



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

Robert Gamble, Michael Fogarty

Ecosystem Based Fishery Management Strategy Review

April 30 – May 4, 2018

Woods Hole, MA

TOR 1: Evaluate the Approach used to
Identify Ecological Production Units



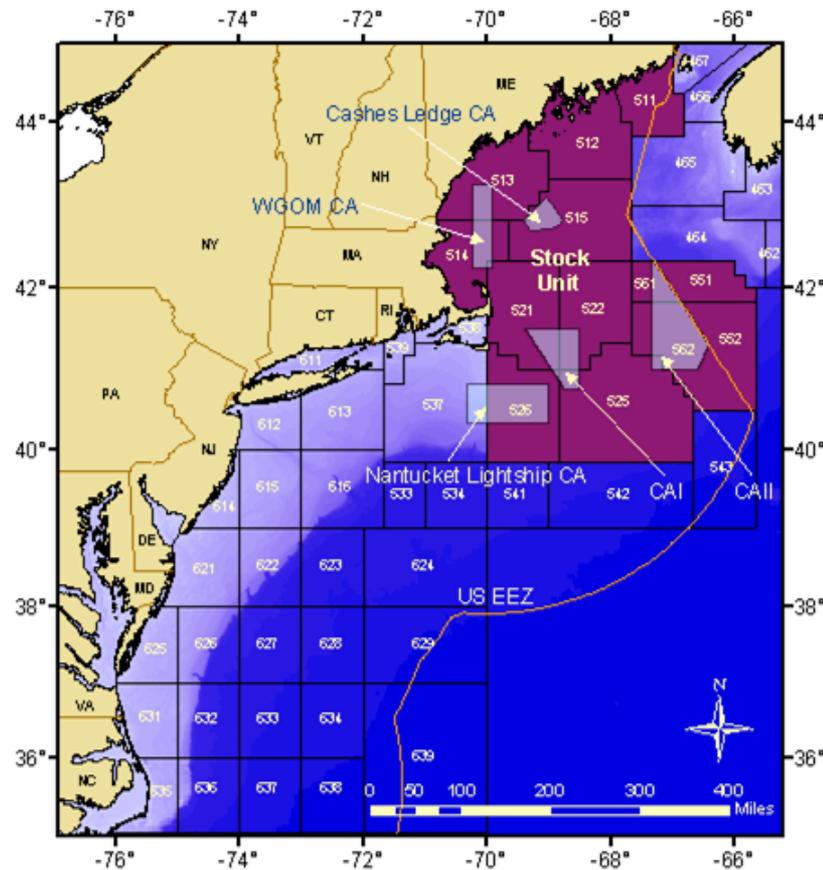
NOAA
FISHERIES

NEFSC

Why Geographical Management Units?

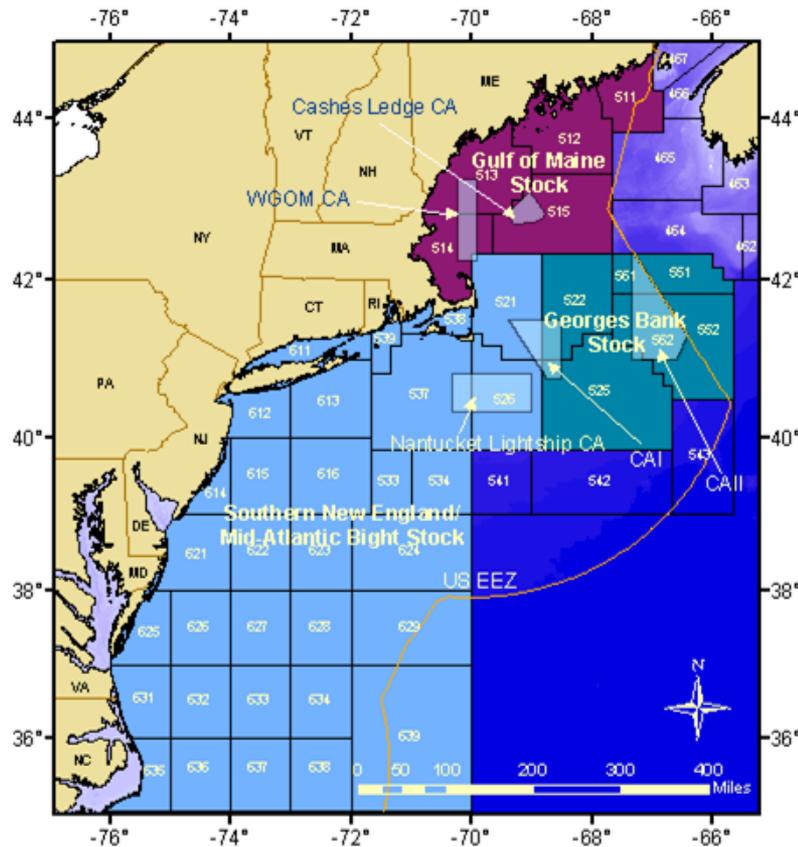
- Ecosystems are typically defined in terms of spatial extent and characteristics
- The single most important difference between Ecosystem-Based Management and Current Management will be the development of integrated management plans for ecological regions
- We already do this with stock management areas (but have to deal with a large number of different spatial units)
- Can we simplify by identifying fewer spatial management units using objective and consistent methods?

