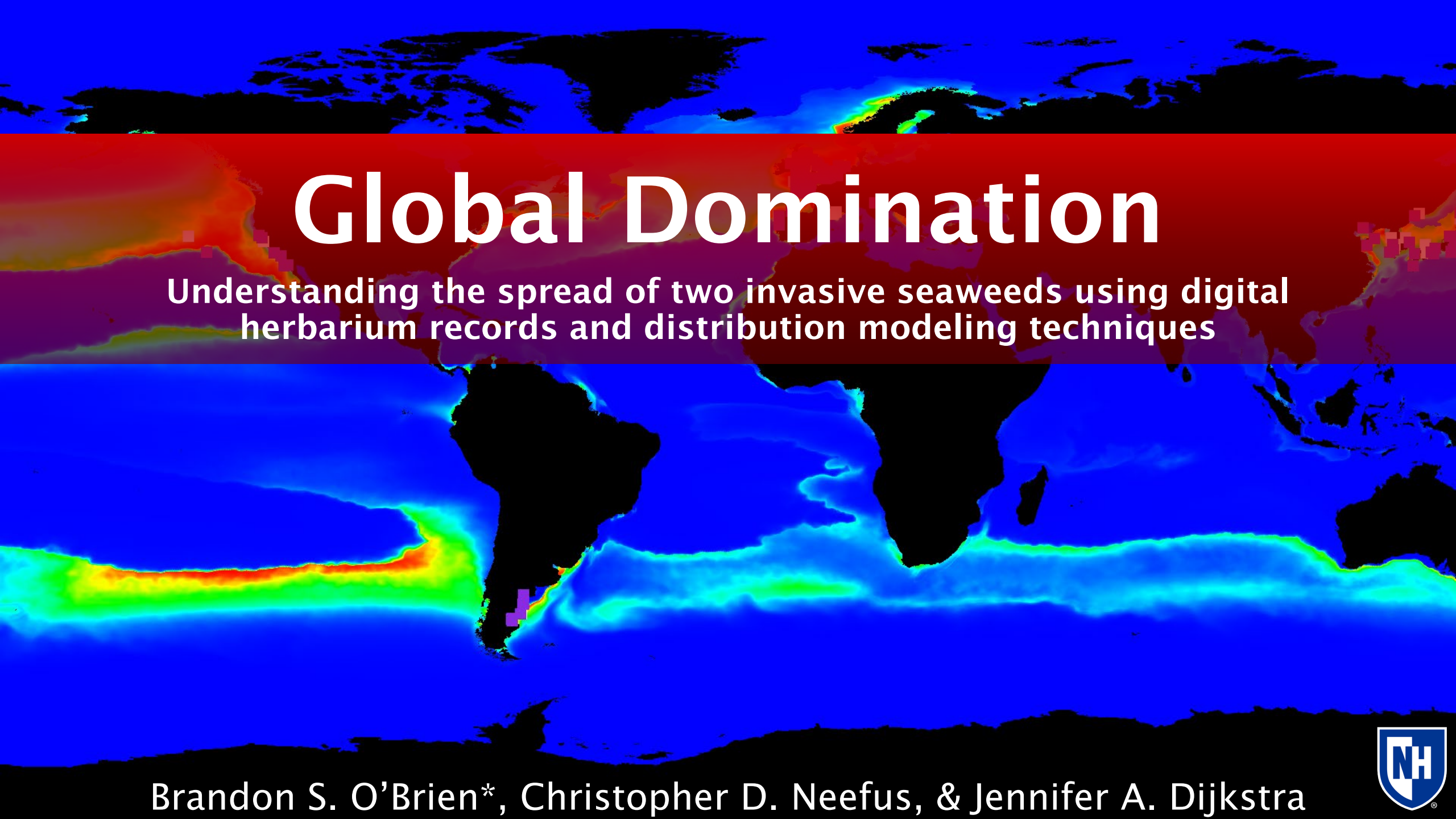


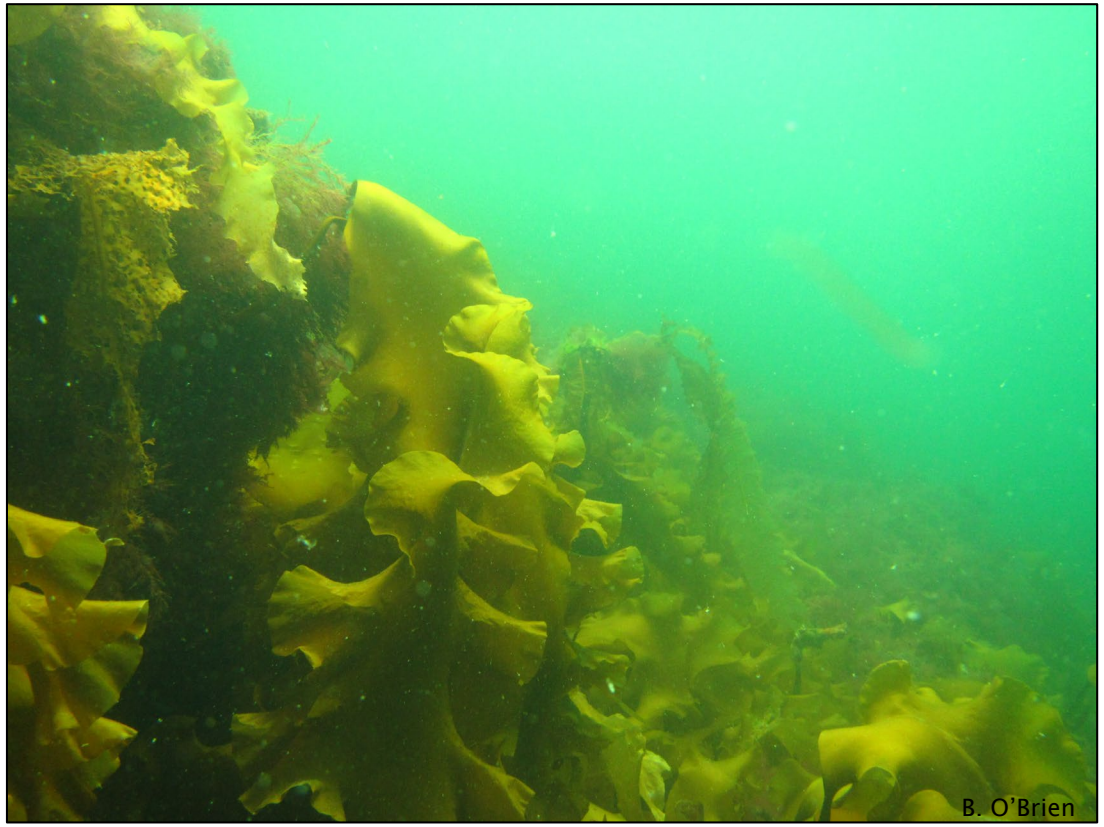
Global Domination

Understanding the spread of two invasive seaweeds using digital herbarium records and distribution modeling techniques

Brandon S. O'Brien*, Christopher D. Neefus, & Jennifer A. Dijkstra

