Characteristics that affect valuation of ecosystem services in the Great Bay Estuary watershed

Noah El-Naboulsi & Shannon Rogers

Introduction

The Great Bay Estuary (GBE), located in southeastern New Hampshire near the southern tip of Maine, is one of twenty-eight "estuaries of national significance" listed by the Environmental Protection Agency (EPA) (NH Department of Environmental Services, 2016).
- Estuaries are rich in biodiversity, can support many habitat types, and produce ecosystem services (EPA, 2016).
- Ecosystem services are benefits that humans can derive from healthy and functioning ecosystems; such as recreation, clean drinking water, and wildlife richness (Reyers et al., 2012).

From 1990-2013, the amount of impervious surface cover in the state of New Hampshire increased by 120%, and the population increased by 19%, leading to adverse effects in the GBE such as:
- Increased nutrient concentrations
- Decreased clam populations
- Decreased shellfish harvest opportunities
- Decreased eelgrass cover
- Decreased oyster populations

Prior work focused on the value of water quality in New Hampshire and the GBE give support to the necessity for further research and protection of the water body.
- 90% of New Hampshire residents are concerned with pollution in local streams, rivers, lakes, and bays (Rogers et al., 2014).
- 70% of New Hampshire residents would be willing to pay higher water and sewer fees for increased cleanliness (Rogers et al., 2014).
- GBE is one of the six "hot spots" of poor water quality in New England (Berg et al., 2016).

The combination of results such as these provided a base for researchers from the EPA, Dartmouth College, University of New Hampshire, Plymouth State University, and UMass Boston to study the valuation of water quality improvements and associated ecosystem services in the GBE.

Research Questions

1. Does geographical distance from the Great Bay Estuary affect valuation of ecosystem services?
2. What demographic characteristics, if any, affect valuation of ecosystem services in the Great Bay Estuary?
   - Age
   - Education
   - Gender
   - Income
   - Race
   - Political Affiliation
3. Is there a difference in valuation of ecosystem services between community types with regards to the Great Bay Estuary?
   - Urban
   - Suburban
   - Rural
4. Does time of residence affect valuation or willingness to pay with regards to the Great Bay Estuary?
5. Is there a difference in level of concern or willingness to pay between the different tributaries with regards to the Great Bay Estuary?
6. Does prior level of awareness affect valuation of ecosystem services in the Great Bay Estuary?

