

SYMPATRIC WINTERING OF RED KITES AND BLACK KITES IN SOUTH-EAST EUROPE

IVAN LITERÁK¹, DAVID HORAL², RAINER RAAB³, HYNEK MATUŠÍK⁴, STANISLAV VYHNAL¹
DANA RYMEŠOVÁ¹, PÉTER SPAKOVSZKY³, THEODORA SKARTSI⁵, KOSTAS POIRAZIDIS⁶
SYLVIA ZAKKAK⁷, ADRIAN TOMIK⁸ and MYKOLA SKYRPAN⁹

¹Department of Biology and Wildlife Diseases, Faculty of Veterinary Hygiene and Ecology
University of Veterinary and Pharmaceutical Sciences Brno
Palackého tř. 1, 61242 Brno, Czech Republic

E-mails: literaki@vfu.cz, <https://orcid.org/0000-0001-9885-6840>
stanislav.vyhnal@seznam.cz, dana.rymi@post.cz, <https://orcid.org/0000-0003-2087-9481>

²Nature Conservation Agency of the Czech Republic, Regional Office Brno
Kotlářská 51, 60200 Brno, Czech Republic, E-mail: david.horal@seznam.cz

³Technisches Büro für Biologie Mag. Dr. Rainer Raab, Quadenstrasse 13
2232 Deutsch-Wagram, Austria, E-mails: rainer.raab@tbraab.at, peter.spakovszky@tbraab.at
⁴68713 Březolupy 324, Czech Republic, E-mail: hynekmb@centrum.cz

⁵WWF Greece, Dadia Program, 21 Lempesi str., 11743 Athens, Greece, E-mail: d.skartsi@wwf.gr

⁶Department of Environmental Sciences, Ionian University
Minotou Gianopoulou, Panagoula, 29100, Zakynthos, Greece

E-mail: ecopaira@yahoo.gr, <https://orcid.org/0000-0003-4239-2041>

⁷Dadia-Lefkimi-Soufli Forest National Park, Management Body, p.o. 1413, 68400 Dadia, Greece

E-mail: zak.sylvia@gmail.com, <https://orcid.org/0000-0002-5229-400X>,

⁸Croatian Society for Birds and Nature Protection, I. Meštrovića 74, 31326 Darda, Croatia

E-mail: tomikadrian@gmail.com, <https://orcid.org/0000-0002-1243-2025>,

⁹Ukrainian Birds of Prey Research Centre and West-Ukrainian Ornithological Society
Kyiv, Ukraine, E-mail: kolya1992@gmail.com

We characterized the spatiotemporal activities in winter grounds of the tagged Red Kites *Milvus milvus* originated from Austria, Czech Republic and Slovakia and wintering in south-east Europe. Birds arrived to winter grounds in Hungary, Croatia, and Greece from 10 July to 12 December (median 22 October) and departed from winter grounds between 14 February and 22 May (median 14 March), thus staying at winter grounds from 121 to 229 days (median 145, mean 161±43 SD). If we regarded kernel density estimate 80% (area of main foraging and roosting activities) as the best indicator as to the size of home range, we revealed that the size of a home range for Red Kites staying at one place through the entire winter was from 10 to 108 km² (median 72, mean 60±36 SD) and that the size of home range for birds with local shift(s) in winter grounds was from 344 to 620 km² (median 434, mean 466±115 SD). We found not only Red Kites at these places but often also Black Kites *Milvus migrans*. The numbers of Black Kites wintering together with Red Kites were higher than the number of Red Kites at all Greek winter grounds. At winter grounds in Hungary and Croatia, the number of Black Kites was lower than the number of Red Kites or Black Kites were wholly absent. Sympatric occurrences according to only direct observations of wintering Red and Black Kites were found also in some other locations in Bulgaria, Croatia, Greece and Hungary.

