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COMPARISON OF ARRIVAL DATES OF LONG-DISTANCE MIGRATORY RED-BACKED SHRIKE *Lanius collurio* WITH SPRING AIR TEMPERATURE AND YEAR

Usporedba datuma povratka rusog svračka Lanius collurio s proljetnom temperaturom i godinama istraživanja

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ABSTRACT

In the Northern Hemisphere, numerous bird species have started to arrive earlier over the previous couple of decades as a result of higher spring air temperatures caused by climate warming. I have studied potential long-term changes in the arrival date of Red-backed Shrike *Lanius collurio*. This paper illustrates how long-term data (from 1991 to 2016) can provide a wider and more comprehensive picture on bird responses to average spring air temperatures in the village of Mokrice (mosaic farmland area), north-western Croatia. Mean spring air temperatures (April – May) have shown a significant increase over a period of 26 years. In this study, I found no significant correlation either between the arrival date and average spring air temperatures or between the arrival date and the research period. This finding indicates that spring migration phenology in Red-backed Shrike is probably not impacted by spring warms in north-western Croatia.

Keywords: Red-backed Shrike, *Lanius collurio*, arrival date, spring air temperature, north-western Croatia

INTRODUCTION

Global average air temperatures have been increasing over the previous hundred years (IPCC 2014); impacts of global or regional warming have been

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detected in many biological systems (e.g. Root *et al*. 2003, Parmesan 2006). Responses of plants and animals to regional and global climate change have been the topic of many biological studies over the past 40 years. For example, climate change was associated with changes in plant phenology (Mo *et al*. 2017), changes in flight times of butterflies (e.g. Zipf *et al*. 2017), changes of fish reproductive characteristics (e.g. Tao *et al*. 2018), etc. Furthermore, many papers documented various changes in different bird species and populations, for example, changes in morphology (e.g. Yom-Tov & Yom-Tov 2006), geographical distributions (e.g. Lehikoinen & Virkkala 2016), long-term population dynamics (Wittwer *et al*. 2015), egg size (Skwarska *et al*. 2015), brood size (e.g. Hušek & Adamík 2008), reproductive success (e.g. Vengerov 2017), breeding phenology (e.g. Dunn & Winkler 2010), intra-specific differences in migratory birds (Hurlbert & Liang 2012), etc. Numerous works suggest that high spring temperatures are associated with earlier arrival (e.g. Kralj & Dolenec 2008), especially for short-distance migrants (e.g. Deleon *et al*. 2011). In some species, earlier trend was not registered, for example for White Stork *Ciconia ciconia* in Poland (Biaduń *et al.* 2011) and Common Starling *Sturnus vulgaris* in Croatia (Dolenec 2015). Thus, various bird populations can differ in response to climate changes.

Red-backed Shrike (*Lanius collurio*) is a long-distance migrant and carnivorous passerine bird (Cramp 1998). In Europe, the breeding population is estimated to 7,440,000-14,300,000 pairs (BirdLife International 2017). Since there are no published data regarding the influence of climate changes on Red-backed Shrike migration in south-eastern Europe, the aim of this study was to study potential changes in arrival date of this species in north-western Croatia. I have studied spring migration phenology of this bird species in the period from 1991 to 2016.

MATERIAL AND METHODS

The work examines springtime coming back of migrating Red-backed Shrike (observations of the first arrival dates of males) during a period of 26 years (1991–2016) in the Mokrice farmland area (46°00'N, 15°55'E; approximately 140 m a.s.l.) in north-western Croatia. In this study, three parameters have been analysed: the first arrival date, mean spring air temperature, and year. The studied area is 6.4 square km large, representing a mixed farmland area with arable land, orchards, lawns, hedges, small deciduous forest (dominated by Hornbeam *Carpinus betulus* and Pendiculate Oak *Quercus robur*), etc. Each year between 1991 and 2016, first arrival dates were recorded by daily observation of a single observer – the author of this paper – who lives in Mokrice. In this study, only local breeders in this nesting area were included. The first arrival date is the most commonly studied metric of arrival time (e.g. Rubolini *et al.* 2007, Biaduń *et al.* 2009, Dolenec *et al.* 2013). Among climatic traits, I used local air temperature, which is an important single

parameter of bird phenology (e.g. Hušek & Adamík 2008, Dolenec 2017). In the context of studying global warming, large majority of papers have discussed the documented changes with a focus on increased spring temperatures (e.g. Crick 2004, Dunn 2004, Dolenec 2009, Potti 2009, Biadun *et al*. 2011, Dolenec 2018). As Red-backed Shrikes return in April or May, spring air temperature was measured as the average temperature for April and May (average April–May). This monthly average temperature is best adjusted to spring migration phenology for the studied species (according to Gordo & Sanz 2006). Temperature values in the 26-year period were obtained from the Maksimir meteorological station – Meteorological Office in Zagreb (45°83′N, 16°01′E), which is approximately 20 kilometres away from the Mokrice area (April–May, average = 9.2 ± 1.37 ºC; range = 6.5 to 11.9 ºC).

