

## Symposium 19 The evolution of avian migration

### Introduction

Francisco PULIDO<sup>1</sup>, John H. RAPPOLE<sup>2</sup>

1. Max Planck Research Centre for Ornithology, Vogelwarte, Schlossallee 2, D-78315 Radolfzell, Germany; pulido@vowa.ornithol.mpg.de

2. Smithsonian Institution, Conservation and Research Center, Front Royal, Virginia 22630, USA; jrappole@crc.si.edu

Since the very beginning of research into avian migration, the questions of why birds migrate and how migration originated have been at the center of interest. But only since the development of the theory of natural selection has it been possible to formulate testable hypotheses to answer these issues. Alfred Russell Wallace (1874) was probably the first to put forward ideas about how avian migration may have originated by natural selection. Today, it is generally accepted that current migration patterns are maintained and altered by selection (Lack, 1968; Berthold, 1999), yet we are only just beginning to understand the details of this process of adaptive evolution.

Investigation of the evolution of migration encompasses a wide field, including the question of the origin of migration in diverse phylogenetic lineages, mechanisms of adaptive change, and ecological conditions favoring the evolution of migration and its maintenance. Moreover, when we speak of migration, we are not dealing with one trait but with a complex, co-adapted suite of traits characteristic of migratory birds (Dingle, 1996). These traits, such as circannual rhythms, orientation mechanisms, energy storage and utilization, are not exclusive to migrants but are expressed in most birds (Berthold, 1999; Wiltschko and Wiltschko, 1999). One property that runs like a thread through recent studies, including all contributions to this symposium, is that bird migration is highly flexible and variable. Complex interactions between environments and genotypes, between historical factors and extant conditions, are the cause for a great diversity of evolutionary trajectories and of “adaptive solutions” (cf. Pulido, this symposium).

In recent years, some general but hitherto unexpected patterns have become apparent, such as the southern ancestry of most Holarctic migrants (Safriel, 1995; Rappole 1995), the ingrained universality of migratory traits in birds (Berthold, 1999; Rappole, this symposium), the inter-correlation of migratory traits and their evolution (Pulido et al., 1996; Pulido and Berthold, 2003), the flexibility and evolutionary lability of migratory traits and migratory status (Helbig, 2003; Pulido, this symposium), and the variety of ecological conditions pressuring the evolution of migra-

tion or residency (Rappole, 1995). The generality of most of these patterns, however, needs verification. Moreover, we need to investigate how specific character states and ecological conditions facilitate migration, and what evolutionary changes are necessary and adequate to enable bird populations to perform regular seasonal migration or to change migration patterns.

Over the last several years, significant progress has been made in a number of fields, such as phylogenetics, biogeography, and population biology, to have had a major impact on the study of the evolution of avian migration. As a consequence, this field has flourished and ripened. We are now able to investigate the evolution of migration at different levels and on different time-frames, and to test discriminating predictions. So the time is ripe for a synthesis of the field. The contributions to this symposium will surely guide future research, because they show that insights into the evolution of migration hinge upon the integration of different fields and diverse approaches.

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