Zoology and Ecology, 2026, Volume 36, Number 2
Online ISSN: 2165-8013
https://doi.org/10.35513/21658005.2026.2.1

TEMPORAL PATTERNS OF ASIAN AND NORTH AMERICAN VAGRANT BIRD RECORDS IN THE CARPATHIAN BASIN (2000–2024)

László Bozó[a]*, Tibor Csörgő[b]

[a]Institute of Wildlife Biology and Management, University of Sopron, Historical and Applied Zoology Research Group, 9400 Sopron, Bajcsy-Zsilinszky street 4, Hungary; [b]Eötvös Loránd University, Department of Genetics, 1117 Budapest, Pázmány Péter sétány 1/C, Hungary

*Corresponding author. Email: bozolaszlo91@gmail.com

László Bozó: https://orcid.org/0000-0002-3047-6005
Tibor Csörgő: https://orcid.org/0000-0002-7060-9853

Bozó, L., Csörgő, T. 2026. Temporal patterns of Asian and North American vagrant bird records in the Carpathian Basin (2000–2024). *Zoology and Ecology* 36(2), 105–110. https://doi.org/10.35513/21658005.2026.2.1

Article history:
Received 28 April 2026;
accepted: 28 August 2026

Keywords:
Vagrancy; migration; Yellow-browed Warbler; Sociable Lapwing; Nearctic shorebirds

Abstract. The occurrence of Asian and North American vagrant birds has been extensively studied in Western and Northern Europe, but comprehensive analyses from Eastern Europe remain scarce. We analysed 537 records of 56 vagrant bird species in Hungary between 2000 and 2024 that the Hungarian Rarities Committee accepted. We investigated the temporal trends, seasonal occurrence, and species-specific patterns of these species. Of these, 36 species originated from Asia and 20 from North America. Asian vagrants were dominated by passerines, whereas North American species consisted primarily of shorebirds and other waterbirds. The total number of species and observations increased significantly during the study period, although contrasting patterns emerged between the two geographic groups. North American species showed no significant long-term increase and exhibited a pronounced autumn occurrence peak. In contrast, Asian species increased significantly in both the number of species and observation frequency and occurred mainly during spring and autumn. Seasonal patterns differed among taxonomic groups, reflecting variation in migration strategies and breeding distributions. The species breeding closest to Europe were more frequently recorded during spring migration, while most North American shorebirds and Asian passerines showed distinct autumn peaks. Among the most frequently observed species, Sociable Lapwing and Yellow-browed Warbler exhibited significant increases in occurrence. Our results suggest that geographic position, migratory behaviour, climate-driven range shifts, and the emergence of new migratory pathways jointly influence vagrancy patterns in the Carpathian Basin. The increasing occurrence of Asian species is likely associated with westward range expansion and ongoing changes in Eurasian migration systems.

INTRODUCTION

Bird vagrancy has long attracted ornithological interest because it provides insights into migration mechanisms, dispersal processes, and the evolution of migratory routes (Alerstam 1990; Dufour et al. 2024). Western Europe, particularly the British Isles, receives substantial numbers of birds originating from North America and Asia, and the factors underlying these occurrences have been investigated for more than a century (Elkins 1979, 1999; McLaren et al. 2006; Bozó and Csörgő 2024).

Recent studies indicate that climate change, altered weather patterns, range expansions, and increasing observer coverage contribute to the rising number of vagrant records across Europe (Jiguet and Barbet-Massin 2013; de Vries et al. 2024). In the case of several Asian passerines, vagrancy has even facilitated the establishment of novel migratory routes and the establishment of stable wintering populations in Western Europe (Dufour et al. 2021, 2022, 2024, 2025). At the same time, the westward shift in the breeding range of eastern species also increases the likelihood of their occurrence in Europe (Jiguet and Barbet-Massin 2013; Keller et al. 2020).

In the case of the North American species, particularly shorebirds, transatlantic vagrancy is strongly associated with weather, wind drift, and annual breeding success (Elkins 1979, 1999; Bowler 2015; Linke and Dierschke 2021; de Vries et al. 2024; Lees et al. 2024).

Although these patterns are well documented in Western Europe, little is known about their manifestation within the Carpathian Basin. Hungary occupies a unique geographic position, enclosed by the Alps and the Carpathians, which may influence the arrival and distribution of vagrant birds (Csörgő et al. 2009). The aim of this study was to investigate the taxonomic composition of vagrants, the temporal trends in species richness and observation frequency, the seasonal occurrence patterns, the differences between Asian and North American species, and long-term trends in the most frequently observed bird species.

