Tracking the seasons: tissue-based memory for avian moult?

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Background and Motivation: One of today's major scientific challenges is to understand the effects of global climate change on ecosystem health. For most wild organisms mismatches between seasonally timed activities and environmental conditions can result in fitness costs to the individual as well as the whole population. For example, in species that exhibit geographically fine-tuned seasonal colour dimorphism (eg Ptarmigan), changing weather patterns could lead to temporal colour mismatching that heighten predation risk. In response to changes in ambient temperature some species have adjusted their seasonal migration or breeding distribution and are now exposed to photoperiods that differ from those to which they had formerly adapted. We thus need a greater understanding and ability to predict the costs and consequences of climate change. Birds provide an ideal model to address this as their seasonal activities in the wild are relatively well-known. Avian moult is an easily measurable trait that affects locomotor performance, thermoregulation, ornamentation and camouflage, all of which are linked to fitness. Therefore, it can be used to study scheduling in evolutionary and ecological contexts, as well as for investigating regenerative, cyclical processes and how these can be affected by climate change. This PhD project will address mechanisms of annual timing, specifically of avian moult, from a physiological perspective, with the aim of establishing links to seasonal processes in free-living birds.

Study system and Objectives: Many physiological processes are driven by underlying circannual rhythms which 'entrain' to periods of one year like the annual cycle in daylength. Although the mechanisms underlying circannual rhythmicity are poorly understood they appear to involve central regulation (the output of a master clock) that interacts with local clocks in peripheral tissues such as skin or feather follicles. Moult in birds can be driven by changes in photoperiod, but evidence is emerging that it is also locally sensitive to hormones including androgens, prolactin and thyroid hormones. To address the effects of climate change, in this project the timing of moult will be manipulated with photoperiodic and hormone treatments at central and local levels in Quail (*Coturnix coturnix*) and Willow ptarmigan (*Lagopus lagopus lagopus*). The project will have four specific objectives:

1) To characterise clock components in avian skin and feather follicles.
2) To localise properties that foster interaction between central and local timing mechanisms (e.g., receptors of hormones involved in seasonal timing).
3) To experimentally test the interactions between central and tissue-based timers in captivity.
4) To assess the consequences of timing manipulations under (semi-) natural conditions.

Methodological approach and Training opportunities: This interdisciplinary project will bring together ecological, chronobiological and physiological approaches to address the stated aims. Methods to be used will include local application of hormones as injections or implants, moult and feather characterisation, collection of skin biopsies, immunohistochemical identification and localisation of hormone receptors in the avian skin, measurement of photoperiodically regulated reproductive hormones in the blood by radioimmunoassay, and quantification of clock genes by in situ hybridization histochemistry.

Further Information -

To obtain more detailed information about the project, please contact the primary project supervisor, Barbara Helm (helm@orn.mpg.de).

Relevant publications by supervisory team and consultants:

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