. Coast Guard Documented Vessel Database and databases of state registered boaters from New York, Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine. Recreational boaters who owned vessels that met the following criteria were eligible for the survey:

- Registration: Currently registered with a state in the Northeast and/or registered as a documented vessel with the U.S. Coast Guard, with a hailing port in the Northeast
- Primary Use: Recreational use designation
- Length: At least 10 feet in length
- Saltwater (if specified; only Maine and New Hampshire required this information)
- Location: Located in a “coastal county”. The survey team defined “coastal counties” as those that border saltwater, or those that were highlighted by state coastal planners as likely containing large amount of saltwater boating activity.

Based on the 2010 Massachusetts Survey and budgetary considerations, the project team determined an overall sample size that would provide sufficient spatial and economic data for both each state, as well as the whole Northeast. Because of the, at times, large discrepancies between the number of eligible boats in some states, the team decided that certain states with fewer eligible boats should also have a supplemental sample of boats in addition to the pure random sample. To ensure the sample represented the total population of registered boats in the Northeast, the sampling method included considerations of state, geography and size class. Of the 373,766 boats eligible for the survey, the base of randomly sampled boats included 50,000 boats from across all six states. In addition to this base, the survey team sampled 17,772 boats as a supplemental sample, including: 1,772 boats of 26 feet in length or more from across all six states to increase the number of large boats in the sample, and 16,000 additional boats to ensure each state had enough responses for the statistical analysis. These included 10,000 boats from Maine, 2,500 boats from Rhode Island, 2,000 boats from New Hampshire and 1,500 boats from Connecticut. This resulted in a total of 67,772 boaters invited to participate in the study.

Boater Recruitment and Response

In the survey invitation package, the survey team also sent invited boaters a questionnaire to verify eligibility to participate in the survey. Eligibility requirements consist of: boat is used in saltwater; boat is used for recreational purposes; and boaters have access to the internet with a working email address. 12,218 boaters responded to the invitation; however only 7,800 of these respondents were found to meet all of the above criteria. From this sample, 4,297 individual boaters completed at least one monthly survey.

Surveying Process

The study consisted of six monthly surveys and one end of season survey. The online monthly surveys gathered spatial and economic data on recreational boating activity that occurred during the previous month. The online survey had two parts: 1) a survey with questions about general boating activity during the previous month, and the boater's last trip of the month (specifically focusing on spending), and 2) a mapping application developed by [Ecotrust](#) where boaters plotted their boating route and identified any areas where they participated in activities, such as fishing, diving, wildlife viewing, swimming and relaxing at anchor. The end of season survey gathered a variety of information that could not be gathered in the monthly surveys. The end of season survey contained questions about yearly boating-related expenditures (e.g., dockage, storage, taxes, yearly maintenance), feedback on the survey itself, and general boating-related questions (e.g. whether boaters have taken a boating safety course).

Density Analysis

The density analysis described in the following paragraphs was vetted by a technical advisory team consisting of representatives from the Massachusetts Office of Coastal Zone Management (MA CZM), NROC, Maine Coastal Program and Applied Science Associates (ASA) and was based on mapping and analysis protocols from the 2010 Massachusetts Survey.

To develop the density layer, vessel routes were drawn in WGS 1984 in the Ecotrust mapping application and were imported into Excel, then ArcMap using a data frame in that coordinate system. Routes from the random sample were selected from that data layer, and the data layer was re-projected into two separate shapefiles, one in UTM 18 and one in UTM 19. A line density analysis using a 250 m square grid cell with a 675 m neighborhood was applied to each shapefile. The 675 m neighborhood was applied to account for inherent user error in the mapping tool. The line density analysis resulted in a raster grid for each UTM zone. Each raster was clipped by the boundaries of its UTM zone, re-projected into the North American Albers Equal Area Conic Projection, and the separate rasters were mosaicked together. At the boundary of the two raster grids there was a line of cells with no data value. This was a result of mosaicking rasters that originated in different coordinate systems. To approximate values in the blank cells, each blank cell was populated by a value from a focal statistics calculation. The focal statistics expression took the mean of all cells in a 4x4 neighborhood around each blank cell. The values were then converted to Z-scores using the raster calculator by taking the log of the density values, subtracting the mean value, and dividing the resulting value by the standard deviation of the value. This layer was clipped again using the NOAA medium resolution shoreline dataset.