MATERIALS AND METHODS

The dataset comprised 537 records belonging to 56 vagrant species, including 36 Asian and 20 North American bird species. We analysed all observation and ringing data of all vagrant species from these areas that were accepted by the Hungarian Rarities Committee (HRC) between 1 January 2000 and 31 December 2024 and published in the annual reports of the HRC (MME Nomenclator Bizottság 2001, 2006a–c, 2008a–b, 2010a–b, 2011a–b, 2013, 2016a–c, 2017, 2018, 2019, 2020, 2021, 2023a–b, 2025a–b). Species were classified as rare (1–9 records), sporadic (10–49 records), or common (≥ 50 records). The classification is based on the characteristics of the dataset itself. For individuals remaining multiple days, only the first observation date was used in phenological analyses. In cases where a bird was still present in the area the following year (e.g., found in December and observed in January too), we still only used the first observation. Any observation in which it can be proven that a different bird or birds were sighted is considered a separate observation. If the same bird or birds were observed more than once, only the first observation was counted.

First, we examined how many species per family occurred in Hungary from each region (Asia and North America), how many records there were for these species, and how the number of records changed over time. Subsequently, based on the species' places of origin (Asia, North America), we examined the temporal changes in the number of data and species, the distribution of observations within a given year, and the distribution within a given year based on their frequency.

After grouping the data by geographic unit, we analysed the occurrence of the most common species on a species-by-species basis. For shorebirds and the Yellow-browed Warbler (*Phylloscopus inornatus*), we examined how the number of species and the number of total observations changed from year to year, and Spearman correlation analyses were used to evaluate temporal trends across the study period using Past 3.14 (Hammer et al. 2001).

RESULTS

Most bird families were represented by only one or two species. Exceptions included Scolopacidae (12 species), Sylviidae (9 species), Charadriidae (6 species), Turdidae (5 species), and Emberizidae and Laridae (4 species each). Among Asian vagrants, Passerines dominated (24 species), whereas North American vagrants consisted primarily of shorebirds (12 species) and other waterbirds (7 species) (Table 1).

A total of 405 records referred to Asian species, and 132 to North American species. Both the number of species recorded annually ($R = 0.676$, $p < 0.001$) and the total number of observations ($R = 0.735$, $p < 0.001$) increased significantly during the study period (Figure 1).

Among North American species, 17 were classified as rare, two as sporadic, and one as common. Shorebirds constituted the dominant group, accounting for 11 of the 19 species. Neither the number of North American species observed annually ($R = -0.01$, $p = 0.959$) nor the total number of observations showed significant long-term increases ($R = 0.141$, $p = 0.5$). Observation frequency was generally lower during the last decade than during the first fifteen years of the study (Figure 1).

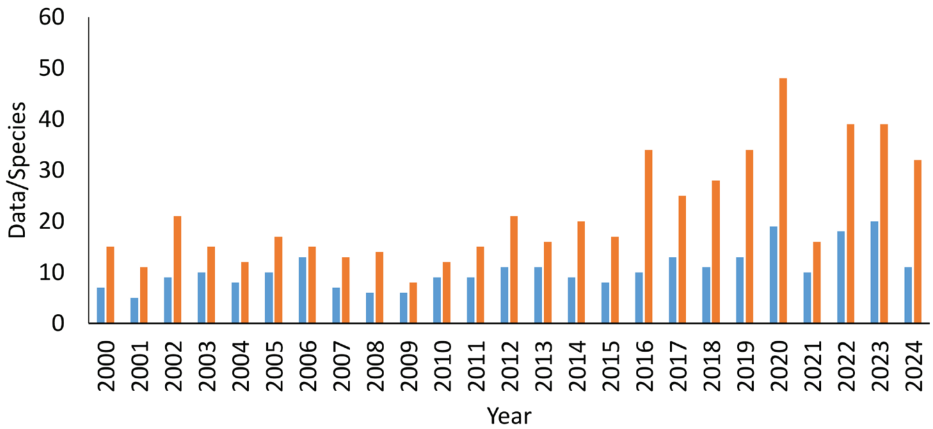

Figure 1. Species observed annually between 2000 and 2024 (blue bars) and the total number of their annual observation data (orange bars).

Table 1. North American and Asian vagrant bird species detected in Hungary during the study period (2000–2024).