Associations between parameters (first arrival date, mean air spring temperature, study period) were measured with correlation (Spearman's coefficient), and trends were calculated by regression methods. All analyses were executed in SPSS 13.0 for Windows.

RESULTS

The first arrival date of Red-backed Shrike in the Mokrice rural area was ranged from 28 April to 9 May (mean 3 May, SD = 3.51). The average air spring temperature (April–May) increased in the study sites during the research period from 1991 to 2016. Correlation between the research period and the spring air temperature was significantly positive (Spearman's coefficient was r = 0.47, p = 0.016, n = 26; regression equation was y = –117.86 + 0.066x; Figure 1). Long-term datasets in NW Croatia revealed an increase in the mean air spring temperature of about 2 degrees in the studied time period. During the periods of observations by the Mokrice farmland area, Red-backed Shrike did not arrive earlier (r = – 0.24, p = 0.235, n = 26; y = 236.13 – 0.101x; Figure 2). The coefficient of regression for the studied bird species suggests an earlier arrival of 2.63 days over the research period (not statistically significant advance over the 26-year period). Correlation between spring air temperature and first arrival date was non-significant as well (r = – 0.21, p = 0.315, n = 26; y = 42.11– 0.661x; Figure 3).

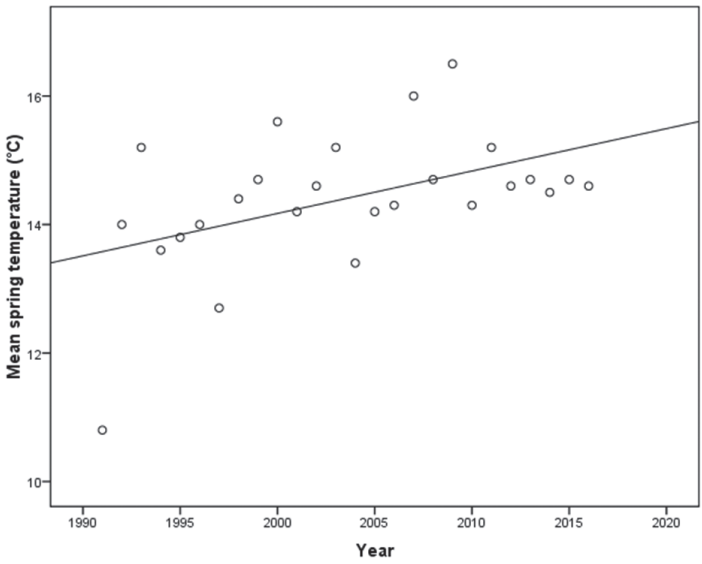

Figure 1. Relationship between mean local air spring temperature (April–May) and year (1991–2016) in north-western Croatia.

Slika 1. *Odnos između srednje proljetne temperature zraka (travanj–svibanj) i godina istraživanja (1991.–2016.) na području sjeverozapadne Hrvatske.*

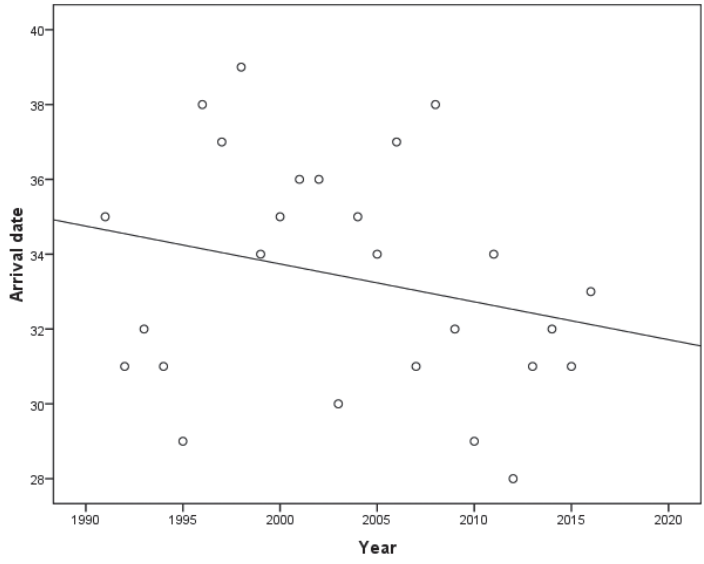

Figure 2. Temporal trends (1991–2016) in first arrival dates of the Red-backed Shrike in north-western Croatia.