Seaweeds

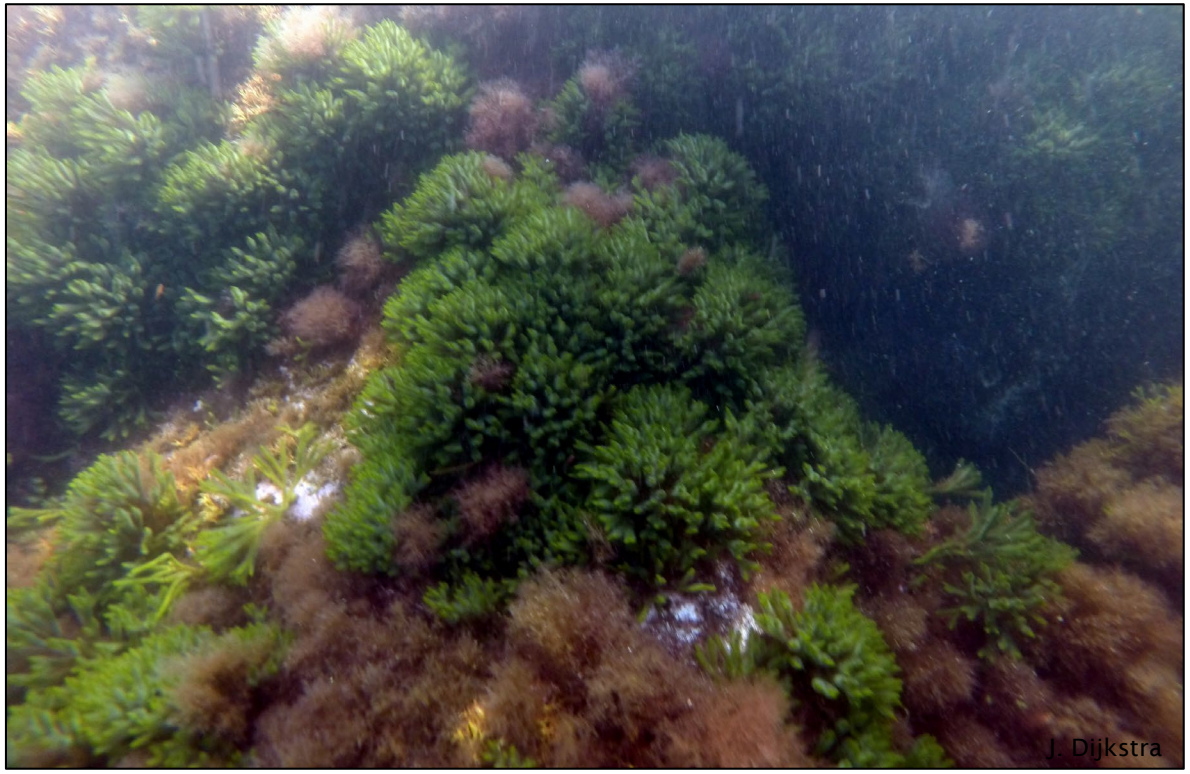
- Diverse group of primary producers found in marine, estuarine, and aquatic ecosystems.
- Foundation species which create habitat structure.
- Provide food, substrate, and shelter for other marine organisms.