Keywords: raptors, telemetry, winter grounds, home ranges, *Milvus milvus*, *Milvus migrans*

INTRODUCTION

Red Kite *Milvus milvus* is essentially a European raptor, and outside Europe, it is found only scattered in North Africa. The total population in the Western Palearctic (and in the world) is between 25,000 and 33,000 breeding pairs. Germany, Switzerland, France, and Spain are the most important areas for its occurrence and are home to about 90% of the world population (GÉNSBØL & THIEDE 2008, BIRDLIFE INTERNATIONAL 2015). In 2014, we began using telemetry to study the biology of Red Kite populations in Austria, Czech Republic, and Slovakia exhaustively. These countries are located in the eastern part of the Red Kite breeding area. The density of the Red Kite population is relatively low in Austria, Czech Republic, and Slovakia, consisting respectively only 28–35 breeding pairs (an estimate for 2011–2012), about 165–185 pairs (2012), and 13 pairs (2015) (RAK 2013, BIRDLIFE INTERNATIONAL 2015, MADERIČ & SVETLÍK 2016). From these countries, the Czech Republic provides an excellent example of positive development in a breeding population. Red Kite recolonized the Czech Republic after an absence of about 100 years, with 1974 being the year of the first newly confirmed breeding (ZUNA-KRATKY *et al.* 2000). Since then, the population has expanded to 30–50 breeding pairs in 1985–1989, 70–100 breeding pairs during 2001–2003, and about 175 breeding pairs at present (BIRDLIFE INTERNATIONAL 2004, ŠŤASTNÝ *et al.* 2006, RAK 2013).

Kites of the nominal subspecies *Milvus migrans migrans* (BODDAERT, 1783) (hereafter called Black Kites) breed in the Western Palearctic and Central Asia (FERGUSON-LEES & CHRISTIE 2001). There exists a relatively small European population (< 100,000 pairs), and this declined substantially between 1970 and 1990 (BIRDLIFE INTERNATIONAL 2004). The birds winter mainly in sub-Saharan Africa, and a few remain to winter in the Mediterranean region, and rather more winter in the Middle East down to southern Arabia (FERGUSON-LEES & CHRISTIE 2001). Prior to 2000, the European population of Black Kites was regarded as strictly migratory, even though the northernmost limit of its irregular wintering encompassed southern Spain, France (including Corsica), and Italy, as well as Germany, Switzerland, Greece, Bulgaria, and Romania (GLUTZ VON BLOTZHEIM *et al.* 1971, ORTLIEB 1998). Exceptionally, wintering Black Kites were observed in the second half of the 20th century also, in Sweden, Poland, and Russia (ORTLIEB 1998).

Black Kite is today the most common wintering raptor in Israel, where its numbers have been increasing since the 1980s (SHIRIHAI *et al.* 2000). They have begun to winter regularly also in Sicily (SARÀ 2003), and significant concentrations of wintering Black Kites have appeared in Turkey (BIRIČIK & KARAKAŞ 2011). Regular wintering of Black Kites has begun recently in Greece, where dozens of wintering Black Kites of unknown origin constitute quite a new phenomenon in that country (LITERÁK *et al.* 2017). Formerly, only a few indi-

vidually wintering Black Kites had been observed in Bulgaria, but recently (and surprisingly) 7 Black Kites were observed wintering together with 5 Red Kites near the village of Han Asparuhovo in the Upper Thracian Plain (BSPB 2017, DIMITAR DEMERDZHIEV personal information).

Red Kites tagged with telemetry devices (loggers) in Austria, Czech Republic, and Slovakia winter in a broad belt from the Iberian Peninsula to Greece (RAAB *et al.* 2017). In a part of these birds, we have been able to characterize their spatiotemporal activities at their winter grounds using telemetry data. Moreover, we have been able to check personally local areas chosen by Red Kites in south-east Europe for their wintering and communal roosting and to characterize the habitats they prefer. Surprisingly, we found not only Red Kites at these places but also Black Kites. We also checked some recently known sites in Greece and Bulgaria with many wintering Black Kites and incidentally found Red Kites occurring sympatrically in one of these places in Greece. Sympatric wintering of Red Kites and Black Kites in Greece has been noted recently (LITERÁK *et al.* 2017).

