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Mercury (Hg) concentrations in predatory bird livers and eggs as an indicator of changing environmental concentrations

ABSTRACT: We quantified recent and current Hg concentrations in sparrowhawk livers and in the failed eggs of inland feeding golden eagles. In this poster, we argue that these measures can be used to assess the effectiveness of the Minamata Convention on Mercury.

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Introduction

The Minamata Convention on Mercury (Hg) aims to control anthropogenic Hg releases to the environment and reduce impacts on humans and wildlife. Monitoring is one strand of evidence needed to determine if the convention is successful.

The Predatory Bird Monitoring Scheme (PBMS; http://pbms.ceh.ac.uk/) monitors long-term trends in environmental Hg concentration in sentinel predatory bird species in Britain. The aim is to detect changes in exposure at large spatial scales. Sentinel species for lowland and upland habitats are the sparrowhawk *(Accipiter nisus) and the* golden eagle *(Aquila chrysaetos*), respectively.

Our monitoring of Hg in sparrowhawk livers and in failed golden eagle eggs provide a means of detecting change in bioavailable Hg and, thereby, a way of assessing how trends in environmental Hg in lowland and upland Britain change as Minamata progresses.

Mercury concentrations in sparrowhawk livers

We analysed liver Hg in sparrowhawk carcasses collected from 1990 onwards. Analysis was restricted to non-starved birds [starvation-induced liver wastage can affect liver Hg concentration]. Liver Hg was higher in adults than first-years ($F_{1, 515}$=15.2, P<0.001) and in males than females ($F_{1, 515}$=7.55, P=0.006). It also varied between years ($F_{23, 515}$= 2.10, P=0.002), but there was no consistent progressive upward or downward time trend (Figure 1).