Invasive Seaweeds

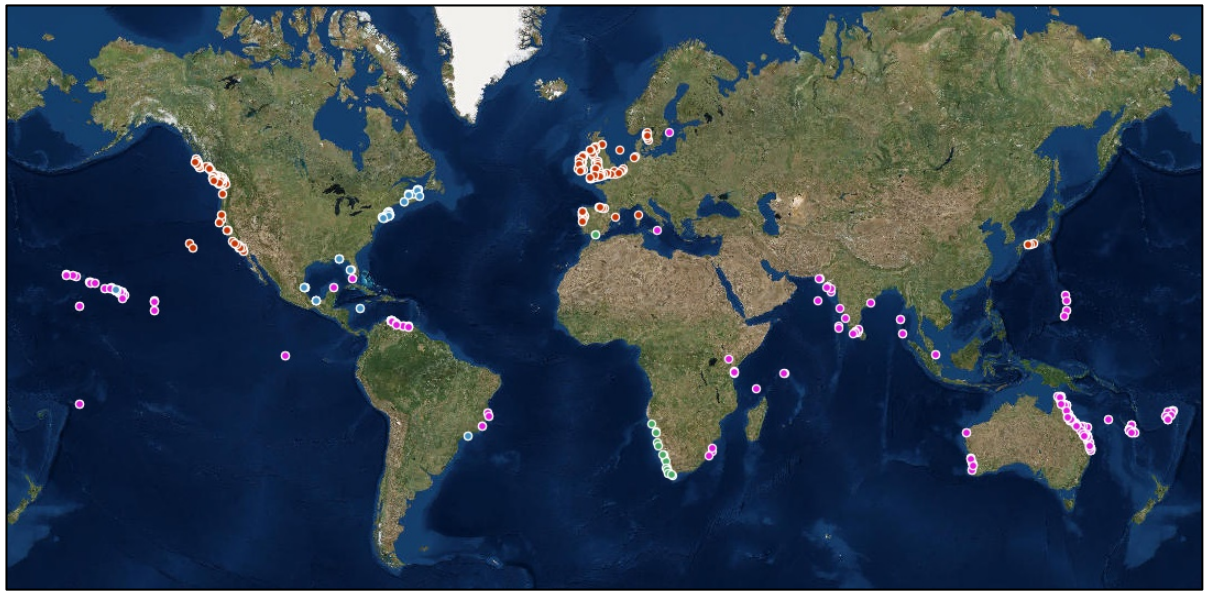
- 277 species worldwide.[1]

- Ecological impacts
  - Reduce biodiversity
  - Compete with native species
  - Alter habitat structure