This paper aimed to i) identify Red Kite winter grounds in south-east Europe and estimate their home ranges, ii) characterize habitats preferred by Red Kites for wintering in south-east Europe, and iii) characterize an occurrence of Black Kites wintering together with Red Kites in this area. We were able to compare data about sympatrically wintering Red Kites and Black Kites from south-east Europe with such data regarding Red Kites obtained from other European countries and bird populations, including the United Kingdom (WEIR 1973, CARTER & GRICE 2000), Spain (HEREDIA *et al.* 1991, HIRALDO *et al.* 1993, 1995), Portugal (FERREIRA *et al.* 2014–2015), France (VALET 1975), Germany (HELLMANN 1996, NACHTIGALL *et al.* 2003, PFEIFFER & MEYBURG 2009), and to compare the data with recent results on this topic presented at the International Red Kite Symposia in 2009 and 2015 (DAVID 2009, DE LA PUENTE & DE LA TORRE 2015). Information about habitat demands of Red Kites originated from Austria, Czech Republic, and Slovakia and wintering in south-east Europe can be useful in protecting this raptor species. Red Kite is regarded as a near-threatened species, and its population is decreasing in various parts of Europe (BIRDLIFE INTERNATIONAL 2017).

MATERIAL AND METHODS

Birds tracked with telemetry devices

Ten juvenile Red Kites (pulli) equipped with GPS/GSM telemetry loggers on nests in central Europe (Austria, Czech Republic, Slovakia) during 2014–2017 and wintering in south-east Europe were included into the study (Table 1). Saker H loggers (20 g, Ecotone, Poland) were used to track the birds. Loggers were fitted onto the backs of the birds using

Table 1. Red Kites tagged with telemetry devices which wintered in south-eastern Europe. A, Austria; CZ, Czech Republic; SK, Slovakia; F, female; M, male; red kites D5605 and D5603 are siblings.

Red Kite (ring, ringer)	Origin of bird (country, nest coordinates)	Date of tagging, Age of bird	Sex
CT1587, H. Matušík	CZ, 48.90 N, 17.26 E	10 Jul 2014, pull.	F
D5605, V. Pečeňák	SK, 48.93 N, 21.75 E	14 Jun 2015, pull.	F
D5603, V. Pečeňák	SK, 48.93 N, 21.75 E	14 Jun 2015, pull.	F
JC57514, R. Raab	A, 48.55 N, 16.77 E	14 Jun 2015, pull.	F
JC75455, R. Raab	A, 48.60 N, 16.92 E	2 Jun 2016, pull.	F
CT1679, H. Matušík	CZ, 48.67 N, 16.96 E	5 Jun 2016, pull.	M
CT1682, H. Matušík	CZ, 48.62 N, 16.95 E	5 Jun 2016, pull.	M
CT1697, H. Matušík	CZ, 48.77 N, 16.88 E	13 Jun 2016, pull.	M
D5607, V. Pečeňák	SK, 48.93 N, 21.84 E	15 Jun 2016, pull.	F
D6161, V. Pečeňák	SK, 48.90 N, 21.77 E	24 Jun 2017, pull.	F

harnesses (backpacks) consisting of 6 mm Teflon ribbon encircling the body by two loops around the bases of the wings and joined in front of the breastbone. The loggers function in GPS (global position system)/GSM (global system for mobile communication) systems. The GPS positions of the birds were collected according to the individual setting (usually one position fixed per 6 h) and were sent as SMS (short message service) text messages by local mobile operators to the Ecotone Center in Poland, where they were saved and archived. Coordinates of bird positions at the winter grounds were analysed using GIS (Geographic Information System) and the software ArcGIS 10.1 with Spatial Analyst and Home Range Tools extensions (Esri, Redlands, USA) and QGIS (A Free and Open Source Geographic Information System, www.qgis.org).

Birds observed

We checked personally local areas in south-east Europe chosen by Red Kites that we had tagged to observe all Kites, including tagged ones, wintering at these locations and their habitat requirements. We also checked some recently known places in Greece and Bulgaria recognized to be winter grounds for Kites but not for those Red Kites that we had tagged. Moreover, available information on wintering Red and Black Kites from both published (printed and internet), as well as unpublished (personal communication) sources from the countries covered by this study was compiled. In the case of Black Kites, and because we did not follow any satellite-tagged bird, we relied on direct observations of wintering birds only. At Dadia-Lefkimi-Soufli National Park in north-eastern Greece, Black Kites have been counted regularly since 2000 at vulture feeding places on every week. This survey was carried out by WWF Greece during 1987–2015 and by the national park management body since that time.

