Marić, D. (2026). Impact of short-term temperature variation on the migration timing of the great grey shrike (Lanius excubitor) in karst poljes of Bosnia and Herzegovina. Agriculture and Forestry, 72 (2): 233-242. https://doi:10.17707/AgricultForest.72.2.15

DOI: 10.17707/AgricultForest.72.2.15

Drago MARIĆ*[1]

IMPACT OF SHORT-TERM TEMPERATURE VARIATION ON THE MIGRATION TIMING OF THE GREAT GREY SHRIKE (*Lanius excubitor*) IN KARST POLJES OF BOSNIA AND HERZEGOVINA

SUMMARY

This study provides new data on the migration timing of northern populations of the Great Grey Shrike (*Lanius excubitor*) in two karst poljes (Pašića polje and Resenovačko polje) in Bosnia and Herzegovina. The research was conducted over a 10-year period within an area of approximately 25 km² in the municipality of Bosansko Grahovo. A Pearson correlation analysis between the date of the first cold spell in October and the date of first observation of the species in the study area showed a strong positive relationship ($R=0.97$, $n=9$, $p<0.01$), indicating that earlier temperature drops corresponded with earlier arrivals. These results indicate that short-term temperature fluctuations may act as an important environmental cue influencing migration timing of the species in karst poljes. The study contributes to the limited knowledge on migration ecology of *L. excubitor* in the Dinaric karst region.

Keywords: Great Grey Shrike, migrations, temperature fluctuations, karst polje, Bosnia and Herzegovina

INTRODUCTION

The Great Grey Shrike (*L. excubitor*) is a polymorphic species comprising several subspecies—according to some authors, at least twelve (Olson *et al.*, 2010; Yosef 2016, 2025). Within Europe, however, two subspecies are generally recognized: *L. e. excubitor*, distributed from western and northern Europe eastwards to western Russia, and *L. e. homeyeri*, inhabiting the Balkan Peninsula.

The species is widely distributed across the Holarctic region (Cramp and Perrins 1993; Panow 1996; Yosef 2020), although it remains scarce throughout large parts of its range. In northern Europe, breeding populations are migratory, whereas in southern and southeastern Europe, including Slovenia and other Balkan countries, *L. excubitor* occurs primarily during the autumn and winter seasons (BirdLife International 2021). In Italy, the species is considered a regular

[1]Drago Marić (corresponding author: dragomrc@yahoo.com), University of Montenegro, Podgorica, Slovačka bb, MONTENEGRO, https://orcid.org/0000-0001-5537-557X

Notes: The author declare that there is no conflicts of interest. Authorship Form signed online.

Recieved:20/01/2026 *Accepted:25/05/2026*

migrant and winter visitor, with irregular breeding occurrences (Fraticelli and Marangoni 2018). In Bosnia and Herzegovina, particularly in karst poljes, the species is recorded during the non-breeding season (Obratil 1967, 1984, 2006; Marić 2022a).

The Great Grey Shrike exhibits flexible winter strategies, with part of the population migrating southwards while others remain on or near the breeding grounds (Bylicka *et al.*, 2007). Despite its wide distribution, population declines have been documented across much of western and central Europe, primarily due to habitat loss and land-use changes (Lefranc and Worfolk 1997; Schön 2000; Biver *et al.*, 2009). By contrast, stable populations persist in Norway, Sweden, Russia, Belarus, and Poland (Lorek 1995; Schön 1995; Lefranc and Worfolk 1997; Hagemeijer and Blair 1997; Harris and Franklin 2000).

The available literature provides little information on populations migrating south of the breeding range. For Bosnia and Herzegovina, most records concern site-specific occurrence, while data on abundance and long-term phenology are scarce (Obrati, 2000l 1987; Marić 2022a). Collecting such data is important for understanding migration patterns and habitat use in karst poljes.

The aim of this study is to analyse the timing of autumn occurrence of the Great Grey Shrike in karst poljes of Bosnia and Herzegovina and to examine its relationship with short-term temperature fluctuations recorded in the study area over a ten-year period. This approach allows assessment of local environmental influences on migration timing without extrapolating from conditions in northern or northeastern Europe, from where cold spells influencing arrival originate.