Current Stock Boundary Units



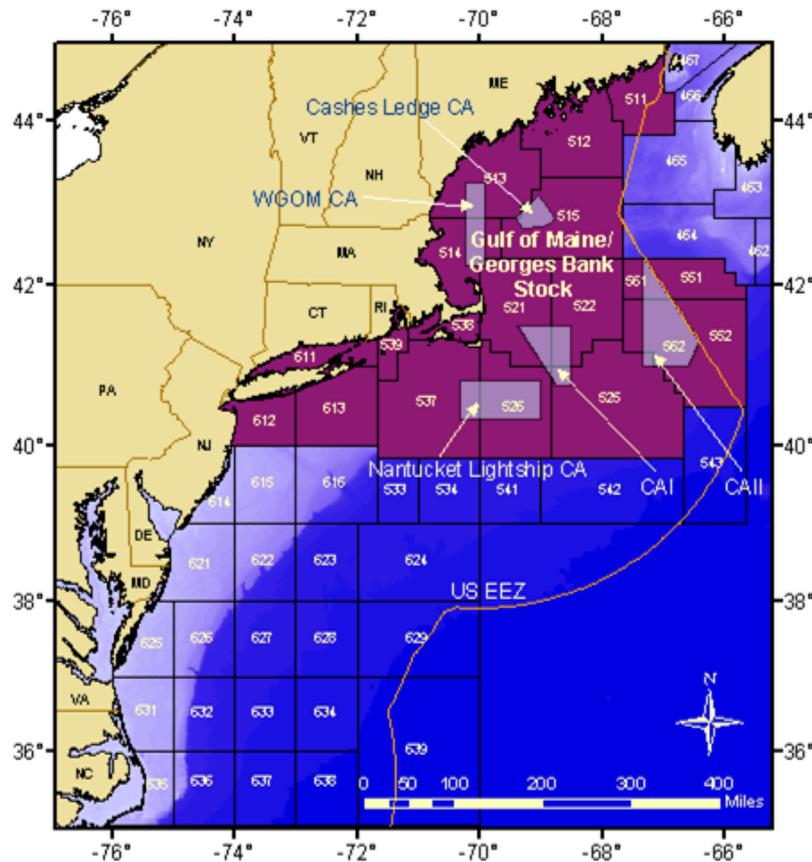
- Acadian Redfish

Current Stock Boundary Units



- Winter flounder

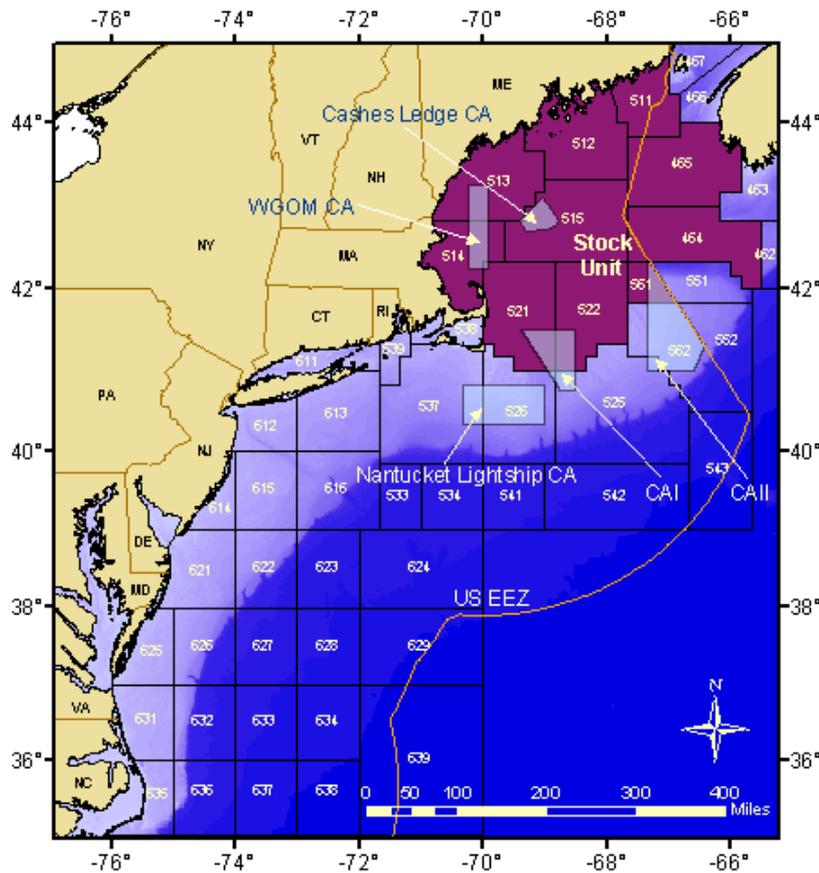
Current Stock Boundary Units



- Pollock

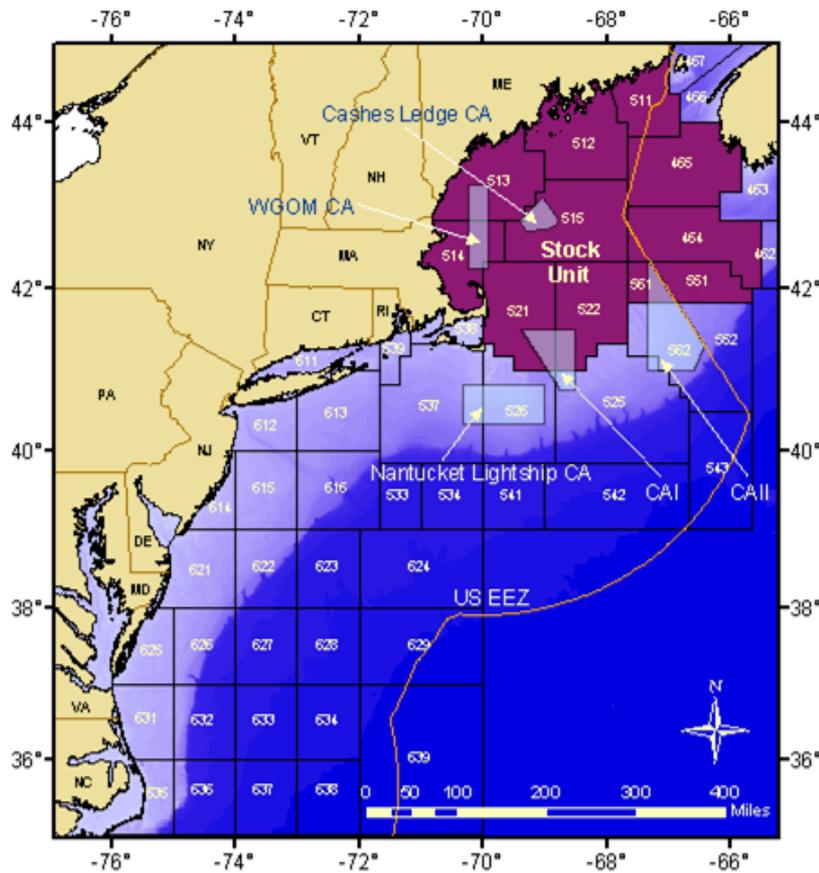
Current Stock Boundary Units

- Northern Shrimp

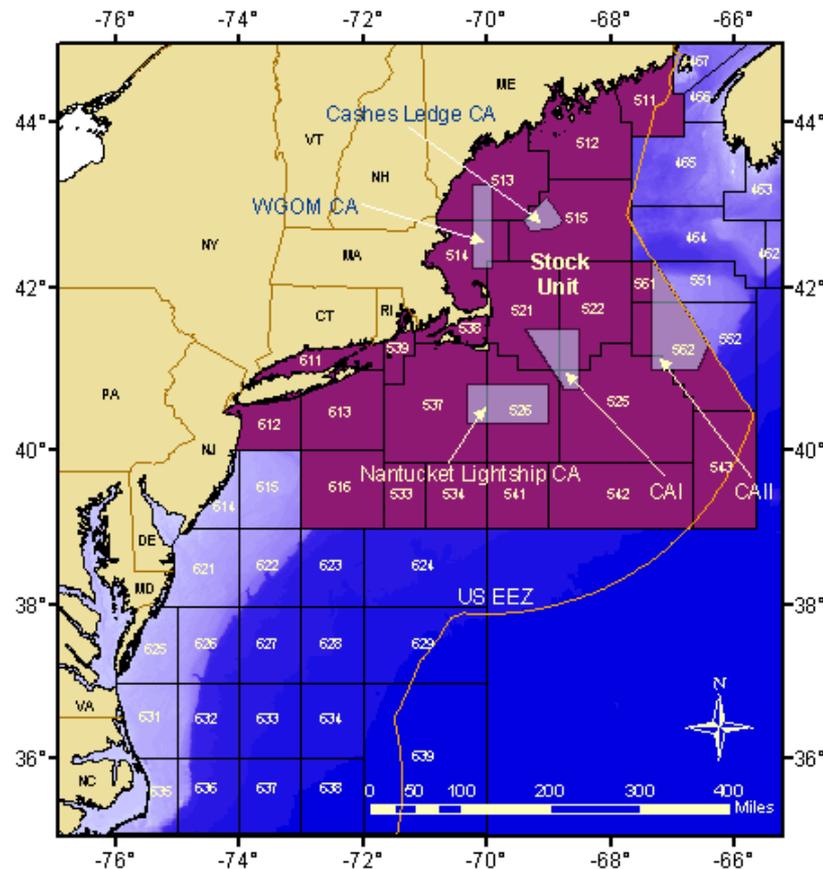


Current Stock Boundary Units

- Cusk



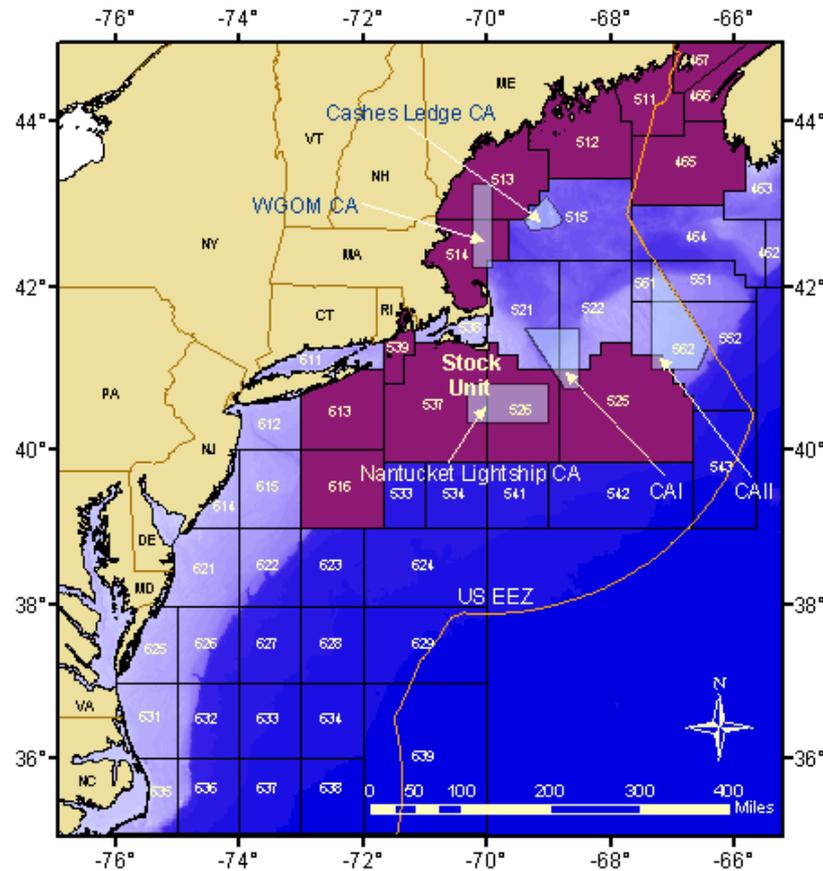
Current Stock Boundary Units



- Smooth Skate

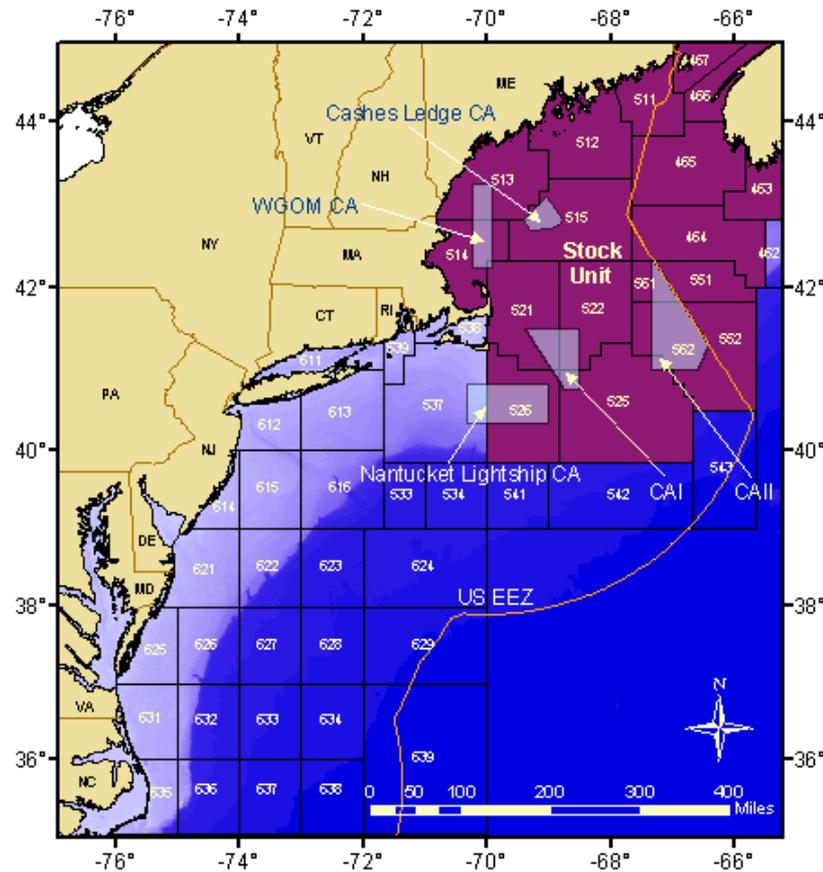
Figure 27.1. Statistical areas used to define the barndoor skate stock.

