Can autopsy measurements be used as health indices to provide early warning of population impacts?

Centre for Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL
enquiries@ceh.ac.uk
www.ceh.ac.uk

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

Richard F. Shore*, Lee A. Walker, Elaine D. Potter, Lydia H.V. Franklinos†, Jacky S. Chaplow, M. Glória Pereira

Centre for Ecology & Hydrology,
Lancaster Environment Centre , Lancaster, UK
† Institute of Zoology, Zoological Society of London, Regents Park, London NW1 4RY, UK

*Corresponding author: rfs@ceh.ac.uk

Richard Shore

ABSTRACT : A key challenge when assessing the risk from contaminants and other pressures is to evaluate if populations are likely to be affected. We examined the use of necropsy measurements as potential population health indicators in a sentinel species, the sparrowhawk *Accipiter nisus*. We established current "norms" for metrics that were indicative of population demography, nutritional status or physiological stress. Rapid assessment of deviations from these "norms" may aid detection of nascent ecologically-significant changes.

Introduction

The Predatory Bird Monitoring Scheme (PBMS; http://pbms.ceh.ac.uk/) monitors contaminant levels in the tissues of sentinel birds of prey. The aim is to detect and quantify how chemical threats vary spatially and temporally.

All birds submitted to the PBMS undergo a post-mortem (PM) examination and ~ 60 macroscopic measurements are made. We explore how carcass measurements can potentially be used to assess health status and provide information on changes in pressures that are likely to exert population effects. Here, we demonstrate this approach with some exemplar measurements in sparrowhawks (*Accipiter nisus*).

Age class

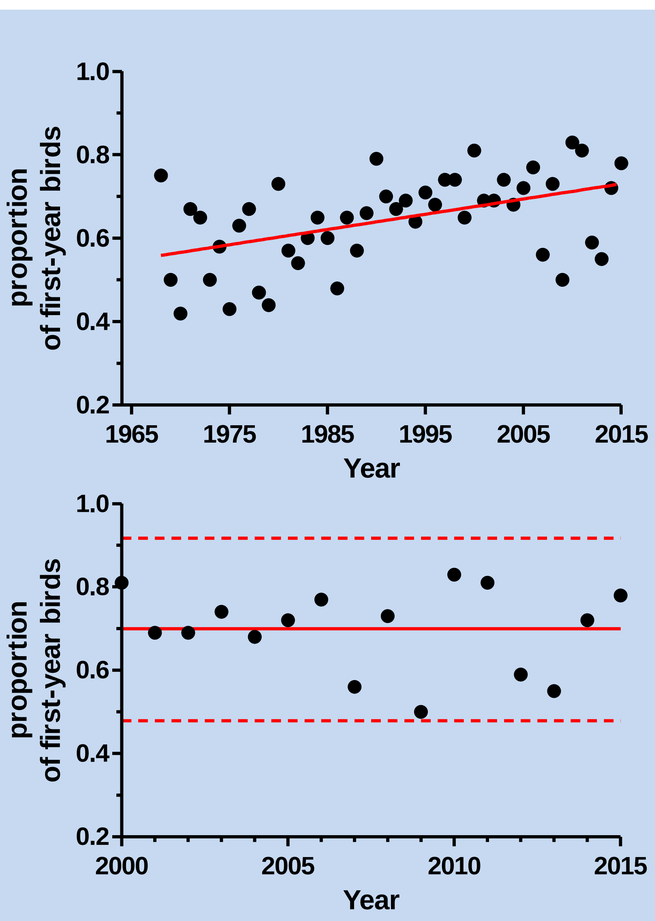


Figure 1. Annual proportion of sparrowhawks that were first-years (birds that hatched in the current or previous year). Number of birds per year ranged from 10 to 132.

Top graph: significant (R^2=0.235. P=0.001) increase in the proportion of sparrowhawks between 1968 and 2015 that were first-years.

Bottom graph: proportion of sparrowhawks between 2000 and 2015 that were first-years was constant [solid line is the mean, dotted lines are 95% prediction intervals]

The increasing proportion of first-years (top graph) likely reflects reducing DDE contamination and eggshell breakage, and a consequent increase in breeding success and first year recruitment.

Examination of data post-2000, when DDE induced effects were negligible (bottom graph), indicated no time trend. The mean value and its prediction intervals can be used to identify future years and time trends when the % of first-year birds in the population is lower than expected, likely indicative of poor juvenile recruitment.

Condition Index

The analysis of condition index (CI) in sparrowhawks (Figure 2) allowed calculation of "normal" CI values for adult females against which future change can be assessed. It also suggested that CI was increasing over time, or perhaps recovering, in males, suggesting improving food availability for males.