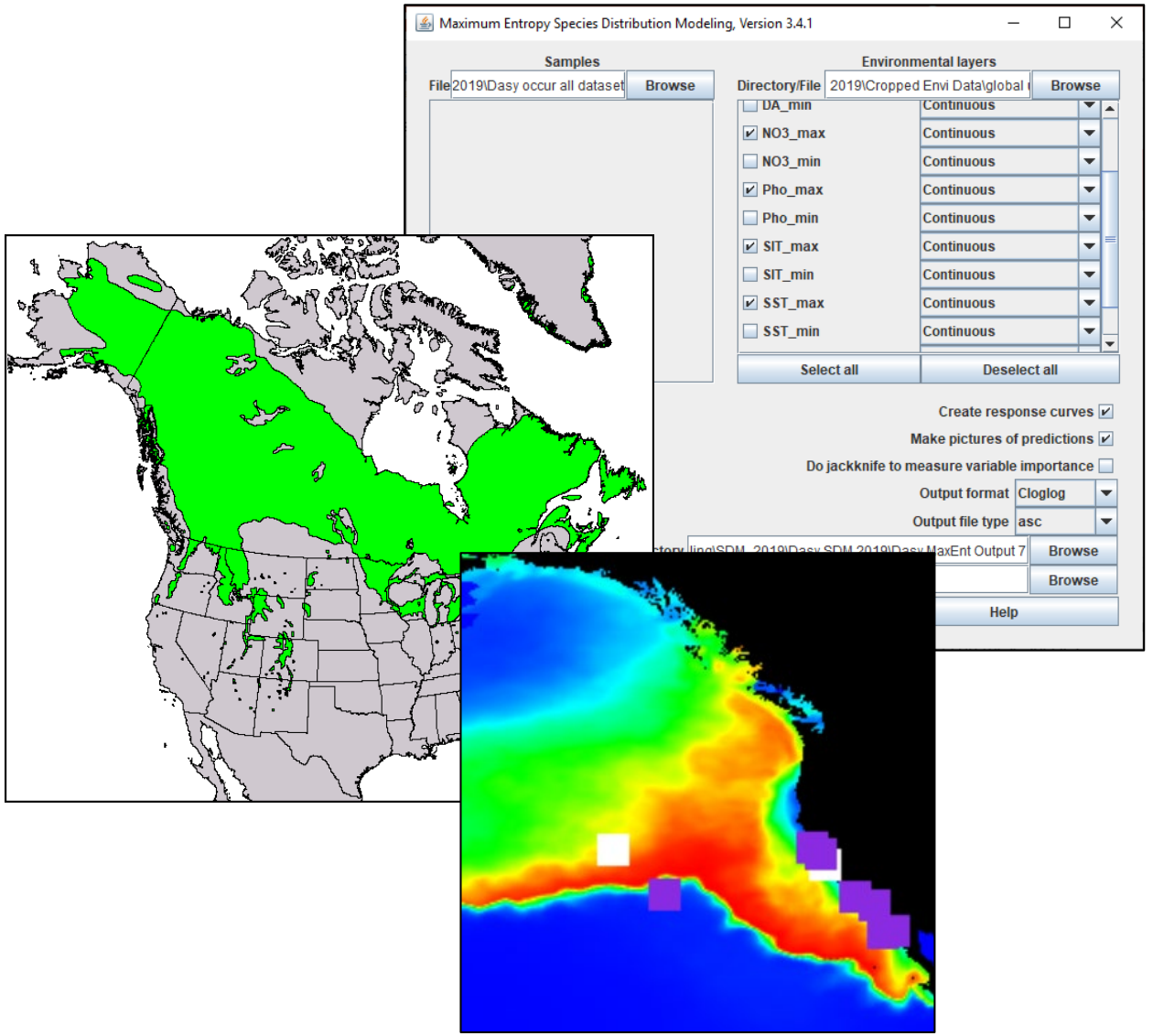
What makes an invader?

- Transport to new region
- Habitat suitability
- Geographic expansion



Distribution Modeling

- Tool for assessing large-scale biogeographic questions
- Combine environmental data with species occurrence data
- Make predictions in geographic space
- Popular in climate change research