Definitions of wintering period, winter grounds

The wintering period was defined to be the month of January, and the winter grounds were defined as an area where the birds stayed in January. Usually, the birds had arrived to this area before January and left this area after January. Hence, we specified the wintering period as time following autumn migration and preceding spring migration when birds occupied one defined area for the entire wintering period. Periods of autumn and spring migration were characterized by extensive restlessness of each individual accompanied by long-distance movements (hundreds of kilometres) on a continental scale. On the other hand, the wintering period was characterized by the stay of one bird at one place or, less often, at several places not far from one another (separated by dozens of kilometres). Using this method enabled wintering period to be easily stated for birds tracked by telemetry. For other birds observed only visually, wintering period was considered as the period from 1 November through the end of February and winter grounds as whatever place the birds were observed during that time.

SE Europe, characteristics of wintering period and winter grounds

In the present context, south-east Europe is defined to include Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Hungary, Kosovo, North Macedonia, Moldova, Montenegro, Romania, Serbia, and Slovenia.

We recorded the following characteristics: location(s) of winter grounds, duration of a tagged Red Kite's stay on winter grounds in days, fidelity of individual Kites to winter grounds, home ranges of individual Red Kites calculated as minimum convex polygon (MCP) 100%, MCP 95%, kernel density estimate (KDE) 95%, KDE 80%, and KDE 50%. MCP and KDE (= fixed kernel, href method) were created using Home Range Tools v. 2.0.20 (HRT, <http://flash.lakeheadu.ca/~arodgers/href/>) in ArcGIS 10.1. MCP 95% means the entirety of the winter grounds used, KDE 80% means foraging and roosting area, and KDE 50% means core area with main activity concentrated (see Bosch *et al.* 2010). Habitats of winter grounds and numbers of Red Kites and Black Kites at winter grounds were described during *in situ* inspection of winter grounds found by tracking tagged Red Kites. Kites on winter grounds were counted mostly at and around their communal roosting places.

All statistical computations were made using Microsoft Excel.

RESULTS

Wintering in SE Europe of Red Kites tagged with telemetry devices

Red Kites tagged in Austria, Czech Republic, and Slovakia, which wintered in south-east Europe occupied winter grounds in Hungary, Croatia, and Greece (Tables 1–4, Fig. 1). We identified 11 winter grounds with tagged birds. Two Red Kites wintered three times repeatedly at the same winter grounds. One Red Kite changed its winter grounds. Birds arrived to winter grounds between 10 July and 12 December (median 22 October, $n = 15$ cases) and departed from winter grounds from 14 February to 22 May (median 14 March, n

= 15 cases), staying at winter grounds from 121 to 229 days (median 145, mean 161 ± 43 SD, $n = 14$ cases (Fig. 2). An individual found dead 17 days after arrival was excluded from the data set. Distances of winter grounds from the nests of the respective birds ranged from 150 to 1247 km (median 368, mean 557 ± 399