Current Stock Boundary Units



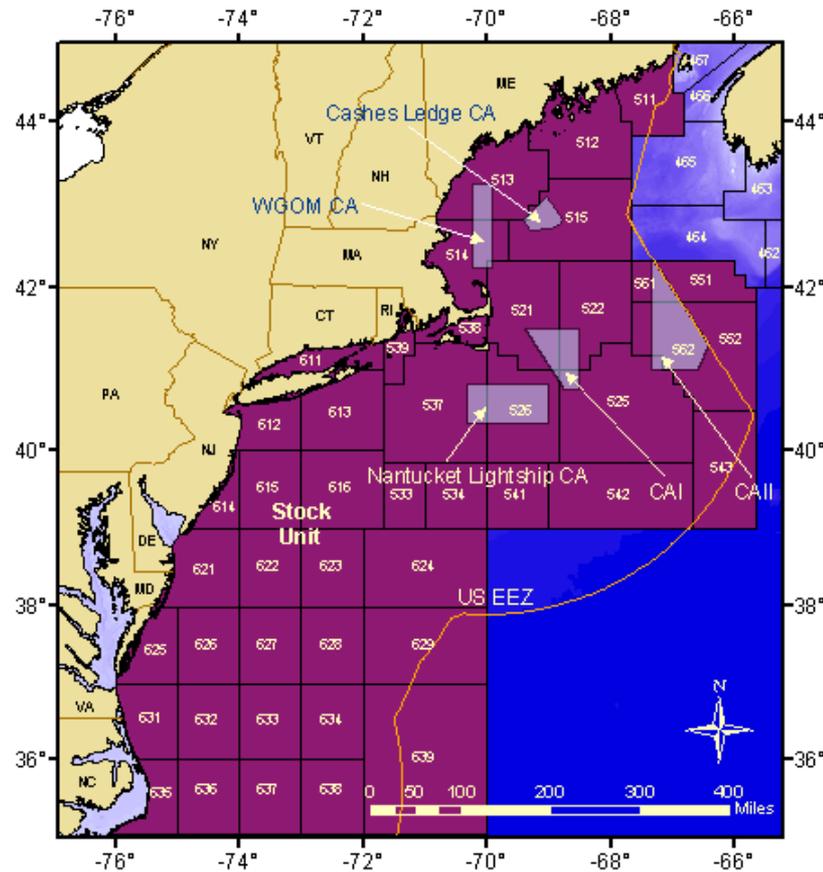
- American Shad

Current Stock Boundary Units



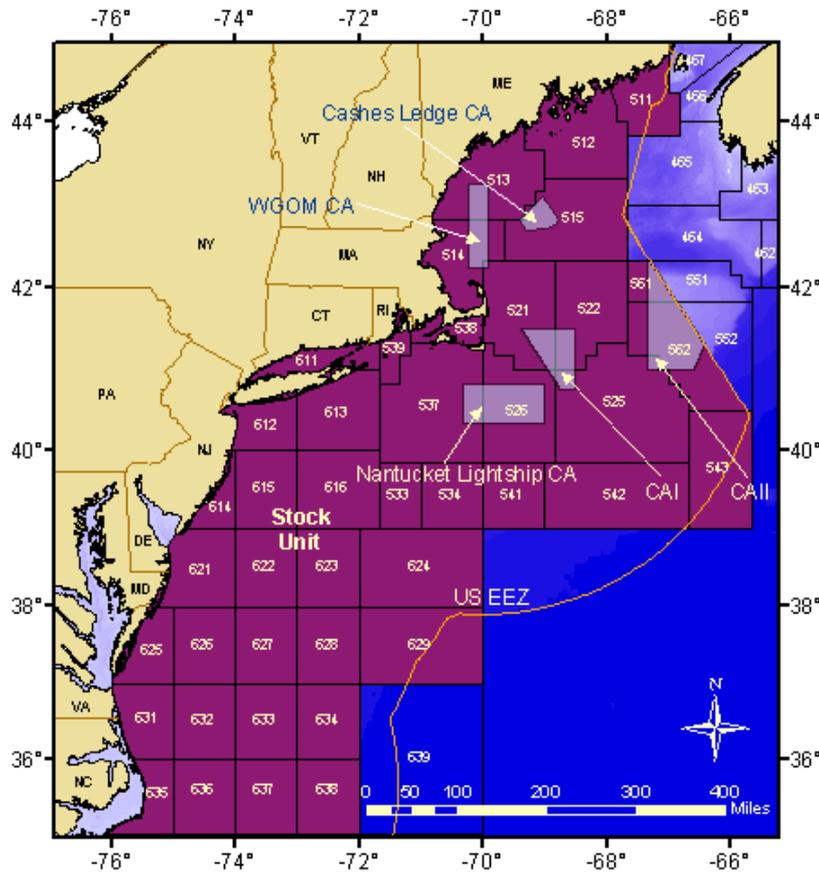
- Atlantic wolffish

Current Stock Boundary Units



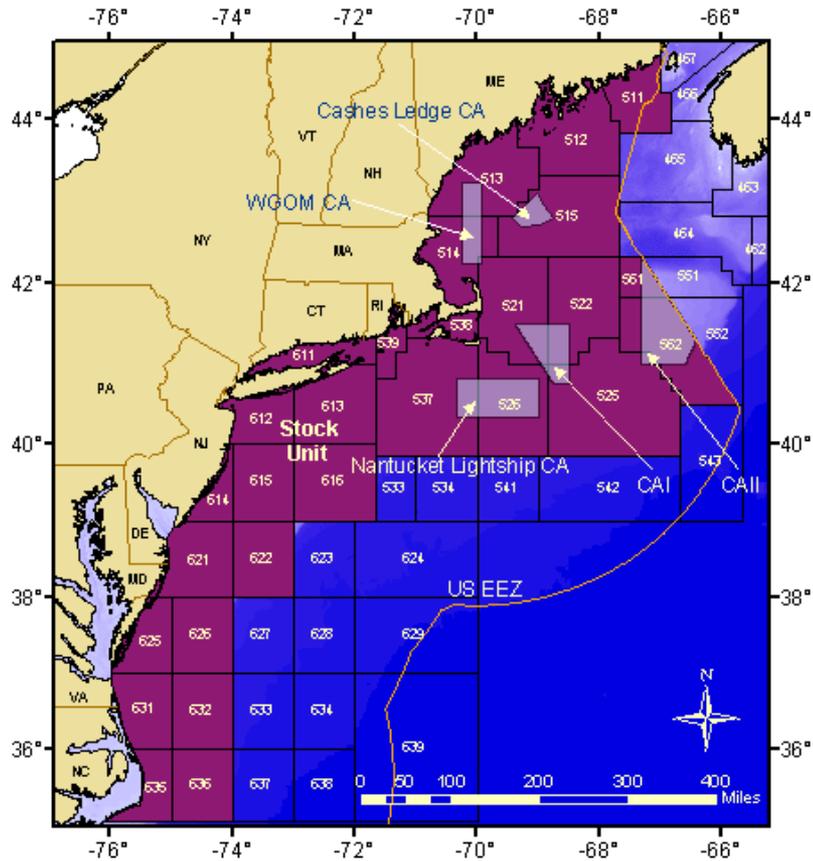
- Summer Flounder

Current Stock Boundary Units



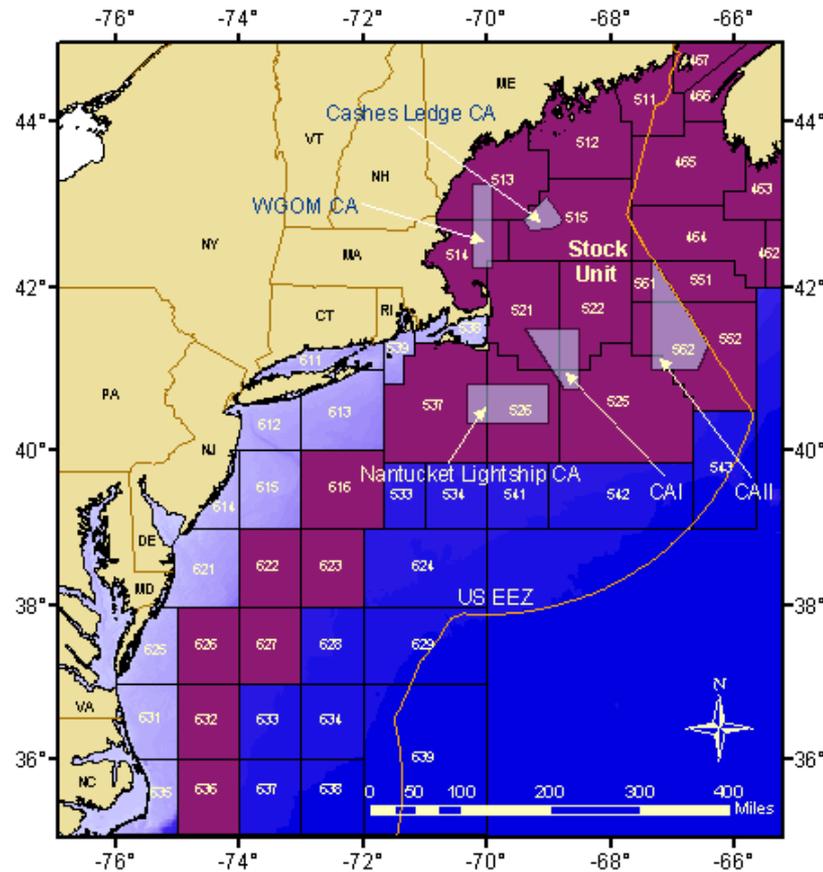
- Little Skate
- Winter Skate

Current Stock Boundary Units



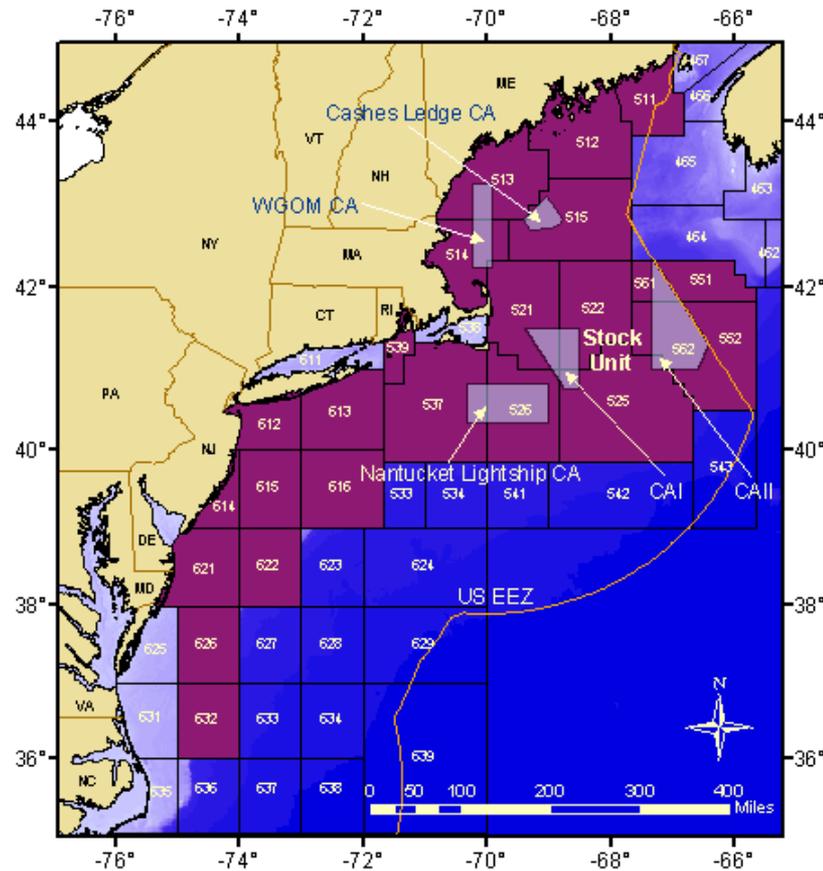
- Alewife
- Blueback herring

Current Stock Boundary Units



- Hagfish

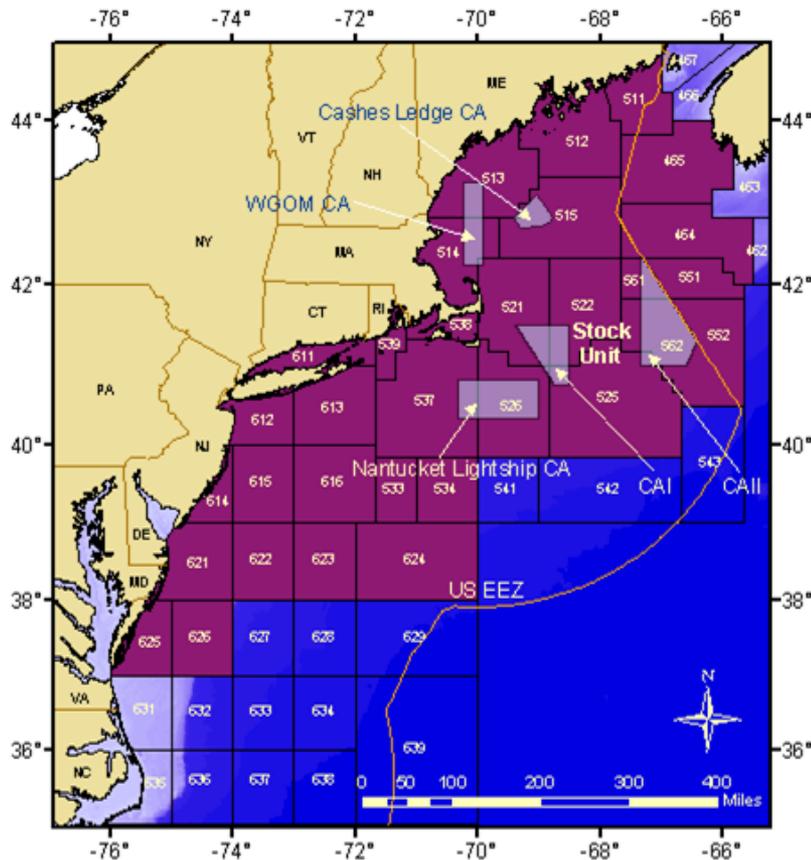
Current Stock Boundary Units



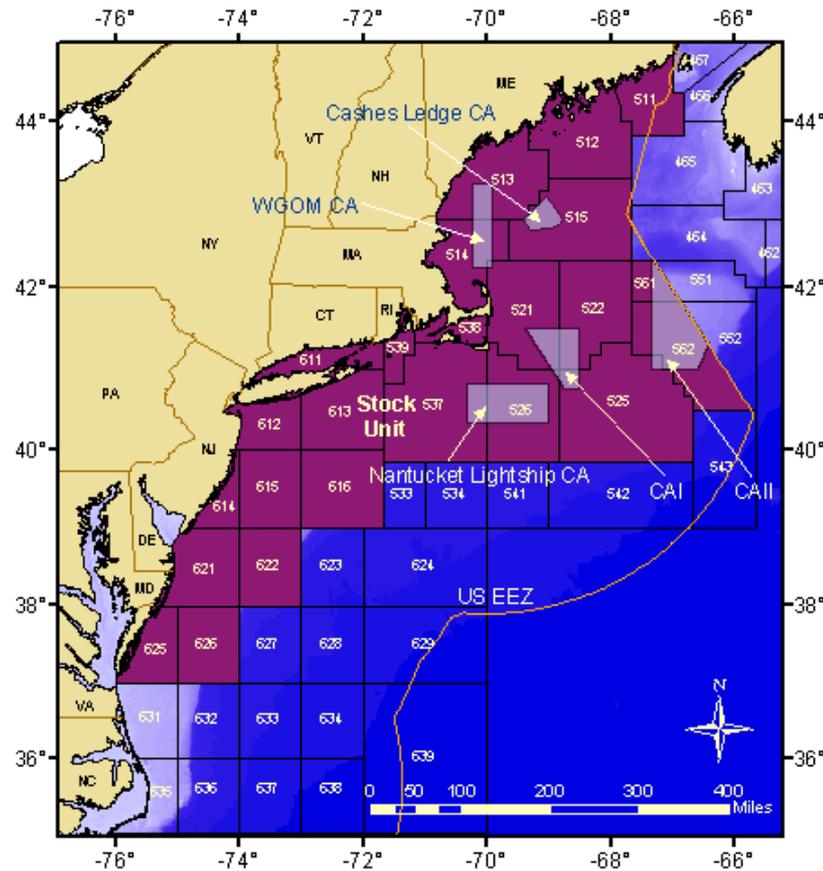
- Sea Scallop

Current Stock Boundary Units

- White Hake

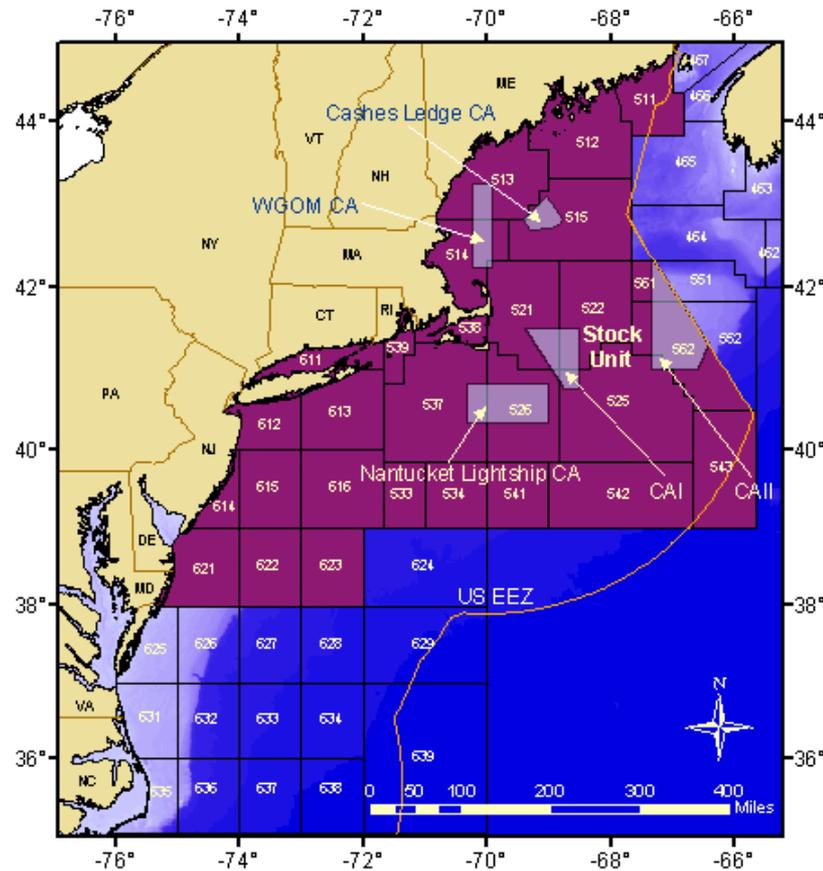


