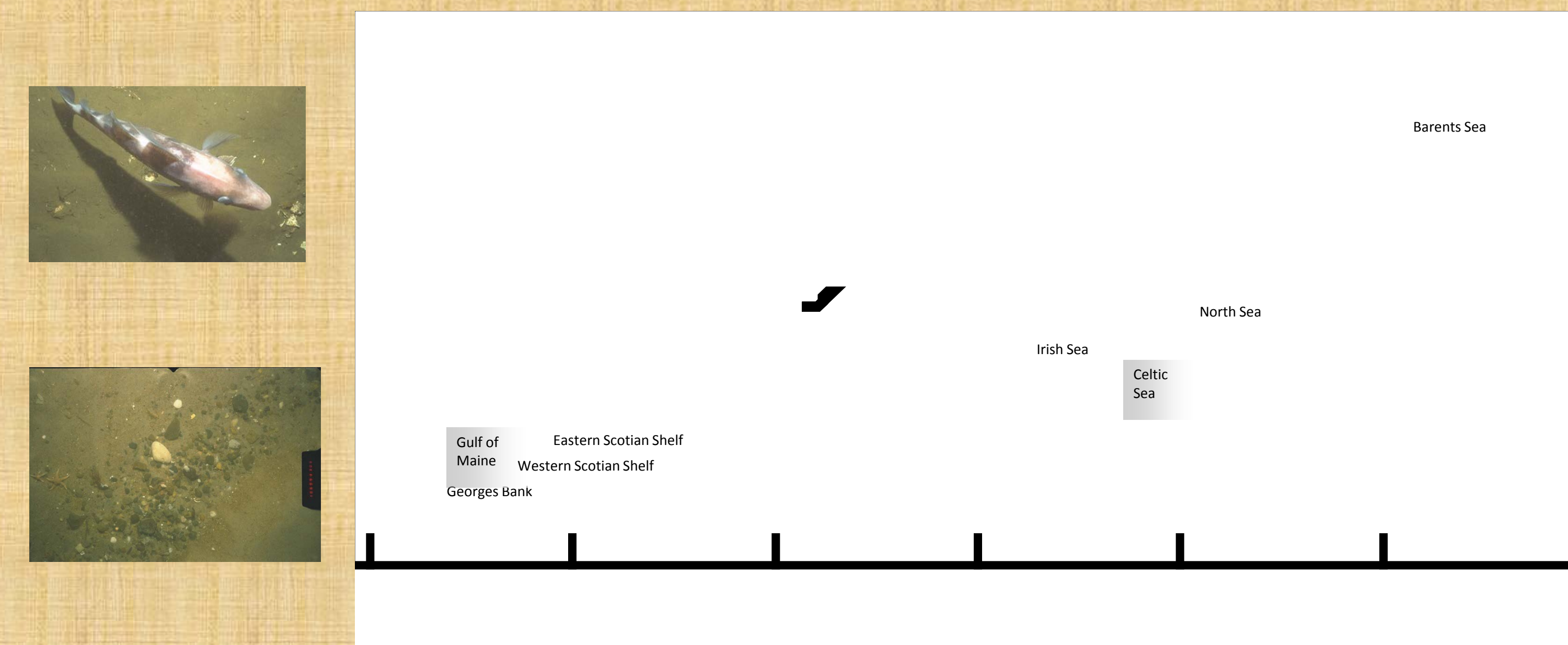


# To Eat Glass or Fish, That Is the Question: A Trans-Atlantic Examination of Haddock (*Melanogrammus aeglefinus*) Food Habits