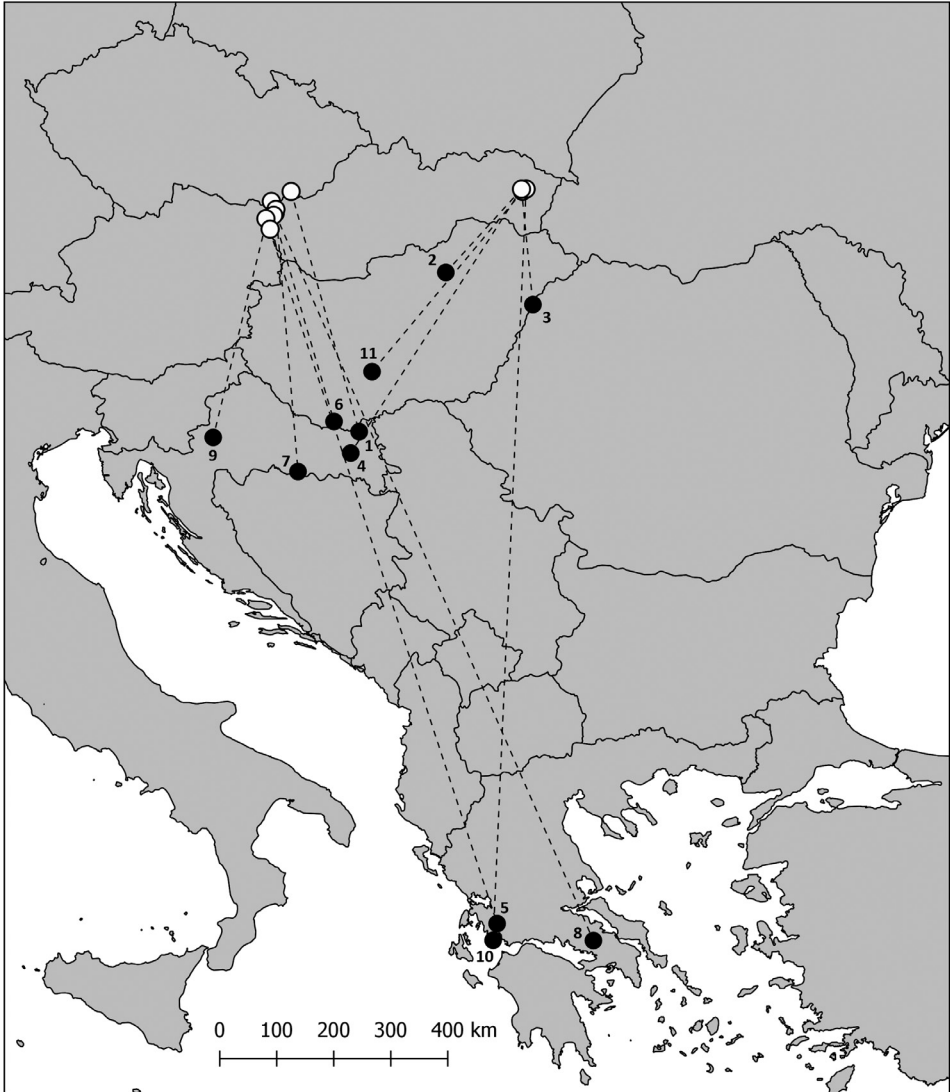


Fig. 1. Locations of winter grounds in SE Europe of Red Kites with telemetry transmitters. White circles indicate nests where Red Kites were tagged. Black circles show winter grounds. Broken lines are links between nests and winter grounds of respective birds (flight course not shown), numbers indicate individual winter grounds. For detail, see Tables 2–4.

Table 2. Characteristics of wintering grounds of tagged Red Kites according to telemetry data. H, Hungary; HR, Croatia; GR, Greece; D, died on that day.

Red Kite (ring)	Country with winter grounds, municipality	Arrival to winter grounds	Departure from winter grounds	No. of days at winter grounds	Distance from the nest (km)	Azi-muth from the nest	Winter grounds no.
CT1587	HR, Jagodnjak	18 Oct 2014	16 Feb 2015	121	368	164°	1
D5605	H, Mezőkövesd, Eger	10 Jul 2016	4 Mar 2017	248	150	217°	2
	H, Álmosd	29 Sep 2017	9 Mar 2018	162	170	174°	3
D5603	HR, Tovarnik, Koritna, Punitovci	18 Sep 2015	5 Apr 2016	229 (200 + 29)	464 (Punitovci)	214°	4a
	HR, Koritna, Punitovci	26 Apr 2016	22 May 2016	29			
		21 Sep 2016	16 Mar 2017	187 (178 + 9)	464 (Punitovci)	214°	4b
		25 Mar 2017	2 Apr 2017				
	HR, Punitovci	5 Sep 2017	25 Mar 2018	202	464	214°	4c
JC57514	GR, Ochtia, Lepenou	12 Dec 2015	12 Apr 2016	122	1159	160°	5a
	GR, Ochtia, Lepenou	1 Nov 2016	31 Mar 2017	151	1159	160°	5b
	GR, Ochtia, Lepenou	12 Oct 2017	10 Mar 2018	150	1159	160°	5c
JC75455	H, Kőrös, Baksa	25 Oct 2017	11 Mar 2018	138	313	163°	6
CT1679	HR, Sičce	23 Oct 2016	14 Feb 2017	114	389	175°	7
CT1682	GR, Orchomenos, Aliartos	8 Nov 2016	24 Mar 2017	138	1247	154°	8
CT1697	HR, Donja Zdenčina	9 Nov 2016	16 Mar 2017	128	358	194°	9
D5607	GR, Katochi	2 Nov 2016	19 Nov 2016 ^P	(11)	1170	182°	10
D6161	H, Dunaszentgyörgy	22 Oct 2017	10 Mar 2018	140	343	221°	11