Undaria pinnatifida

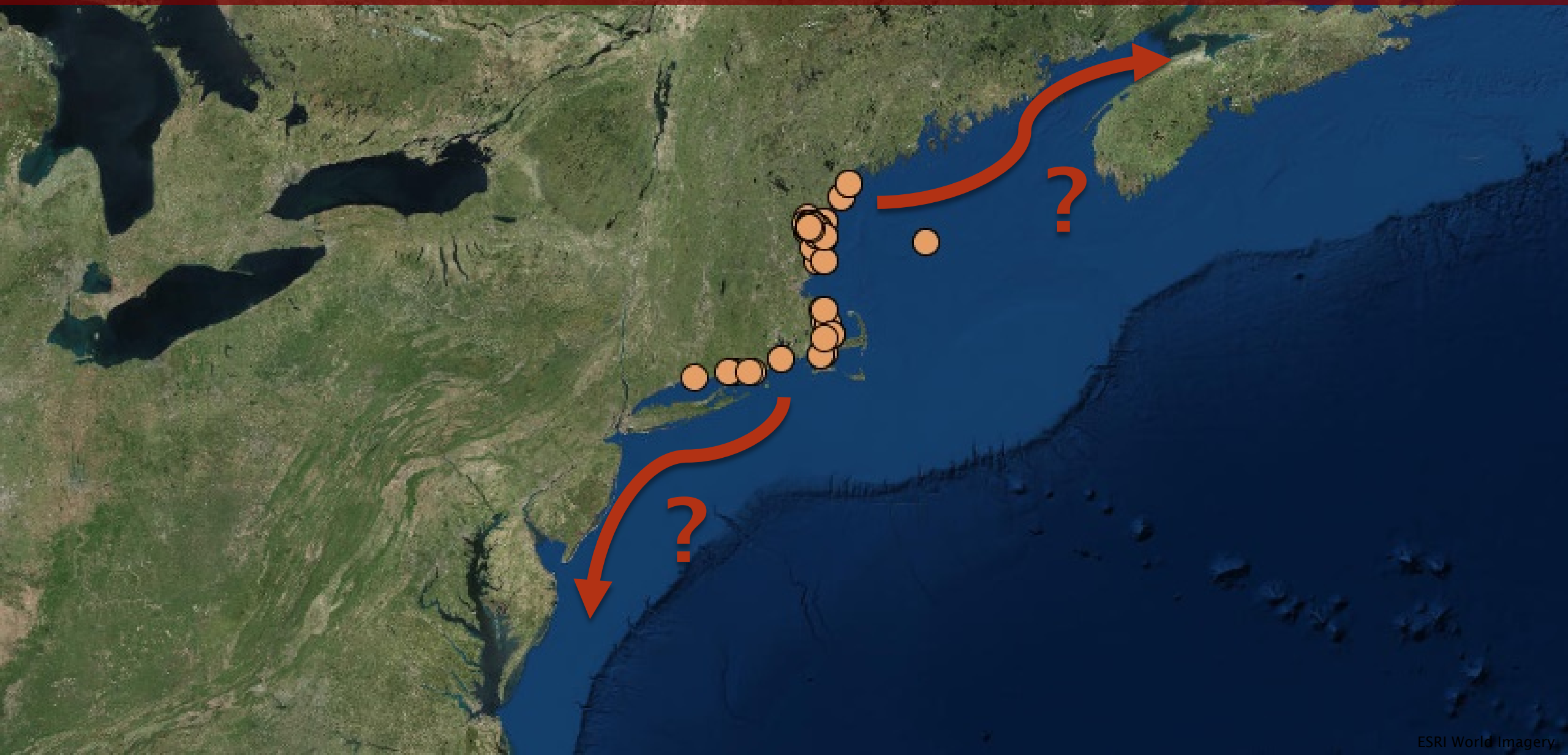
- Cold-temperate kelp
- Native to Japan and coastal Asia
- Since 1970s, has become invasive in Europe, Australia, South America, California.[2]
- Forms dense upright canopy

Undaria pinnatifida

Dasysiphonia japonica

- Native to Japan and coastal Asia
- Red filamentous algae
- Since 2011, has spread from Connecticut to New York to Maine.
- Also invasive in Europe

Dasysiphonia japonica



Project Goals

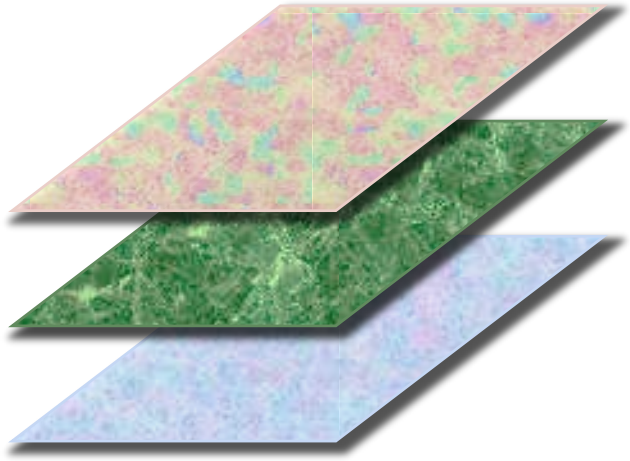
- To create accurate species distribution models for these two species, and use those models to address the following two questions:

- *Undaria pinnatifida* – Does the Northwest Atlantic represent suitable habitat for this species, if it were to arrive here?

