



Trophic coupling of zooplankton and forage fishes on the Northeast U.S. Shelf revealed by stable isotopes

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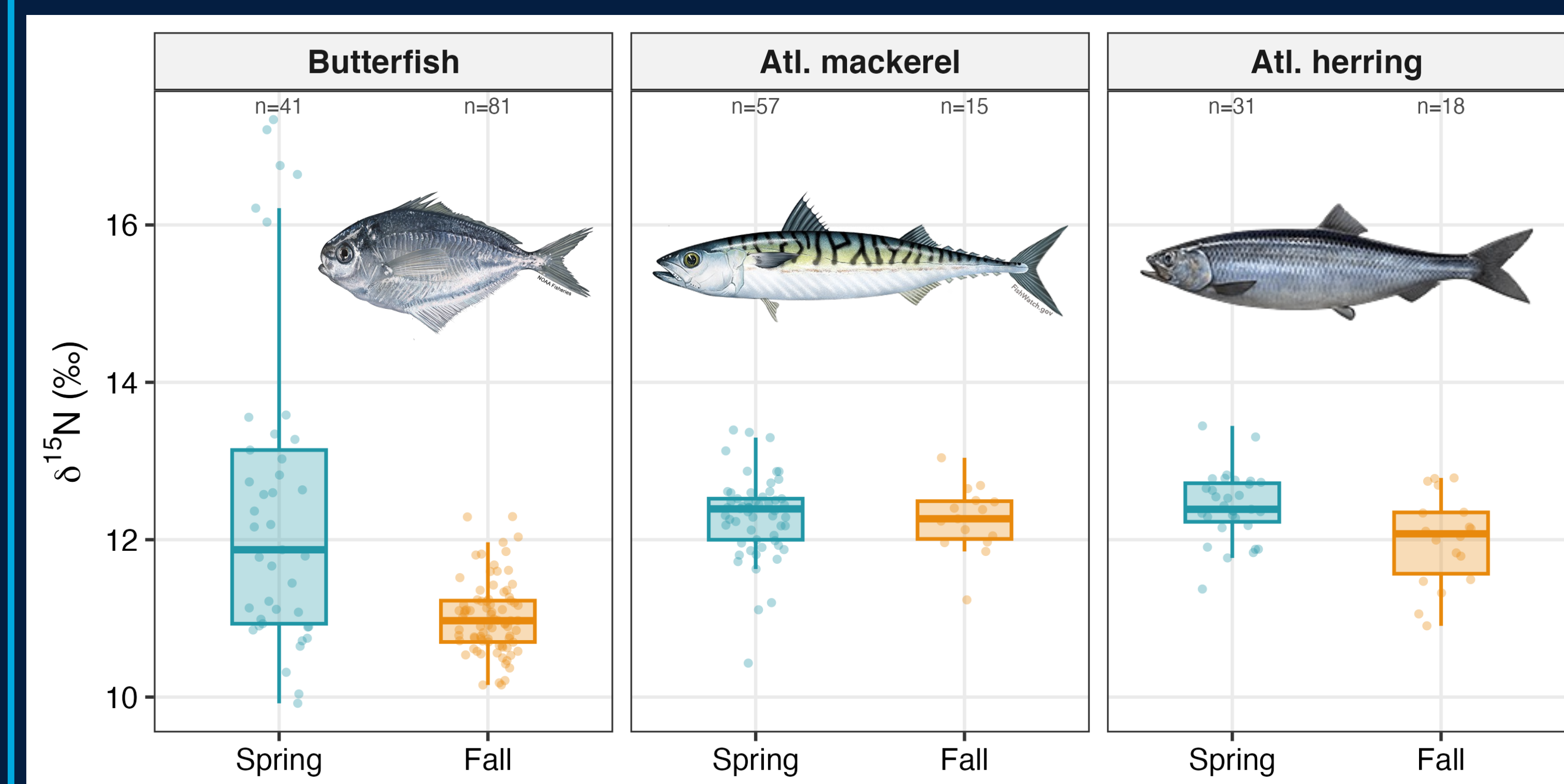
INTRODUCTION

The Northeast U.S. Continental Shelf (NES) supports some of the most productive fisheries in the world, yet trophic dynamics linking zooplankton communities to forage fish remain poorly resolved.