Family	North America		Asia	
	Common name	Scientific name	Common name	Scientific name
Anatidae	Lesser Scaup	*Aythya affinis*	–	–
	Ring-necked Duck	*Aythya collaris*		
	American Wigeon	*Mareca americana*		
Gruidae	Sandhill Crane	*Antigone canadensis*	Demoiselle Crane	*Grus virgo*
Glareolidae	–	–	Oriental Pratincole	*Glareola maldivarum*
Charadriidae	American Golden Plover	*Pluvialis dominica*	Pacific Golden Plover	*Pluvialis fulva*
	–	–	White-tailed Lapwing	*Vanellus leucurus*
			Sociable Lapwing	*Vanellus gregarius*
			Greater Sand Plover	*Anarhynchus leschenaultii*
			Caspian Plover	*Anarhynchus asiaticus*
Scolopacidae	Baird's Sandpiper	*Calidris bairdii*	Terek Sandpiper	*Xenus cinereus*
	White-rumped Sandpiper	*Calidris fuscicollis*	–	–
	Sharp-tailed Sandpiper	*Calidris acuminata*		
	Long-billed Dowitcher	*Calidris pusilla*		
	Semipalmated Sandpiper	*Calidris himantopus*		
	Lesser Yellowlegs	*Calidris subruficollis*		
	Stilt Sandpiper	*Tringa flavipes*		
	Wilson's Phalarope	*Limnodromus scolopaceus*		
	Upland Sandpiper	*Bartramia longicauda*		
	Red Phalarope	*Phalaropus tricolor*		
	Buff-breasted Sandpiper	*Phalaropus fulicarius*		
Laridae	Bonaparte's Gull	*Chroicocephalus philadelphia*	Armenian Gull	*Larus armenicus*
	Sabine's Gull	*Xema sabini*	–	–
	Franklin's Gull	*Leucocephalus pipixcan*		
Columbidae	–	–	Oriental Turtle Dove	*Streptopelia orientalis*
Meropidae	–	–	Blue-cheeked Bee-eater	*Merops persicus*
Falconidae	–	–	Amur Falcon	*Falco amurensis*
Alaudidae	–	–	Calandra Lark	*Melanocorypha calandra*
Motacillidae	–	–	Richard's Pipit	*Anthus richardi*
Prunellidae	–	–	Siberian Accentor	*Prunella montanella*
			Black-throated Accentor	*Prunella atrogularis*
Turdidae	–	–	Pied Wheatear	*Oenanthe pleschanka*
	–	–	Black-throated Thrush	*Oenanthe isabellina*
	–	–	Naumann's Thrush	*Turdus atrogularis*
	–	–	Isabelline Wheatear	*Turdus naumanni*
	–	–	Red-flanked Bluetail	*Tarsiger cyanurus*
Sylviidae	–	–	Hume's Warbler	*Phylloscopus humei*
			Radde's Warbler	*Phylloscopus schwarzi*
			Dusky Warbler	*Phylloscopus fuscatus*
			Pallas's Leaf Warbler	*Phylloscopus proregulus*
			Yellow-browed Warbler	*Phylloscopus inornatus*
			Paddyfield Warbler	*Acrocephalus agricola*
			Blyth's Reed Warbler	*Acrocephalus dumetorum*
			Menetries's Warbler	*Curruca mystacea*
			Booted Warbler	*Iduna caligata*
Paridae	–	–	Azure Tit	*Cyanistes cyanus*
Fringillidae	–	–	Trumpeter Finch	*Bucanetes githagineus*
Emberizidae	–	–	Rustic Bunting	*Emberiza rustica*
			Pine Bunting	*Emberiza leucocaphalos*
			Chestnut Bunting	*Emberiza rutila*
			Little Bunting	*Emberiza pusilla*