- *Dasysiphonia japonica* – Does the current range of this species in the Northwest Atlantic represent the full possible extent that it could inhabit?

MaxEnt

- Maximum Entropy modeling technique
- Open source software produced by Phillips et al. (2004).[3,4]

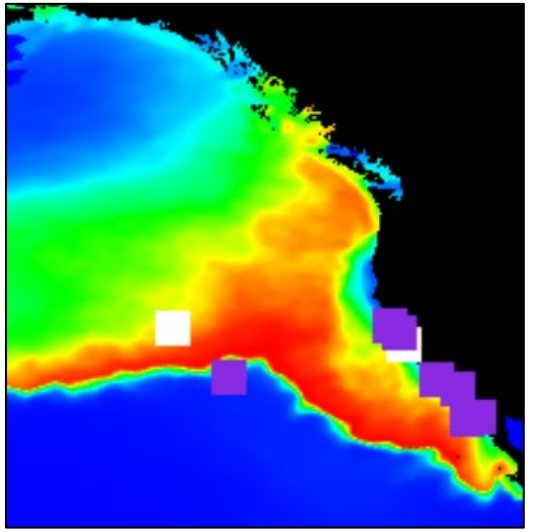


Environmental Raster Data

+

Species Occurrence Data

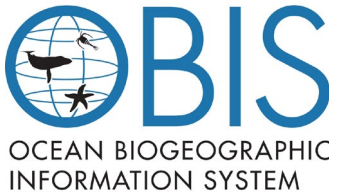
→



Habitat Suitability Predictions

Data Sources

- Environmental Data:
  - Bio-ORACLE[5]



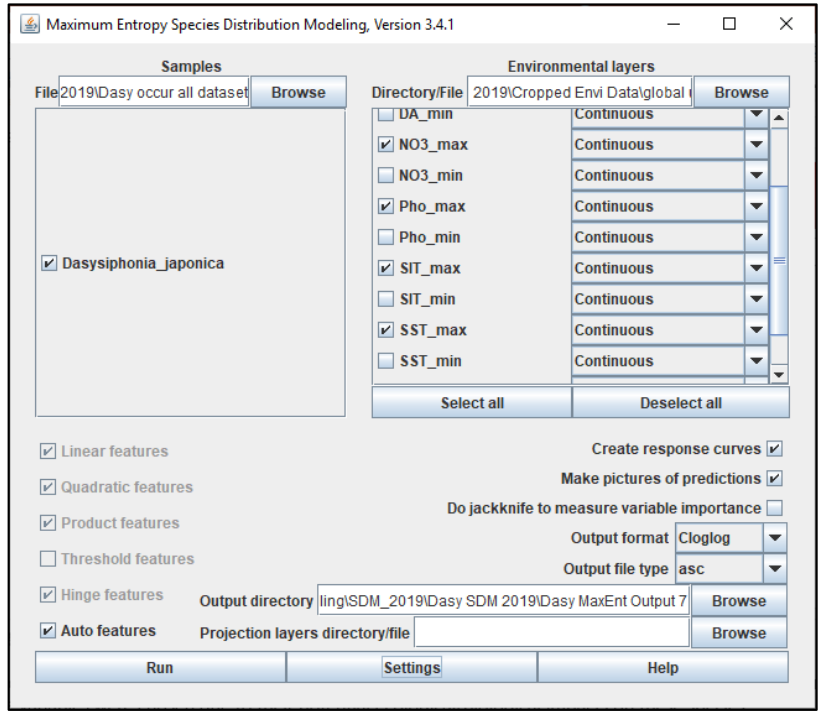
- Species Occurrence Data:
  - Macroalgae Herbarium Portal (MHP)[6]
  - Ocean Biogeographic Information System (OBIS)[7]
  - Global Biodiversity Information System (GBIF)[8]

