The use of stable isotopes to explain PCBs load in Golden Eagles (*Haliaeetus albicilla*), in the UK

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Introduction

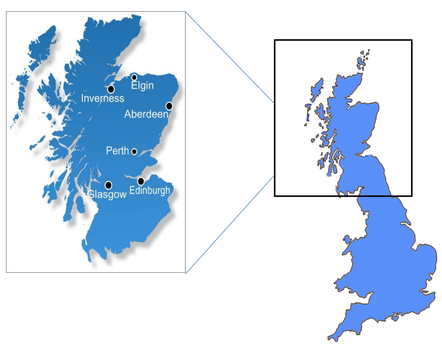
PCBs are highly persistent and bioaccumulative in lipid rich organs in biota and have been related to adverse effects.

Stable-isotope analysis of avian eggs can be a useful tool in elucidating changes in the diet of marine birds. The ratio of ^{15}N to ^{14}N ($\delta^{15}N$) exhibits stepwise enrichment with trophic transfers, and is a powerful tool for estimating trophic position. Ratios of ^{13}C to ^{12}C ($\delta^{13}C$) can be used to determine the sources of dietary carbon and $\delta^{34}S$ is a good indicator for marine and terrestrial environments.

The aim of this study was to determine if stable isotopes can explain intra specific and temporal variations in the polychlorinated biphenyls (PCBs) in golden eagle (*Haliaeetus albicilla*) eggs.

Location and Methods

Golden eagle eggs, a species of high conservation concern in Britain, have been studied as part of the long-term monitoring work of the UK Predatory Bird (http://pbms.ceh.ac.uk). Failed eggs were collected from coastal (up to 3km from the sea) and inland areas in Scotland (coastal and inland eggs).



PCBs (from 1970 – 2008) were quantified using GC-ECD and stable isotopes (from 1990 to 2008) were measured using an elementar analyser interfaced with a ratio mass spectrometer.

Fig. 1 *Sample location*

Sum of PCB congeners

Our analyses revealed (Fig 2):

- Significant higher concentrations of PCBs in coastal (0.02 to 0.87 µg g^{-1} w w) than inland (0.03 to 0.32 µg) eggs;
- No significant temporal decline in PCB concentrations in coastal eggs;
- Significant temporal decline in PCBs in eggs of inland nesting birds.

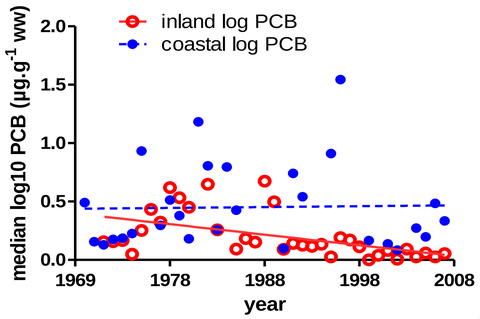


Fig. 2. *Temporal concentrations of sum PCB congeners in inland and coastal golden eagle eggs*

$\delta^{15}N$, $\delta^{13}C$ and $\delta^{34}S$ variation

- $\delta^{13}C$ in coastal and inland eggs varied between -28‰ and -25‰;
- Coastal eggs had slightly higher $\delta^{15}N$ than inland eggs, but did not indicate feeding at a different trophic level (Fig. 3);
- $\delta^{34}S$ in coastal eggs varied between 6-14 ‰ and inland eggs between 5-12 ‰ (Fig. 3).

No significant correlation was found with $\delta^{13}C$ and % of lipids, although a negative relationship has been found by others.

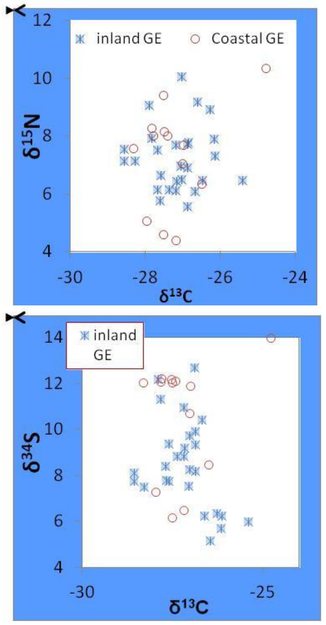


Fig. 3. *Relationship between $\delta^{13}C$ and $\delta^{15}N$ and $\delta^{13}C$ and $\delta^{34}S$.*

$\delta^{15}N$, $\delta^{13}C$ and $\delta^{34}S$ variation temporal trends

General Linear models (GLM) were used to test the temporal relationship between isotopes, location and year. We found a:

- Significant temporal increase $\delta^{15}N$ and $\delta^{34}S$ for inland and coastal eggs with time;
- A slight (but not significant) temporal decline in $\delta^{13}C$;
- Significant higher $\delta^{34}S$ in coastal than inland eggs;

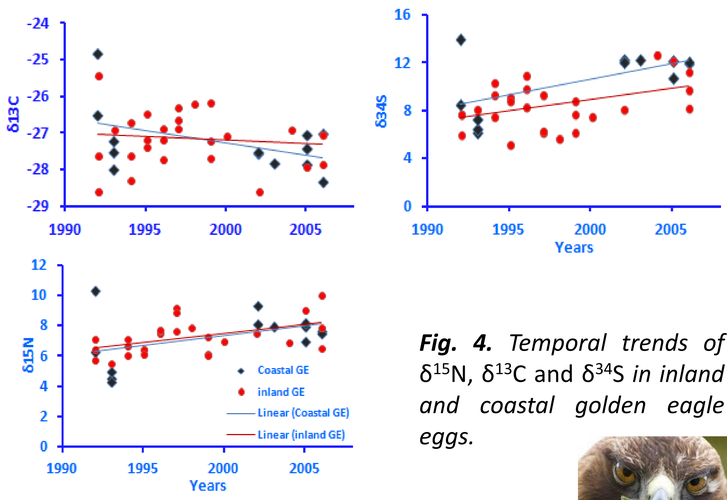


Fig. 4. *Temporal trends of $\delta^{15}N$, $\delta^{13}C$ and $\delta^{34}S$ in inland and coastal golden eagle eggs.*

Relationship between Sum PCBs and Stable isotopes

- Higher PCBs in coastal than in inland eggs can be attributed to coast-nesting birds preying, at least partly, on seabirds and being exposed to marine food web. This is confirmed by the higher $\delta^{34}S$ in coastal than inland eggs. $\delta^{13}C$ variability suggests different diets, depending on individual birds and/or year. The lack of temporal trend in $\delta^{13}C$ suggests that changes in PCBs are not linked to changes in diet.
- PCBs in inland eggs showed a temporal decline. This suggests an actual environmental decline in PCBs – even though there is an increase in $\delta^{15}N$ and $\delta^{34}S$.
- PCBs showed no decline in coastal eggs in the last 30 years, even though PCBs have been banned since the 70's. The lack of temporal decline could be linked to an increase in $\delta^{15}N$ and $\delta^{34}S$ - more marine diet in recent years.

Predatory Bird Monitoring Scheme
http://pbms.ceh.ac.uk/

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