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SHORT COMMUNICATION

Spring migration characteristics of the House Martin, *Delichon urbica* (Aves: Hirundinidae) in Croatia: A response to climate change?

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ABSTRACT. Many authors have discussed use of birds (and other organisms) as sensitive biomonitors for climate change. In this paper we investigate the long-term trends in first arrival dates of the long-distance migratory House Martin, *Delichon urbica* (Linneus, 1758), in north-western Croatia during the 28-year period. The aim of this paper is to identify possible relationship between arrival times and local spring air temperatures. Between 1981 and 2008 the House Martin arrived progressively earlier (5.9 days), probably in response to climate change. First arrival dates correlated significantly with increasing March-April mean temperatures. Correlation between mean spring air temperature and yearly temperatures were also statistically significant. Our results suggest that the arrival timing of the House Martin is influenced by spring air temperatures.

KEY WORDS. Arrival date; climate change; Croatia, *Delichon urbica*.

In many areas, global warming has increasing influence on numerous organisms (e.g. Parmesan & Yohe 2003). Several studies have indicated changes in avian phenology in the past 30-40 years, which authors attributed to climate change. For example, coinciding with increasing spring temperatures, some bird species have advanced their egg laying dates (e.g. Sergio 2003, Dolenec *et al.* 2009, Dolenec 2009a), some bird species have moved their former northernmost nesting border (Thomas & Lennon 1999) and some papers have indicated an increase in brood size (e.g. Dolenec 2009b). Furthermore, correlation between climatic parameters and demography can have important consequences for population dynamics (e.g. Sillet *et al.* 2000). The migration phenology for a number of birds has also been affected by climatic variations (e.g. Gordo & Sanz 2006, Dolenec & Dolenec 2010). For example, in Poland, Tryjanovski *et al.* (2002) revealed trends toward earlier spring arrival dates in 14 of 16 species, over a 27-year period.

Objectives of the present study were to investigate to which extent the Croatian population of the House Martin, *Delichon urbica* (Linneus, 1758) has changed its first arrival dates in relation to changes in mean spring air temperatures.

This study was conducted in the Oroslavje area (46º00'N, 15º56'E; ca. 5 km^2) in north-western Croatia, during the period from 1981 to 2008. It is a suburban area consisting of buildings (houses, garages, etc), gardens, trees and bushes. The altitude of the study area is approximately 171 m above sea level. The House Martin is a small (12 cm) socially monogamous, long-distance insectivorous passerine migrant, which winters in Africa (Cramp 1998). During the spring and summer it is a common bird in the study area (Kralj 1997).

First arrival date for each year was calculated as the mean of the first five bird arrivals recorded for that year (method previously used by Both *et al.* 2005). During most years (19 years), the arrival of the first five birds on the Oroslavje area was highly synchronous (range 1-4 days). Dates were converted to numerical values such that 1 = 1 March. There is a general consensus that bird migration is influenced by temperature (e.g. Sokolov *et al.* 1998, Tryjanovski *et al.* 2002). To evaluate the impact of climate on spring arrivals, we took into account temperature data from the breeding grounds (March-April) (method previously used by Gordo & Sanz 2006). Croatia's climate in the spring was measured as the average of the mean monthly temperature for the two months best adjusted to the arrival date of each species. Therefore, we used the mean of temperatures for March and April for the House Martin. Temperature data (1981-2008) were obtained from the Maksimir weather station (Meteorological Office in Zagreb), ca. 20 km from the study area (March, mean = 6.7ºC, SD = 2.2, range = 1.7-10.3ºC and April, mean = 11.3ºC, SD = 1.4, range = 8.2-14.2ºC). Mean spring air temperatures were calculated from the mean temperatures for March and April (mean = 9.0ºC, SD = 1.3, range = 6.5-11.3ºC). Statistical analyses were performed using the SPSS 13.0 statistical package and all tests are two-tailed.

