Habitat Selection by Flatfishes Along Gradients of Environmental Variability: Implications for Susceptibility to Hypoxia in the Northern Gulf of Mexico

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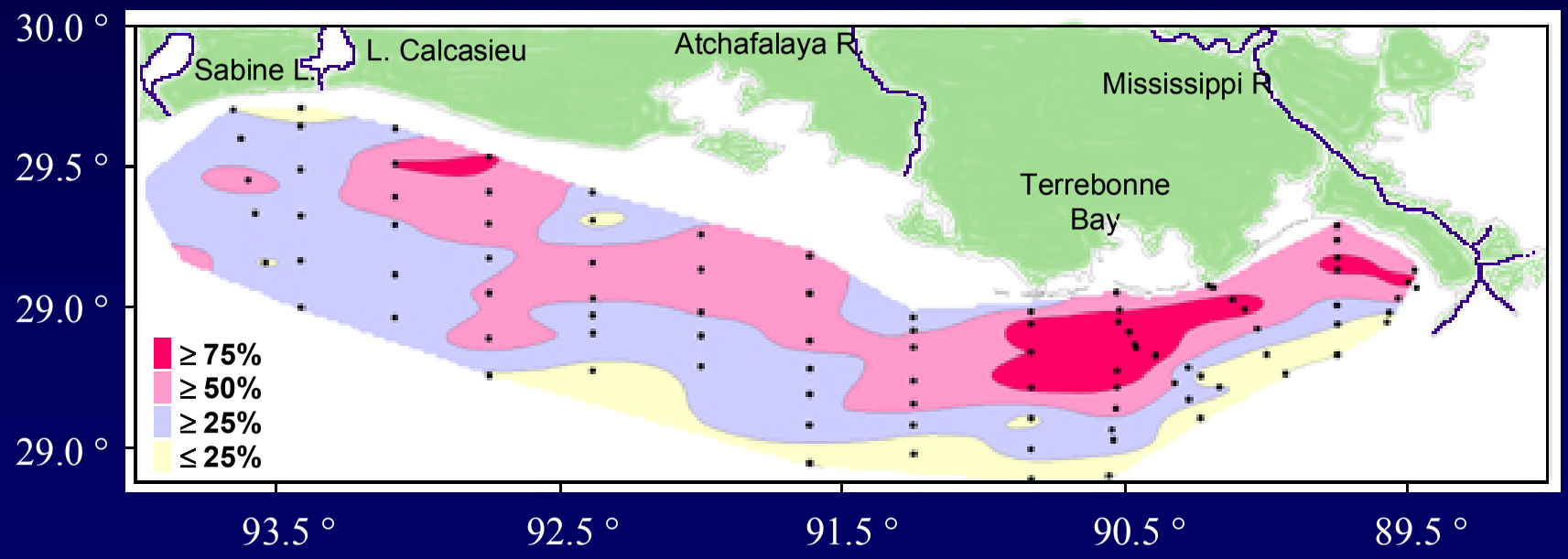
Coastal Eutrophication

- Nutrient input
- Eutrophication in northern Gulf of Mexico

- Productive fish and shellfish resources
- However…

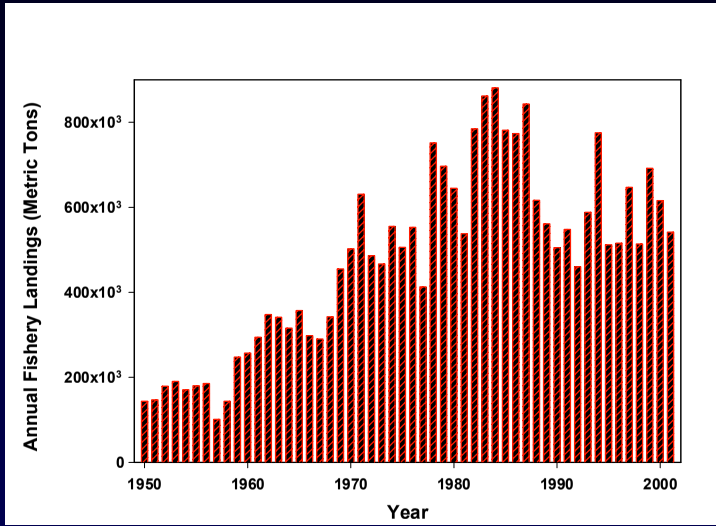
Hypoxia

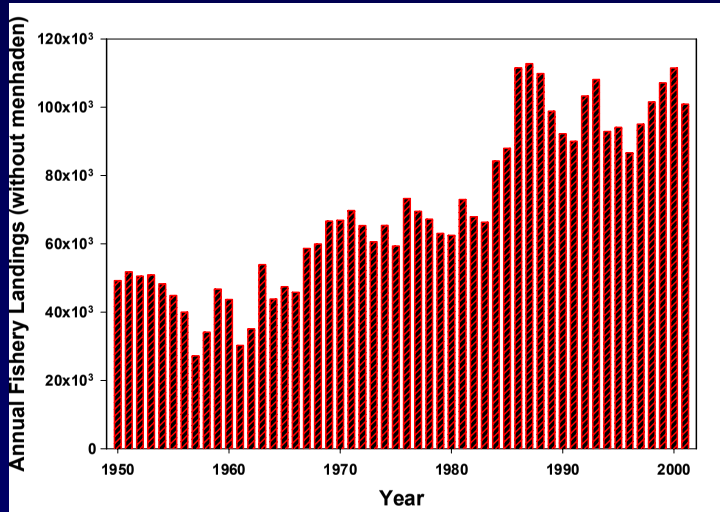
- Excess primary production
- Vertical stratification of water column
- Seasonal formation of hypoxic bottom waters



Data source: N. Rabalais; modified from Rabalais et al. 2001

Threat to Fisheries?

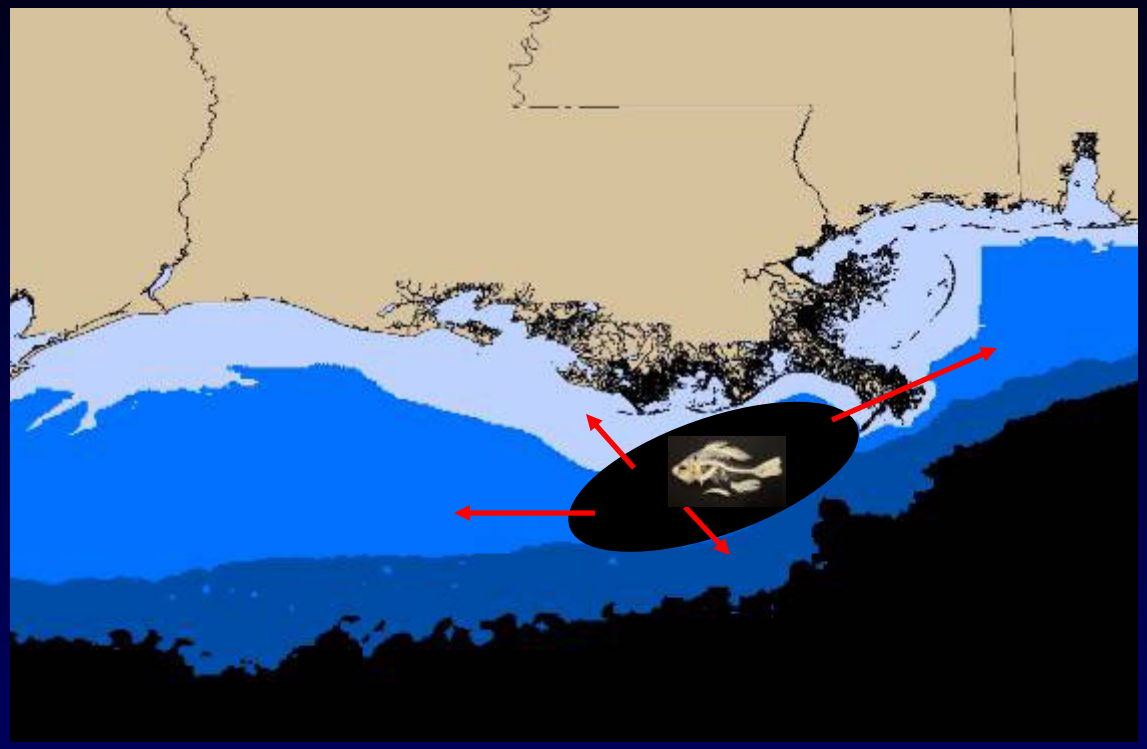




Source: NMFS

- Fishery landings remain strong
- Hypoxia a threat to sustainability:
  - Forcing individuals from favored habitat
  - Altered prey distributions
  - Altered migration pathways

