APPENDIX S1. PATTERNS OF DIFFERENTIAL MIGRATION

Sex and age classes of many seasonally reproducing organisms segregate in space and time during the non-reproductive period. Sexual segregation may arise due to differences in habitat preference, social affinity and energetic or nutritional requirements of males and females (Ruckstuhl, 2007). In bird species of the temperate zone, latitudinal sexual segregation, in which males tend to winter closer to the breeding grounds than females, appears to be a widespread phenomenon (Newton, 2008). Despite the lack of hard evidence in the form of ringing recoveries or isotopic signatures (Berthold, 2001; Newton, 2008; Coppack & Pulido, 2009), there are indications of a similar pattern for Nearctic-Neotropical (Komar et al., 2005) and Palearctic-African (Catry et al., 2005) migrants.

We currently lack an in-depth understanding of the proximate mechanisms that cause sex- and age-specific differences in the timing and extent of migration (Coppack & Pulido, 2009). In one sense, research on differential migration has not progressed very far since the first account of the phenomenon, published by bird observer Heinrich Gätke 130 years ago (Gätke, 1879, pp. 98–99): “The young birds of the summer open the grand autumnal flight, unaccompanied by any old, the very finest old males at the close of the season bringing up the rear. In spring, however, quite the reverse invariably takes place, then the most perfect old males appear first, followed soon by old females, and later by younger birds of less perfect appearance.”

Considering age and sex adds considerably to the within-season complexity of phenological patterns. So far, patterns of sex- or age-specific migration have received only limited attention in the study of responses of migratory birds to climate change (Møller, 2004; Rainio et al., 2007; Tøttrup & Thorup, 2008; Coppack & Pulido, 2009). For most species, breeding phenology will be limited by the arrival of females, which is usually later than
arrival of males (Kokko et al., 2006; Coppack & Pulido, 2009). Laboratory experiments have shown that females of such species initiate migratory activity later, indicating differences between the sexes in the circannual clock mechanism or in the response to photoperiod (Coppack & Pulido, 2009). Departure dates from the wintering grounds are, however, hard to observe for most species. Studies on Setophaga ruticilla (American redstart) wintering in Jamaica show sexual habitat segregation, with females (generally being less dominant than males) settling in lower quality habitat, resulting in poorer physiological condition and later departure (Marra, Hobson & Holmes, 1998; Marra & Holmes, 2001; Studds & Marra, 2005).

Differences in the timing and extent of migration may expose males and females of the same species to different patterns of seasonal environmental change, since both sexes pass through different latitudes and climatic conditions at different times of the year. Selection pressures acting on the timing of migration and arrival at the breeding grounds may differ significantly between males and females (Morbey & Ydenberg, 2001), and responses to climate change may need to be understood in the context of sexual selection (Møller, 2004; Spottiswoode, Tøttrup & Coppack, 2006). Also, changes in the timing of arrival of one sex relative to the arrival of the other in immediate response to changing environmental conditions in winter or during migration could influence mating opportunities, with consequences for reproductive success, individual fitness and population viability. A detailed review on the relative contributions of natural and sexual selection in the adaptation of migrants to climate change is provided by Spottiswoode & Saino (2010).

REFERENCES


