Session: Ecosystem Delineation and Production

Ecological Production Units for the Northeast U.S. Continental Shelf

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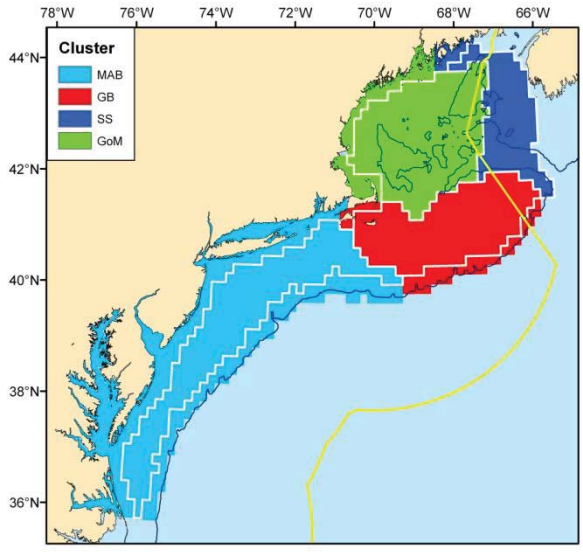
The definition of Ecosystem Based Fishery Management specifies that it is place-based (NOAA 2016). There have been many spatial delineations of the Northeast U.S. Continental Shelf Large Marine Ecosystem (NES LME), from the broader-scale NAFO statistical areas, to sampling strata, to purely management-based delineations between the New England and Mid-Atlantic management regions. However, none had been based on an objective analysis of the biogeophysical characteristics of the NES LME. Therefore, an analysis was done to delineate Ecological Production Units (EPUs).

Each data set (see page 2 for details) includes the years 1998 to 2007, and was binned into 10-minute squares. For 10 minute squares without data, interpolations were made using ArcGIS's built-in Inverse Distance Weighting (IDW) algorithm. A spatial principle components analysis (PCA; e.g. Pielou 1984; Legendre and Legendre 1998) examined the multivariate structure of the data. A disjoint cluster analysis was then applied using the K-means procedure (Legendre and Legendre 1998) on the principal component scores to select 4 to 8 possible clusters based on a minimum cluster-cell number of 20 contiguous units. We created the final EPUs (Figure 1) by further simplifying the clusters with ArcMap 9.3's boundary clean and majority filter algorithms.



Initially, the nearshore regions and the shelf-break regions were separate clusters that were then consolidated into the main clusters resulting in four EPUs: Mid-Atlantic Bight (MAB), Georges Bank (GB), Gulf of Maine (GoM), and Scotian Shelf (SS). Each EPU contains special consideration regions for the nearshore and/or shelf break.

The data sets chosen did not include ecological data of species other than phytoplankton, or data from human activities, in order to take advantage of the greater stability likely present in the data sets analyzed. However, when these higher-level data sets were overlaid onto the EPUs, it is evident that managed stocks and fishermen 'see' patterns of productivity similarly to the EPUs (Lucey and Fogarty 2013). Species richness peaks on the

northern edge of Georges Bank, and fishing effort is often constrained to one or two EPUs depending on the port, gear, and target species.

The EPUs will likely simplify the creation of integrated management plans, but there are challenges. The EPU boundaries are open; neither fish nor fishermen are constrained by them. The EPUs do not conform to the border of jurisdiction between the Mid-Atlantic Fishery Management Council and the New England Fishery Management Council. Also, the EPUs themselves might change if the data sets used to construct them change. Another challenge will be determining the appropriate time scale for reanalysis. Fortunately, the framework of the analysis is well established.

The data sets used are summarized here:

Variable	Sampling Method	Original Resolution	Units	Source
Bathymetry	Soundings / Hydroacoustics	2 meter	M	http://www.ngdc.noaa.gov/mgg/coastal/coastal.html
Grain size	Benthic grab	Lat/Long point	unitless	http://pubs.usgs.gov/ds/2005/118/data/
Fall bottom salinity	Vertical CTD cast	Lat/Long point	unitless	NMFS/NEFSC Oceanography Branch
Fall surface salinity	Vertical CTD cast	Lat/Long point	unitless	NMFS/NEFSC Oceanography Branch
Spring bottom salinity	Vertical CTD cast	Lat/Long point	unitless	NMFS/NEFSC Oceanography Branch
Spring surface salinity	Vertical CTD cast	Lat/Long point	unitless	NMFS/NEFSC Oceanography Branch
Fall bottom temperature	Vertical CTD cast	Lat/Long point	^{o}C	NMFS/NEFSC Oceanography Branch
Fall surface temperature	Vertical CTD cast	Lat/Long point	^{o}C	NMFS/NEFSC Oceanography Branch
Spring bottom temperature	Vertical CTD cast	Lat/Long point	^{o}C	NMFS/NEFSC Oceanography Branch
Spring surface temperature	Vertical CTD cast	Lat/Long point	^{o}C	NMFS/NEFSC Oceanography Branch
SST mean	Satellite	4.0 km^2	^{o}C	http://oceancolor.gsfc.nasa.gov/cgi/l3
SST gradient	Satellite	4.0 km^2	^{o}C	http://oceancolor.gsfc.nasa.gov/cgi/l3
SST span	Satellite	4.0 km^2	^{o}C	http://oceancolor.gsfc.nasa.gov/cgi/l3
CHLa mean	Satellite	1.25 km^2	mg m^{-3}	http://oceanocolor.gsfc.nasa.gov
CHLa gradient	Satellite	1.25 km^2	unitless	http://oceanocolor.gsfc.nasa.gov
CHLa span	Satellite	1.25 km^2	mg m^{-3}	http://oceanocolor.gsfc.nasa.gov
PPD mean	Satellite	1.25 km^2	gC m^{-2} d^{-1}	http://oceancolor.gsfc.nasa.gov/cgi/l3
PPD span	Satellite	1.25 km^2	unitless	http://oceancolor.gsfc.nasa.gov/cgi/l3

References

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