Model Building

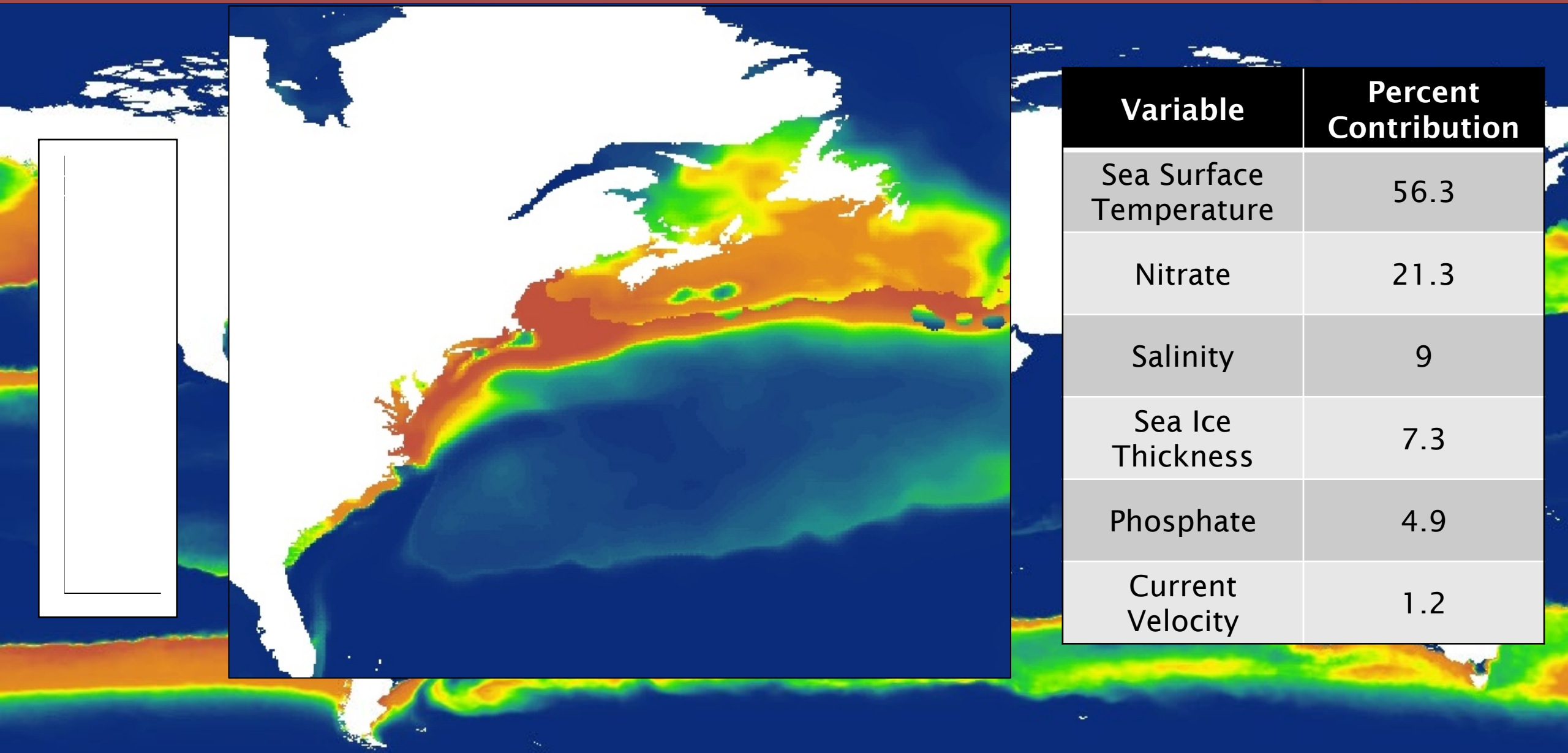
- Environmental variables:
  1. Sea Surface Temperature
  2. Current Velocity
  3. Sea Ice Thickness
  4. Surface Nitrate
  5. Surface Phosphate
  6. Salinity

- 70% training, 30% validation

- Number of points used for each species:
  - *Undaria*: 167
  - *Dasysiphonia*: 155