Unraveling the Effects of Hypoxia

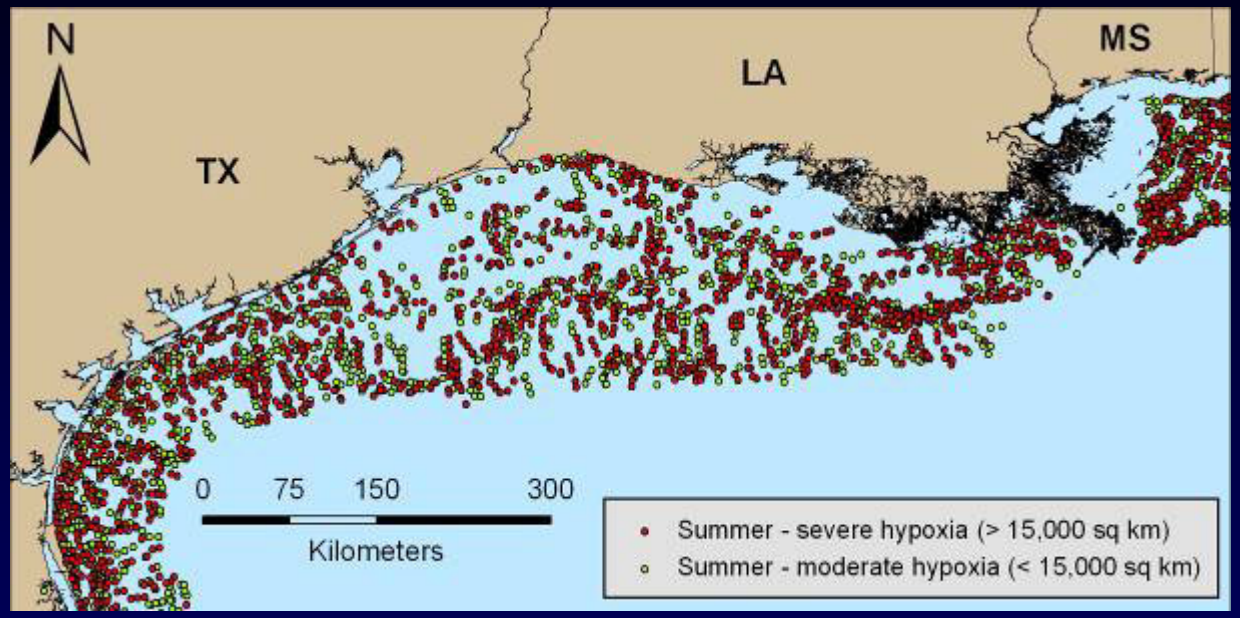


- In response to hypoxia, nekton may move:
  - Vertically
  - Alongshore
  - Inshore/offshore

- Problem: distribution results from orientation along multiple environmental gradients
- Goal: examine resource use patterns along multiple environmental gradients – identify response to hypoxia

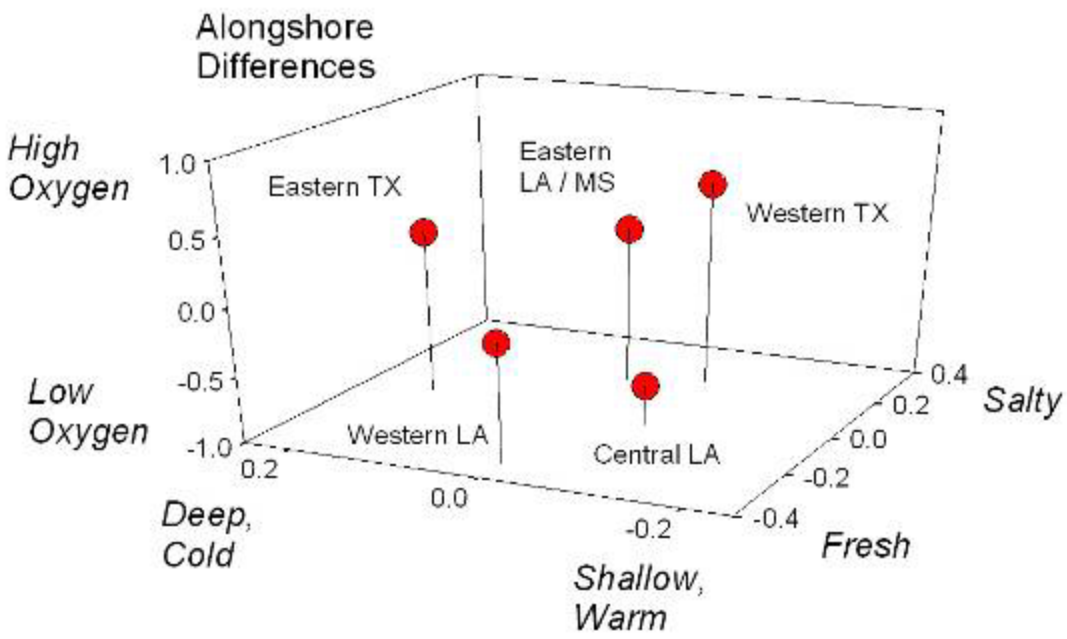
SEAMAP Data

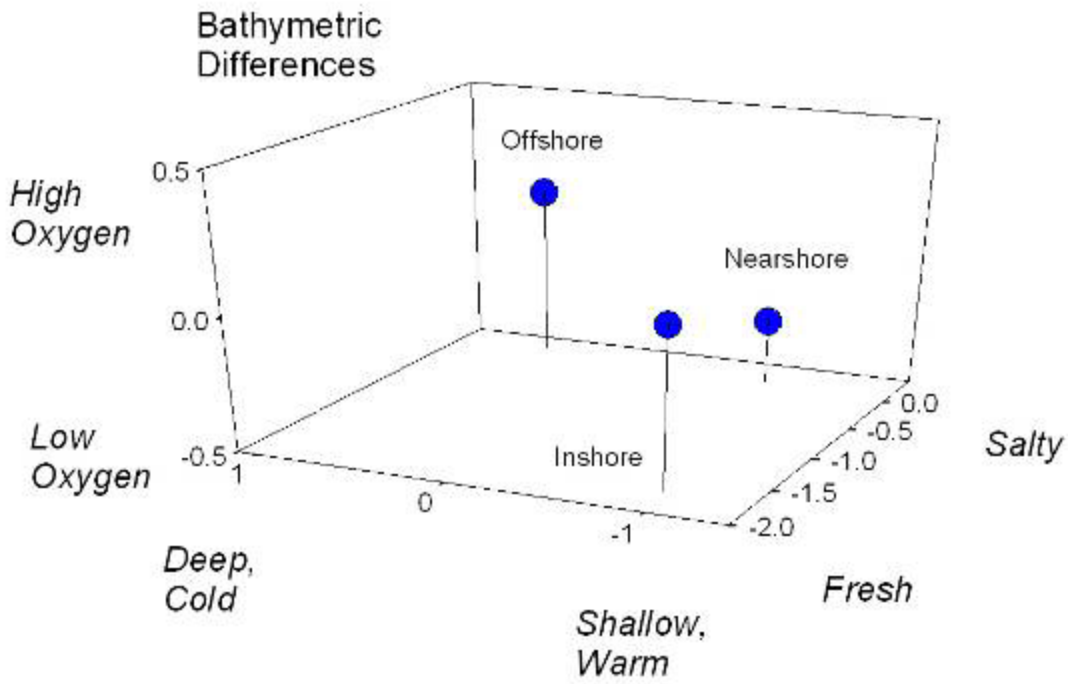
- SEAMAP Data:
  - 12.8 m shrimp trawl
  - 1987 – 2000
  - Summer only