Current Stock Boundary Units



- Atlantic surfclam

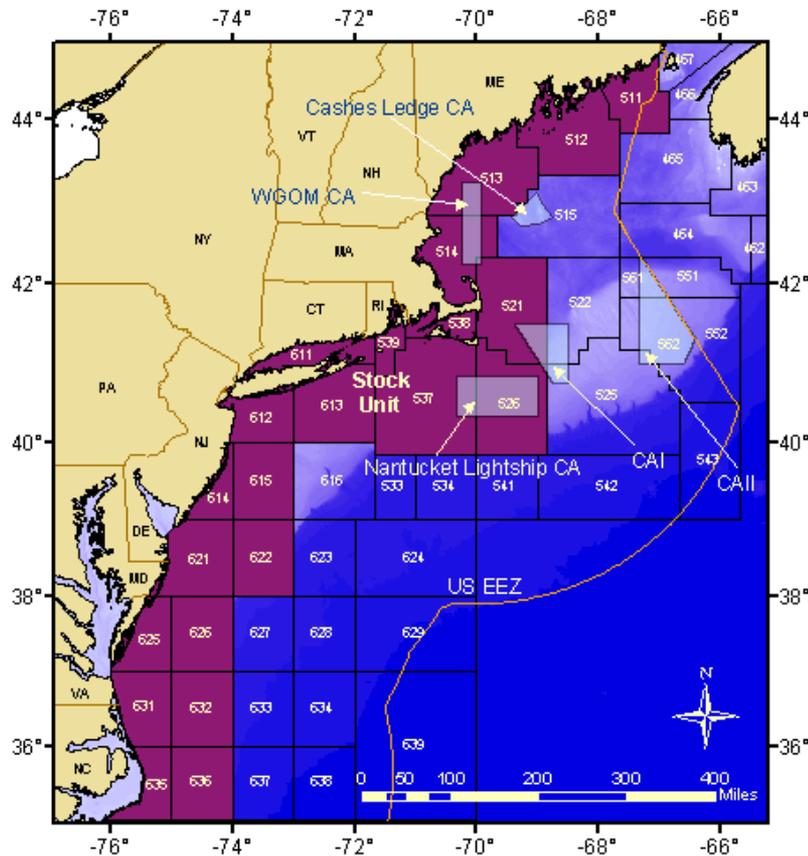
Current Stock Boundary Units



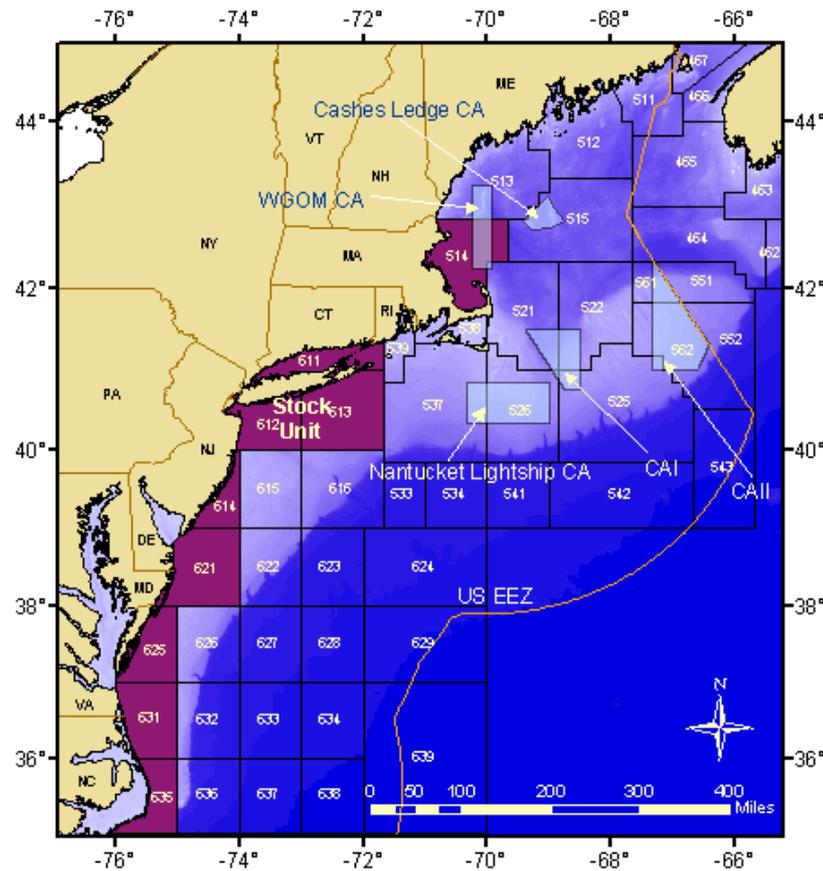
- Ocean Pout

Current Stock Boundary Units

- American eel

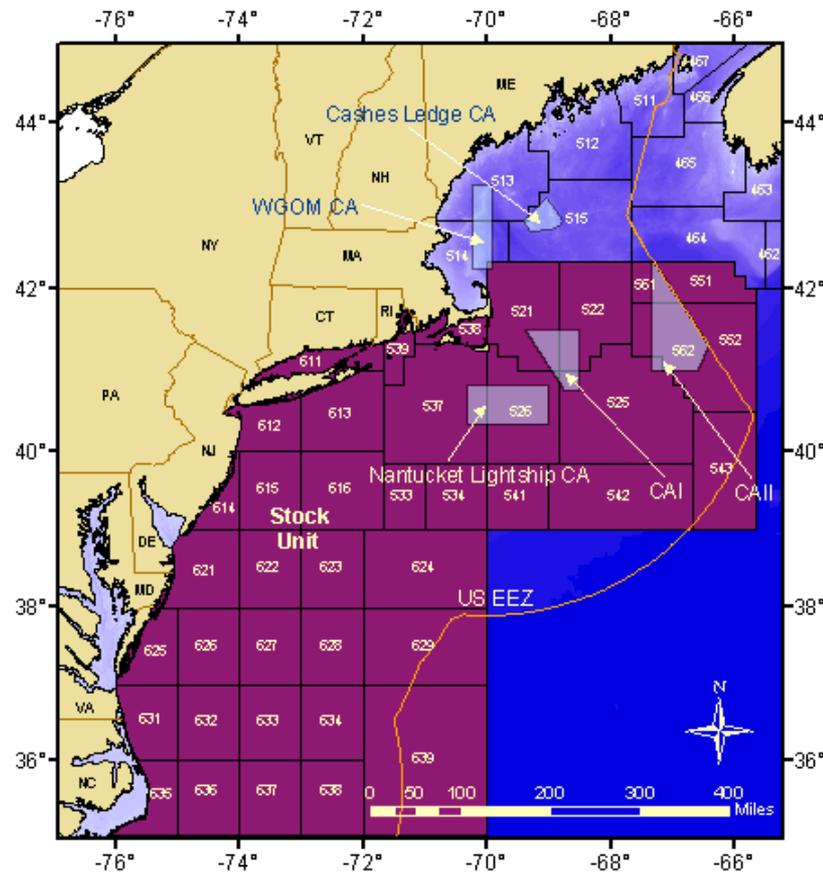


Current Stock Boundary Units



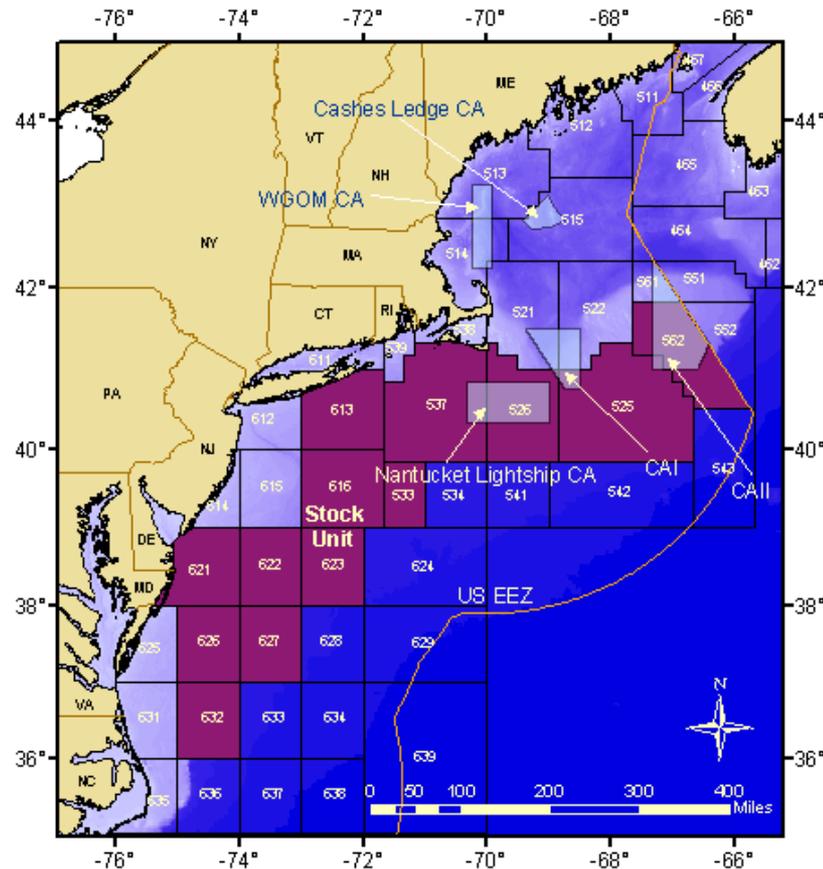
- Sturgeon

Current Stock Boundary Units



- Butterfish

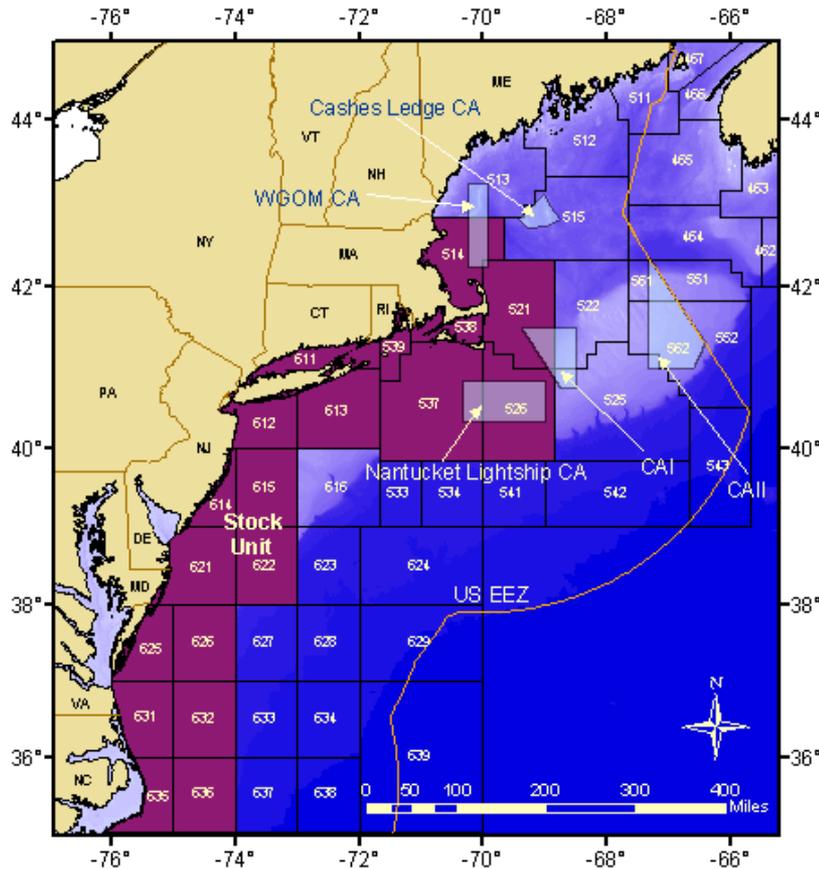
Current Stock Boundary Units



- Deepsea Red Crab

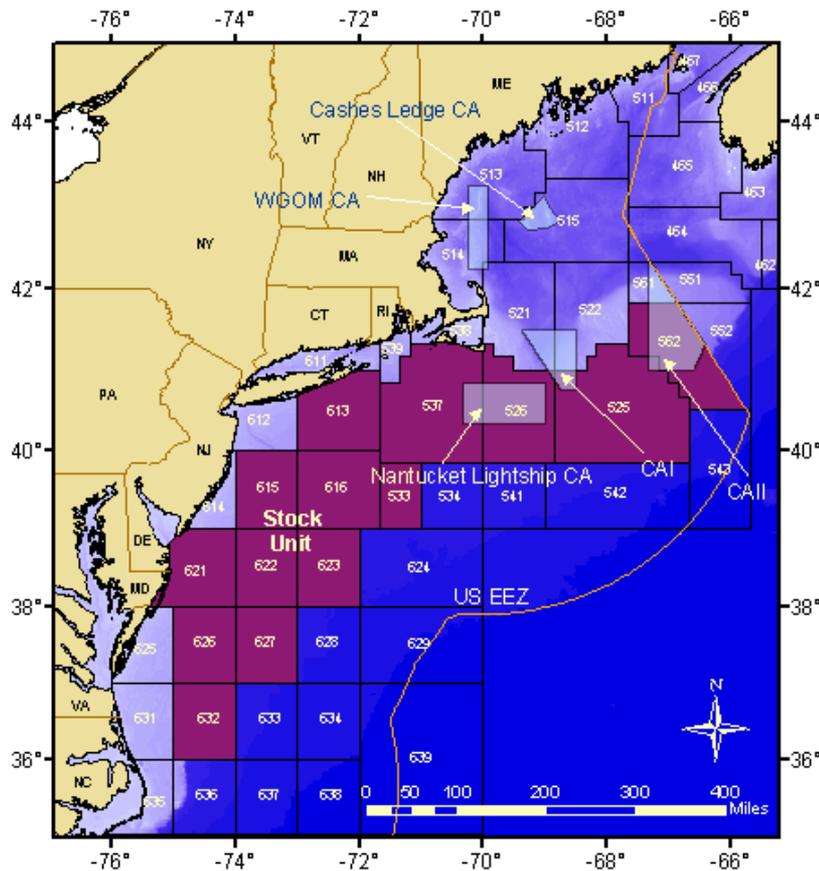
Current Stock Boundary Units

- Black Sea Bass

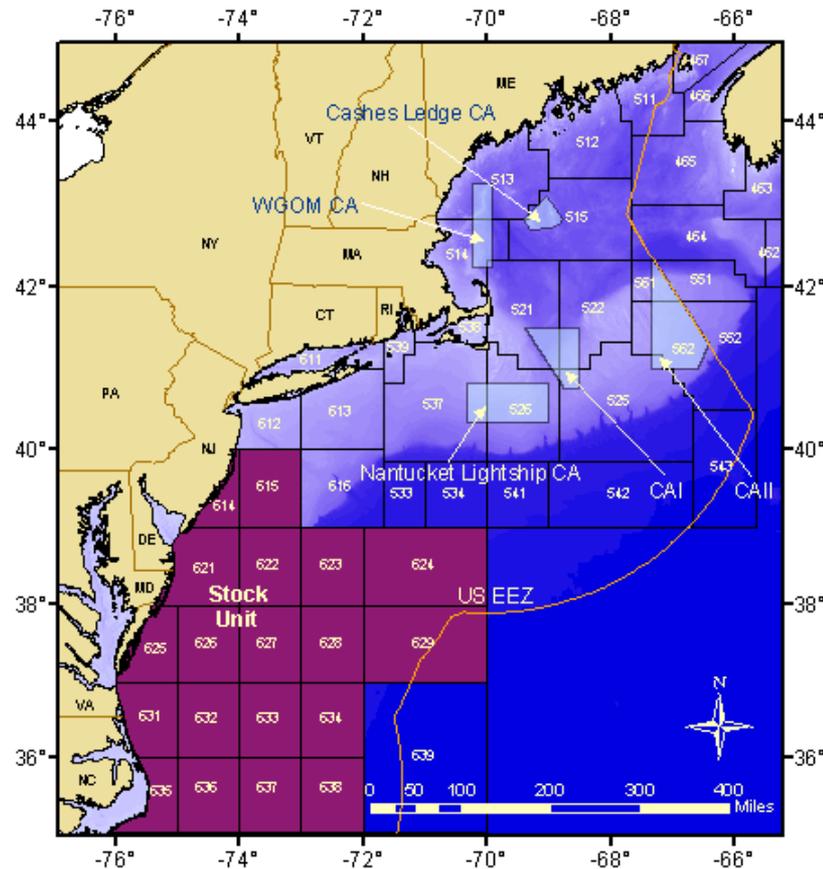


Current Stock Boundary Units

- Tilefish

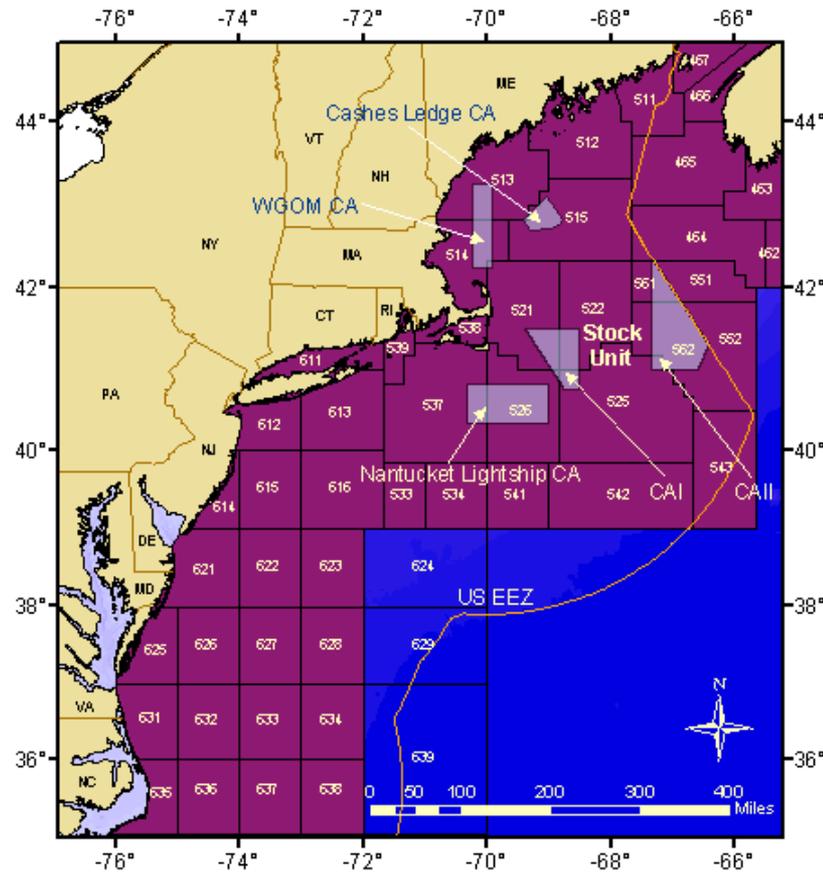