MATERIAL AND METHODS

Study area

The study was conducted in the municipality of Bosansko Grahovo (B. Grahovo), in two karst fields (Pašića Polje and Resenovačko Polje) in western Bosnia and Herzegovina. The research area (44°07′N, 16°25′E) is located northwest and southeast of the town of Bosansko Grahovo, covering approximately 40 km². The study area lies at an elevation of 785–830 m a.s.l. and consists of a mosaic of continental habitat types, including arable land, meadows, grasslands, shrublands, and settlements. The central parts of the karst poljes are generally marshy or cultivated, although each field has its own distinct landscape characteristics. Pašića Polje and Resenovačko Polje exhibit these features (Fig. 1).

The central zone of both poljes (around 800 m a.s.l.) is classified as ‘Meadows and Agricultural Land’, through which the Korana River flows (Pašića Polje) and the Struga River flows (Resenovačko Polje). Around the fields lie small settlements, and beyond them pastures and shrublands. Most of the area is covered by human-modified natural vegetation. For additional details on the characteristics of the study area, see Marić (2022a, 2023 b). The habitats in this region are highly suitable for the two shrike species that breed here (see Marić 2023b, 2026).

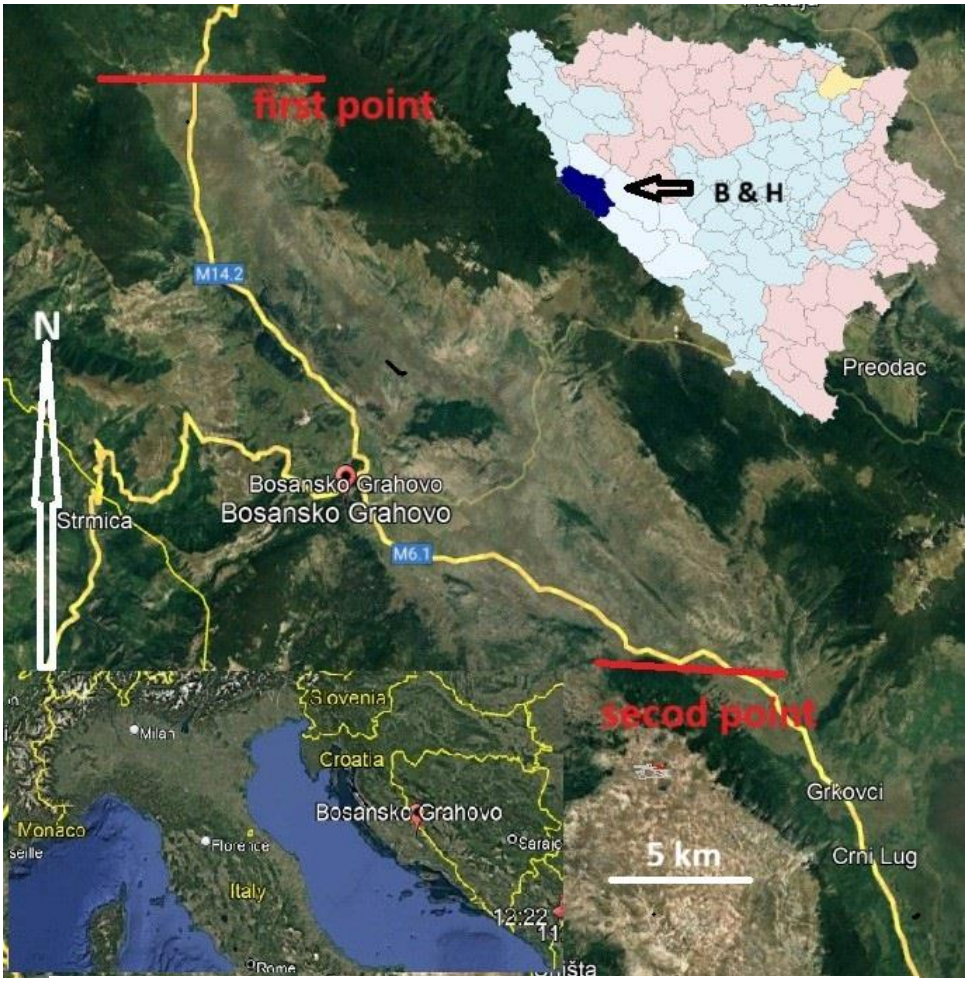

Figure 1. Position of investigated areas in the municipality of B. Grahovo (localities): B & H - Bosnia and Herzegovina; black horizontal arrow – position of the municipality of B. Grahovo; yellow line road – transect by car; red line – start and end of the transect

Climate data

Temperature data were obtained from the meteorological station in Livno, as no such station exists in Bosansko Grahovo. Livno (mean annual temperature 9.3 ℃) and Bosansko Grahovo share a very similar climate. Some minor local differences occur: minimum morning temperatures in Bosansko Grahovo tend to be slightly lower, and the overall mean temperature is also slightly lower due to an elevation difference of approximately 100 m and reduced exposure to warmer southern air masses from Dalmatia. The study area has a mean annual temperature of 8.2 ℃ and experiences three winter months with average temperatures below 0 ℃.