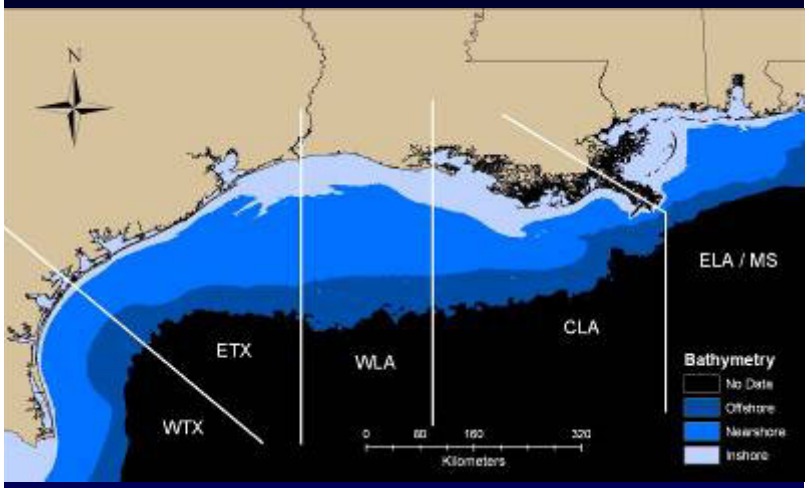


- Years classified as severe hypoxia (> 15,000 km^2) or moderate hypoxia (< 15,000 km^2) based on Rabalais et al. (2002)
- No 1989 (no hypoxia data)

Spatial Variability – SEAMAP Data





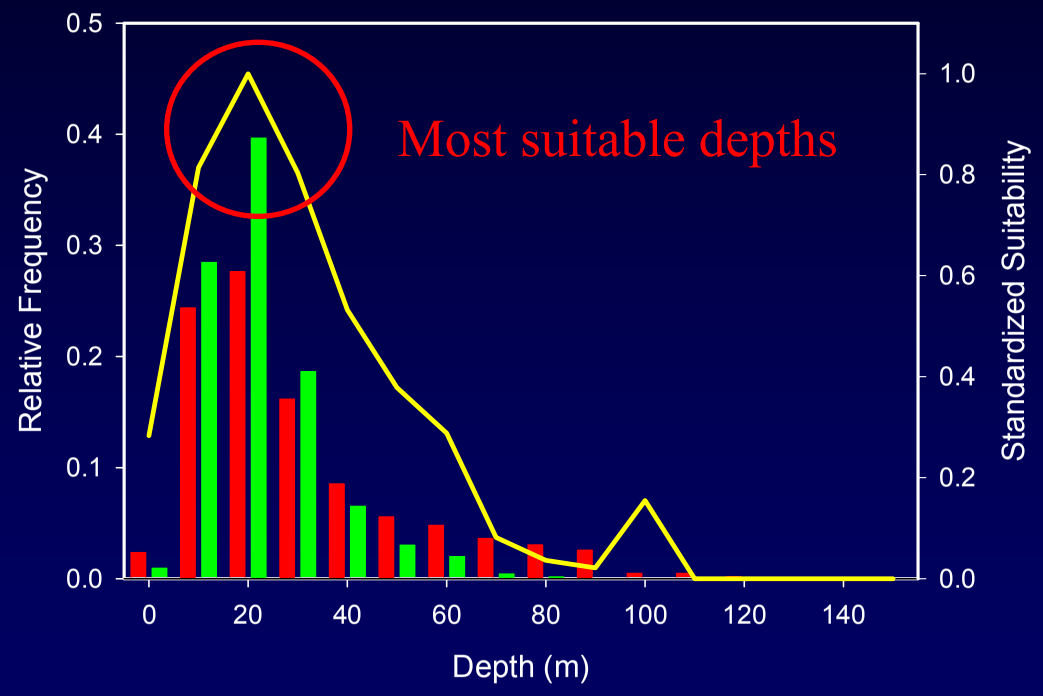


- Lower salinities + less oxygen in CLA & WLA
- Lower salinities inshore

Environmental Suitabilities

- Focused on abundant flatfishes – limited vertical displacement

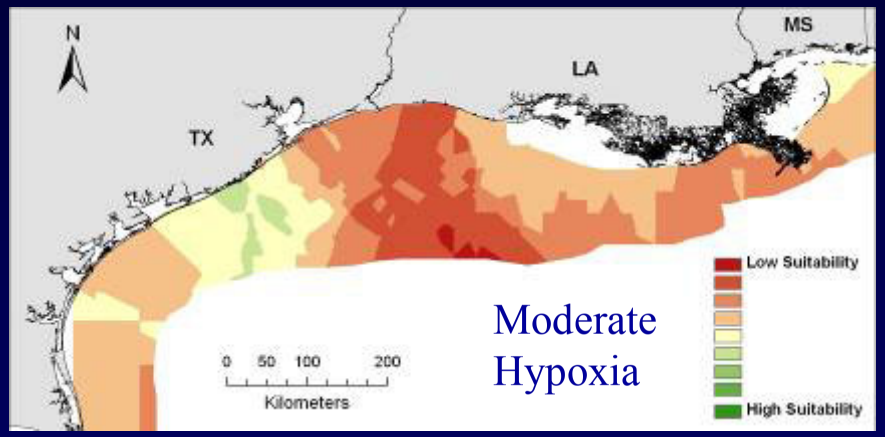
- Environmental suitabilities:
  - Depth
  - Temperature
  - Salinity
  - Dissolved Oxygen

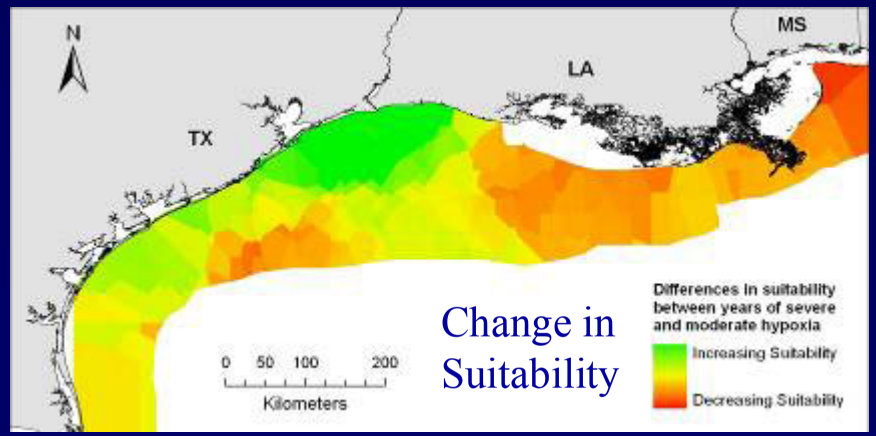


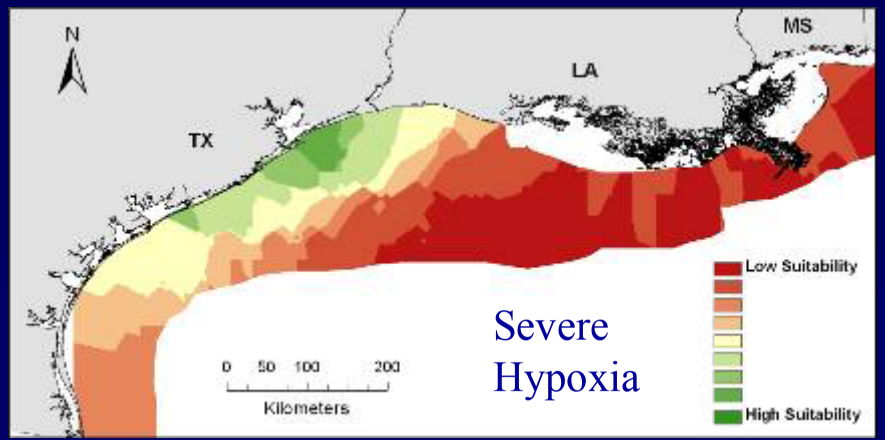
- Environmental suitabilities incorporated all data

