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Comment on "Rapid Advance of Spring Arrival Dates in Long-Distance Migratory Birds"

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Jonzén *et al.* (Reports, 30 June 2006, p. 1959) proposed that the rapid advance of spring migration dates of long-distance migrants throughout Europe reflects an evolutionary response to climate change. However, most migrants should not advance their migration time because the phenology of their breeding grounds has not changed. It is more likely that migration speed has changed in response to improved environmental circumstances.

One of the great ecological concerns about climate change is that the phenology of different trophic levels responds at different rates (1), causing a mismatch between the timing of peak food requirements and peak food availability (2, 3). My colleagues and I have argued that long-distance migratory birds in particular have problems in responding appropriately to climate change. At their wintering grounds, migrants cannot accurately predict the phenology of their breeding grounds and, as a solution, they have evolved clock mechanisms to start their spring migration (4). These endogenous mechanisms have become maladaptive because of climate change, and at present birds arrive too late at their breeding sites (5). A change in migration time requires either an evolutionary change in the time of year that clocks instruct the birds to fuel and go or a phenotypic reaction to changed environmental conditions.

Jonzén and co-workers (6) recently showed that African-Palearctic long-distance migrants have advanced their spring migration time through Italy and southern Fennoscandia, and they argued that this is the expected evolutionary change. This is an important claim, suggesting that the inadequate timing responses may be only temporary and that at present rapid evolution solves the birds' problems. I agree that the

observed advances are an interesting phenomenon and that an evolutionary response in migration time is indeed expected. However, I strongly disagree that the observed effects are caused by such an evolutionary response.

An evolutionary change is a change in gene frequencies within populations, and in the present case it requires genetic variation for migration time as well as consistent selection for early migration. We showed that selection for early breeding and arrival increased for Dutch pied flycatchers *Ficedula hypoleuca* in response to climate change (5), and Jonzén *et al.* (6) used this as the backbone for their suggestion of evolutionary change. However, they failed to take into account key information about the precise breeding populations to which the study birds belonged. Most species examined have their distributional center of gravity in Fennoscandia and Northern Russia (7, 8), where spring temperatures have not increased during the last decades and egg-laying dates have not advanced (9). This lack of change in selection for early arrival and breeding makes the suggested evolutionary response unlikely.

Two alternatives can explain the observed changes in migration time: (i) migration is faster because environmental conditions during migration improved, or (ii) the mixture of birds from different breeding populations changed, and these populations differ in migration dates. Jonzén *et al.* (6) have overlooked the second hypothesis, but they discuss and reject the first

option, assuming it unlikely that climate change has improved conditions for migration in Africa. However, improved conditions in North Africa may be responsible for the advanced passage through Italy, because they correlate with arrival and breeding in several migrants (10, 11). Furthermore, rainfall has increased in the Sahel since the early 1980s (12), probably improving conditions during migration for many species.

In conclusion, the suggestion of a climate-driven evolutionary change (6) is weak because phenotypic responses are likely, and selection for earlier arrival and breeding has not increased in the majority of populations studied by Jonzén *et al.* There is little doubt that evolutionary changes will occur in the near future, but it is difficult to predict whether these will be sufficient to meet the requirements of climate change. Even if we accept the assertion of an evolutionary response, for pied flycatchers the advance in passage time through Italy (0.21 days per year) is still far less than the advance of their food peak on the Dutch breeding grounds (0.78 days per year) (13).

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