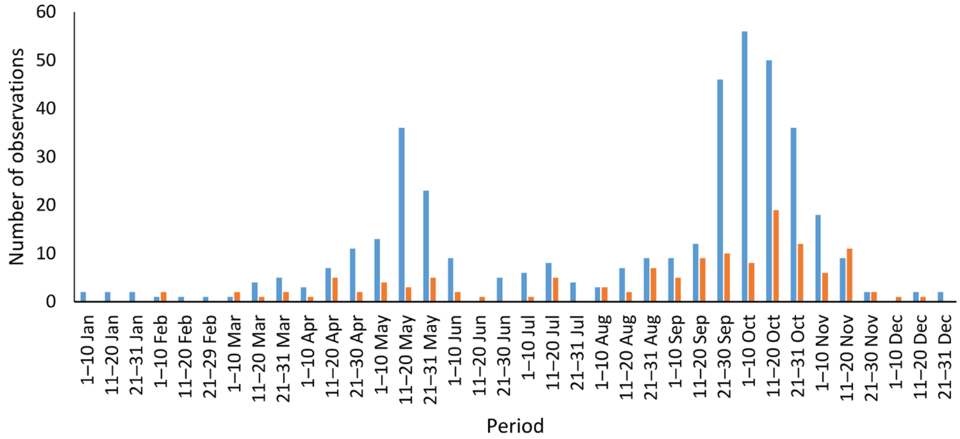

Figure 2. Number of observations of Asian (blue bars) and North American (orange bars) vagrants by 10-day intervals during the study period (2000–2024).

Seasonal distribution was characterised by a weak spring migration between April and June and a pronounced autumn migration extending from July to November and peaking in late September. Rare species occurred proportionally more frequently in spring, whereas scarce and common species were strongly concentrated in autumn (Figure 2).

Of the 36 Asian species, 27 were rare, six sporadic, and three common. The family Sylviidae was represented by the highest number of species. Unlike birds originated from North America, both the annual number of species (R = 0.784, $p < 0.001$) and total observations (R = 0.699, $p < 0.001$) increased significantly through time. The increase accelerated markedly after the mid-2010s (Figure 1).

Asian species occurred throughout the year but exhibited distinct peaks in spring and autumn. Family-level analyses revealed substantial differences: Charadriidae were primarily autumn migrants, whereas Scolopacidae showed stronger spring occurrence. Among passerines, warblers and buntings occurred predominantly during autumn (Figure 2).

The most frequently observed shorebird species included the Red Phalarope (*Phalaropus fulicarius*) (57 observations), Sociable Lapwing (*Vanellus gregarius*) (54 observations), and Terek Sandpiper (*Xenus cinereus*) (76 observations). Among these, only the annual number of observations of the Sociable Lapwing showed a significant increase (R = 0.514, $p = 0.008$), whereas trends in the remaining species were non-significant (Red Phalarope: R = 0.216, $p = 0.299$; Terek Sandpiper: R = -0.065, $p = 0.756$).

Among passerines, the number of observations of the Yellow-browed Warbler (109 observations) showed a significant increase during the study period (R = 0.602, $p = 0.001$) and remained strongly associated with autumn migration.

DISCUSSION

The results demonstrate clear differences between the vagrancy patterns of Asian and North American species within the Carpathian Basin. North American species were almost entirely represented by waterbirds, whereas Asian species included numerous passerines. Notably, no North American passerine species was recorded in Hungary during the study period despite occasional large-scale invasions in Western Europe (McLaren et al. 2006; Lees et al. 2024).

The Carpathian Basin appears more accessible to Asian species arriving overland from eastern breeding grounds. Passage through north-eastern Carpathian corridors allows eastern migrants to reach suitable habitats without crossing major ecological barriers (Csörgő et al. 2009). This likely explains why almost twice as many Asian species were recorded compared with North American species.

One of the most important findings is a significant increase in the number of species and in the number of observations of Asian birds. Although the number of observers has likely increased and technology (ID books, binoculars, etc.) has also advanced, this increase is unlikely to be explained solely by observer effects. In Western Europe, for example, where the observation network has also expanded, the number of observations of certain bird species has increased over time, while that of others has declined significantly (Bozó and Csörgő 2024). Instead, westward range expansion (especially in the case of species that breed in Asia), climate change, and the establishment of novel migration routes may contribute substantially to the observed pattern (Jiguet and Barbet-Massin 2013; Keller et al. 2020; Dufour et al. 2021, 2024).

The contrasting seasonal patterns of the birds originating from the two studied areas are also noteworthy. Most North American species occurred predominantly during autumn, whereas several Asian species showed a remarkable spring occurrence pattern. Species whose breeding ranges extend closest to Europe, such as the Terek Sandpiper (Keller et al. 2020), were particularly frequent during spring migration. This is likely because, in the case of birds migrating to nearby nesting areas, the spring overshooting or some other genetic mutations may cause them to arrive to Europe. A similar phenomenon can be observed in spring among bird species breeding in southern Europe (Lees and Gilroy 2021). The autumn peak in numbers of warblers and buntings is – at least partly – due to the fact that bird banding takes place at this period, which increases the chances of detecting these species.