Table 3. Characteristics of winter grounds of tagged Red Kites according to the *in situ* inspection. All winter grounds were located in lowlands, sometimes at the foot of a hilly forested area or small hills with xerothermic vegetation, usually in agricultural landscape with small fields, meadows, ponds, orchards, small to medium-sized forest patches, domestic animals, and small villages or small cities nearby, from 4 to 150 m a.s.l.

Wintering grounds no.	Date of visit	No. of Red Kites	No. of Black Kites	Observer
1 (Jagodnjak)	26.03.2015	7	1	I. Literák, H. Matušík, L. Peške
	22.01.2017	8	-	I. Literák, H. Matušík
	8.01.2018	4	-	A. Tomik
2 (Eger)	29.10.2016	1	-	M. Horváth
3 (Álmosd)	17.10.2017	1	-	S. Konyhás, M. Dudás, G. Papp
4a (Punitovci)	21.01.2016	11	-	I. Literák, H. Matušík, R. Petro
4b (Punitovci)	23.01.2017	2	-	I. Literák, H. Matušík
4c (Punitovci)	27.10.2017	13	3	D. Laczik
	26.12.2017	3	6	J. Ledínšćak
	5.01.2018	4	8	J. Ledínšćak, A. Tomik,
	10.02.2018	7	10	D. Horal, I. Literák, M. Literáková
5a (Ochtia, Lепенou)	23.01.2016	5	65	I. Literák, H. Matušík, R. Petro
	28.02.2016	6	56	E. Shogolev
5b (Ochtia, Lепенou)	15.01.2017	12	61	N. Probonas
	30.01.2017	6	68	I. Literák, H. Matušík
	5.03.2017	min. 1	67	R. Raab, B. Raab
	31.03.2017	min. 1	65	R. Raab, B. Raab
6 (Baksa)	9.10.2017	31	1 or 2	D. Laczik
	15.10.2017	24	2	D. Laczik
	21.10.2017	32	2	D. Laczik, T. Budai
	23.10.2017	32	2	D. Laczik
	26.10.2017	35	0	D. Laczik, T. Budai
	2.01.2018	unknown	2	Á. Takács
	6.01.2018	37	2	D. Laczik
	12.–14.01.2018	37	2	Z. Meisztericz, Á. Takacs
2.02.2018	47	4	L. Németh-Bóka	
7 (Sičice)	24.01.2017	3	-	I. Literák, H. Matušík

Table 3 (continued)

Wintering grounds no.	Date of visit	No. of Red Kites	No. of Black Kites	Observer
8 (Aliartos)	2.02.2017	5	6	I. Literák, H. Matušík
9 (Donja Zdenčina)	25.01.2017	3	-	I. Literák, H. Matušík
10 (Katochi)	31.01.2017	-	-	I. Literák, H. Matušík
11 (Dunaszentgyörgy)	16.10.2017	4 or 5	-	M. Gubacsi
	20.10.2017	2	-	M. Gubacsi
	21.10.2017	3	-	M. Gubacsi
	23.10.2017	3	-	D. Laczik
	26.10.2017	5	-	M. Gubacsi

SD, $n = 11$ cases from 10 individuals, individuals repeatedly wintering at the same site were included into the calculation only once), and azimuths ranged from 106° to 221° (median 175, mean 183 ± 23 SD, $n = 11$ cases).

Table 4. Home ranges of individual Red Kites wintering in south-eastern Europe (MCP 95, whole area used; KDE 80, foraging and roosting area; KDE 50, core area with main concentrated activity, see Bosch *et al.* 2010; ^{LSWG}, important local shift in winter grounds).