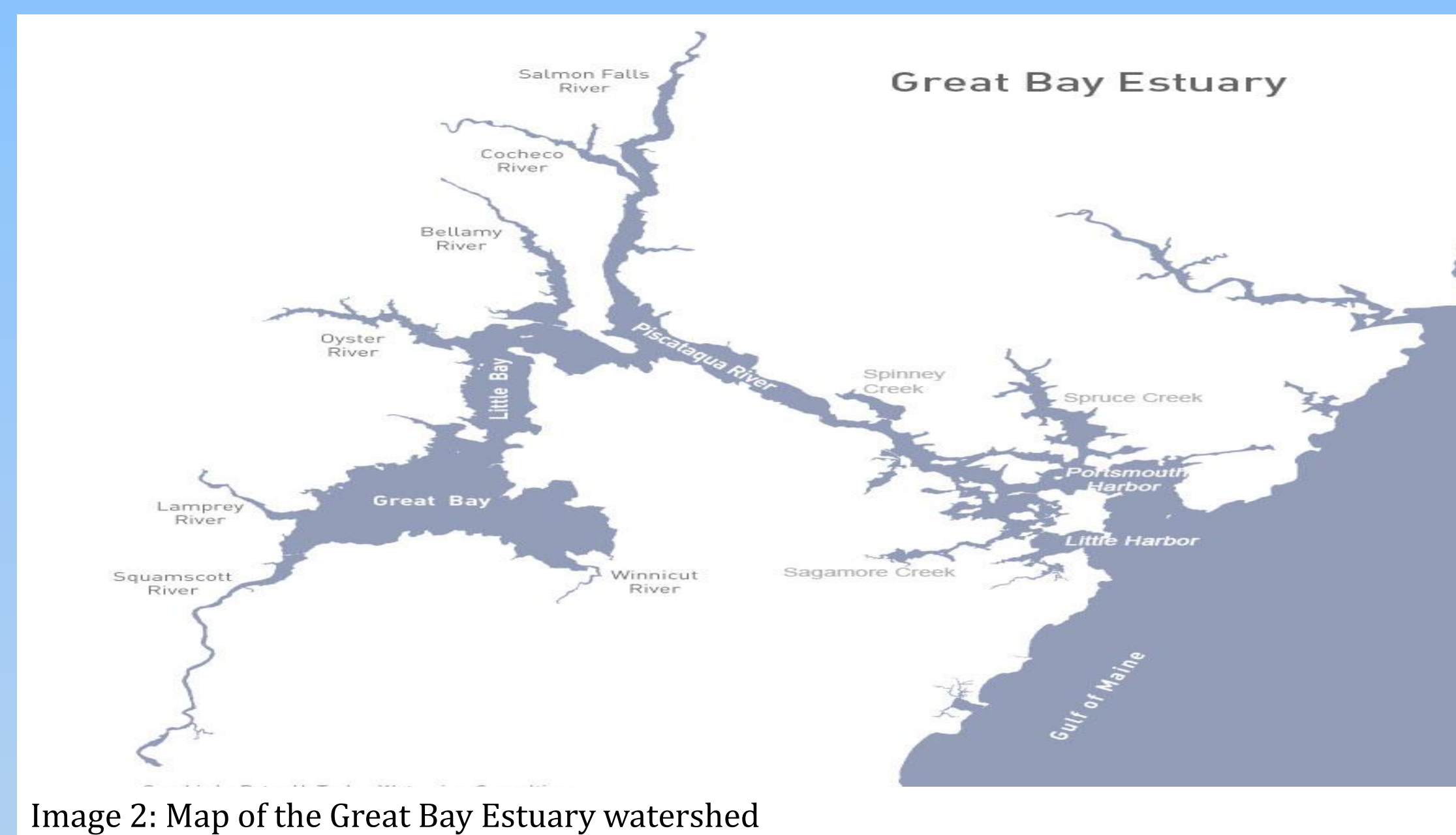Image 1: Aerial photo of the Great Bay Estuary