Spatial Suitabilities

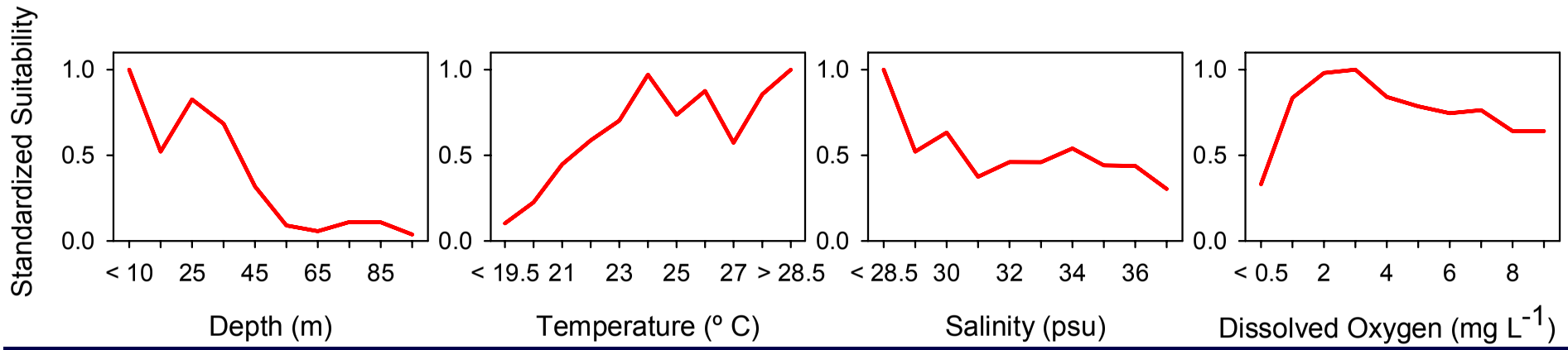
- Suitabilities calculated for 0.5º latitude by 0.5º longitude grids:
  - moderate and severe hypoxia years
- Interpolated using ArcGIS Spatial Analyst
- Change = severe - moderate







Influence of Hypoxia on Habitat Suitability – *Citharichthys spilopterus*



Source: G. Sneegas

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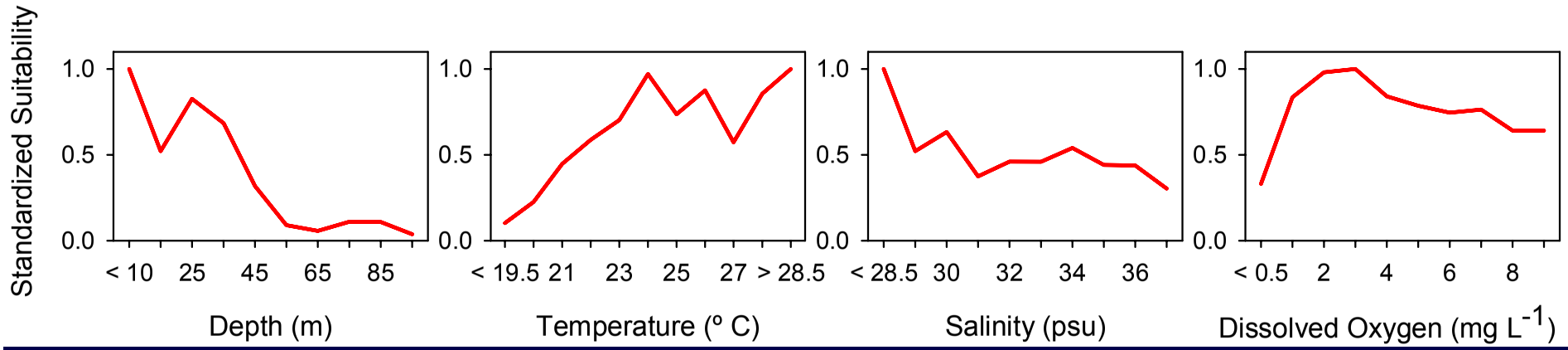
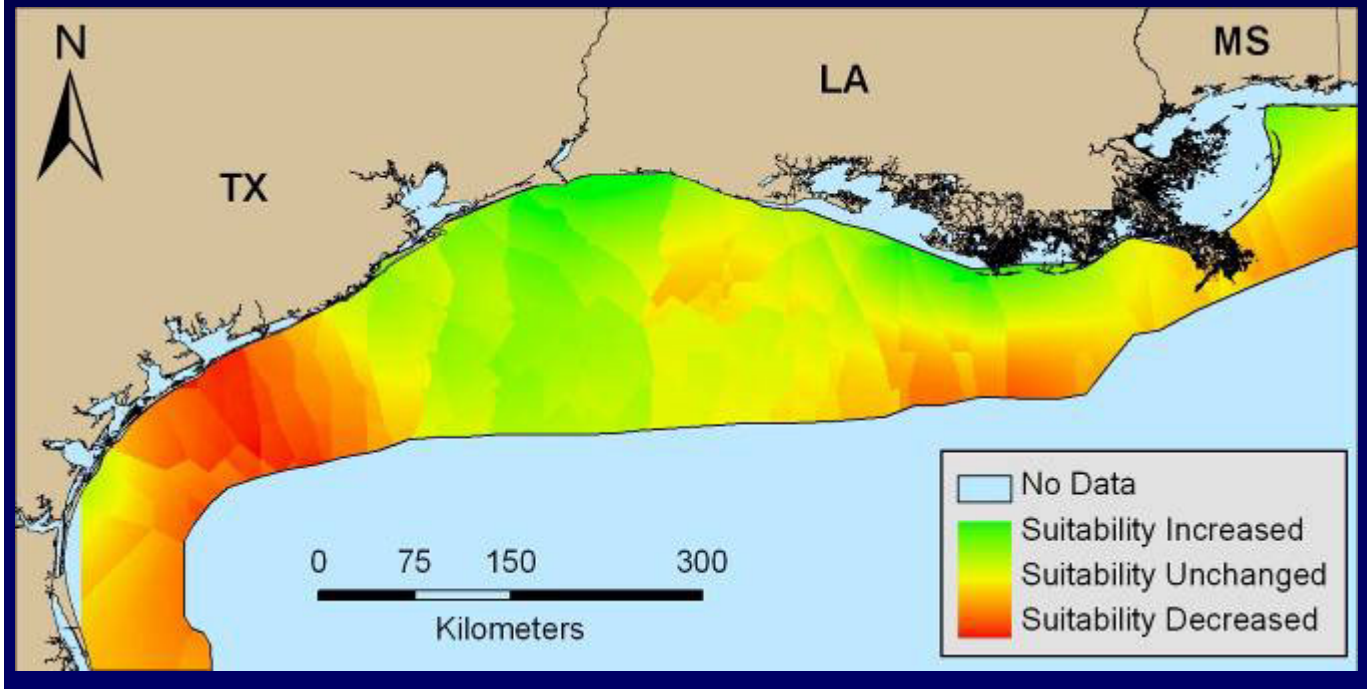
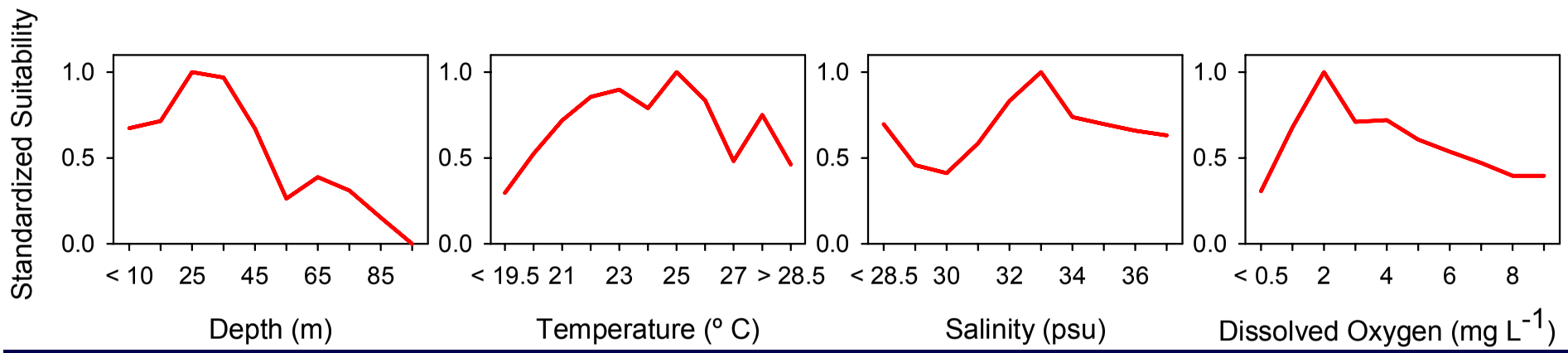
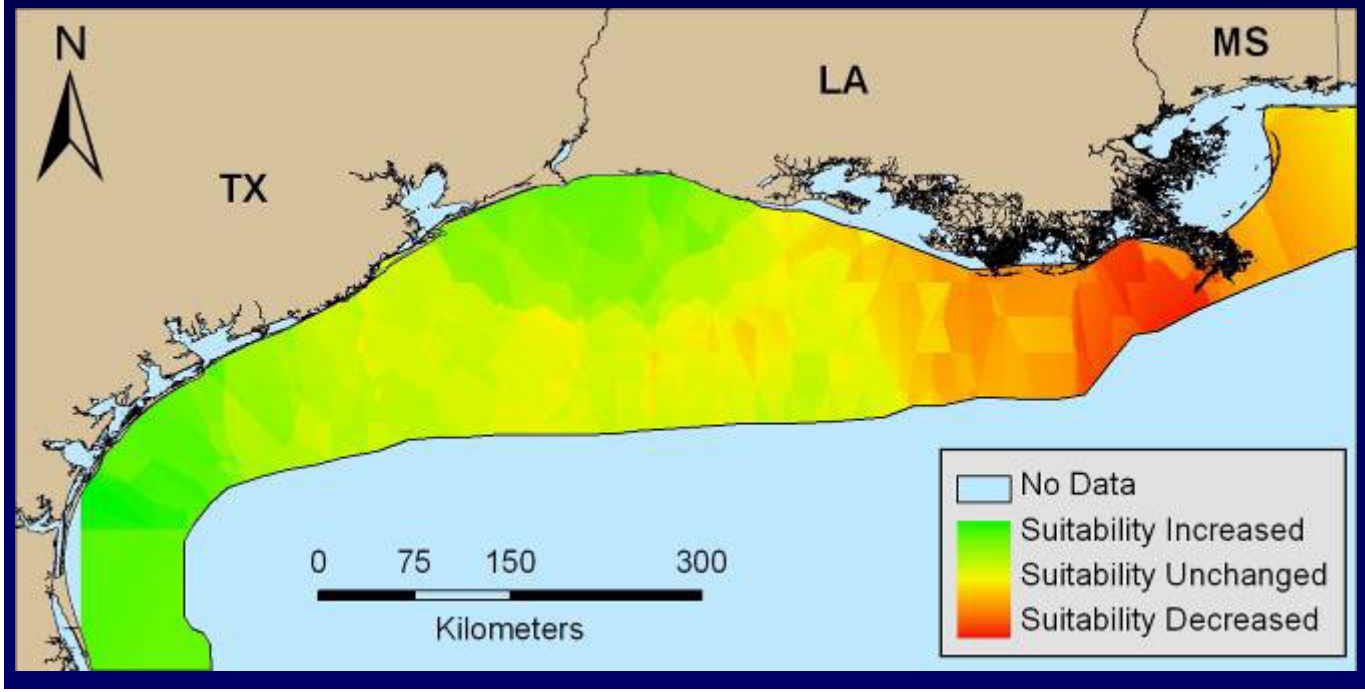