Mean arrival of the first five birds, between the years 1981-2008, varied from April 3 to April 18 (mean = April 9, SD = 3.83). The correlation between the first arrival date and the study period (1981-2008) was significant (r = -0.458, p = 0.014, n = 28; regression equation was y = 465.10-0.21x; Fig. 1). The coefficient of regression (slope = 0.21) for the House Martin indicates an earlier arrival of 0.21 days per year, or 5.9 days over the study period (1981-2008). Correlation between first arrival date and the mean air spring temperatures (March-April) was also significant (r = -0.539, p = 0.003, n = 28). Temperature in March-April increasing significantly during 1981-2008 (r = 0.385, p = 0.043, n = 28; Fig. 2). Our studies suggested that spring temperatures have an influence on the date of first arrival in the studied population.

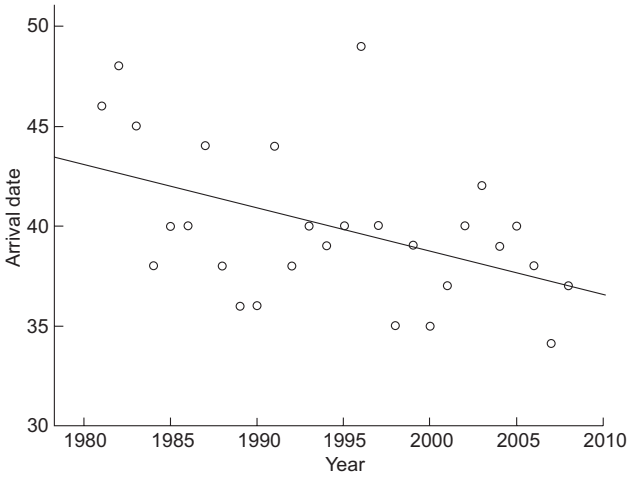

Figure 1. Temporal trends in first arrival dates of the House Martin *D. urbica* in north-western Croatia, 1981-2008 (1 = 1 March).

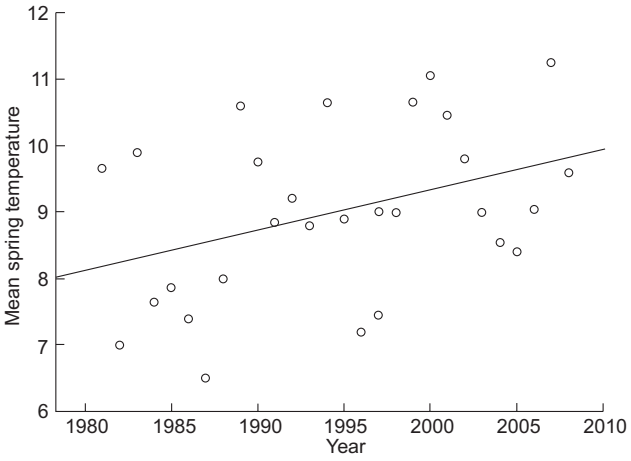

Figure 2. Correlation between spring temperature (°C) (March-April) and year (1981-2008) in north-western Croatia.

The significant temporal trend in arrival dates of house martin is consistent with the findings of a similar study in Germany (Peintinger & Schuster 2005), United Kingdom (Croxton *et al*. 2006) and Lithuania (Zalakevicius *et al*. 2004). In migratory species, time of arrival at the breeding site is a major determinant of breeding characteristics. According to Crick & Sparks (1999), earlier arrival in United Kingdom fit a trend to earlier egg-laying by several bird species. Earlier nesting could be beneficial if juvenile survival is significantly enhanced before winter; conversely, birds may be adversely affected if they become unsynchronised with the phenology of their food (Crick *et al*. 1997). The ready response of many bird species to recent climate change indicates that most species have the phenotypic plasticity to cope with such a change (Crick 2004), but not all. In some cases, although timing in the arrival of spring migrants is earlier during warmer springs, no trends are yet apparent, because local temperatures have yet to show any trend (Barrett 2002). According to Lehikoinen *et al*. (2004), understanding of ecological species traits, their responsiveness to climate change and the consequences to the life history of different species should be the next step on which to concentrate further studies.

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