Precipitation, mostly in the form of rain, is relatively frequent but irregular throughout October. Snowfall is rare and was not recorded during the study period, although low night temperatures are common. In general, low temperatures are associated with intrusions of cold air masses from the north and northeast.

Census method

Studying large, mobile bird species over extensive areas using conventional point counts or walking transects is often logistically difficult. Road-based surveys from a moving vehicle represent an efficient alternative and have been shown to produce reliable results in open habitats (Marić 2023a). The Great Grey Shrike is particularly suitable for such surveys due to its winter detectability, territorial behaviour, and frequent use of exposed perches.

Counts were conducted between 20 September and 30 October from 2016 to 2025. Surveys were performed at intervals of approximately three days, depending on weather conditions, using a car-transect method under suitable weather conditions (no heavy rain; wind ≤ Beaufort 6). Each transect was driven at 20–25 km/h between 07:00 and 11:00 h.

Abundance was recorded along a 25-km route, of which approximately 20 km consisted of effectively surveyed open habitat. Individuals observed on electric wires, trees, or in flight were recorded. In forested and urbanized sections near Bosansko Grahovo, visibility was reduced; these sections were compensated for by an alternative side route covering the opposite side of Pašića Polje.

At six fixed points, short stationary observations (5–10 minutes) were conducted to improve detectability. In total, 43 double-transect surveys (outward and return) were conducted during the ten-year study period.

Due to the application of the double-transect design, data from the outward and return passes were not summed in order to avoid potential double counting of individuals. For each individual survey, the highest number of individuals recorded during either pass was used. For example, if three individuals were recorded during the outward pass and four during the return pass, the higher value was taken as the final count for that survey. This approach reduces the risk of duplicate counting and minimizes variation arising from differences in detectability between the two passes. In addition, the solitary behaviour of the species and the large distances between recorded individuals further reduced the likelihood of repeated counts of the same birds.

During the study years, surveys were repeated several times within the season, occasionally up to five times. The study did not attempt to distinguish between individual birds recorded during repeated surveys within the same season. For comparative purposes, only the single highest number of individuals recorded during one transect pass (outward or return) within a given month was retained and used in the analyses. The highest number of individuals recorded within a single month is presented in Table 1 and was used for comparison with data from the literature.

Statistical analyses

A chi-square test was used to determine differences in the use of perching sites. A Pearson correlation analysis was performed between the date of the first local cold spell in October and the date of first observation of the Great Grey Shrike.

RESULTS AND DISCUSSION

The results of *Lanius excubitor* abundance across the two karst poljes are presented in Table 1 and refer to observations conducted within a single migration season. Abundance varied between 2 and 5 individuals, although 4 individuals were most frequently recorded during autumn migration. The Great Grey Shrike was observed 65 times on electric wires and 21 times on other perches (trees), with statistically significant differences between perch types (χ^2=12.04, p=0.005; p<0.01). During October 2024, up to the 25th, no individuals were detected despite continuous monitoring.

In Pašića Polje, 3–4 individuals were recorded, while 2–3 individuals were observed in Resenovačko Polje. Individuals were always recorded solitarily, and the minimum distance between birds was approximately 3 km, as measured by car odometer. Considering the surveyed area of approximately 25 km², the estimated hunting territory available per individual was around 5 km² (500 ha).