Source: G. Sneegas

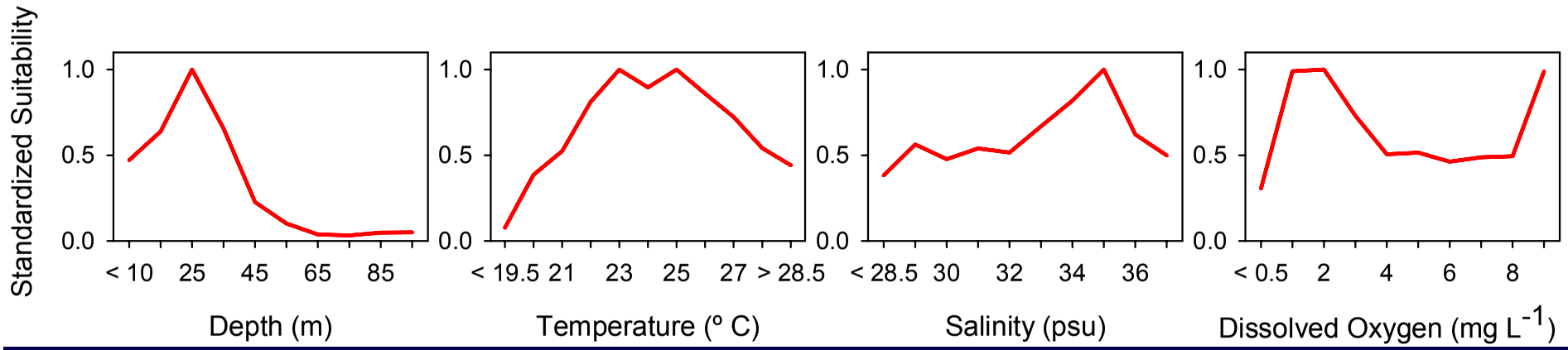
Influence of Hypoxia on Habitat Suitability – *Symphurus plagiusa*