- Small pelagic fishes (SPF) occupy a critical mid-trophic position, linking zooplankton production to predators including tuna, whales, and seabirds, however their populations are highly variable and their trophic roles may be shifting with documented distributional and abundance changes across the NES.
- *Clupea harengus* (Atlantic herring), *Scomber scombrus* (Atlantic mackerel), and *Peprilus triacanthus* (Atlantic butterfish) are abundant SPF on the NES with distinct diets and feeding strategies, including crustacean and gelatinous zooplankton, making stable isotopes particularly valuable for resolving their trophic niches.

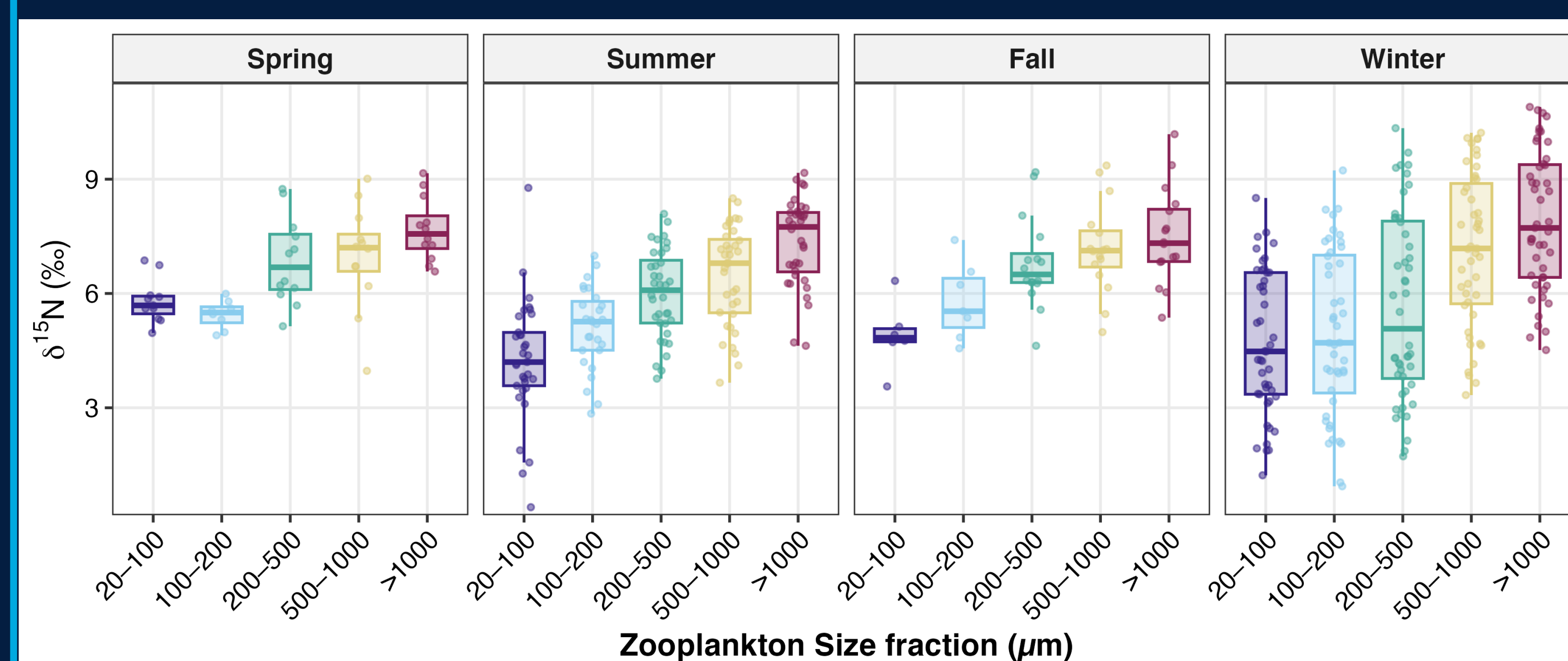
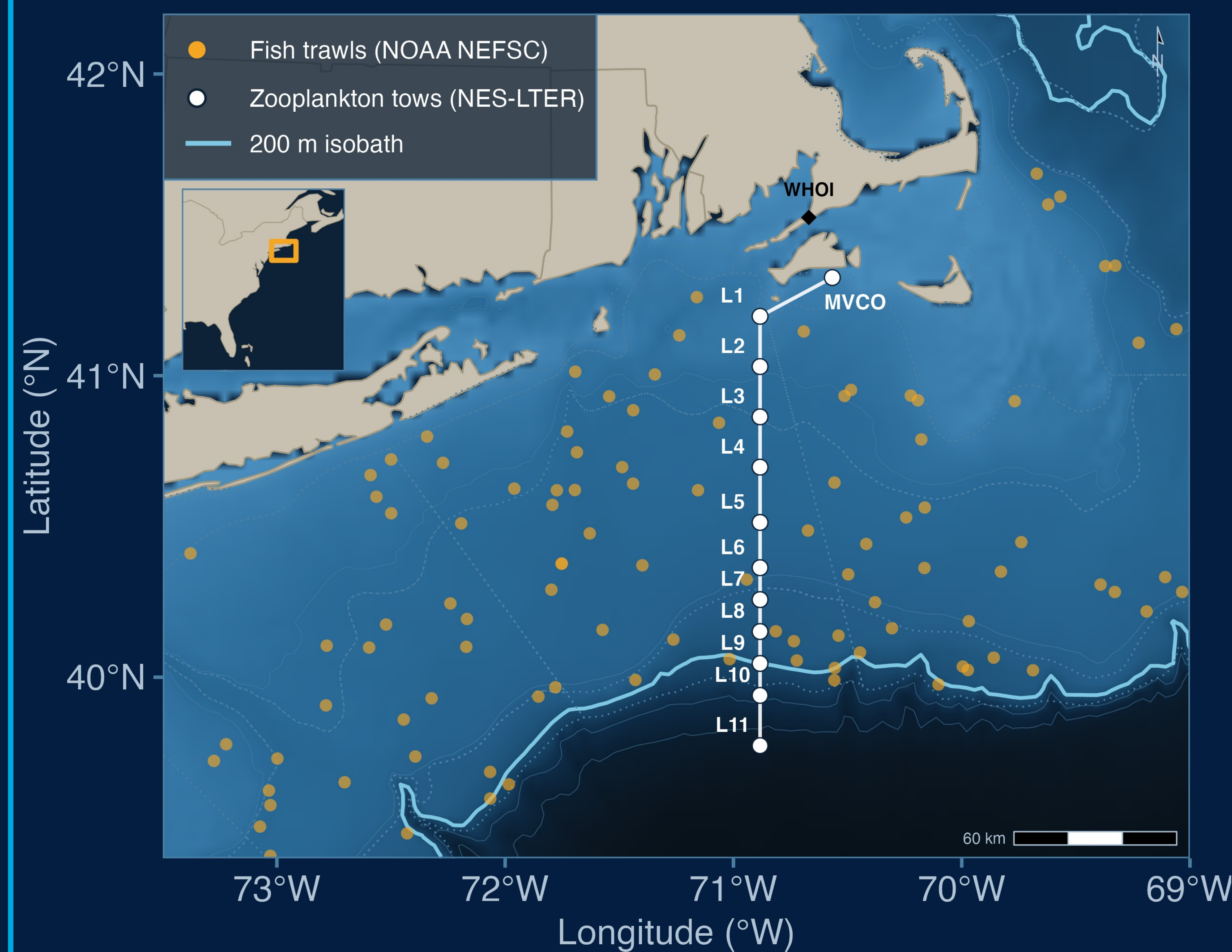
QUESTIONS

