

RTD23 Integrating the avian annual cycle

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1 Issues

In recent years, there have been exciting developments in understanding the interaction of seasonal activities (e.g. Nilsson and Svensson, 1996; Hemborg and Lundberg, 1998; Dawson et al., 2000; Both and Visser, 2001; Webster et al., 2002). So it is timely to integrate research carried out on various stages of the life-cycle. The aim of this round table was to bring together ornithologists working on various stages of the life-cycle to encourage discussion and exchange ideas. The workshop attracted c. 50 researchers from very different backgrounds. To stimulate discussion, six ornithologists commented, from their research background and perspective, on core issues confronting integration of the annual cycle.

Christiaan Both, Heteren, The Netherlands, illustrated the integration of different stages in the life-cycle with his work on the pied flycatcher (*Ficedula hypoleuca*). This long-distance migrant has advanced its laying date over the past 20 years in response to climate change (Both and Visser, 2001). However, further advancement of laying has been hampered because the date of arrival has not changed. Here the timing of reproduction is directly affected by the preceding stage of the life-cycle, migration to breeding grounds.

Francisco Pulido, Radolfzell, Germany, addressed the tight correlation between timing of moult and onset of migration in the blackcap (*Sylvia atricapilla*). The interval between moult and migration was highly heritable, being unaffected by experimental delays in the moult process. This clearly illustrates that the timing of one stage in the life-cycle is tightly linked to the timing of the next. Due to genetic correlation, evolutionary change in one stage is not independent of changes in others (Pulido and Berthold, 2002).

Lukas Jenni, Sempach, Switzerland, summarized the function and costs of moult, stressing the central role of moult in the annual cycle (Jenni and Winkler, 1994). He suggested that although the direct costs of moult may be less dramatic than generally assumed, indirect costs may have extremely high consequences for subsequent stages of the life-cycle. Thus delayed initiation of moult can lead to a more rapid moult, and as a consequence reduced feather

quality (Dawson et al., 2000; Serra, 2001). This, in turn, can affect survival and the timing and success of all subsequent events in the annual cycle.

Thomas Weber, Lund, Sweden, introduced a conceptual approach to modelling annual routines (Houston and McNamara, 1999; Clark and Mangel, 2000). State-dependent models can be based on a state variable that is resilient against short-term fluctuations and takes a relatively long time to be depleted and restored. For example, body condition decreases over the breeding season and cannot be restored within that stage of the life-cycle. Thus it facilitates the interdependence of stages in the life-cycle. Questions relating to which state variables are the most important, and how their dynamics may best be described, are still open.

Michaela Hau, Princeton, USA, emphasized the advantages of using a comparative approach to understanding interactions between stages of the life-cycle. Comparative analyses could elucidate the “scope” of physiological systems controlling the stages, revealing the extent to which annual cycles can be modified. As one example, comparison of seasonal regulation of the reproductive stage between temperate-zone and tropical birds reveals different breeding strategies. She compared cycles in an opportunistic tropical breeder, a Darwin’s finch (*Geospiza fuliginosa*), and a seasonal tropical breeder, the spotted antbird (*Hylophylax naevioides*), to breeding in temperate zone birds. Her results indicate that annual cycles may be regulated more flexibly in tropical birds, which live in seasonally more variable environments than temperate zone birds (Hau, 2001).

Richard Holmes, Hanover, USA, introduced the concept of migratory connectivity (Webster et al., 2002). He emphasized that population dynamics have to be studied year-round over the entire annual cycle (Marra et al., 1998; Sillert et al., 2000) and presented a number of techniques that could be used to link cyclic behavior between breeding grounds and winter quarters. Stable isotopes are one of the most promising tools, as he showed for the black-throated blue warbler (*Dendroica caerulescens*; Rubenstein et al., 2002). Identifying the degree of connectivity as well as the amount of mixing in populations in both breeding and wintering areas is essential for modeling year-round popula-

tion dynamics and for conservation planning. Real information from wintering quarters, rather than the “black-box approach” that is often applied in migrant species, might improve our knowledge about interrelations among life-cycle stages greatly.

2 Outcomes

Lively discussion followed the presentations, raising a number of topics. One emerging theme was the perhaps central role of moult in the annual cycle. Feather quality might serve as a good state variable because its long-lasting effects contribute to the interdependence of life-history stages. The RTD revealed the considerable extent to which different stages in the life-cycle affect one another. One outstanding problem is how to break into the annual cycle experimentally to assess the fitness consequences of its stages. Furthermore, constraints imposed by physiological mechanisms, as well as the genetic bases underpinning the interdependence of life-cycle stages, remain little known. Progress in answering these questions promises to lead to a deeper understanding of the evolution of avian life histories and of the factors and processes affecting population dynamics.

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