The occurrence of the Great Grey Shrike in October showed clear interannual variation and was primarily recorded in years with pronounced temperature declines. Based on the data (Table 2), the species was observed more frequently during the first decade of October (6 years) than later in the month (3 years) (Table 3). Statistical analysis revealed a strong positive correlation between the onset of local cold spells and the first observation of the species (R=0.97, n=9, p<0.01). Individuals were usually detected 3–6 days after the initial temperature decline, with a longer interval (9 days) recorded only in 2021 (Table 4). In that year, only two individuals were recorded during the entire study period, the lowest number observed among all years, and the delayed detection may therefore reflect reduced detectability associated with a very low number of individuals dispersed over a large area. The observed interval likely reflects the time required for migrating birds to reach the study area from their breeding grounds. No precise data are available on the geographic origin of the observed individuals.

Table 1. Maximum number of *L. excubitor* individuals recorded during a single outward or return transect pass in two karst poljes during the study period (2016–2025)

Years	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Nº	5	4	4	4	3	2	3	4	-	5

Table 2. Ten-year minimum daily temperatures during October – meteorological station in Livno
– = temperature higher than 6°C, usually 6–10°C; Bold = lower temperatures; the final temperature value also corresponds to the first observation of individuals.

	Years									
Date	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
1	5	4	-	10	6	-	6	-	-	**5**
2	9	4	-	10	9	-	7	-	-	**1**
3	7	6	-	**4**	13	-	8	-	-	**0**
4	**4**	8	-	**3**	9	8	**4**	-	-	**-2**
5	**0**	8	-	**4**	9	11	**3**	-	-	**2**
6	**0**	**3**	-	**4**	8	8	**7**	-	-	**3**
7	**2**	**3**	-	**4**	**4**	**5**	**7**	-	-	
8	**1**	**0**	-	**3**	**4**	**3**	**5**	-	-	
9			-		**3**	**2**		-	-	
10			-		**3**	**1**		-	-	
11			-			**1**		-	-	
12			-			**1**		9	-	
13			-			**1**		8	-	
14			-			**1**		9	-	
15			-			**0**		9	-	
16			9					**1**	-	
17			8					**3**	-	
18			7					**3**	-	
19			7						-	
20			**3**						-	
21			**3**						-	
12			**6**						-	
23			**3**						-	
24			**4**						-	

Table 3. Dates of the first cold spell and first observation of *Lanius excubitor* in October in the karst poljes near Bosansko Grahovo (NA – no observation recorded in that year)

Years	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
First cold spell (October day)	4	6	3	7	7	7	4	16	-	1
First observation of *L. excubitor* (October day)	8	8	24	8	10	16	8	18	NA	6

Table 4. Number of days between the first cold spell and the first observation of *L. excubitor* in karst poljes near Bosansko Grahovo (2016–2025)

Years	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Days	5	3	5	6	4	9	5	5	NA	6

DISCUSSION

Phenological Responses and Migration Patterns

The Great Grey Shrike occurs in the studied karst poljes during autumn and winter, consistent with previous observations from Bosnia and Herzegovina (Obratil 1967, 1984, 2006; Marić 2022a). During this period, the species occupies open farmland and karst pastures as primary habitats.

Comparative data indicate regional differences in migration timing. In Western Europe, first arrivals may occur as early as late September, with peak migration in October and early November (Schekkerman *et al.*, 2015). In contrast, in parts of the Balkans where the species does not breed, first records are often later, occurring after mid-November (Rašajski 2017). Previous studies have also demonstrated a relationship between winter occurrence and environmental conditions (Olsson 1986; Bassin 1995; Gorban 2000).

The early arrival of the Great Grey Shrike coincides with the migration period of several raptor species (e.g., *Buteo buteo, Falco tinnunculus, Falco naumanni*, Falco vespertinus). The area, characterized by low human population density following wartime depopulation, has recently shown increased raptor presence (see Marić 2022b). Similar depopulation patterns have also affected other karst poljes in the region.

According to the results of this study, the arrival of the Great Grey Shrike is closely associated with local temperature changes. A Pearson correlation between the date of the first cold spell in October and the species' first arrival date showed a strong positive relationship ($R=0.97$, $n=9$, $p<0.01$), indicating that earlier temperature declines corresponded to earlier arrivals. The observed lag of several days between the onset of cold weather and first detection likely reflects dispersal time to the study area. These temperature changes may reflect broader atmospheric patterns, although such processes were not analysed in this study.

The present results indicate that sudden temperature declines are associated with earlier arrival of the species. However, the data do not allow conclusions about broader ecological effects, such as migration success or interspecific interactions.