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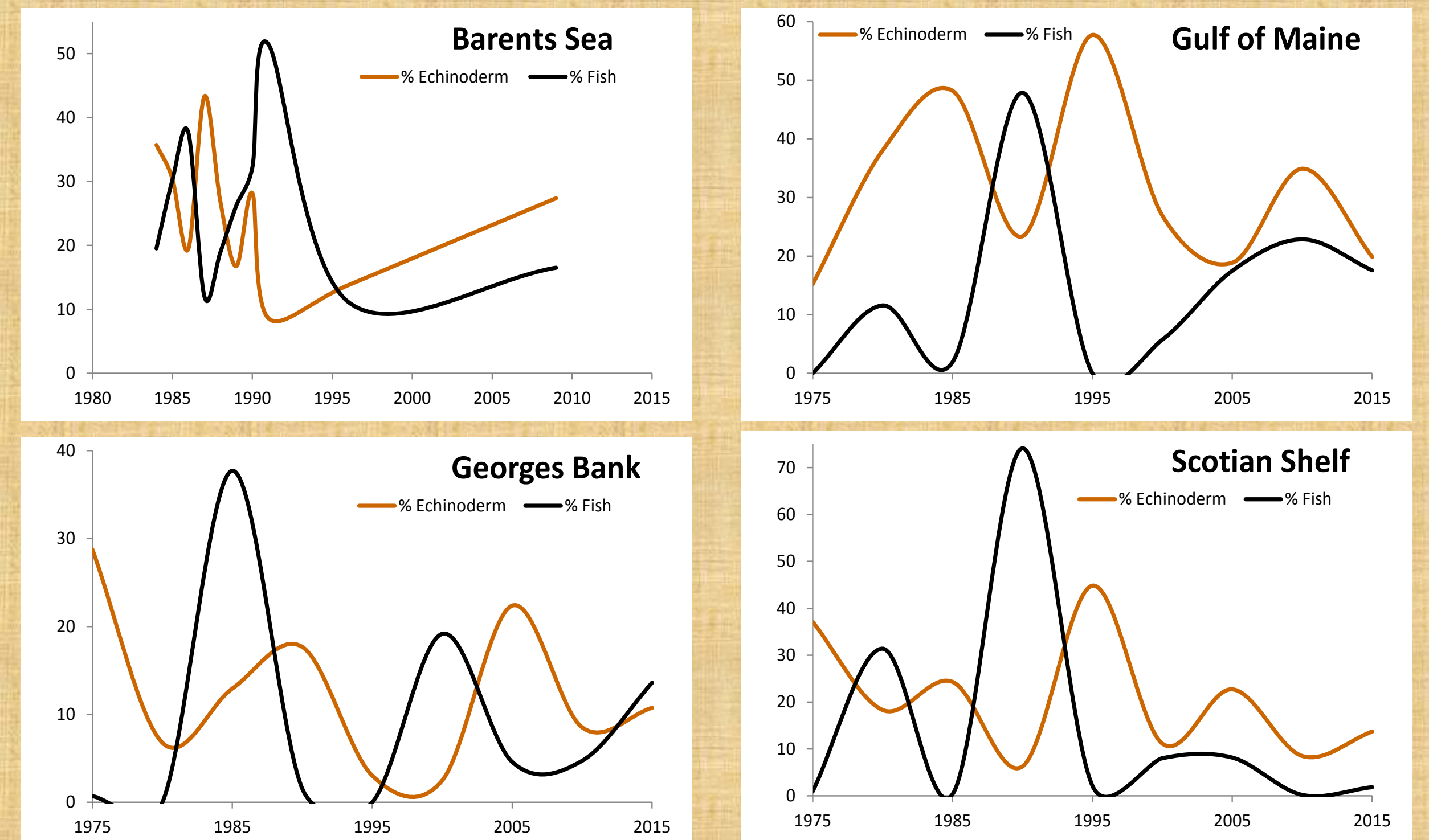
**Abstract-** Haddock (*Melanogrammus aeglefinus*) are a commercially and ecologically important gadoid across the North Atlantic; their importance in the food web and economies of these many regional ecosystems has been well documented. The feeding habits of haddock have similarly been well described. What remains intriguing is that in some locales or at some times haddock are primarily piscivores whereas in other situations they are primarily echinoderm feeders. Additionally, haddock have exhibited comparable shifts in primary dietary focus over time for any given ecosystem. Haddock do not regularly exhibit the increase in piscivory with ontogeny that other gadids often show. Here we explore and contrast the food habits of haddock across multiple northeastern and northwestern Atlantic ecosystems, using databases that span multiple decades. The results show that the major determinants of the diet are indeed difficult to unravel, but common patterns do emerge regarding when haddock primarily eat fishes versus echinoderms. We view this apparent binary choice as actually part of a gradient of prey options, contingent upon a suite of factors external to haddock dynamics. We discuss the energetic consequences of this prey choice, noting that in some instances it may not be a "choice" at all.