Slika 2. *Trend datuma povratka rusog svračka u razdoblju od 1991. do 2016. godine na području sjeverozapadne Hrvatske.*

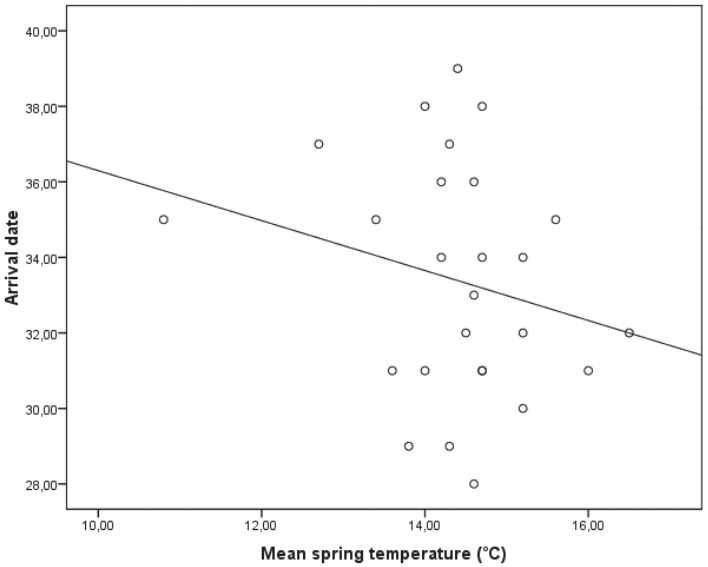

Figure 3. Relationship between first arrival date and mean local air spring temperature (April–May) of the Red-backed Shrike in north-western Croatia (1991–2016).

Slika 3. *Odnos datuma dolaska rusog svračka i srednje proljetne temperature zraka (travanj–svibanj) na području sjeverozapadne Hrvatske (1991.–2016.).*

DISCUSSION

The results of this work suggest that Red-backed Shrike breeding in the Mokrice area (north-western Croatia) has not responded to climate fluctuations by significantly shifting the date of spring migration. Spring warming had no influence on the arrival date of Red-backed Shrike in the research area in the period from 1991 to 2016. Several other authors have reported similar results (e.g. Zalakevicius *et al*. 2006, in Lithuania). However, some studies indicated that Red-backed Shrike arrived early to nesting site in the past few decades (e.g. Tryjanowski & Sparks 2001, in Poland). These conflicting trends in spring migration phenology in Europe demand further studying, especially in other areas. Moreover, some papers indicated that global and regional warming might not act uniformly on different birds species. For example, there was no change in first arrival dates of White Wagtail *Motacilla alba* (Dolenec 2012), whereas Chiffchaff *Phylloscopus collybita* advanced its first arrival date (Dolenec 2013) in response to spring warming.

In the future studies, more data should be collected concerning the effects of climate change on bird migration and general bird phenology. According to Hurlbert & Liang (2012), understanding how the strength and magnitude of these responses vary across species and with the ecological context is crucial in order to predict the effects of climate change and identify the species most at risk.

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SAŽETAK

Posljednjih nekoliko desetljeća niz znanstvenih radova sugerira da su klimatske promjene (posebice temperatura) već ostavile traga u mnogim segmentima živoga svijeta. Pionirskim dokumentima smatraju se rezultati istraživanja u području fenologije kako biljaka tako i životinja. Međutim, rezultati nisu jednoznačni pa ima različitih reakcija na zatopljenje kako između vrsta i unutar vrsta tako i različitih područja obitavanja pojedinih organizama. Tako se i rusi svračak na neka europska područja vraća ranije dok u drugim nisu zabilježeni značajni pomaci ranije proljetne selidbe. Na području sjeverozapadne Hrvatske u razdoblju od 1991. do 2016. godine nije zabilježen značajan raniji povratak rusog svračka sa zimovanja iako je u tom razdoblju srednja temperatura mjeseca travnja i svibnja značajno porasla. Buduća još intenzivnija istraživanja trebala bi dati daljnje odgovore u vezi utjecaja klimatskih promjena na razne životne cikluse ptica i to posebice ona koja se odnose na njihovu moguću ugroženost, odnosno opstanak.