1. How is the zooplankton prey field isotopically structured across size fractions and seasons?
2. How do forage fish trophic niches differ by species and season relative to their zooplankton prey?
3. Have fish isotopic niches shifted over a decade of NES ecosystem change?



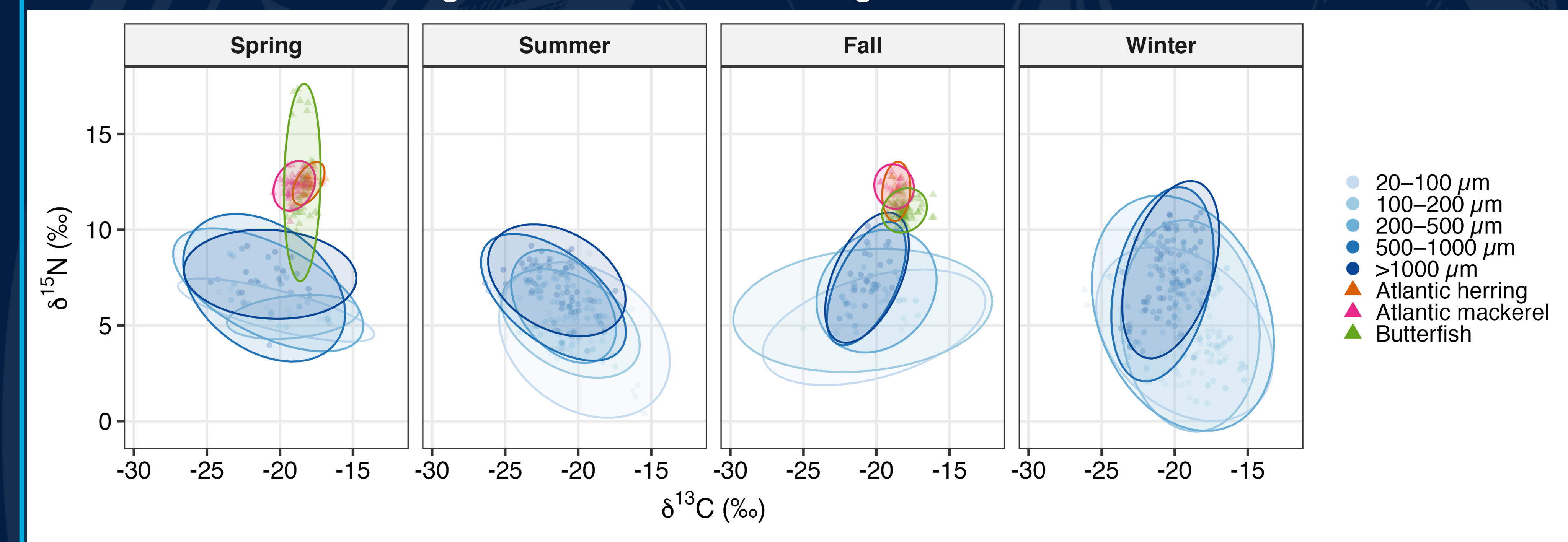
METHODS

- Zooplankton: bongo (150 μm) and ring net (20 μm) tows at NES-LTER stations; size-fractionated into 5 size fractions: 20-100, 100-200, 200-500, 500-1000, >1000 μm
- Zooplankton sampling: winter & summer 2018–2020; all four seasons 2023–2024
- Forage fish: NOAA NEFSC Bottom Trawl Survey spring & fall 2018–2020
- Bulk δ¹³C and δ¹⁵N on fish dorsal muscle tissue and size-fractionated zooplankton analyzed at the UC Davis Stable Isotope Facility
- Fish δ¹³C lipid-corrected (Post et al. 2007)



RESULTS

- δ¹⁵N increases with zooplankton size fraction across all seasons, consistent with size-based trophic structuring; δ¹³C shows a modest depletion with increasing size fraction, though the pattern is more variable and season-dependent.
- Butterfish shows the largest seasonal δ¹⁵N shift (spring >> fall) and widest niche width, suggesting greater dietary flexibility or individual-level diet variability.
- Atlantic herring and Atlantic mackerel show tighter, more stable niches across seasons, with mackerel showing the least seasonal change.



CONCLUSION

Forage fish trophic niches are structured above a size-dependent zooplankton prey field, with **species-specific differences in niche width and seasonal plasticity**. Butterfish stands out as the most ecologically distinct, with the largest seasonal δ¹⁵N shift and widest niche, consistent with greater dietary flexibility, seasonally variable prey fields, and/or distributional changes. Modest but significant δ¹⁵N shifts (~0.5‰) in some species relative to Suca et al. (2018) suggest possible trophic reorganization over the past decade. Next steps include **CSIA-AA to disentangle whether seasonal and decadal δ¹⁵N shifts reflect true trophic position changes or shifting isotopic baselines**, and linking zooplankton community composition from bongo tows to fish isotopic variability. We will also examine environmental drivers of variability, including temperature, mixed layer depth, and water mass composition, to contextualize spatiotemporal patterns across the NES shelf.



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