Population Densities

The mean density recorded in this study (3–5 individuals per 25 km²) was relatively low compared to values reported from other parts of Europe. Higher densities of wintering individuals and migrants have been documented in Ukraine (Gorban 2000), Poland (Kuczyński *et al.*, 2009), Slovenia (Koce 2015), and Central Europe (Schön 1995).

Differences among regions likely reflect variation in habitat characteristics, weather conditions, and population dynamics. The investigated karst poljes are characterized by extensive open habitats and low human population density, distinguishing them from many previously studied areas. The study focused on the migration period only; therefore, seasonal variation in abundance was not assessed.

CONCLUSIONS

The results indicate that the arrival of the Great Grey Shrike in the studied karst poljes is closely associated with the occurrence of the first local cold spells. A strong positive correlation was found between the timing of temperature decline and the first observation of the species ($R=0.97$, $p<0.01$), suggesting that short-term temperature variation acts as an important proximate factor influencing migration timing in the study area.

The study is limited to local-scale observations and does not allow broader ecological conclusions beyond the observed relationship between temperature and arrival timing.

ACKNOWLEDGEMENTS

I thank two anonymous reviewers, whose constructive comments greatly improved this paper.

Funding: This research received no funding.

Conflicts of Interest: author declares no conict of interest.

REFERENCES

Bassin, P. (1995). Status and trends of shrikes in Switzerland with special reference to the Great Grey Shrike. Proceedings of the Western Foundation of Vertebrate Zoology, 6: 45-48

BirdLife International (2021). European Red List of Birds. Luxembourg: Publications Office of the European Union.

Biver, G., P. Lorgé, F. Schoos, M. Grof & F. Sowa, 2009. Artenschutzprogramm Raubwürger *Lanius excubitor* in Luxemburg. Ministére du développement durable et des infrastructures du Luxembourg, 38 pp.

Bylicka, M., Ciach, M., Wikar, D. & Bylicka, M. (2007). Density changes and habitat shift of great grey shrike *Lanius excubitor* during the non-breeding season. Biologia, 62: 617–621. DOI: 10.2478/s11756-007-0124-2

Cramp, S. & Perrins, C. (1993). The Birds of the Western Palearctic (7: Flycatchers to Shrikes). Oxford Univ. Press., Oxford. 610 pp. ISBN 978-0-19-857510-8,

Fraticelli, F. & Marangoni, C. (2018). Le averle maggiori *Lanius excubitor* L. della collezione ornitologica Arrigoni degli Oddi al Museo Civico di Zoologia di Roma. Rivista Italiana di Ornitologia - Research in Ornithology, 88(1): 43-46, DOI: 10.4081/rio.2018.405

Hagemeijer, J. M. & Blair, M. J. (1997). (editors) The EBCC Atlas of European Breeding Birds: their distribution and abundance. T & AD. Poyser.London. 903 pp. ISBN-10: 0856610917

Harris, T. & Franklin. K. (2000). Shrikes & bush-shrikes. Christopher Helm, London. 392 pp. ISBN-13: 9780713638615

Koce, U. (2015). Številčnost in razširjenost velikega srakoperja *Lanius excubitor* na Ljubljanskem barju (osrednja Slovenija) v zimah 2008/09, 2011/12 in 2012/13 [Abundance and distribution of the Great Grey Shrike *Lanius excubitor* at Ljubljansko barje (Central Slovenia) in winters 2008/09, 2011/12 and 2012/13] Acrocephalus, 36 (166/167): 133–144, 10.1515/acro-2015-0009

Kuczyński, L., Rzępała, M., Goławski, A. & Tryjanowski, P. (2009). The wintering distribution of Great Grey Shrike *Lanius excubitor* in Poland: predictions from a large-scale historical survey. Acta Ornithologica, 44: 159–166. DOI 10.3161/000164509X482731

Lefranc, N. & Worfolk, T. (1997). Shrikes - A Guide to the Shrikes of the World. Pica Press Sussex, 192 pp. ISBN-13 : 978-0300073362

Lorek, G. (1995). Breeding status of the Great Grey Shrike in Poland. Proc. Proceedings of the Western Foundation of Vertebrate Zoology, 6: 98–104. ISSN (ISSN-L): 0511-7550

Marić, D. (2022a). A preliminary assessment of the ornithological importance of karst poljes at Bosansko Grahovo (Western Bosna and Herzegovina) - results of a large-scale survey in period 1974 to 2020. Agriculture and Forestry, 68(1): 95 – 113. DOI: 10.17707/AgricultForest.68.1.05