2. PURPOSE

This dataset can be used by coastal planners in ocean planning activities to develop a better understanding of how and where humans use the ocean in the Northeast to inform regional ocean planning and minimize ocean use conflicts. This effort also fulfilled a recommendation from the 2010 Massachusetts Survey to expand the survey's geographic range to the Northeast Region, allowing for the capture of interstate traffic between states in the Northeast. Furthermore, this dataset can also be used by the boating industry to show the importance of recreational boating to the region and to inform business planning.

3. SOURCES AND AUTHORITIES

- 2012 Northeast Recreational Boater Survey, SeaPlan 2013
- NOAA Medium Resolution Shoreline Dataset

4. DATABASE DESIGN AND CONTENT

Native storage format: ArcGIS File Geodatabase Raster

Columns and Rows: 3886, 4858

Number of Bands: 1

Cell Size: 250 meters

Source Type: continuous

Pixel Type: floating point

Pixel Depth: 32 Bit

Statistics:

Minimum: -10.04834938049316

Maximum: 3.436755657196045

Mean: 0.09926157765271766?

Standard Deviation: 1.005643995322989

Dataset Name: RecreationalBoaterRouteDensity

Dataset Status: Complete

5. SPATIAL REPRESENTATION

Reference System: GCS North American 1983

Horizontal Datum: North American Datum 1983

Ellipsoid: Geodetic Reference System 1980

Linear Unit: Meter (1.0)
 Angular Unit: Degree (0.0174532925199433)
 False Easting: 0.0
 False Northing: 0.0
 Central Meridian: -96

Geographic extent: -76.72 to -65.72, 35.00 to 45.18

ISO 19115 Topic Category: environment, oceans, biota, economy, transportation

Place Names:

Atlantic Ocean, Bay of Fundy, Cape Cod Bay, Chesapeake Bay, Delaware Bay, Gulf of Maine, Georges Bank, Long Island Sound, Massachusetts Bay, Nantucket Shoals, Northwest Atlantic, Rhode Island Sound

Recommended Cartographic Properties:

(Using ArcGIS ArcMap nomenclature)

Unclassified Stretched, Histogram Equalize, Condition Number color ramp

Scale range for optimal visualization: 6,771 to 6,933,504

6. DATA PROCESSING

Processing environment: ArcGIS 10.05, Windows 7 Ultimate SP5, Intel Xeon CPU

	Process Steps Description
1	Raw routes from mapping application imported into ArcMap
2	Routes from random sample selected using select by attributes query
3	Routes projected into two separate shapefiles (UTM Zones 18 & 19)
4	LINE DENSITY tool in spatial analyst applied to each shapefile using a 250 m square grid with a 675 m neighborhood
5	Resulting rasters clipped to their respective UTM Zones using the EXTRACT BY MASK tool
6	Rasters reprojected to North America Albers Equal Area Conic Projection, using PROJECT tool
7	MOSAIC tool used to merge rasters
8	Focal mean expression (4x4 neighborhood) used to approximate and fill cells with no data at the boundary between mosaicked rasters
9	Raster calculator used to calculate Z-scores $\frac{(\ln(\text{Value}) - \text{Mean})}{\text{Std. Deviation}}$
10	Raster clipped by NOAA Medium Resolution Shoreline data using EXTRACT BY POLYGON tool

7. QUALITY PROCESS

Attribute Accuracy: The lines used to generate the density grid were derived from a mapping tool used by boaters to reconstruct their boating routes. To ensure that boaters included their round-trip route the mapping applications would send the user an error message asking them to re-plot the route or the program would automatically return the route to the starting point. This application also restricted the scale at which users could draw their routes, reducing the amount of error that could occur from plotting routes at too small a scale. Clipping this layer with a regional ocean shapefile derived from the NOAA medium resolution shoreline dataset excluded route density resulting from routes drawn over land, in freshwater, or outside of northeastern waters.

Logical Consistency: None

Completeness: Only reported routes from the random sample were included. Routes from the supplemental sample were excluded from this analysis. Route density occurring over land, freshwater areas, or outside northeastern waters was excluded by the final geoprocessing step.

Positional Accuracy: The positional accuracy of the routes is dependent on the individual reporting routes through the mapping tool.

Timeliness: This dataset represents data collected from May through October of 2012.

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