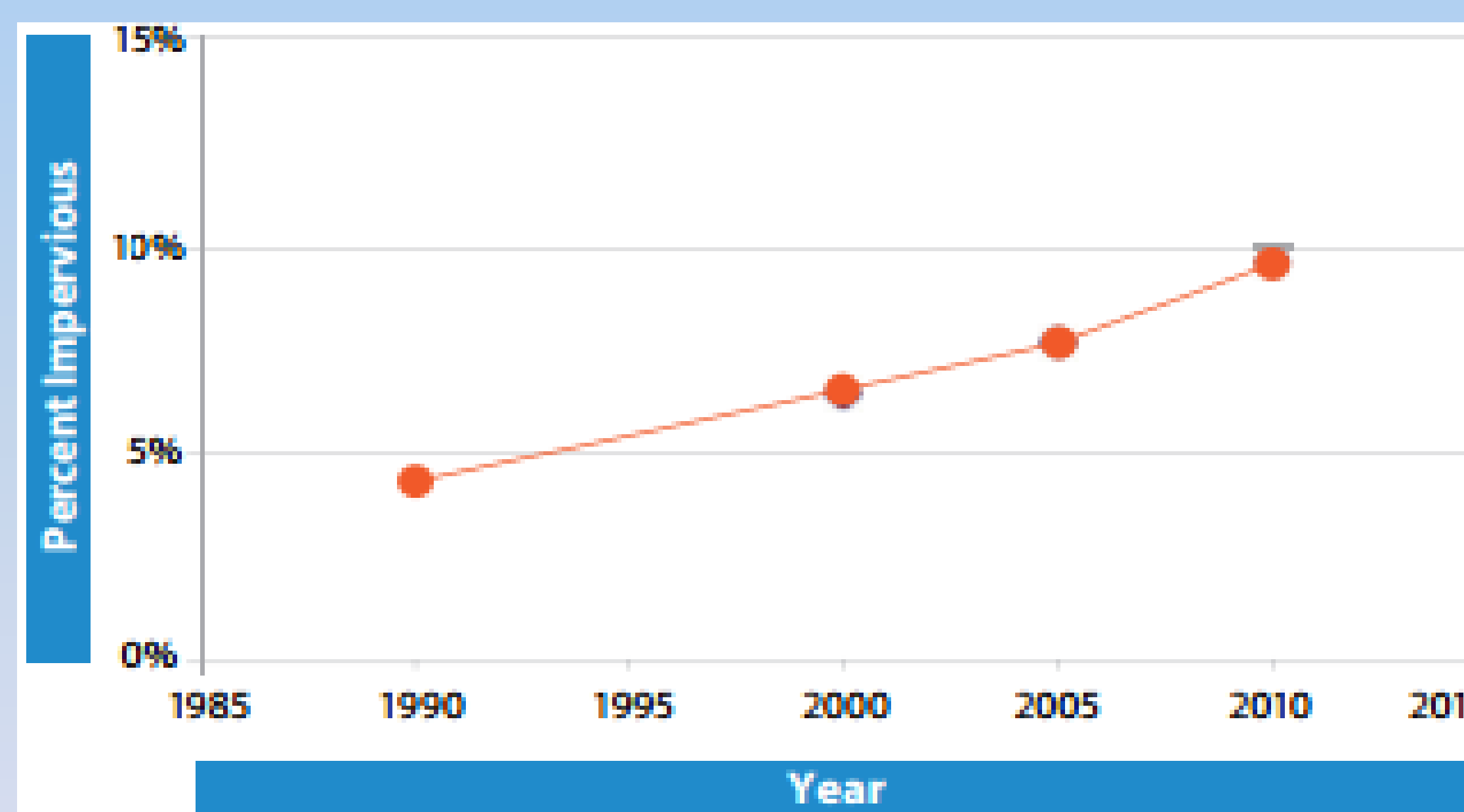

Image 2: Map of the Great Bay Estuary watershed

Image 3: Impervious surface increase in the Great Bay Estuary watershed
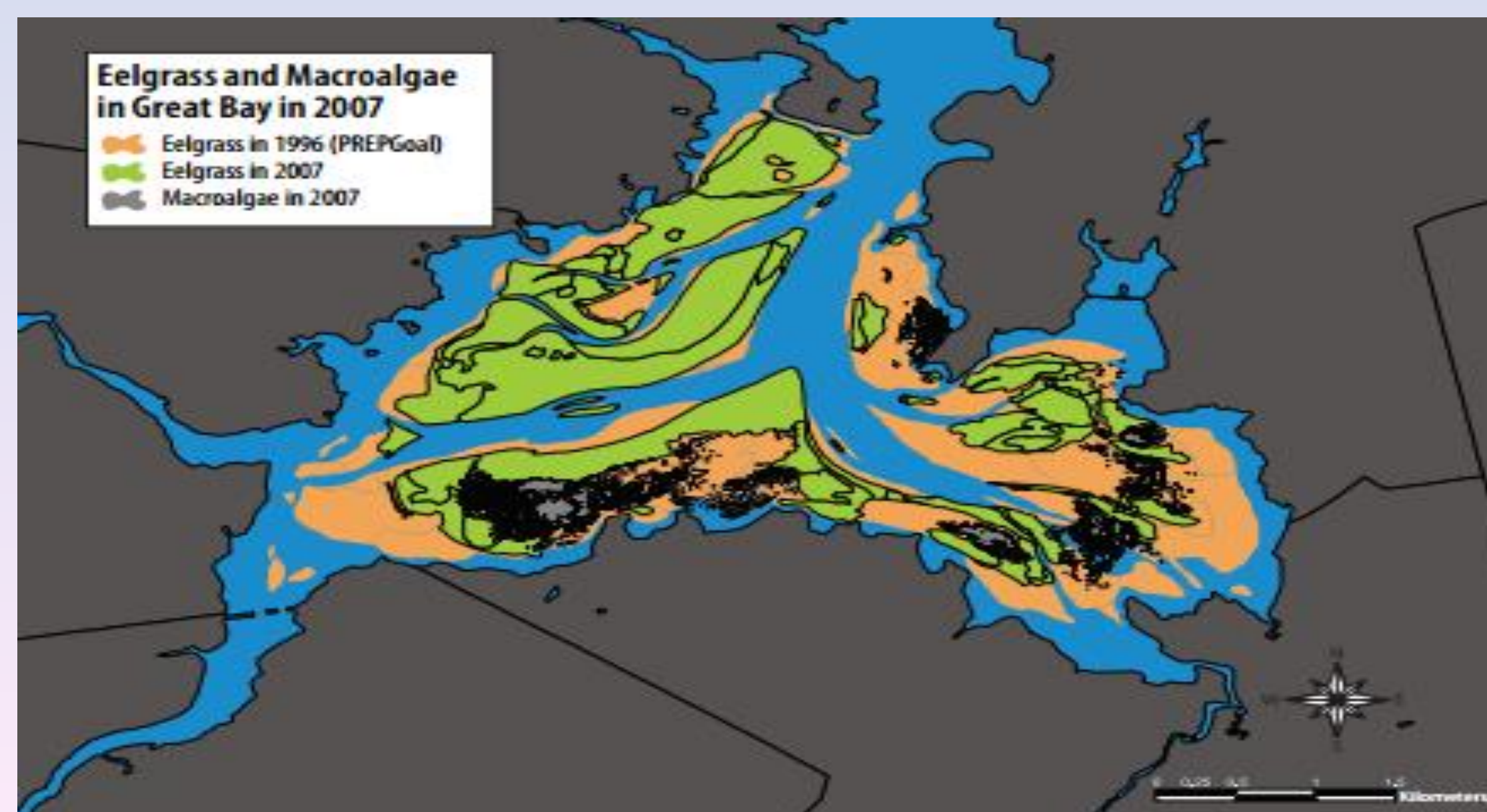