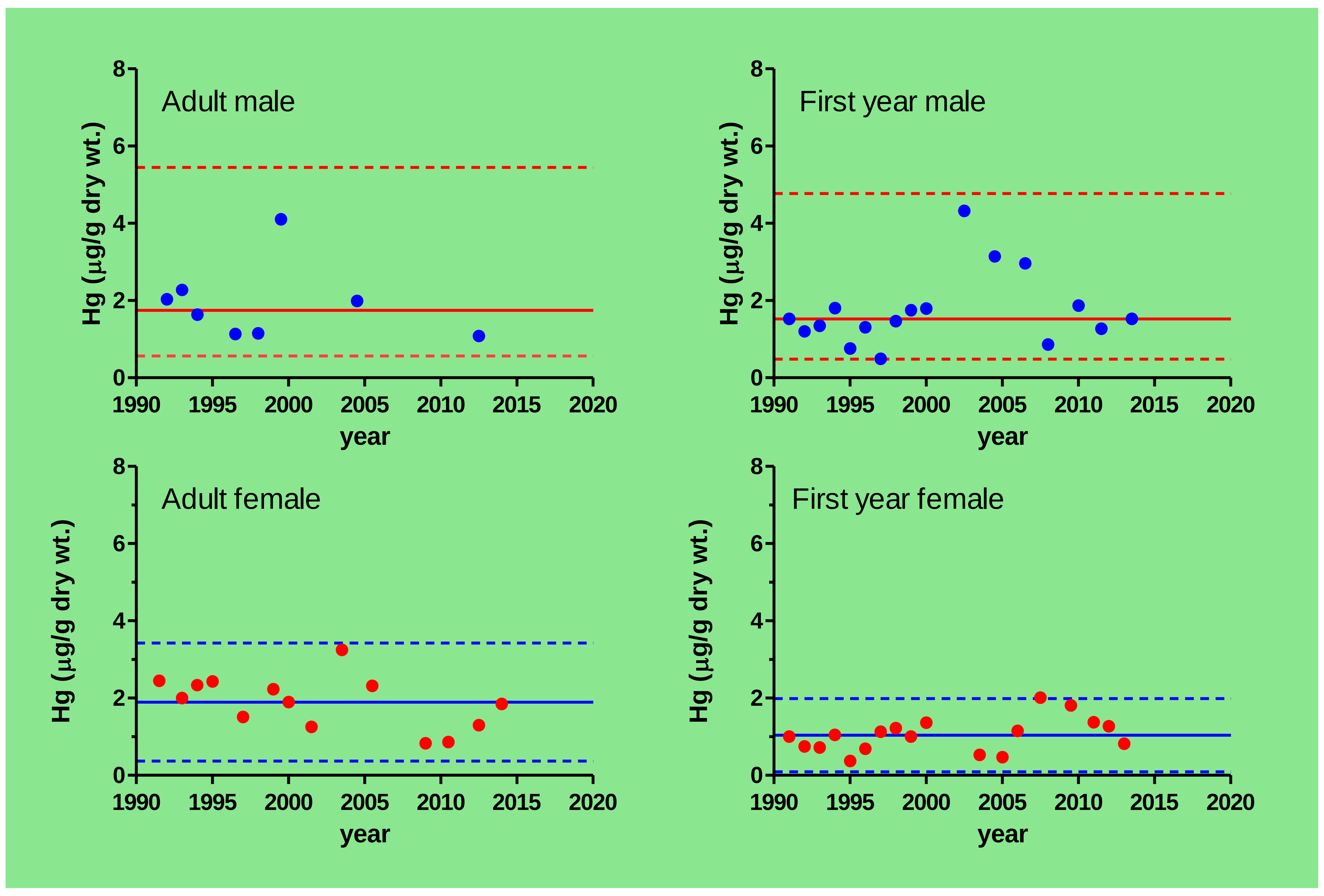


Figure 1. Annual median liver Hg concentrations in non-starved (fat scores ≥ 2) sparrowhawks. Solid and dotted lines are mean and 95% prediction intervals. The average (and range) for the number of birds upon which annual medians were based was 6 (5-9) for adults and 11 (5-24) for first-year birds. Values are geometric means and prediction intervals for males (data for annual medians were log-normally distributed) and arithmetic means and prediction intervals for females (data normally distributed).

Hg in failed golden eagle eggs

Golden eagles in Scotland feed on upland terrestrial prey and carrion but also on seabirds. We distinguished if birds had been feeding on predominantly terrestrial or on marine prey using stable isotope (SI) analysis (Figure 2). Eggs with SI signatures within the "inland" envelope were considered to contain Hg accumulated through terrestrial feeding.