Marić, D. (2022b). The emigration of the population from the area of Western Bosnia and Herzegovina during the Balkans civil conflict and implications for the Avifauna (Case study Pašića polje at Bosansko Grahovo). Ecologica Montenegrina, 53: 73-91. at: www.biotaxa.org/emhttps://dx. doi.org/10.37828/em. 2022.53.8

Marić, D. (2023a). Climate change and implications on the ornithofauna -case study of the Eurasian Magpie. Agriculture and Forestry, 69(2): 45-57. doi:10.17707/AgricultForest. 69.2.04

Marić, D. (2023b). Changes in the habitat and nest site distribution for two Lanius species in karst poljes (Bosnia and Herzegovina). Agriculture and Forestry, 69 (4): 157-172. doi:10.17707/AgricultForest.69.4.10

Marić, D. (2026). Habitat succession and population density of breeding Lanius collurio in Pašića polje, Bosnia and Herzegovina. Natura montenegrina. 15 (1): 13-22

Obratil, S. (1967). Pregled istražIvanja ornitofaune Bosne i Hercegovine (I dio). Glasnik zemaljskog muzeja Bosne i Hercegovine, (PN) NS, 6: 191-268.

Obratil, S. (1984). Naselja ptica (Aves) u kopnenim biocenozama kraških polja Hercegovine. Glasnik zemaljskog muzeja Bosne i Hercegovine, (PN) NS 23: 147-184.

Obratil, S. (1987). Naselje ptica u ekosistemima Gatačkog polja i okoline prije izgradnje TE Gacko, Glasnik zemaljskog muzeja Bosne i Hercegovine, (PN) NS 25-26: 211-237.

Obratil, S. (2006). Ekološka diferencijacija faune ptica Livanjskog polja (Bosna). Glasnik zemaljskog muzeja Bosne i Hercegovine, (PN) NS, 32: 45-81.

Olsson, V. (1986). The winter habits of the Great Grey Shrike (*Lanius excubitor*) V. Choice of prey. Vår Fågelvärld, 45(1): 19-31. ISSN/ISBN: 0042-2649

Panow, E. N. (1996). Die Würger der Paläarktis. Die Neue Brehm-Bücherei, 230 pp. - Pollard, J. (1930): Whisper Songs. Emu 30: 62-63.

Rašajski, J. (2017). Sve ptice Srbije. Laguna, Beograd. 207 pp. COBIS,SR-ID244057356

Schekkerman, H., Hustings, F., van den Bremer, L., Kampichler, C., van Winden, E., Broere M. & de Vries H. (2015). Wintering Great Grey Shrikes *Lanius excubitor* in the Netherlands: Detection, numbers and distribution. Limosa, 88(1): 11-21.

Schön, M. (1995). Habitat structure, habitat changes and causes of decline in the Great Grey Shrike (*Lanius excubitor*) in South Western Germany. Proceedings of the Western Foundation of Vertebrate Zoology, 6: 142-149.

Schön, M. (2000). Conservation concept and detailed conservation measures for semi-open landscapes, by example of the habitats of the Great Grey Shrike *Lanius excubitor* in the region of the southwestern Schwäbische Alb in southwestern Germany. Ökologie der Vögel, 22: 131-235.

Yosef, R. & International Shrike Working Group. (2016). Great Grey Shrike (*Lanius excubitor*). In: del Hoyo, J., Elliott, A., Sargatal, J., Christie, D.A. and de Juana, E. (eds), Handbook of the Birds of the World Alive, Lynx Edicions, Barcelona.

Yosef, R., ISWG International Shrike Working Group, C. J. Sharpe, J. S. Marks, and G. M. Kirwan (2020). Great Gray Shrike (*Lanius excubitor*), version 1.0. In Birds of the World (J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, and E. de Juana, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.norshr1.01

Yosef, R., ISWG International Shrike Working Group, C. J. Sharpe, J. S. Marks, and G. M. Kirwan (2025). Great Gray Shrike (*Lanius excubitor*), version 1.1. In Birds of the World (J. del Hoyo, A. Elliott, J. Sargatal, D. A. Christie, E. de Juana, and M. G. Smith, Editors). Cornell Lab of Ornithology, Ithaca, NY, USA. https://doi.org/10.2173/bow.norshr1.01.1