Current Stock Boundary Units



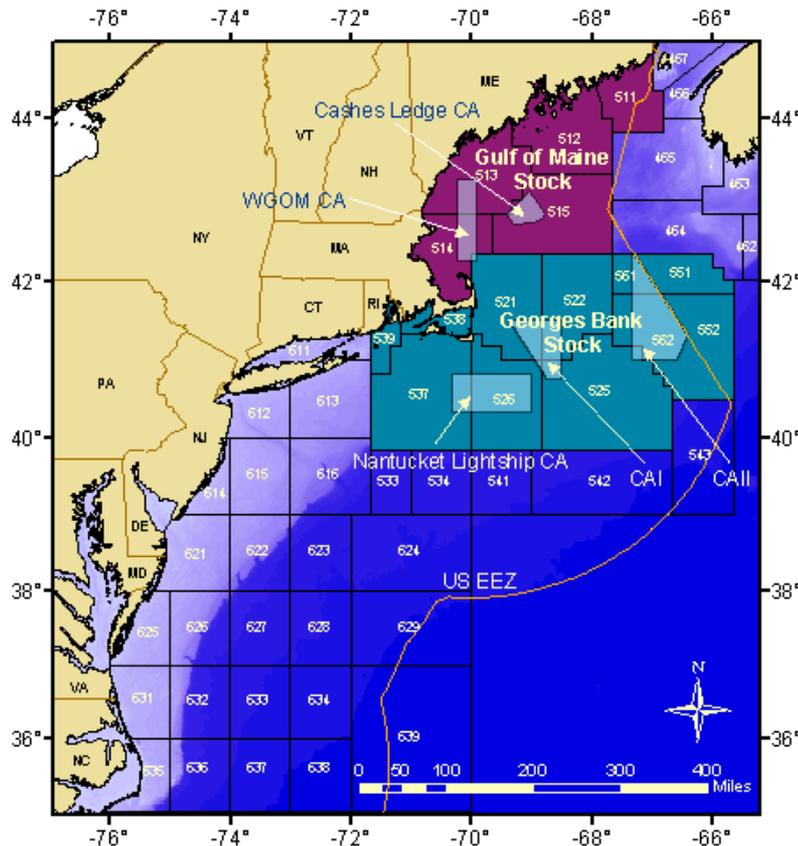
- Clearnose skate

Current Stock Boundary Units



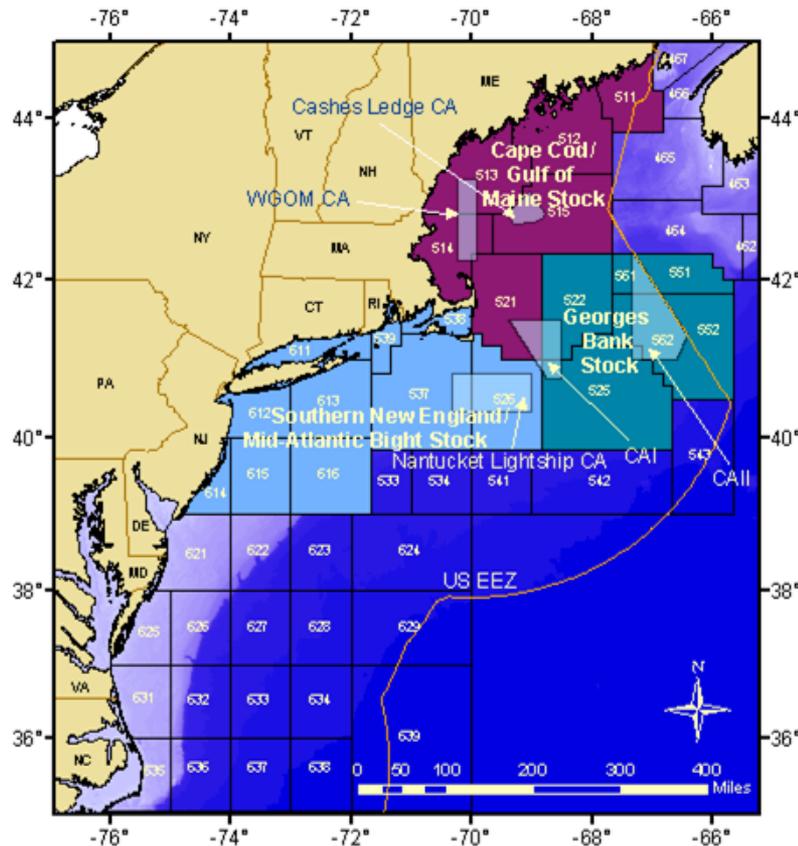
- Spiny Dogfish

Current Stock Boundary Units



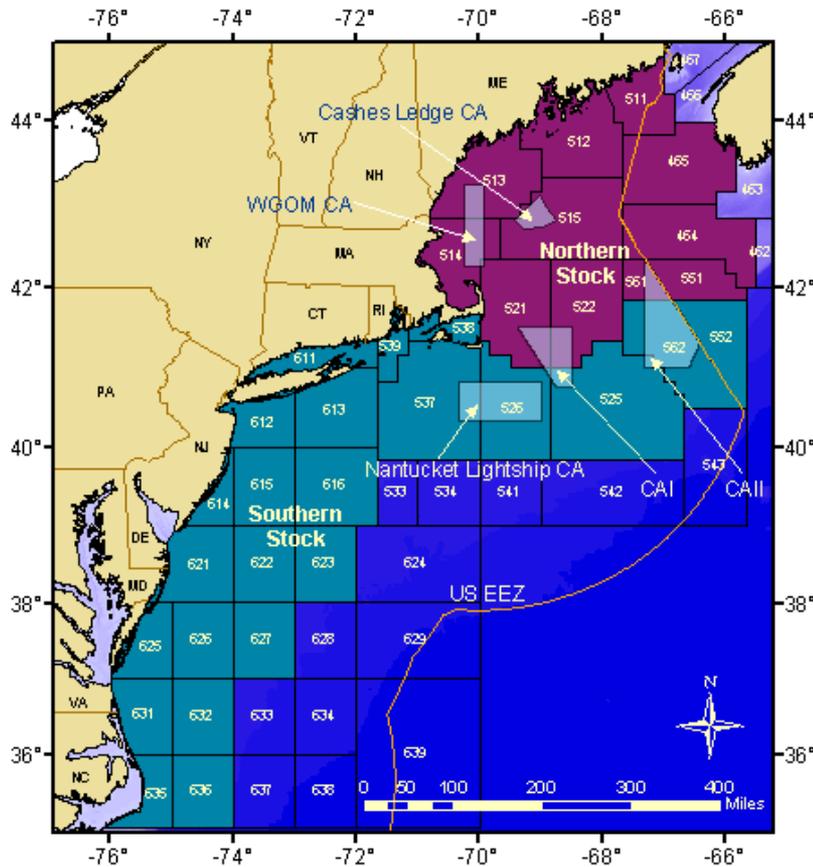
- Haddock
- Comparison of growth rates and age composition of Browns Bank and Georges Bank haddock showed the importance of the Fundian Channel as a barrier
- Vertebral counts confirm these major separations

Current Stock Boundary Units



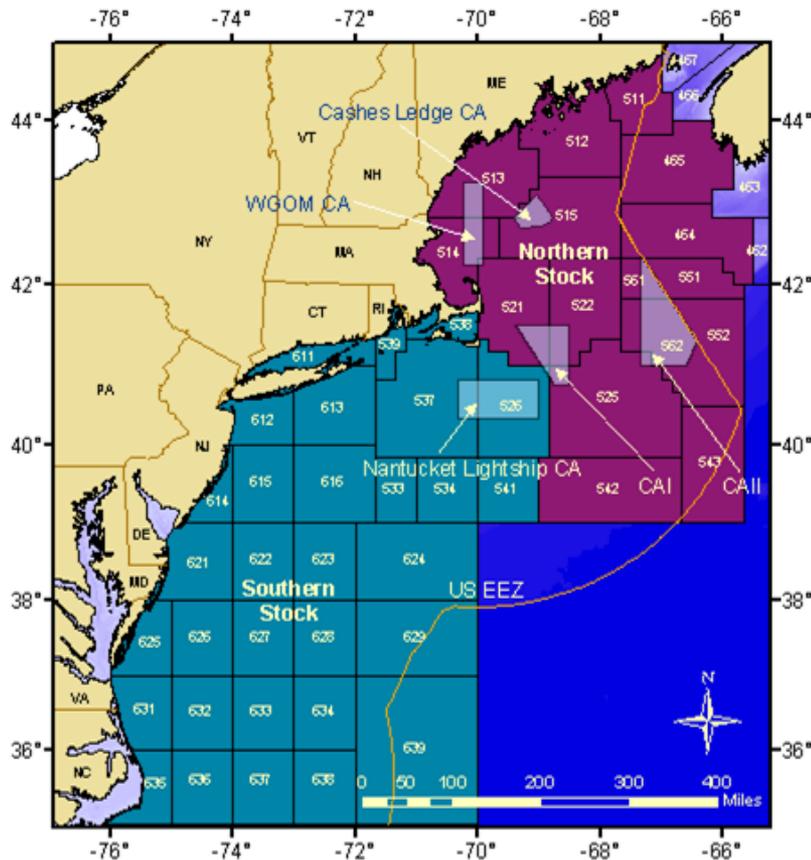
- Yellowtail flounder
- Fishing patterns
- Juvenile/adult distribution
- Genetics (GBK vs. SNEMA)
- Slower growth in north
- CCGOM mature later
- Tagging studies confirm localized populations by management region
