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Ecology and location of marine animals revealed by carbon and nitrogen isotopes

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Direct monitoring of animals at sea is difficult and expensive. The isotopic composition of carbon and nitrogen in tissues such as fish scales, however, provides information not only on the trophic level and nutritional status of the fish, but also on the state of primary production at feeding sites, which can be used to infer migration patterns. Archives of salmon scales dating back decades exist around Europe and may be used to assess historical trends in ecology.

In this project three geographically distinct scale archives from the UK are used: the Cefas North Sea driftnet, the CEH/GWCT Dorset River Frome and the Environment Agency Welsh River Dee archives (all records span 1985-2002). These archives have been selected following an extensive search for salmon scale archives from UK rivers, and were chosen as the longest and most complete archives for comparison.

We are using carbon stable isotope data to identify marine feeding grounds for these fish (MacKenzie *et al.*, 2011), and therefore the extent of population-specific geographic separation. We also test isotopically whether climatically-driven changes in ocean conditions correlate with periods of high or low marine mortality or with changes in trophic level and body condition of the returning fish. The results are compared both within and between populations, in particular assessing differences in marine behaviour of fish that return as 1SW (1 sea-winter) or as MSW (multi sea-winter) fish.

The magnitude and timing of fluctuations in δ^{13}C data are not consistent between archives, and can be used in conjunction with coeval sea surface temperature records as a novel means to determine the areas in which the tissues were grown. Results show a complex, population-specific relationship between ocean productivity, climate indices, migration and fish survival. We are using these results to produce isoscape-style maps showing strengths of covariation between δ^{13}C in these salmon scales and oceanographic variables, providing a method of inferring marine feeding areas for different salmon populations, and for many other pelagic animals, based on their temporal variability in δ^{13}C values.