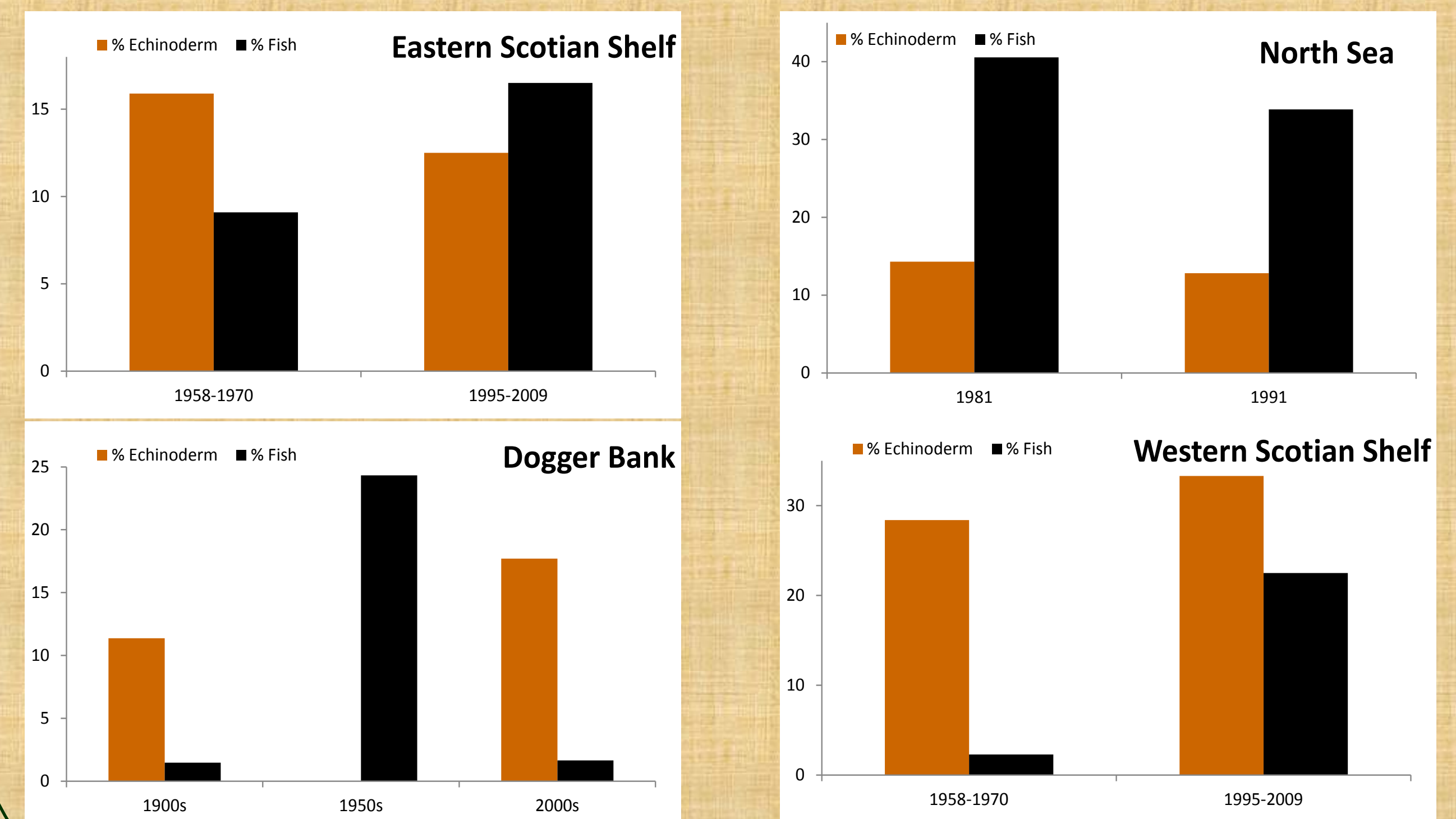
Map denoting the ecosystems with haddock examined in this study

## Temporal changes in haddock diet- fish and echinoderm prey

- Echinoderms have remained a consistent component of haddock diet over time
- It does not appear that echinoderms are replacing fish in the diet
- Although they may be inversely proportional at some times in some ecosystems



Figures denoting the change in percent composition of echinoderms and fish over time (% by weight), for times series presented in 5 yr blocks except Barents Sea which had annual sampling in various years



Figures denoting the change in percent composition of echinoderms and fish over time (% by weight), except Dogger Bank is % by number

## Haddock diet (with respect to echinoderms and fish)

- Haddock feed on a wide variety of invertebrate and fish species
- Echinoderms can comprise up to 30% of the diet of haddock; So can fish
- It may or may not be that fish and echinoderms are inversely proportional in the diet of haddock
- Most of the echinoderms consumed are ophiuroids (brittle stars) or echinoids (urchins, sand dollars)