- CCGOM have different parasites

Current Stock Boundary Units



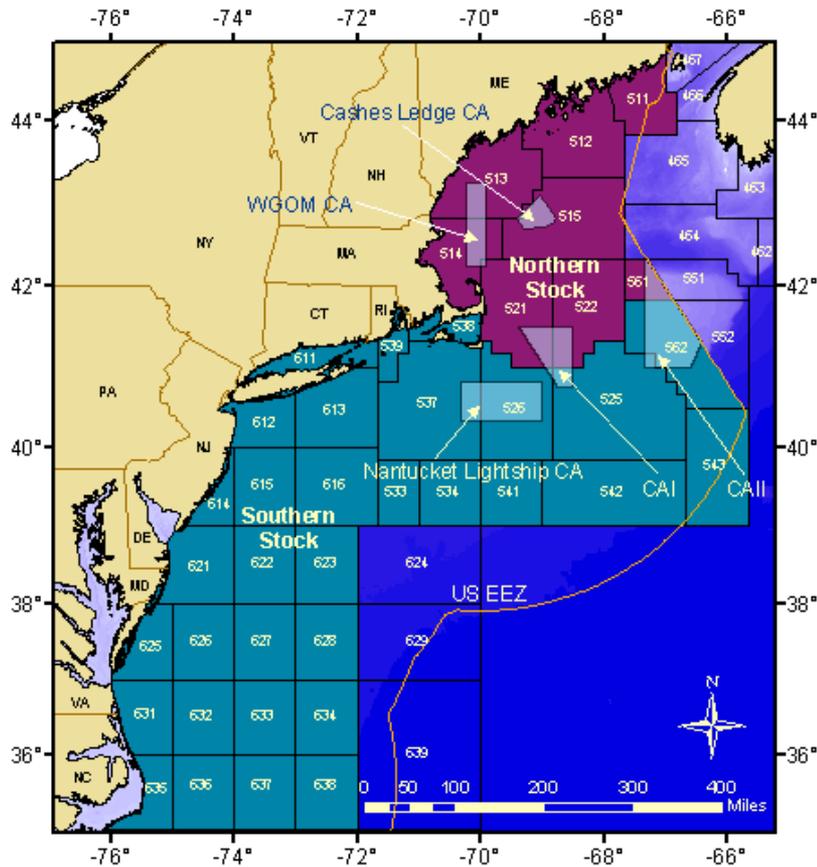
- Goosefish
- Limited biological information on stock structure when mgmt plan was established (1999) suggested possible stock boundary
- Big issue was difference in how fisheries were prosecuted north and south of GB

Current Stock Boundary Units



- Windowpane flounder
- No information on stock structure
- Provisional arrangement divided into 2 stock areas based on evidence for some differences in growth and sexual maturity, and also abundance trends over time

Current Stock Boundary Units

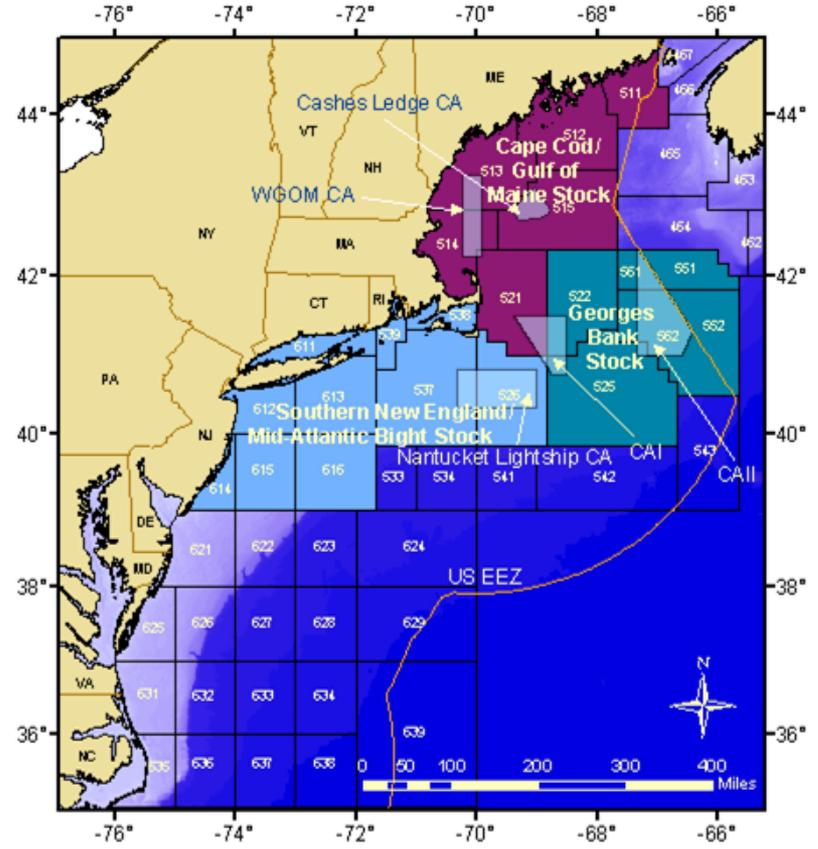
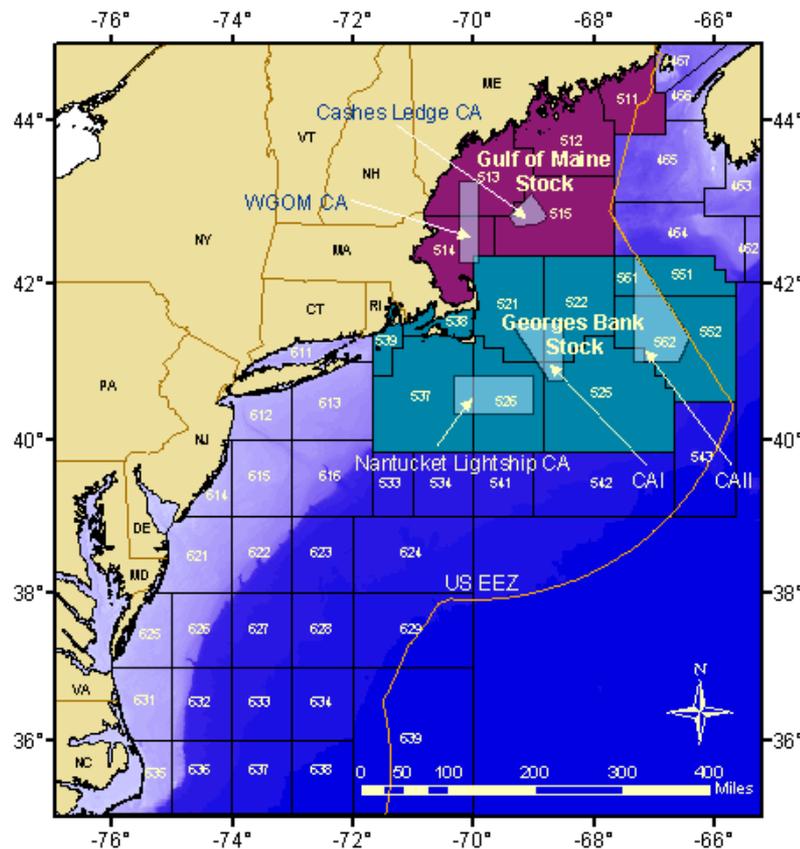