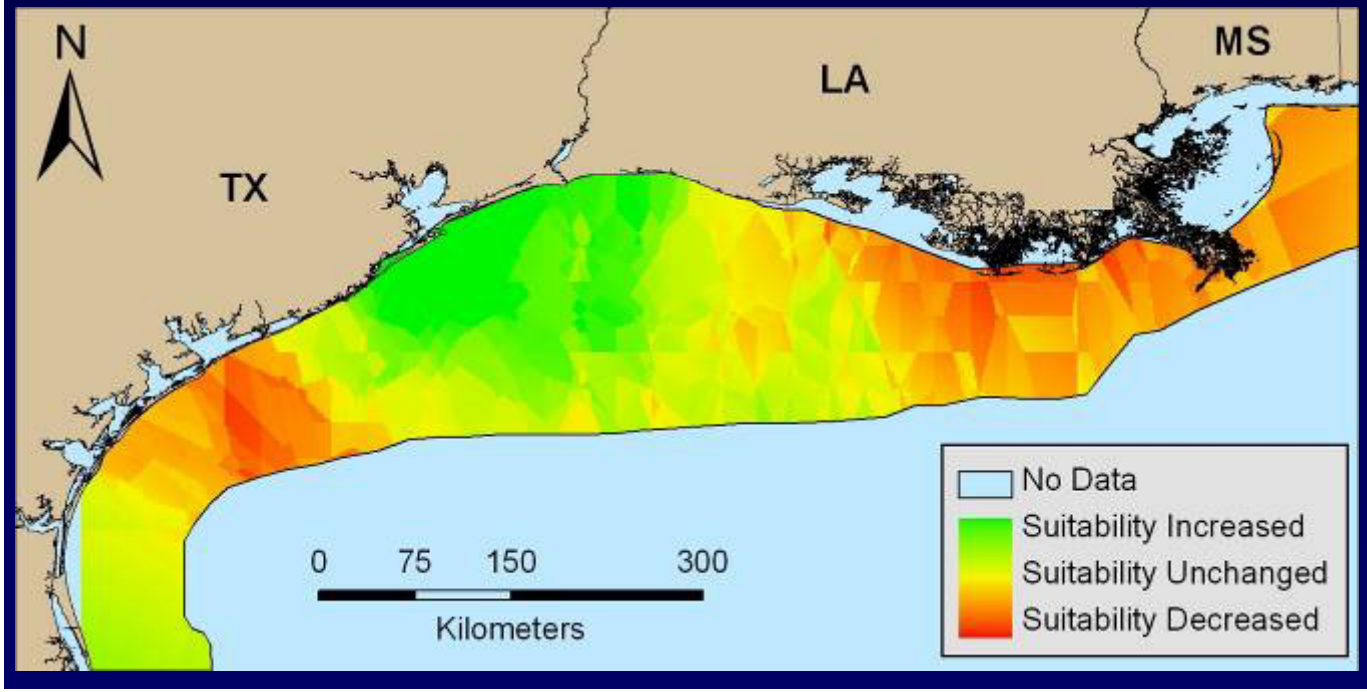




Source: G. Sneegas

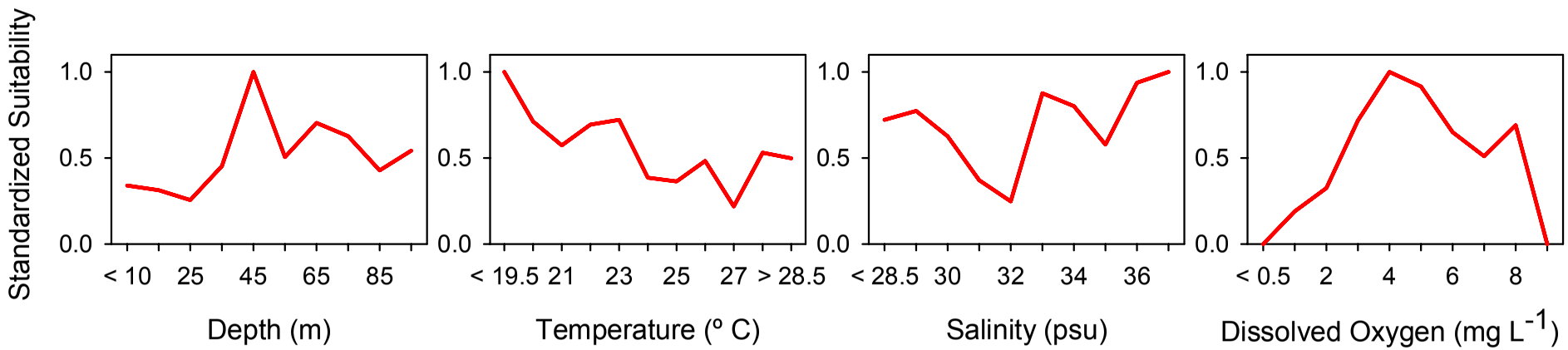
Influence of Hypoxia on Habitat Suitability – *Etropus crossotus*

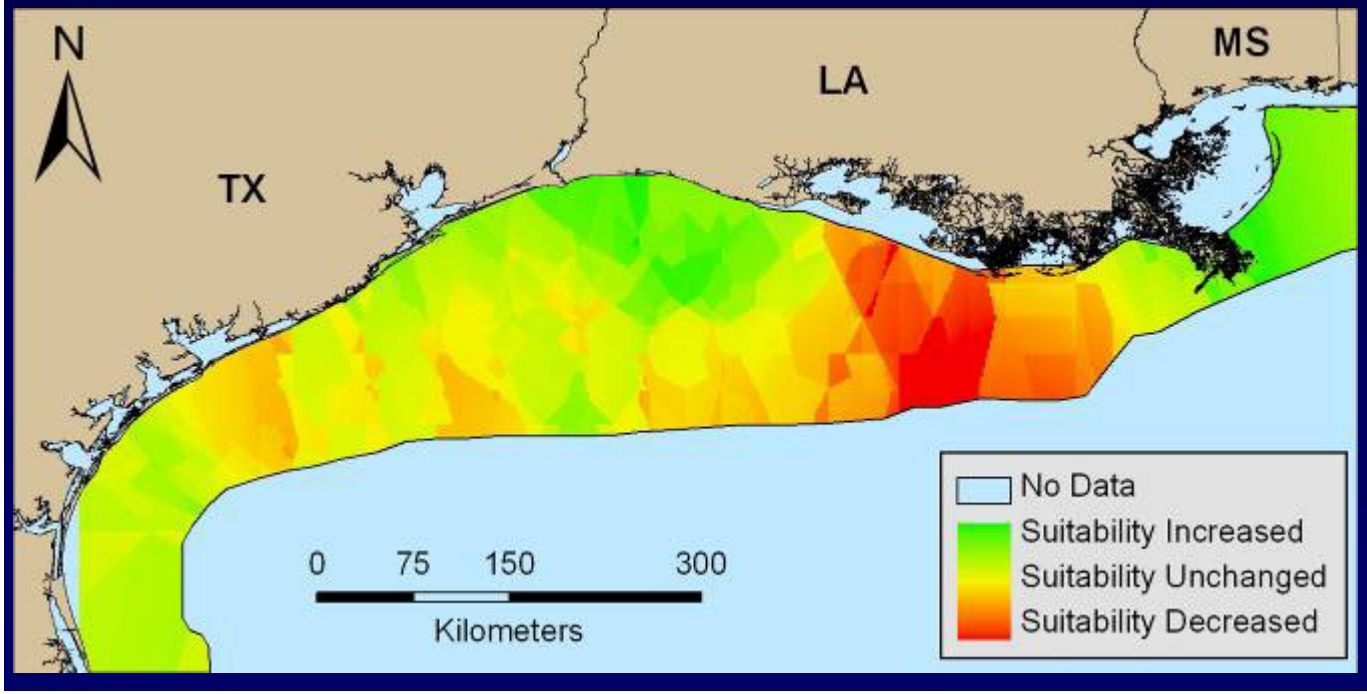




Source: D. Flescher

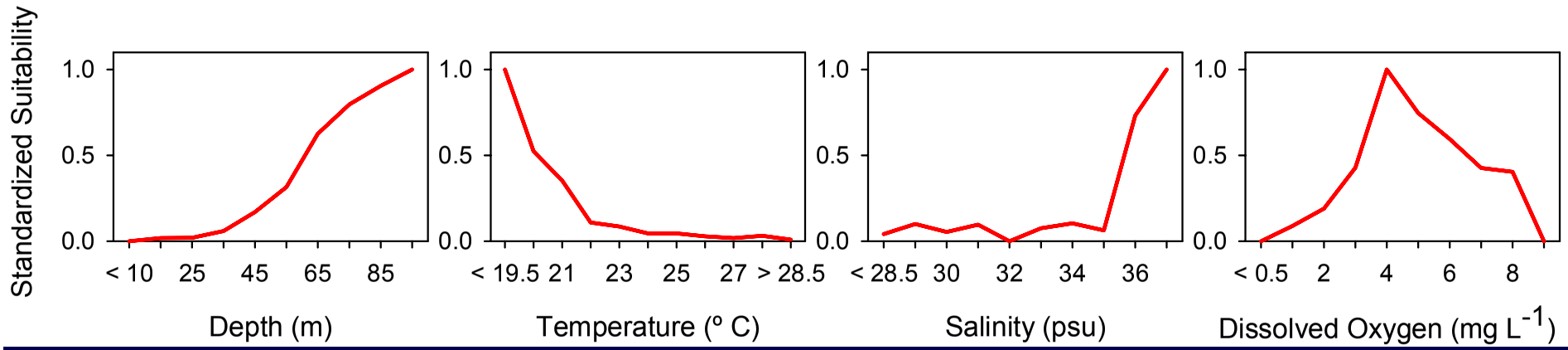
Influence of Hypoxia on Habitat Suitability – *Paralichthys lethostigma*