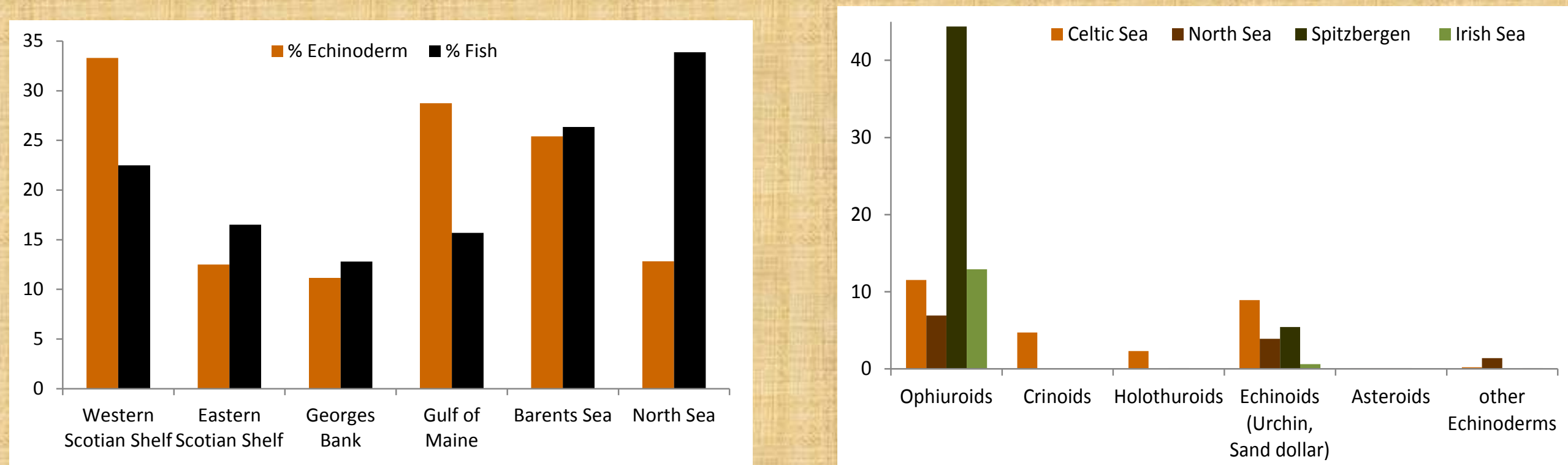


Figure denoting overall diet of haddock with respect to echinoderms and fish for various ecosystems (% by weight)

Figure depicting specific composition of echinoderm prey of haddock for various ecosystems (% by number)



## Selectivity of haddock for echinoderms

- Haddock are generally selective for benthic prey (not shown)
- Haddock tend to select smaller echinoids over larger echinoids or ophiuroids
- Selectivity can vary seasonally and geographically