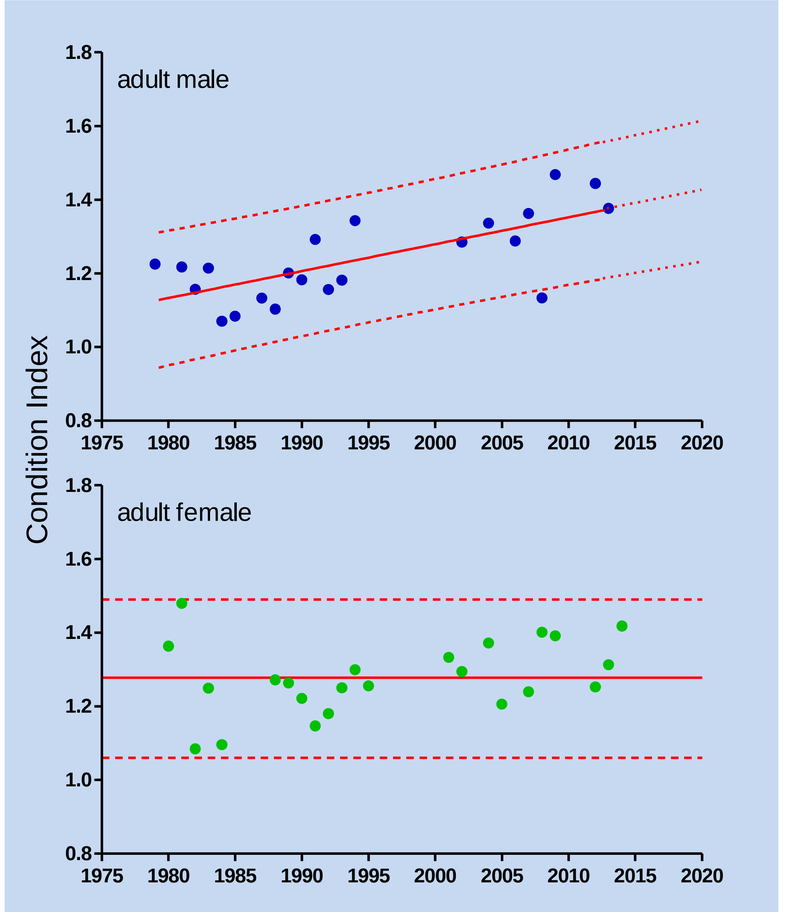
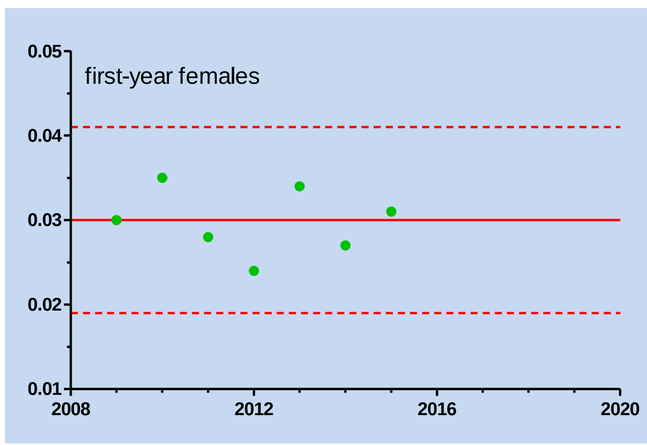


Figure 2. Condition index (*CI-body weight normalised by the cube of the diagonal sternum length*) is a ratio between the body weight of the bird and an independent measure of size.

Annual mean CI increased in adult males (top graph - regression model and 95% prediction intervals) but did not vary over time in adult females (bottom graph - mean [solid line] and 95th prediction intervals [dashed line] presented).

Fluctuating Asymmetry (FA)

Figure 3. Annual mean fluctuating asymmetry (FA) index based on 10th primary feather weight for first-year female sparrowhawks. Mean and 95th prediction intervals are presented by the solid and dashed red lines, respectively.



Despite limited data, mean and 95% prediction intervals for 10th primary FA could be calculated for sparrowhawks of different sex and age class (data for first year females only are shown in Fig. 3). These "current or normal" values can be used to judge if there is significant future change which would likely reflect the effect of single or multiple stressors acting at the time of feather growth.

Conclusion

Necropsy metrics grouped broadly into three categories:

- population demography (including proportion of first-year birds) that indicate altered recruitment, survival and mortality
- nutritional status (including the example of CI)
- physiological stress (such as FA)

Our analysis indicates such metrics can be evaluated using classic quality control approaches, and provide relatively rapid indicators of change in population health status. This will facilitate earlier identification of emerging ecological risks.

Poster: M0033

NERC SCIENCE OF THE ENVIRONMENT