NIRS in Wildlife and Ecology: Diversity, scale and complexity

William Foley

William.foley@anu.edu.au

The Australian National University, Research School of Biology Evolution, Ecology & Genetics, Canberra, Australia

INTRODUCTION

NIRS has been applied to questions in wildlife and ecology for more than 25 years. In that time, there has been a wide range of useful applications developed some of which represent simple extensions of the direct measurements of chemical constituents developed in other fields such as grains and pharmaceuticals. Other applications have been more novel and include “indirect” methods to measure the quality of food eaten by herbivores, the age of sharks and the reproductive state of wild predators. Indirect applications such as these start to unlock the power of NIRS as a transformative analytical tool. In the first part of this presentation I will highlight some of these applications.

RESULTS AND DISCUSSION

The use of NIRS in wildlife and ecological studies raises several questions and challenges for the future. Some of these are issues faced more broadly in any application of NIRS but others represent unique challenges for wildlife biologists and ecologists.

1.Phenotyping (simple reference values). Many ecologists developing applications with NIRS have a poor background in analytical chemistry and limited understanding of replication and inter-assay variation.

2. Phenotyping (complex and indirect traits). As more complex and indirect traits are included in NIRS studies, the need for extensive replication increases because of the inherent variability of biological processes. Practical calibrations of complex traits are relative rare.

3. Scale and databases. Samples collected during ecological studies are more variable than those in most agricultural and industrial settings. There are relatively few broad calibrations based on large sample sets and almost no collaborative calibration efforts that are broadly applicable.

4. Portability: Portable NIRS instruments are perfectly suited to ecological studies but can new users skip the learning curve of collecting spectra under controlled conditions in lab?

5. Removing barriers between NIRS and other techniques. Although the methods developed by practitioners of NIRS are widely applicable, there seem to be relatively little crossover between NIRS and other applications of spectroscopy in ecology. For example, airborne hyperspectral imaging of forests can readily use many of the techniques applied in laboratory-based NIRS.

THE WAY FORWARD

NIRS is a hugely useful tool for wildlife and ecology but despite several highly successful large-scale applications, many studies do not proceed beyond the demonstration of proof of concept via a limited calibration. Poor analytical skills amongst most ecologists remain a major reason for this as well as unrealistic expectations about the challenges of portable and remote sensing applications. Continuing close collaboration with the NIRS community is essential for ecologists. Continuing education and perhaps a dedicated subgroup that meets or runs short courses specifically aimed at ecologists could effect greater engagement with NIRS technology.

ACKNOWLEDGEMENTS

I thank members of the Australian Near Infrared Spectroscopy Group for their interest and support. Discussions with Carrie Webb and Doug Tolleson helped to establish this Theme at NIRS2015