Image 4: Map of eelgrass abundance in the Great Bay Estuary

Methodology

The method of data collection for this research will be an online questionnaire given to residents of four sub-watersheds located in the GBE watershed.
- The four sub-watersheds are the Lamprey River, Oyster River, Cocheco River, and Winnicut River.
- These rivers were chosen because they flow into the GBE (tributaries) and deposit sediments and nutrients from point and nonpoint sources, expelling over 500 tons of nitrogen into the GBE every year (Piscataqua Region Estuaries Partnership, 2013).

The questionnaires will ask participants various questions regarding their personal characteristics, values of ecosystem services, and areas of environmental concern.
- These responses and subsequent data analysis will help to answer the research questions listed earlier.
- Questions of valuation and concern will be structured in the form of "value allocation" and likert scale.
- Likert scales are a format of questionnaire in which respondents rank quality from high to low or best to worst using five or seven levels (Allen an Seaman, 2007).

Q2. Imagine you had 100 "value points" to distribute among the following benefits derived from the Great Bay Estuary Watershed. Based on the level of importance you place on these choices, please allocate your "value points" so that the total of all boxes equals 100.

a. Wildlife Habitat & Biodiversity
b. Drinking Water Supply
c. Recreational Opportunities
d. Commercial Opportunities

Total=100

Figure 1: Example of likert-scale type question

Data Analysis

A large portion of post-questionnaire work will be done with Geographic Information System (GIS) software.
- Each respondent's address will be geocoded into the GIS in order to create a map of visual data points throughout the GBE watershed.
- Each of the points on the map will also contain data related to the associated respondent's levels of valuation and concern.
- This will allow me to generate near tool analyses and heat maps for the purpose of displaying potential relationships between valuation and distance, community type, and tributary.

