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Mercury in golden eagle eggs – use of stable isotopes to distinguish dietary influences in long-term monitoring studies

ABSTRACT : Future global mercury (Hg) emissions may rise. We assessed the potential of using addled eggs from inland-nesting golden eagles (*Aquila chrysaetos*) to detect change in Hg deposition and bioavailability in upland Britain. Our results highlight the need for stable isotope measurements (especially $\delta^{34}S$) to truly distinguish eggs that reflect Hg derived from upland terrestrial diet. Eggs laid by eagles feeding on upland terrestrial prey had significantly lower Hg residues than those laid by eagles feeding partly or largely on marine prey.

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Introduction

Future global mercury (Hg) emissions may rise, partly through increased coal-fired power generation, but the recent UNEP 'Minamata Convention on Mercury' aims to control anthropogenic releases of Hg to the environment. Long-term future trends in environmental Hg concentrations are therefore uncertain.

Accumulation by sentinel wildlife can be used to monitor trends. **Our aim** was to assess the potential of using addled eggs from inland-nesting golden eagles (*Aquila chrysaetos*) to detect change in Hg deposition and bioavailability in the uplands of Britain.

Methods

We measured Hg concentrations in failed eggs (laid between 2009 and 2013) from inland (> 3km from the coast) and coastal (<3 km) nests; coastal nesting birds feed to some extent on seabirds that accumulate high levels of Hg themselves.

We examined stable isotope (SI) signatures (carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$) and sulphur ($\delta^{34}S$)) to see if they differed between eggs from inland and coastal nests in a manner consistent with laying females feeding primarily on terrestrial and marine prey, respectively.

White-tailed sea eagle (*Haliaeetus albicilla*) eggs were also analysed as a comparator for a predominantly marine feeding species.

Results

We found that SI signatures (particularly $\delta^{34}S$ isotopic ratios) and Hg concentrations were similar in golden eagle eggs from coastal nests and white tailed sea eagle (WTSE) eggs (Figures 1 and 2).

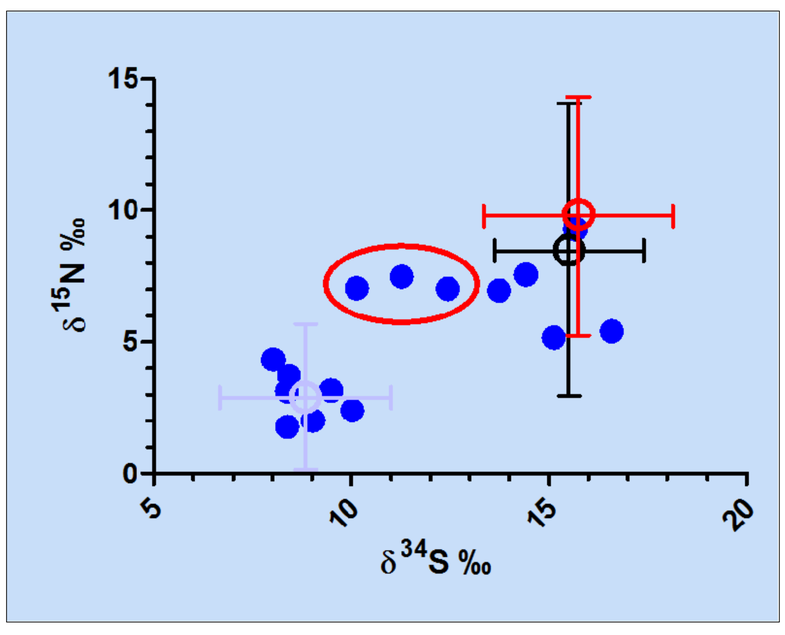

Fig. 1. $\delta^{15}N$ vs $\delta^{34}S$ in GE eggs from inland nests (●) and plots for mean ± 3SDs for $\delta^{15}N$ and $\delta^{34}S$ in GE eggs from coastal nests (black circle and confidence bars) and WTSE eggs (red circle and confidence bars). The ranges (mean ± 3SD) isotope values associated with a cluster of 7 GE eggs (from inland nests) with relatively low $\delta^{15}N$ and $\delta^{34}S$ values is also shown; eggs with intermediate SI values are ringed.

SIs and Hg concentrations in eggs from inland nests were more variable. A third had SI signatures similar to those of eggs from coastal nests, suggesting that they too were laid by females feeding on coastal diets (Fig. 1).

Eggs from terrestrial (upland) feeding golden eagles had significantly lower Hg concentrations than coastal feeding golden eagles and white-tailed sea eagles (Fig. 2).

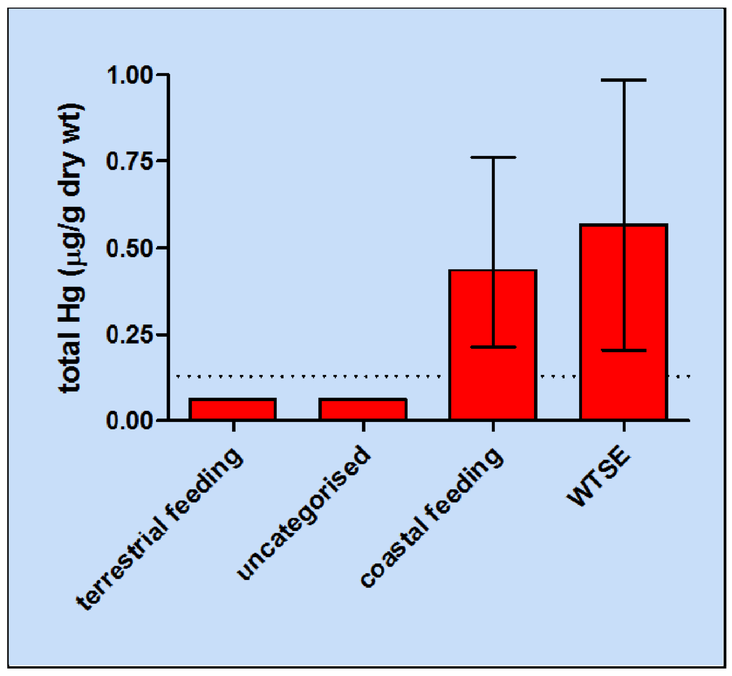

Figure 2. Median (IQR) total Hg dry weight concentrations in: GE eggs associated with SI signal inferred as indicative of (i) terrestrial feeding in laying females (n=7); (ii) uncategorized feeding (n = 3); (iii) coastal feeding (n = 13); and (iv) WTSE eggs (n=6). Dotted line indicates the Limit of Detection.

Discussion

- Differences in diet, inferred from SIs, are a major determinant of Hg concentrations in GE eggs.
- Females from a third of supposed inland nests fed on marine prey.

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- Current levels of Hg deposition in upland areas and subsequent food-chain transfer would appear to be too low to result in Hg concentrations in GE eggs above 65 ng/g dry wt.
- Our results highlight the need for SIs to identify eggs that truly reflect Hg derived from upland terrestrial diet. This is essential if GE eggs are to be used as a biomonitor of change in Hg deposition and bioavailability in upland Britain.

References This poster is based on Walker *et al.*, 2015. Mercury (Hg) concentrations and stable isotope signatures in golden eagle eggs 2009-2013: a Predatory Bird Monitoring Scheme (PBMS) report. Centre for Ecology & Hydrology, Lancaster, UK. A copy of this report can be downloaded from the PBMS website at http://pbms.ceh.ac.uk/

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