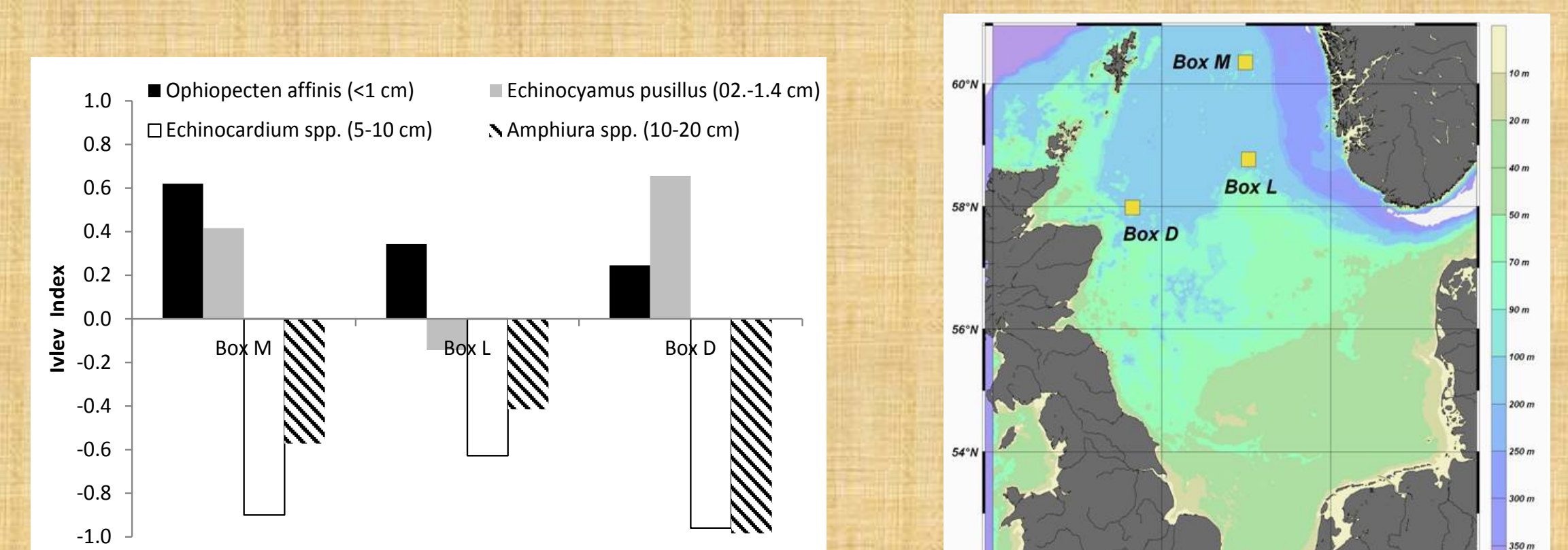


Figure denoting the Ivlev selectivity index for haddock on echinoderms at various locales in the North Sea

Map of various locales sampled for haddock and the benthic community in the North Sea

## Haddock diet across size

- There is no clear ontogenetic shift towards piscivory across ecosystems, although some systems suggest it
- Haddock eat echinoderms across their life history
- Unlike other gadids (not shown), haddock remain highly benthivorous throughout their life

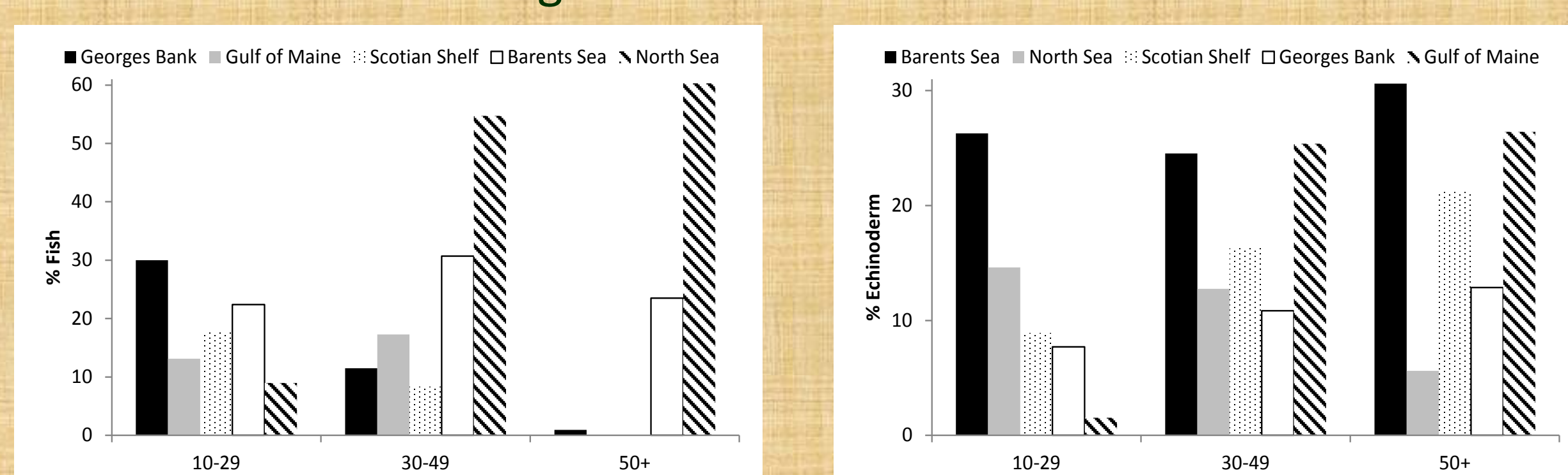


Figure denoting percent composition of fish in haddock diet by size class (% by weight)

Figure denoting percent composition of echinoderms in haddock diet by size class (% by weight)

## Echinoderm energetics

- Echinoderms contain more energy than suspected
  - More like potato chips or cheese puffs than glass
  - Ophiuroids and echinoids average energy density = 4-5 kcal g<sup>-1</sup>
  - Notable seasonal and taxonomic differences, range from 1-6 kcal g<sup>-1</sup>
  - From comparison, fish typically range from 1-5 kcal g<sup>-1</sup>
- Thanks D. Packer for information

## Summary

- Echinoderms are a core, and often preferred, feature of haddock diet, unlike most other gadoids
- No one feature determines the amount of echinoderms in haddock diet
- No other major prey, including fish, are replaced by or replacing echinoderms