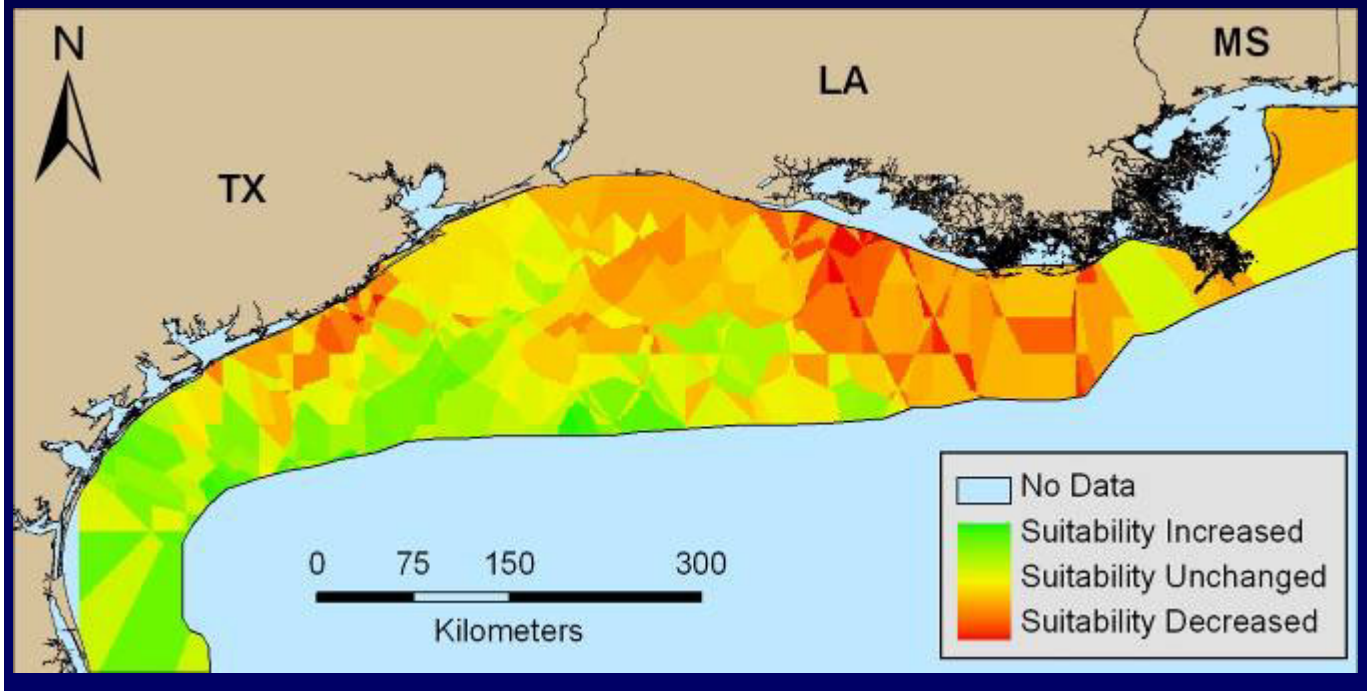


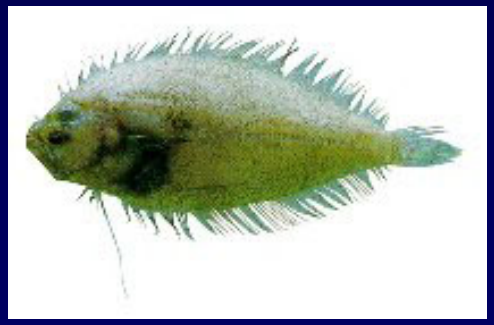


Source: G. Sneegas

Influence of Hypoxia on Habitat Suitability – *Trichopsetta ventralis*

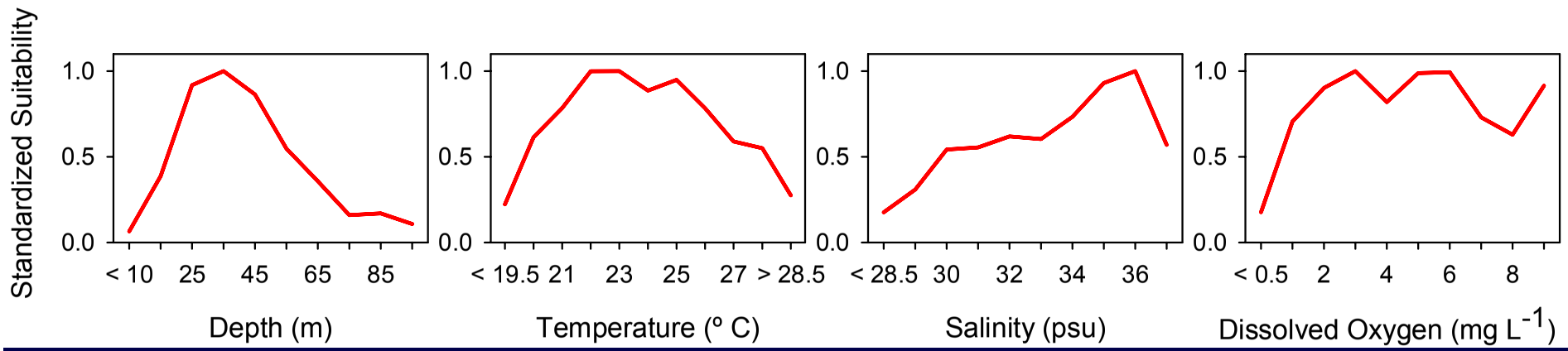


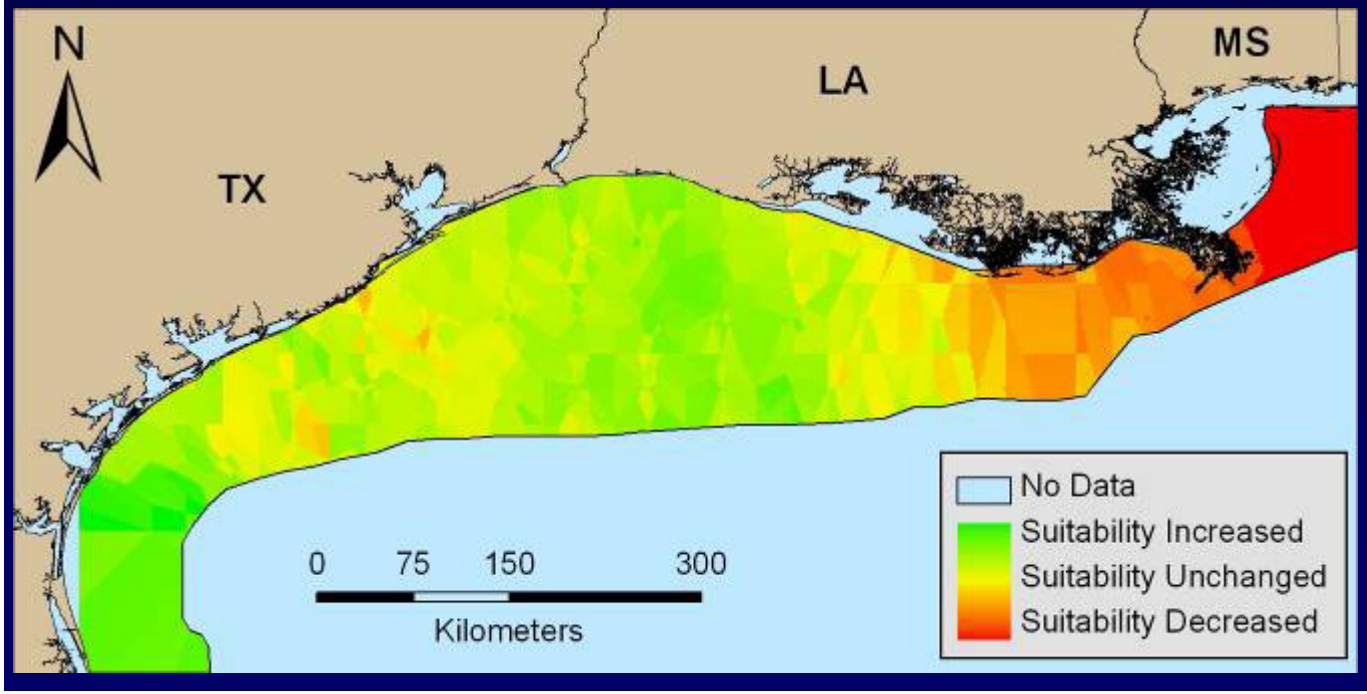




Source: K. Matsuura

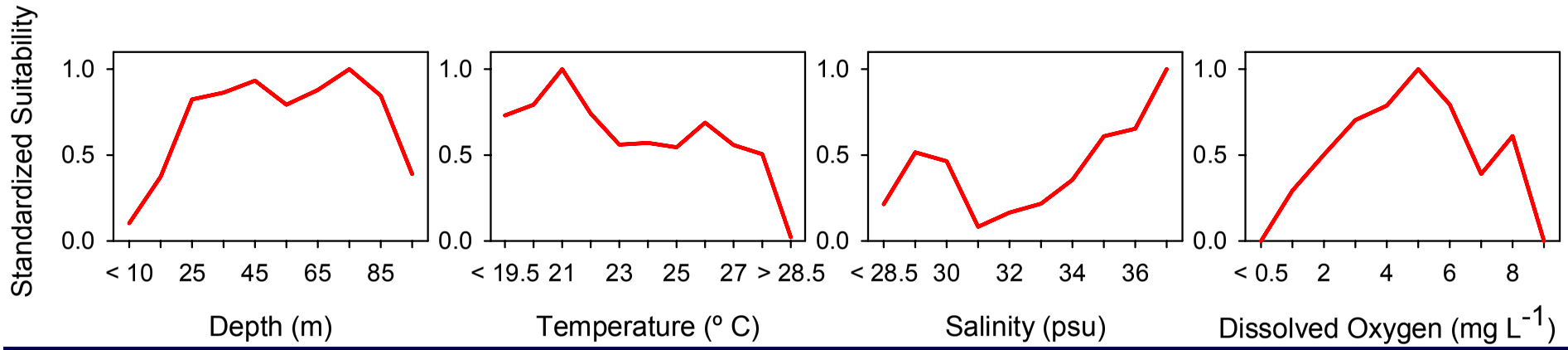
Influence of Hypoxia on Habitat Suitability – *Syacium gunteri*

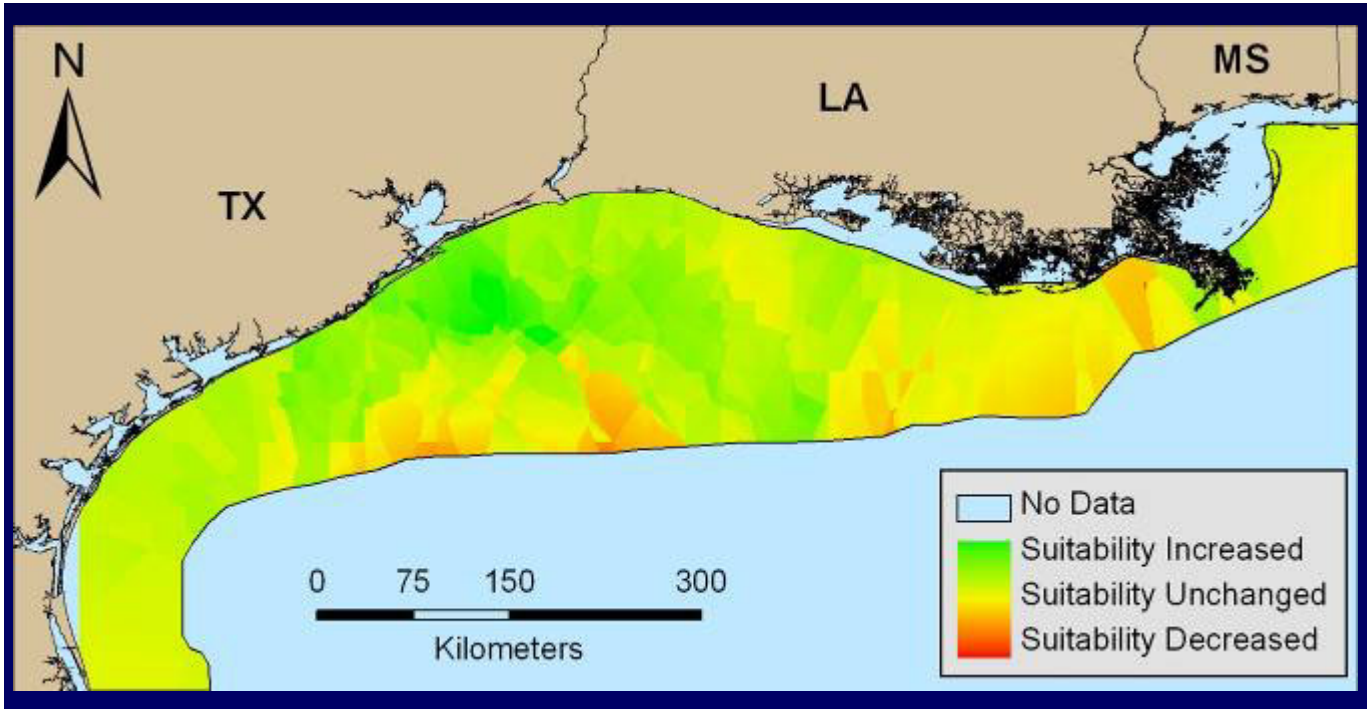




Source: J. Kolding

Influence of Hypoxia on Habitat Suitability – *Syacium papillosum*





Source: D. Flescher

Conclusions

- Most flatfishes exhibited orientation along environmental gradients:
  - Inshore taxa more restricted in terms of suitable depths/temperatures