- Red Hake
- Data was equivocal, so management boundaries are the stock structure

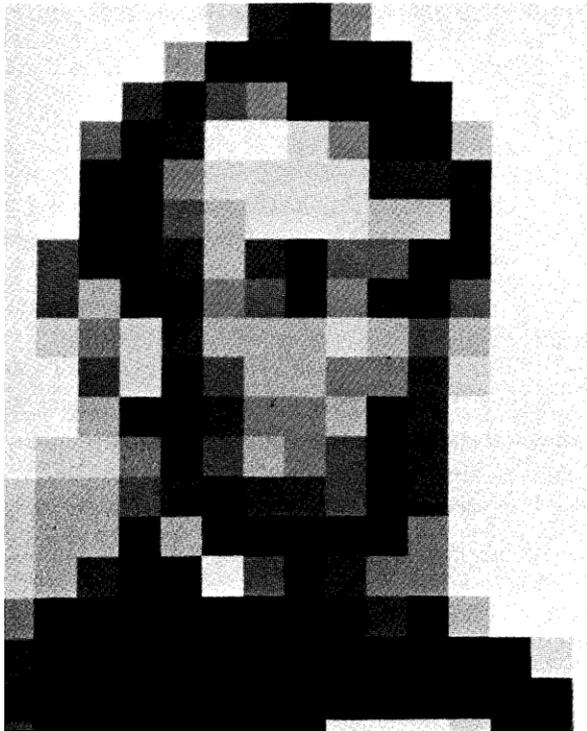
A Final Point

Haddock

Red Hake



Starting Point for Defining Spatial Management Units



- Base on Physical Features, Oceanography, Productivity Patterns
- Define Common Spatial Frame of Reference (10 minute Rectangles – smallest unit for which historical catch data available ~1000 spatial cells)
- Determine statistical patterns of similarity within areas to define ecological subregions

Define Ecological Production Units Based on Pelagic and Benthic Habitat Features and Primary Production

Bathymetry

Surficial Sediments

Mean Sea Surface Temperature (Satellite)

Annual Temperature Gradient (Satellite)

Annual Temperature Span (Satellite)

Temperature (Spring & Fall; Surface & Bottom)

Salinity (Spring & Fall; Surface & Bottom)

Chlorophyll a (Satellite)

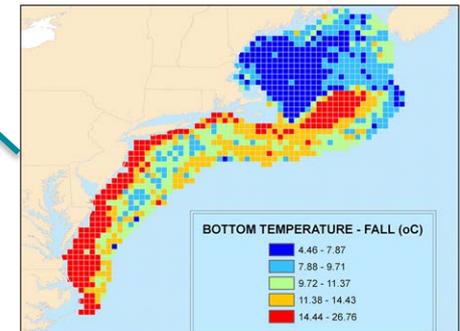
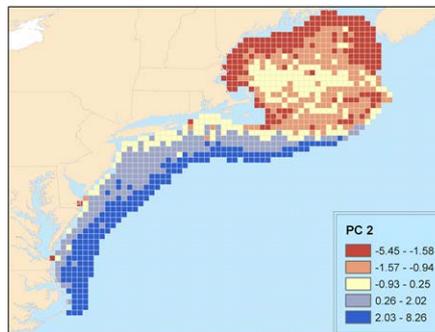
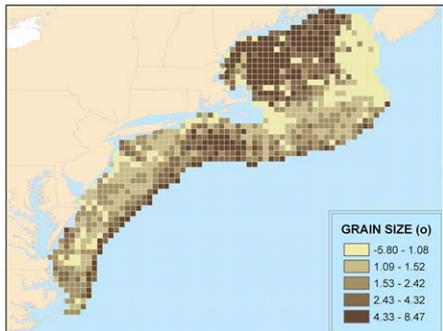
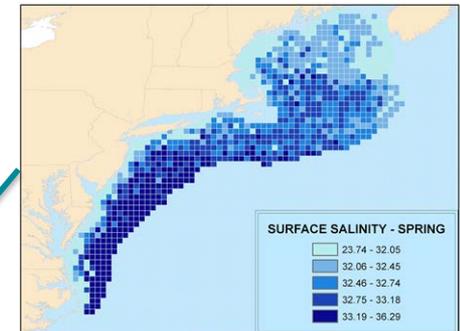
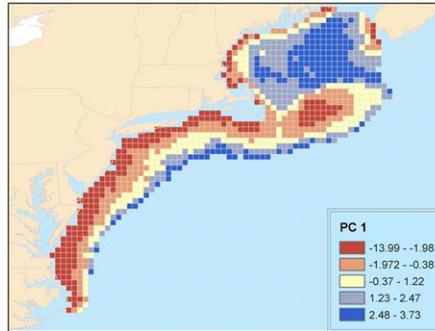
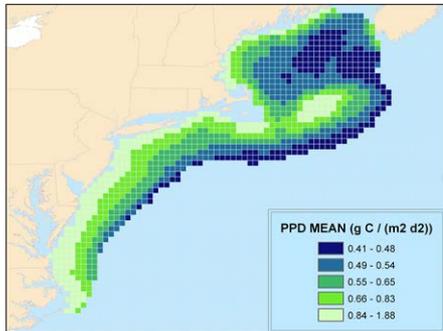
Chlorophyll a gradient (Satellite)

Primary Production (Satellite)

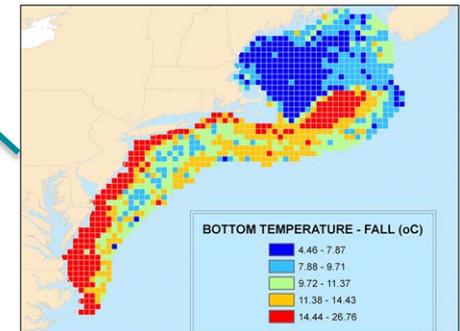
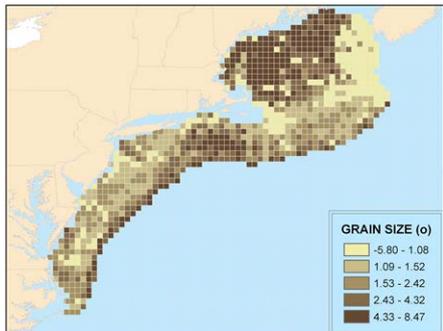
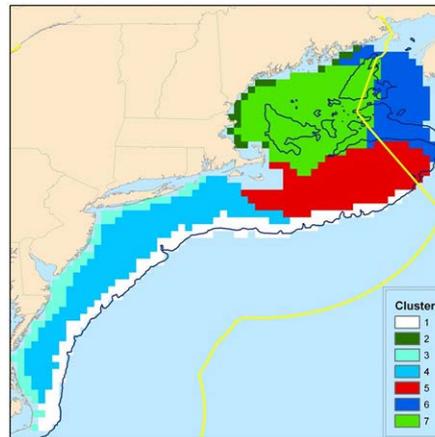
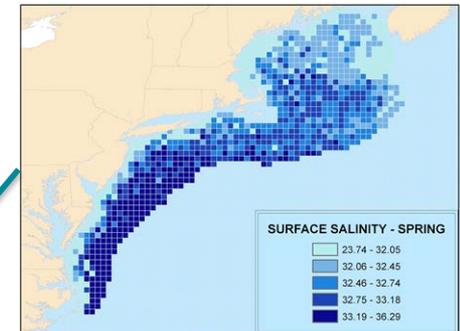
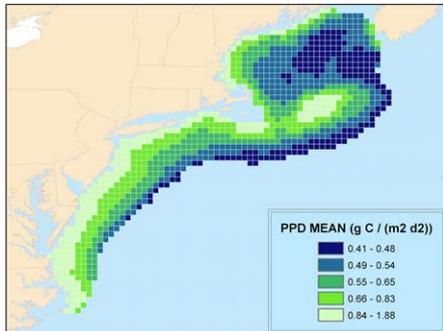
Defining Ecological Production Units

- Principal Components Analysis on all input data to reduce dimensionality
- First four principal components explained >75% of the variance
- Apply K-means cluster analysis to PC scores