The increasing frequency of Sociable Lapwing records is of particular conservation interest because the species remains globally threatened and has undergone severe population declines during recent decades (Sheldon et al. 2013). Whether the observed increase reflects population recovery, altered migration routes, or changing environmental conditions remains unclear. Similarly, the increasing occurrence of the Yellow-browed Warbler corresponds well with broader European trends and may reflect the ongoing establishment of alternative migration systems within Eurasia (Dufour et al. 2022, 2025).

Overall, the results indicate that the Carpathian Basin is considerably more accessible to birds from Asia than those from North America, with recent decades showing a marked increase in the occurrence of Asian taxa. These patterns likely reflect a combination of geographic connectivity, climate-driven range shifts, and changes in migration systems, highlighting the region's growing importance for monitoring large-scale changes in Palearctic bird migration.

Author's contribution

Conceptualization: LB, TCS. Methodology: LB. Software: LB. Formal analysis: LB. Investigation: LB. Data Curation: LB. Writing - Original Draft: LB. Writing - Review & Editing: LB, TCS. Visualization: LB. Supervision: TCS.

Conflict of interest statement

As authors of this article, we declare that we do not have any conflict of interest.

REFERENCES

Alerstam, T. 1990. *Bird migration*. Cambridge: Cambridge University Press, 420 pp.

Bowler, J.M. 2015. Vagrant Nearctic waders on the isle of Tiree, Argyll. *Scottish Birds* 35, 173–179.

Bozó, L., & Csörgő, T. 2024. Causes of vagrancy of North Asian passerines in western Europe. *Ibis* 166, 5–22. https://doi.org/10.1111/ibi.13226

Csörgő, T., Karcza, Zs., Halmos, G., Magyar, G., Gyurácz, J., Szép, T., Bankovics, A., Schmidt, A., & Schmidt, E. 2009. *Magyar Madárvonulási Atlasz*. Budapest: Kossuth Kiadó Zrt., 672 pp. [In Hungarian with English Summary].

de Vries, P.P., Linke, T.J., & Dierschke, J. 2024. Temporal and spatial patterns of Nearctic waders in western Europe during autumn migration in 1980–2020. *Dutch Birding* 46, 289–306.

Dufour, P., de Franceschi, C., Doniol-Valcroze, P., Jiguet, F., Guéguen, M., Renaud, J., & Crochet, P.A. 2021. A new westward migration route in an Asian passerine bird. *Current Biology* 31, 5590–5596. https://doi.org/ 10.1016/j.cub.2021.09.086

Dufour, P., Åkesson, S., Hellström, M., Hewson, C., Lagerveld, S., Mitchell, L., Chernetsov, N., Schmaljohann, H., & Crochet, P.A. 2022. The Yellow-browed Warbler (*Phylloscopus inornatus*) as a model to understand vagrancy and its potential for the evolution of new migration routes. *Movement Ecology* 10, 59. https://doi.org/10.1186/s40462-022-00345-2

Dufour, P., Lees, A.C., Gilroy, J., & Crochet, P.A. 2024. The overlooked importance of vagrancy in ecology and evolution. *Trends in Ecology and Evolution* 39, 19–22. https://doi.org/10.1016/j.tree.2023.10.001

Dufour, P., Hellström, M., Franceschi, C.D., Illa, M., Norevik, G., Cuchot, P., Tillo, S., Bolton, M., Parnaby, D., Penn, A., van der Spek, V., de Knijff, P., Castricum,V.R.S., Damian-Picollet, S., Raitiere, W., Lavergne, S., Crochet, P.A., & Doniol-Valcroze, P. 2025. Using age-ratios to investigate the status of two Siberian *Phylloscopus* species in Europe. *Ibis* 167, 632–645. https://doi.org/10.1111/ibi.13382

Elkins, N. 1979. Nearctic landbirds in Britain and Ireland: A meterological analysis. *British Birds* 72, 417–433.

Elkins, N. 1999. Nearctic landbirds in Britain and Ireland. *British Birds* 92, 83–95.

Hammer, Ø., Harper, D.A., & Ryan, P.D. 2001. PAST: Paleontological statistics software package for education and data analysis. *Palaeontologia Electronica* 4, 9.