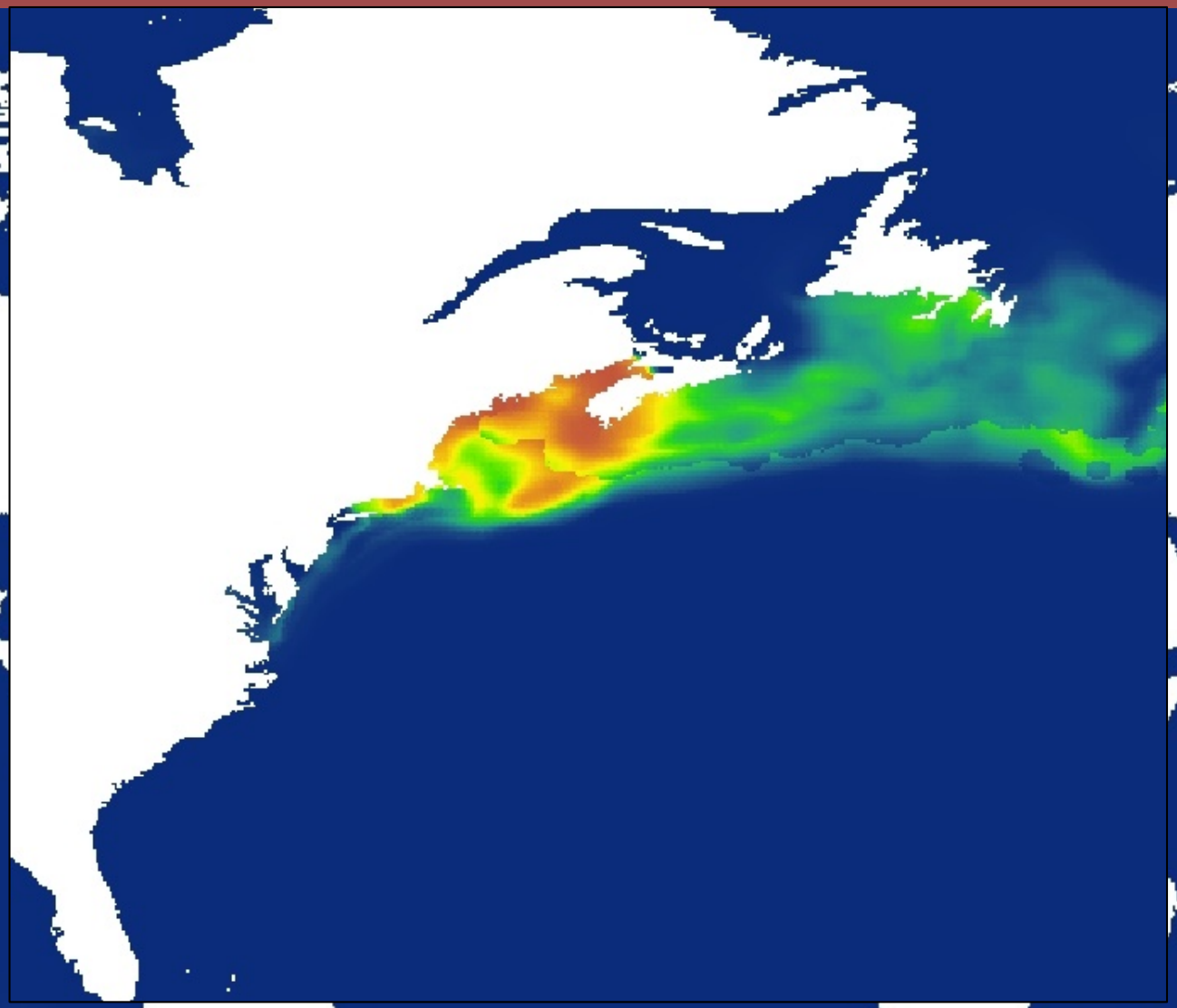


Model Output: *Undaria*



Variable	Percent Contribution
Sea Surface Temperature	56.3
Nitrate	21.3
Salinity	9
Sea Ice Thickness	7.3
Phosphate	4.9
Current Velocity	1.2

Model Output: *Dasysiphonia*



Variable	Percent Contribution
Sea Surface Temperature	48.4
Phosphate	34.3
Salinity	7.2
Nitrate	5.2
Sea Ice Thickness	4.3
Current Velocity	0.5

Discussion: *Undaria*

Discussion: *Undaria*

Discussion: *Dasysiphonia*

Discussion: *Dasysiphonia*


B. O'Brien


K. Mello

Conclusions

- *Undaria pinnatifida*
  - Poses a potential threat to the Northwest Atlantic and the Gulf of Maine
- *Dasysiphonia japonica*
  - Likely to continue spreading northward
- Thoughts on Distribution Models
  - Work in progress – will continue to refine models
  - Useful for testing large-scale hypotheses and big pictures questions in marine ecology

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  - UNH School of Marine Science and Ocean Engineering
  - UNH Graduate School

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Questions?

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