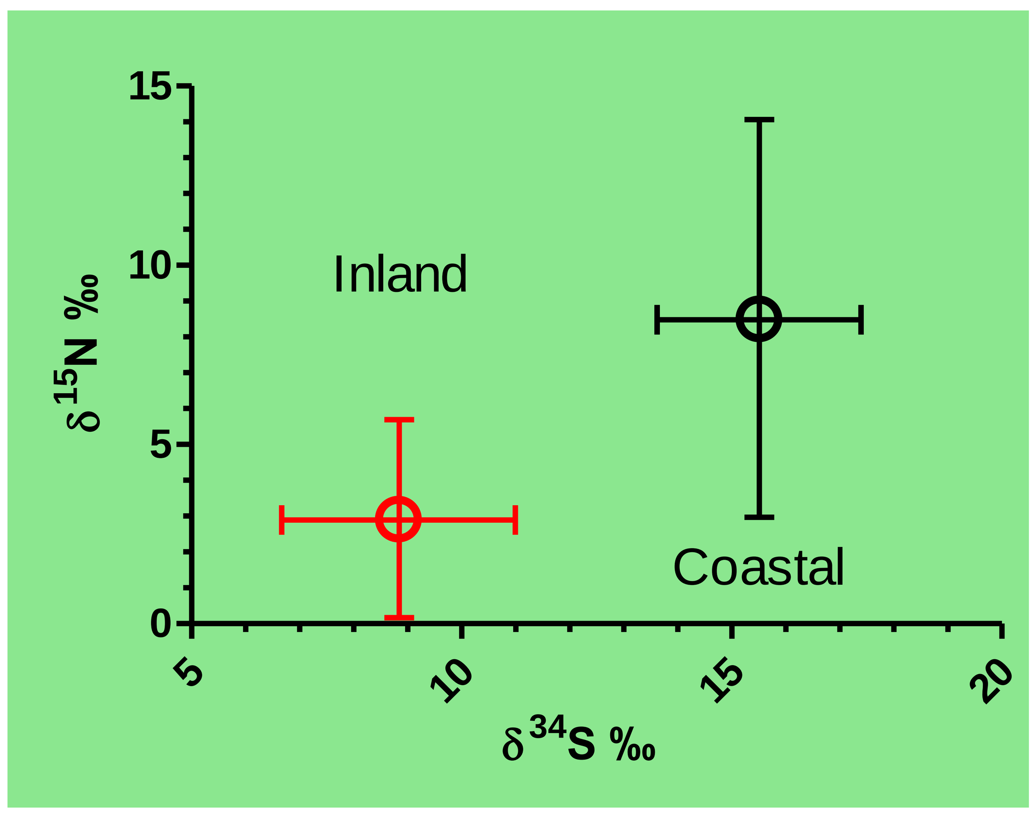
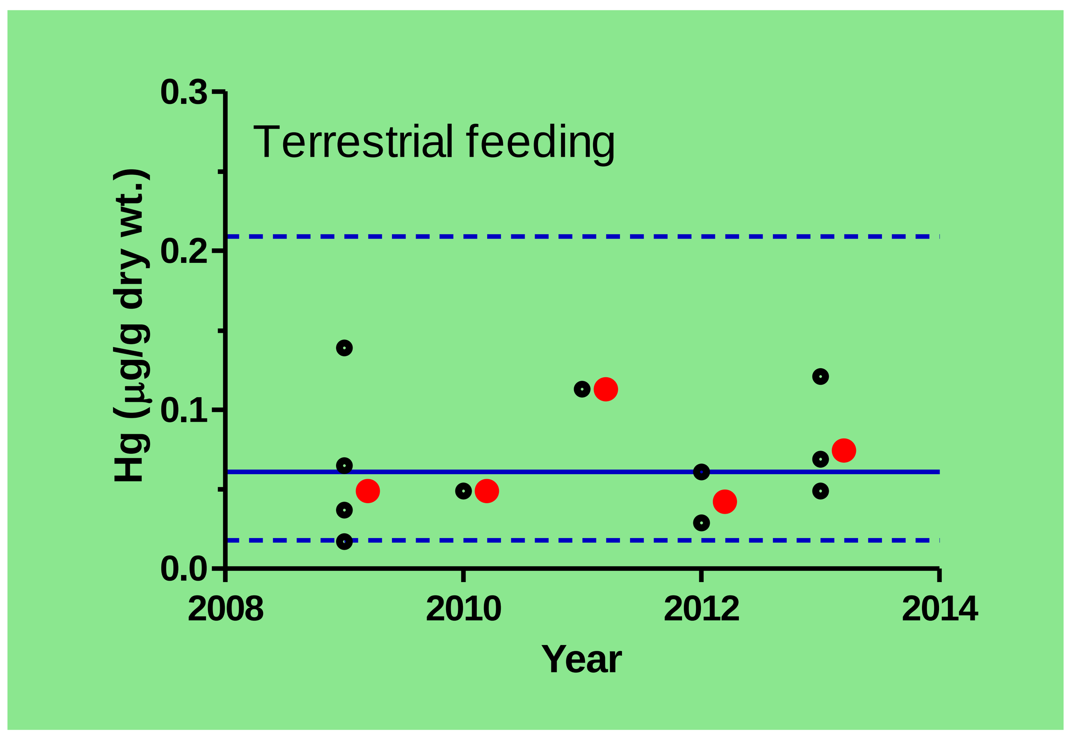


Figure 2. δ 15N vs δ 34S plots envelopes for golden eagle eggs. The envelopes represent mean ± 3SDs for δ15N and δ34S signatures in GE eggs from coastal and inland feeding birds.

Figure 3. Hg residues (µg/g dry wt.) in eggs laid by terrestrial feeding golden eagles. Data are for individual eggs (black dots), annual geometric means (red dots) and overall mean and 95% prediction intervals (blue line).



There was no evidence that Hg concentrations in the eggs of inland feeding golden eagles varied over the monitoring period (Figure 3), although data were limited.

Conclusion

The shewhart charts we constructed (Figures 2 and 3) can be used to identify future years in which average liver and egg Hg concentrations are higher or lower than would be expected by chance. The charts provide rapid visualisation of developing trends, and indicate the magnitude of change that can be detected with statistical significance.

Our monitoring of Hg in sparrowhawk livers and golden eagle eggs provides a means of identifying changes in bioavailable Hg over time in lowland and upland feeding sentinel species. Such changes may arise as a result of, or despite, the Minamata convention.

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