Studying birds… implications of laboratory and field manipulations

Halsey L.G.[1], Willener A. [1] and White C.R.[2]
[1]*University of Roehampton, London, UK*
[2]*University of Queensland, St Lucia, Australia*

Field as well as laboratory investigations of birds can involve manipulations of the subject animals. This raises questions as to the effects of those manipulations on the validity of the data obtained, which we explore across three complementary studies.

Exposure of a wild bird to a laboratory environment and protocol can be expected to cause the animal stress. However to date no research papers have assessed this issue. Here we report on our new study that recorded cardiovascular measures of stress in king penguins in the laboratory, and also on a recent study which sought to ascertain if measures of pedestrian locomotion on the treadmill in birds in general are confounded by stress-related artefacts. The king penguins exhibited increases in both heart rate and rate of oxygen consumption when stressed in the laboratory but with two important caveats: firstly, if changes in activity levels due to the stressor were accounted for then surprisingly the stress response comprised only an increase in rate of oxygen consumption with no change in heart and secondly, in time the birds habituated to the stress. Across species we found a negative relationship between the height of the hip of a bird when standing and the estimate of their rate of oxygen consumption when walking at 0 $m.s^{-1}$ (i.e. the y-intercept; an abstract but potentially insightful measure obtained by extrapolating the linear regression between oxygen uptake and walking speed; Figure 1; Halsey 2013). The extrapolated y-intercept is commonly observed within species to be higher than the value for resting oxygen consumption. The aforementioned negative relationship between hip height and the y-intercept suggests that the elevation of this value above resting levels is not an artefact of animal stress. Rather, it has an anatomical explanation, possibly that birds with higher hips tend to have longer legs, which more efficiently accommodate body motion and/or means their limbs are more aligned with the ground reaction forces.

To investigate the behaviour and physiology of birds in the field they are usually instrumented with a miniature measuring device. For such measurements to be relevant, however, it is essential that the devices themselves do not affect the data of interest. We undertook a meta-analysis of 183 estimates of device impact from 39 studies of 36 species of bird designed to compare the effects of externally and internally attached devices on a range of traits, including body condition, energy expenditure and reproduction (White et al. 2013). We demonstrate that externally attached devices have a consistent detrimental effect (Figure 2), whereas implanted devices have no consistent effect. We conclude that device implantation is preferable to external attachment, providing that the risk from the required surgery can be mitigated.

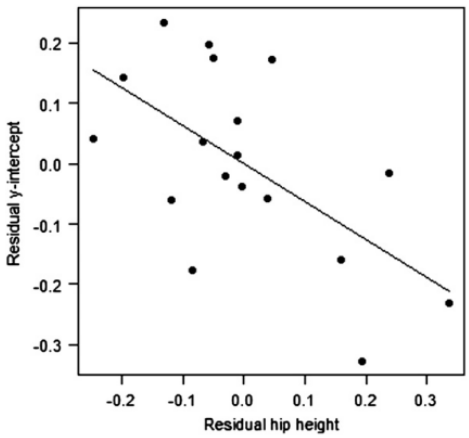

Figure 1. Relationship between y-intercept and hip height.

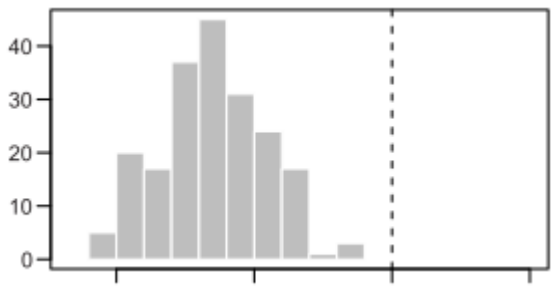

Figure 2. Frequency distributions of 200 resampled mean effect sizes related to metabolism for externally attached devices

References

Halsey, L. G. The relationship between energy expenditure and speed during pedestrian locomotion in birds: a morphological basis for the elevated y-intercept? Comparative Biochemistry and Physiology A 165, 296-298, 2013.

White, C., Cassey, P., Schimpf, N., Halsey, L., Green, J., and Portugal, S. Implantation reduces the negative effects of bio-logging devices on birds. Journal of Experimental Biology 216, 537-542, 2013.