Questions related to demographic characteristics, time of residence, and prior level of awareness will not require the use of GIS.
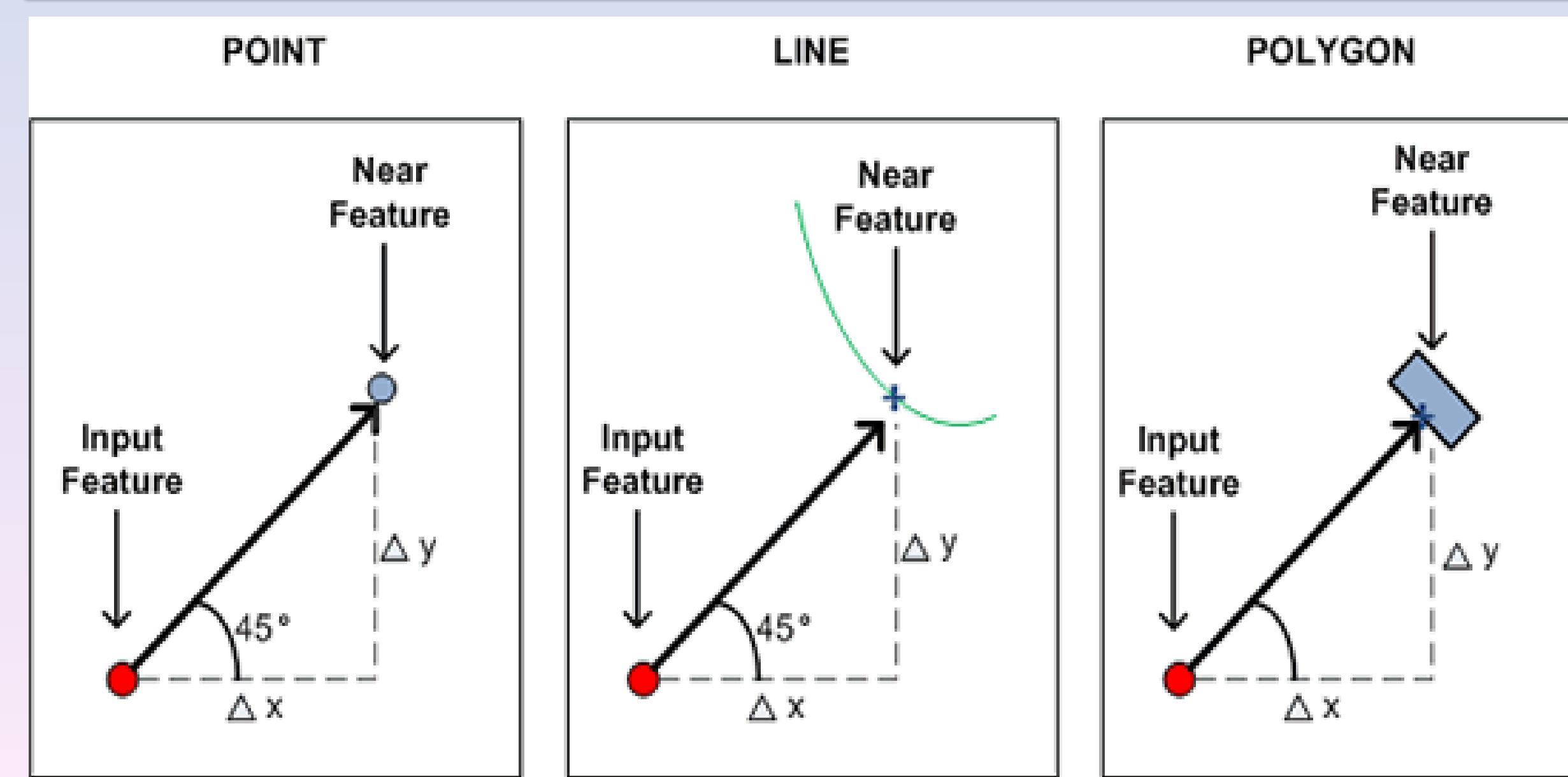

Image 5: Near tool methodology in Arc GIS

Conclusions

The Great Bay Estuary (GBE), known as an "estuary of national significance" is being threatened to due to increased anthropogenic pressures throughout the watershed. As a result, researchers from the EPA, Plymouth State University, Dartmouth College, University of New Hampshire, and UMass Boston got together to research the valuation of water quality improvements and ecosystem services in the GBE watershed. For my thesis-specific research I will be looking at the characteristics that will possibly affect the valuation of these ecosystem services, including: distance, demographics, community type, prior level of awareness, tributary, and time of residence. An online questionnaire will serve as the primary tool for data collection, and GIS software will be used for spatial analyses. I believe this research is important because it can be an effective gauge of how well information and education about the GBE is getting out to relevant communities. Further, assessing the results of different groups on a smaller-scale can allow future outreach and education to be directed towards specific values of said groups.

References

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Image 1: http://portsmouthnh.wpengine.netdna-cdn.com/wp content/uploads/2015/05/greatbayreserve1.jpg
Image 2: http://www.clf.org/wp-content/uploads/2012/01/Great-Bay-Estuary-Map.jpg
Image 3: http://scholars.unh.edu/cgi/viewcontent.cgi?article=1261&context=prep
Image 4: http://scholars.unh.edu/cgi/viewcontent.cgi?article=1261&context=prep
Image 5: http://www.esri.com/news/arcwatch/0808/graphics/tip3.gif

Contacts

- Noah El-Naboulsi: nnelnaboulsi@plymouth.edu
- Shannon Rogers: shrogers@plymouth.edu