A GIS-based Decision Support Tool for Oyster Restoration

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PROBLEM

- Global decline of native oysters (Figure 1)
  - Fueled large-scale oyster restoration
- Multiple reef restoration strategies with differing goals
  - *Sanctuaries*: subtidal constructed reefs protected from harvest
    - Goal: enhance larval production and connectivity
  - *Intertidal*: natural and constructed reefs along shoreline
    - Goal: provide coastal shoreline protection
- **Efficacy of restoration dependent on effective site selection**

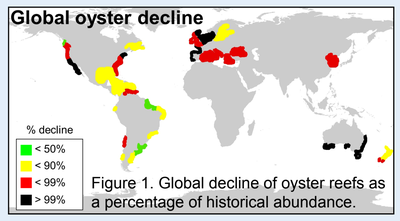


Figure 1. Global decline of oyster reefs as a percentage of historical abundance.

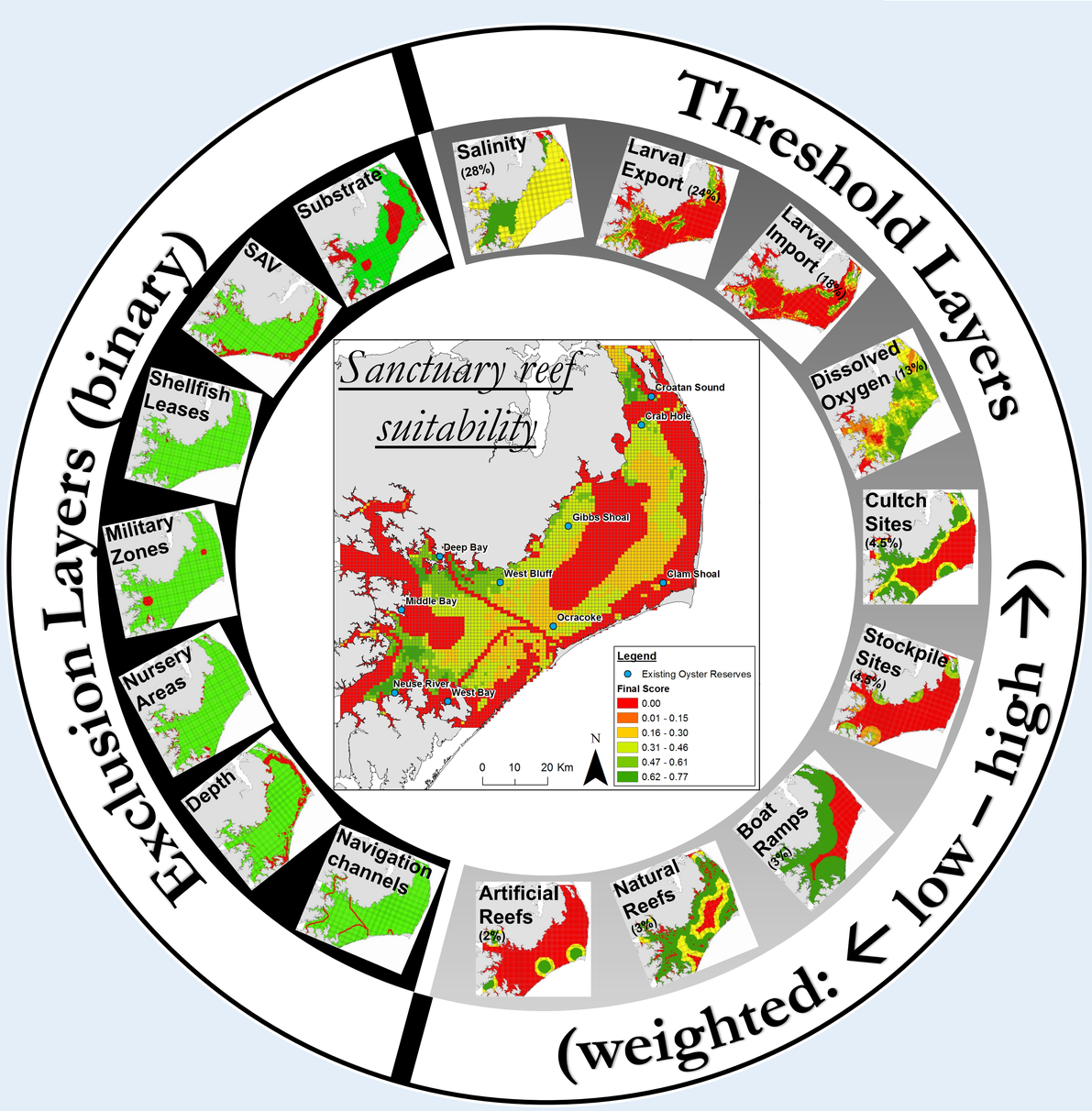
OBJECTIVE

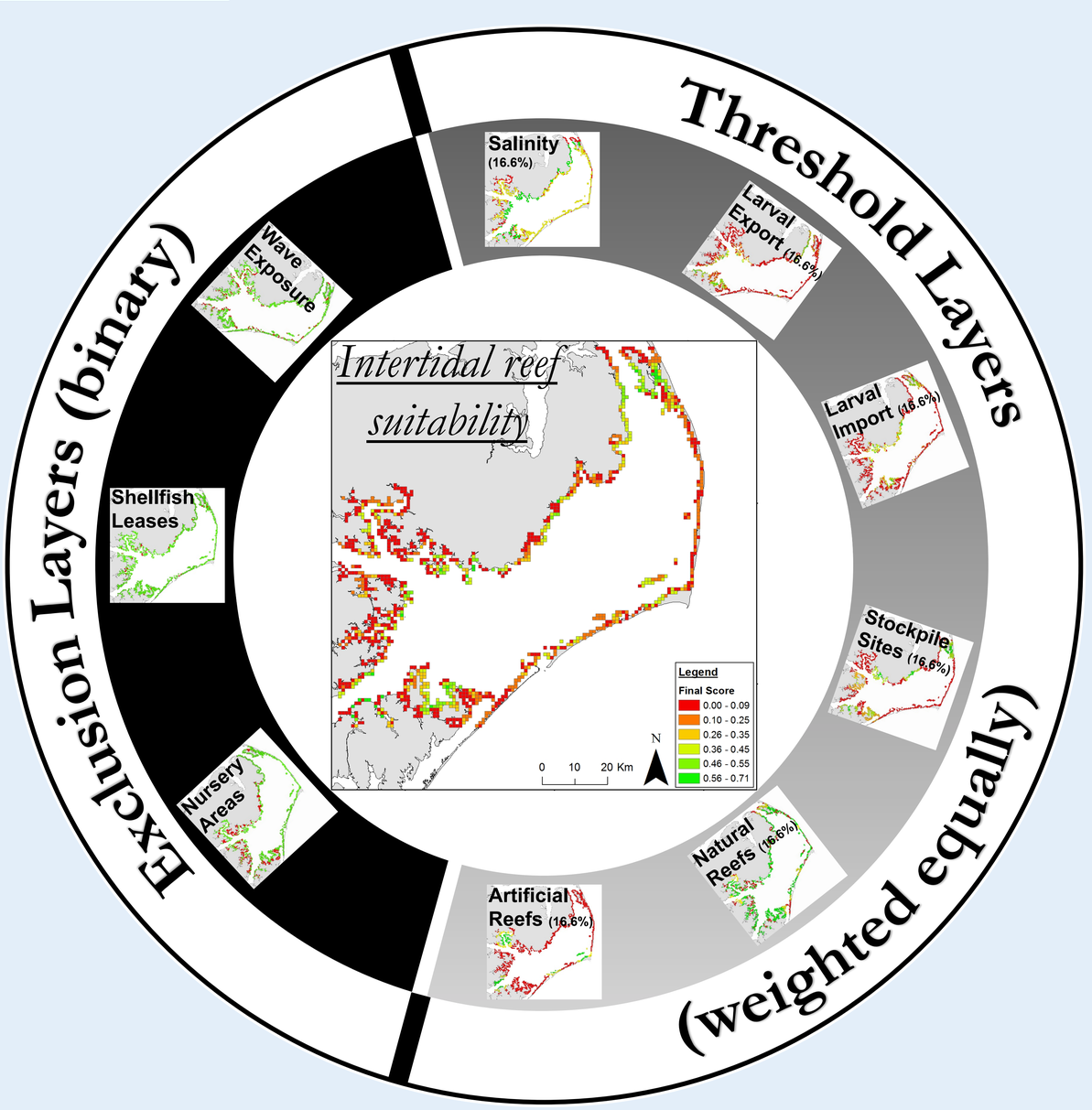
Apply a GIS-based hierarchical optimization algorithm to select optimal subtidal sanctuary and intertidal reef sites based on biological, socioeconomic and ecosystem services data

CONCLUSIONS

GIS-based hierarchical approach to site selection is effective for:

- Maximizing restoration cost-efficiency by optimizing for multiple ecosystem services and functions
- Narrowing large water bodies and shorelines to a manageable number of sites for more detailed study
- Identifying restoration "hot spots" where optimal sites are clustered
- Integrating biological, socioeconomic and ecosystem services considerations in a decision support tool for multiple forms of oyster restoration





METHODS & MODEL DEVELOPMENT