  - Offshore taxa more restricted in terms of suitable salinities

- Low dissolved oxygen unsuitable for most taxa

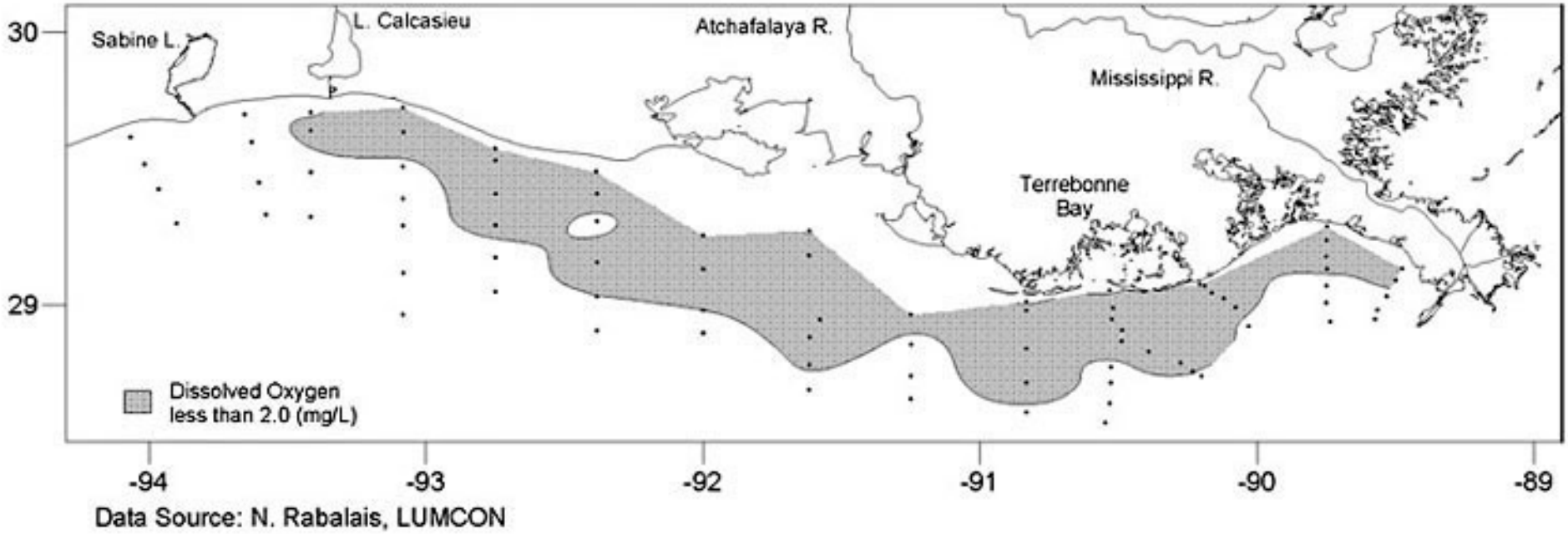
- Seasonal formation of hypoxia likely to force movement away from affected areas

Acknowledgements

- Sarah Frias-Torres
- Yvonne Allen
- Data sources:
  - Mark McDuff, National Marine Fisheries Service
  - Jan Bowman, Louisiana Department of Wildlife and Fisheries
  - James Warren, Mississippi Department of Marine Resources
  - Page Campbell, Texas Parks and Wildlife
- Funding provided by NOAA Coastal Ocean Program

Questions?

July 21-25, 2004 - Area of Bottom Hypoxia



Data Source: N. Rabalais, LUMCON