Jiguet, F., & Barbet-Massin, M. 2013. Climate change and rates of vagrancy of Siberian bird species to Europe. *Ibis* 155, 194–198. https://doi.org/10.1111/ibi.12001

Keller, V., Herrando, S., Voríšek, P., Franch, M., Kipson, M., Milanesi, P., Martí, D., Anton, M., Klvanová, A., Kalyakin, M.V., Bauer, H.G., & Foppen, R.P.D. 2020. *European Breeding Bird Atlas 2. Distribution, Abundance and Change*. Barcelona: European Bird Census Council, Lynx Edicions, 967 pp.

Lees, A.C., & Gilroy, J.J. 2021.*Vagrancy in Birds*. Bloomsbury Publishing.

Lees, A.C., Farnsworth, A., Curley, S.R., Curley, R., &

Gilroy, J.J. 2024. An unprecedented arrival of Nearctic landbirds in Britain and Ireland in September 2023. *British Birds* 117, 292–307.

Linke, T.J., & Dierschke, J. 2021. Records of rare Nearctic waders in Germany. *Seltene Vögel in Deutschland* 2019, 36–53 [In German with English Summary].

McLaren, I.A., Lees, A.C., Field, C. & Collins, K.J. 2006. Origins and characteristics of Nearctic landbirds in Britain and Ireland in autumn: a statistical analysis. *Ibis* 148, 707–726. https://doi.org/10.1111/j.1474-919X.2006.00574.x

MME Nomenclator Bizottság 2001. The 2000 report on accidental birds in Hungary by the MME NB. *Túzok* 6, 105–119 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2006a. The 2002 report on accidental birds in Hungary by the MME NB. *Aquila* 113, 73–89 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2006b. The 2003 report on accidental birds in Hungary by the MME NB. *Aquila* 113, 91–105 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2006c. The 2004 report on accidental birds in Hungary by the MME NB. *Aquila* 113, 107–122 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2008a. The 2001 report on accidental birds in Hungary by the MME NB]. *Aquila* 114–115, 117–136 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2008b. The 2005 report on accidental birds in Hungary by the MME NB. *Aquila* 114–115, 137–152 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2010a. The 2006 report on accidental birds in Hungary by the MME NB. *Aquila* 116–117, 99–114 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2010b. The 2007 report on accidental birds in Hungary by the MME NB. *Aquila* 116–117, 115–128 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2011a. The 2008 report on accidental birds in Hungary by the MME NB. *Aquila* 118, 143–154 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2011b. The 2009 report on accidental birds in Hungary by the MME NB. *Aquila* 118, 155–164 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2013. The 2010 report on accidental birds in Hungary by the MME NB. *Aquila* 120, 61–73 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2016a. The 2011 report on accidental birds in Hungary by the MME NB. *Aquila* 122–123, 139–150 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2016b. The 2012 report on accidental birds in Hungary by the MME NB. *Aquila* 122–123, 151–161 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2016c. The 2013 report on accidental birds in Hungary by the MME NB. *Aquila* 122–123, 163–172 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2017. The 2014 report on accidental birds in Hungary by the MME NB. *Aquila* 124, 115–125 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2018. The 2015 report on accidental birds in Hungary by the MME NB. *Aquila* 125, 101–117 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2019. The 2016 report on accidental birds in Hungary by the MME NB. *Aquila* 126, 121–138 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2020. The 2017 report on accidental birds in Hungary by the MME NB. *Aquila* 127, 55–74 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2021. The 2018–2019 report on accidental birds in Hungary by the MME NB. *Aquila* 128, 115–140 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2023a. The 2020 report on accidental birds in Hungary by the MME NB. *Aquila* 129–130, 109–130 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2023b. The 2021 report on accidental birds in Hungary by the MME NB. *Aquila* 129–130, 131–147 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2025a. The 2022 report on accidental birds in Hungary by the MME NB. *Aquila* 131–132, 93–112 [In Hungarian with English Summary].

MME Nomenclator Bizottság 2025b. The 2023 report on accidental birds in Hungary by the MME NB. *Aquila* 131–132, 113–128 [In Hungarian with English Summary].

Sheldon, R.D., Kamp, J., Koshkin, M.A., Urazaliev, R.S., Iskakov, T.K., Field, R.H., Salemgareev, A.R., Khrokov, V.V., Zhuly, V.A., Sklyarenko, S.L., & Donald, P.F. 2013. Breeding ecology of the globally threatened sociable lapwing *Vanellus gregarius* and the demographic drivers of recent declines. *Journal of Ornithology* 154, 501–516. https://doi.org/10.1007/s10336-012-0921-4