- Study system: Pamlico Sound, North Carolina
  - Contains subtidal sanctuaries and natural intertidal reefs
- Focal species: Eastern oyster (*Crassostrea virginica*)
  - Sessile adults with dispersive larval stage; forms reefs in subtidal and intertidal zones of estuaries
- Model development:
  - Created grid of Pamlico Sound (*Sanctuaries*: 5,987 km^2 cells; *Intertidal*: 1,158 km^2 cells)
  - Assembled GIS layers; two categories: exclusion and threshold
    - *Sanctuaries*: 16 layers, *Intertidal*: 9 layers
  - Calculated suitability value of all cells
    - Scale: 0 (unsuitable; red) to 1 (most suitable; green)

RESULTS

Sanctuary Model:

- Based on exclusion layers, 56% of Pamlico Sound unsuitable for oyster sanctuaries
- Max suitability value: 0.77 (on 0-1 scale); modal suitability value: ~0.38
- Top 50 sites scored > 0.68; optimal sites clustered in SW & N

Intertidal Model: (development in-progress, preliminary results presented)

- Based on exclusion layers, 43% of Pamlico Sound shoreline unsuitable for intertidal reef restoration
  - Expert opinion needed to assign final weights & ID additional layers)
- Max suitability value: 0.71 (on 0-1 scale); modal suitability value: ~0.30
- Top 50 sites scored > 0.52; optimal sites clustered in SW & N, patchy distribution
- Model focuses on siting reefs constructed of natural shell, not alternative materials (currently)

Literature Cited: Beck *et al.* 2011, BioScience 61:107-116

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