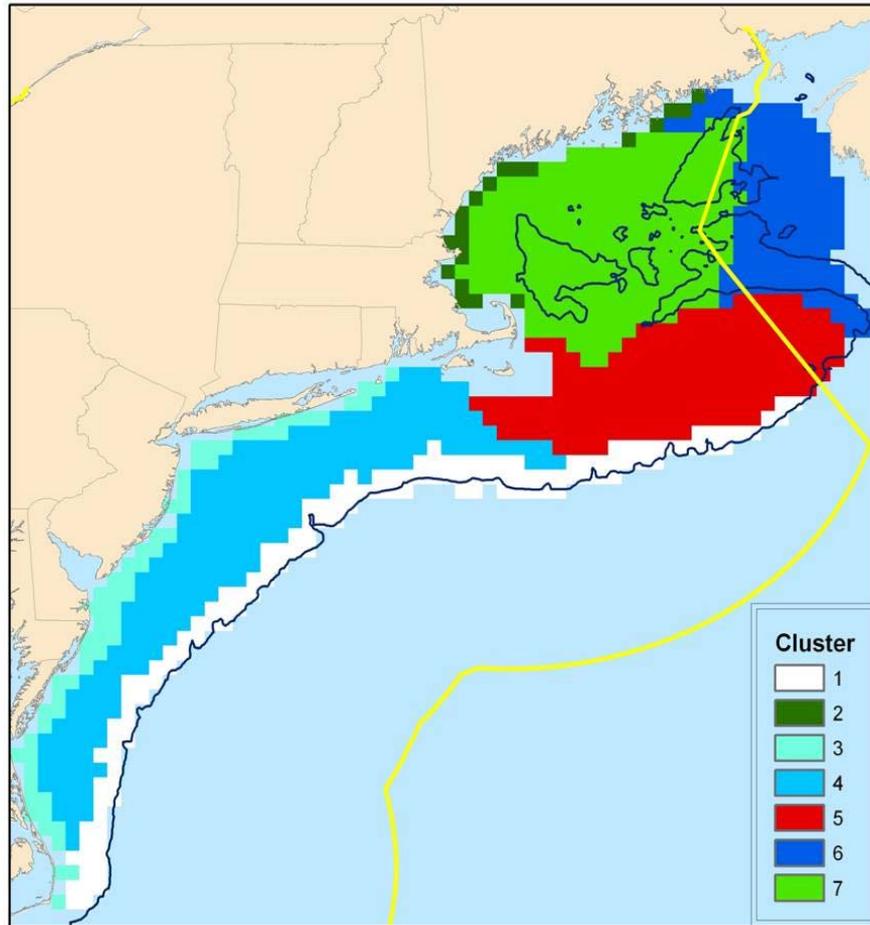
Analysis



Analysis

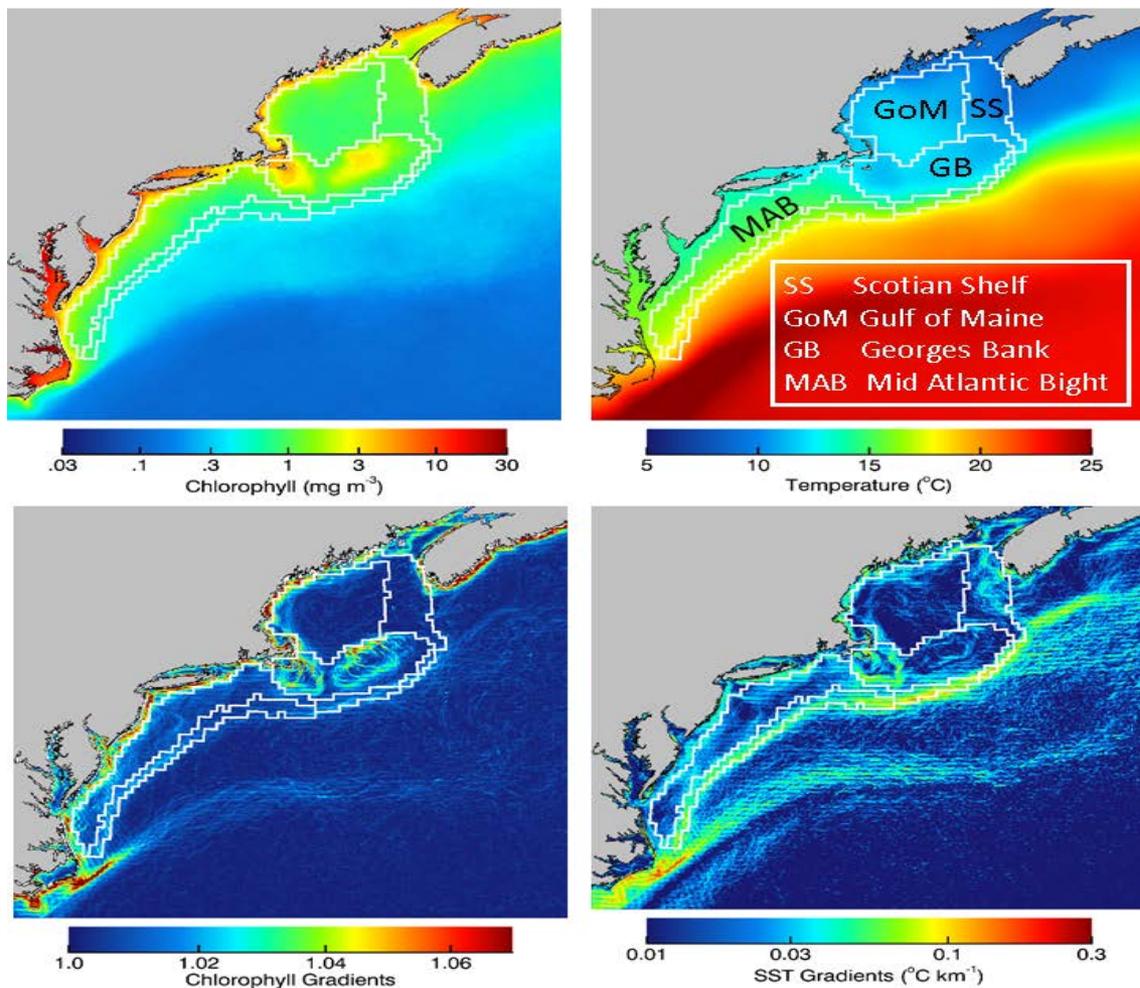


Ecological Production Units: Initial Clusters



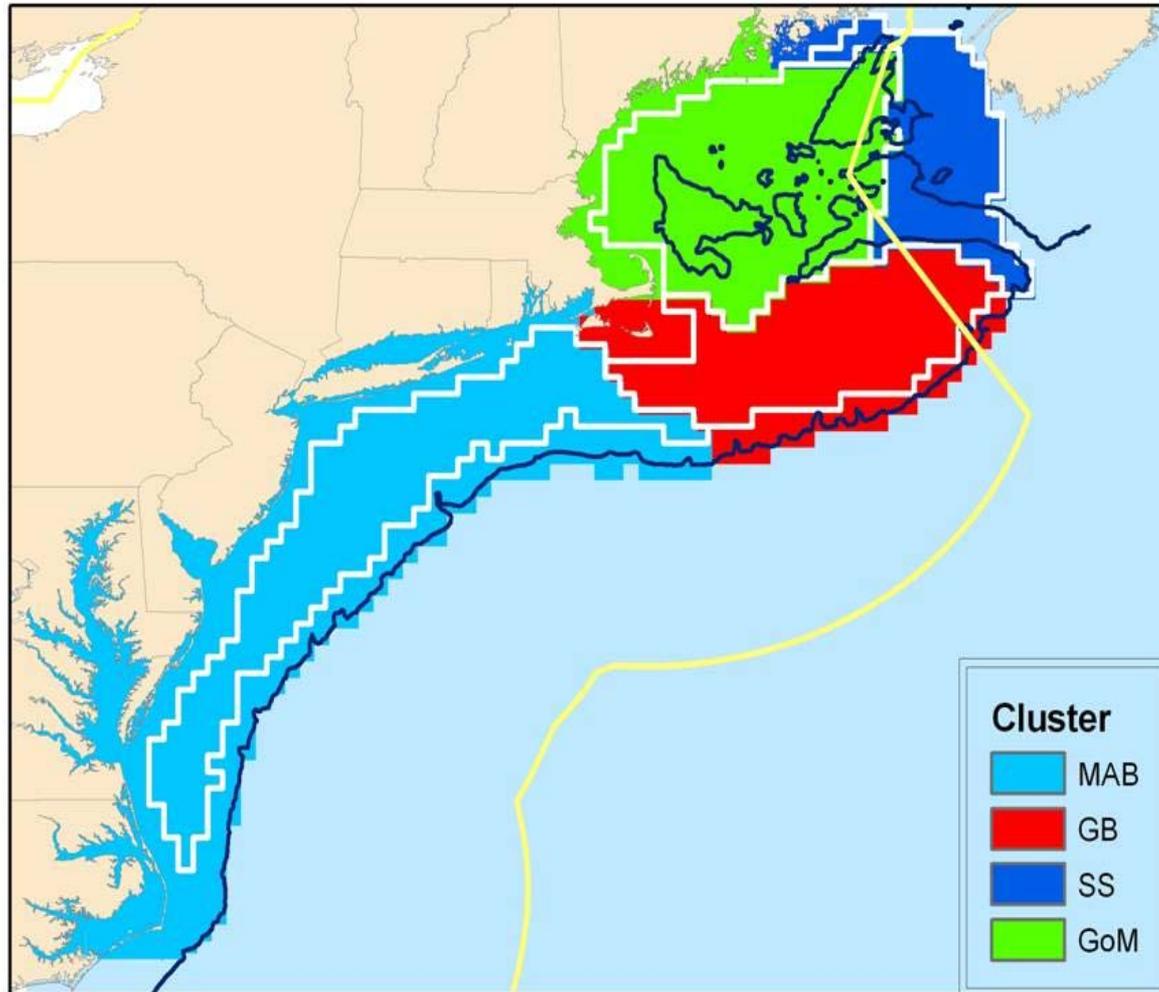
Coastal Areas not covered by shipboard operations not included in initial clusters

Filling in the Blanks and Consolidating Units:

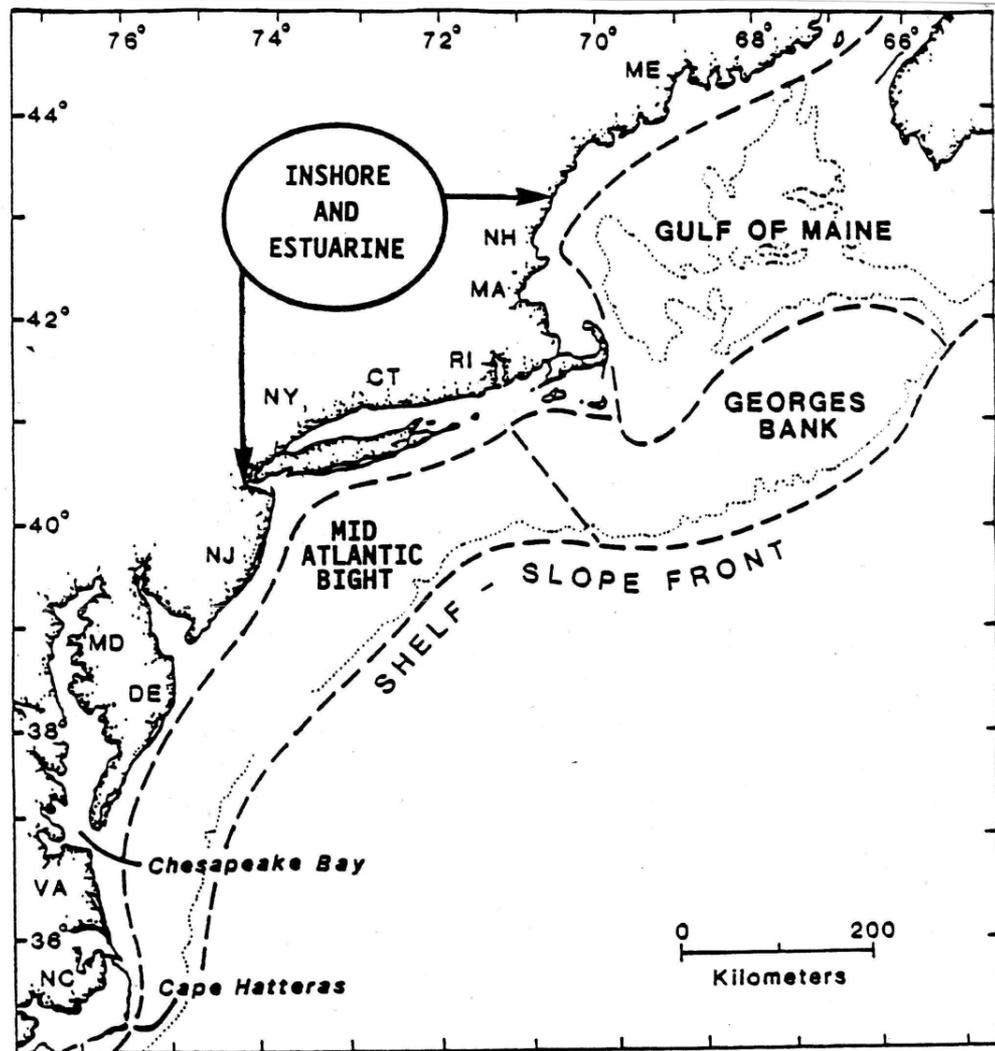


Satellite-based observations permit inferences on nearshore units

Ecological Production Units: Final Clusters



Northeast Regional Ecosystem Plan (NMFS 1988)



Using a very different approach and set of criteria, the NER Ecosystem Plan specified a similar set of boundaries

Conclusions

- Ecological subunits of the Northeast Continental shelf can be effectively defined based on physiographic, oceanographic, and lower trophic variables
- The number and size of the major spatial management units ultimately chosen will involve tradeoffs involving interchange among areas (smaller units involve more interchange).
- Hierarchical spatial management structures can be defined to reflect distribution of vulnerable species, biomass and biodiversity, human use patterns, and management requirements
- The units as defined in this presentation will provide the spatial footprints for the rest of the analyses at this CIE review



Questions?