Red kite (ring), winter grounds no.	No. of fixes	MCP 100 km ²	MCP 95 km ²	KDE 95 km ²	KDE 80 km ²	KDE 50 km ²
CT1587, 1	812	483	84	88	23	7
D5605, 2 ^{LSWG}	960	1607	661	668	344	11
D5605, 3b	522	88	39	45	18	5
D5603, 4a ^{LSWG}	1824	2478	2284	1268	620	230
D5603, 4b	734	467	193	216	91	26
D5603, 4c	823	307	195	188	73	13
JC57514, 5a	632	190	165	208	108	36
JC57514, 5b	872	133	108	150	76	21
JC57514, 5c	672	146	123	217	108	43
JC75455, 6	956	680	162	173	70	26
CT1679, 7	613	49	24	21	10	4
CT1682, 8 ^{LSWG}	678	636	456	975	434	169
CT1697, 9	811	326	23	39	15	6
D5607, 10	136	431	272	238	94	35
D6161, 11	889	175	79	82	30	7

Table 5. Unpublished data or data from electronic databases about observations of sympatric occurrence of Red Kites and Black Kites in south-eastern Europe in winter (November–February) from 1998 to winter 2017/2018. Abbreviations: H, Hungary; HR, Croatia; GR, Greece. Data sources: personal communications; Archives of Croatian Society for Birds and Nature Protection; personal databases from Szilárd Dároczi, László Haraszthy, Roy Clarke, and Dimitris Vasilakis; internet databases: www.observation.org, www.bspb.org, www.eBird.org, www.birding.hu, www.rombird.ro, www.milvus.ro

Country; location, region	Date	No. of Red Kites	No. of Black Kites	Observer
GR; Evros Delta, Thrace	early Jan 2000	2–3	20	G. Gradev
H; Pécs, Baranya	20 Jan 2018	1	2	G. Molnár
HR; Darda-Lug-Grabovac fields, Osijek-Baranja	31 Jan 2007	2	1	A. Tomik
HR; Darda-Lug-Grabovac fields, Osijek-Baranja	23 Jan 2008	2	1	T. Mikuska H. Kuttler
HR; Kneževo fields, Osijek-Baranja	16 Jan 2015	2	1	T. Mikuska A. Tomik

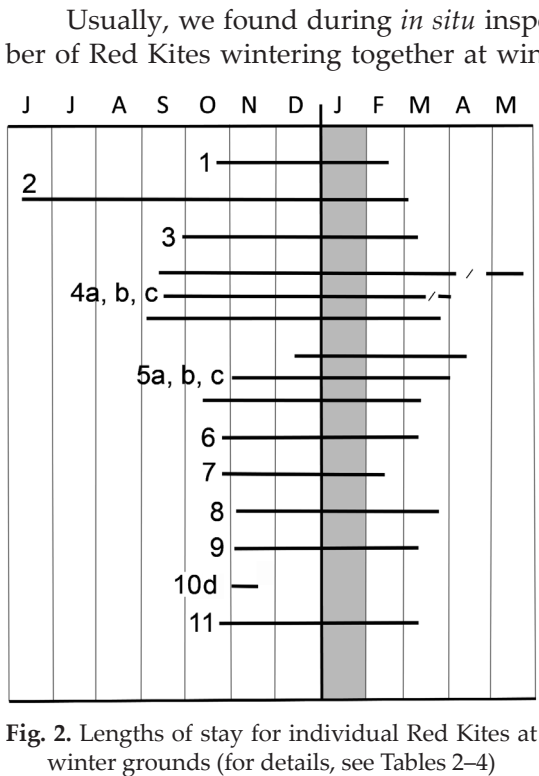


Fig. 2. Lengths of stay for individual Red Kites at winter grounds (for details, see Tables 2–4)

Usually, we found during *in situ* inspections of winter grounds a number of Red Kites wintering together at winter grounds revealed by tracking of tagged Red Kites, but some of the tagged Red Kites wintered alone (Table 3). We also found Black Kites wintering together with Red Kites at the same winter grounds in 6 out of 14 cases (Table 3). The numbers of Black Kites wintering together with Red Kites were higher than the number of Red Kites in all Greek winter grounds. At winter grounds in Hungary and Croatia, the number of Black Kites was lower than the number of Red Kites or Black Kites were entirely absent. Habitats of all winter grounds were similar: They were located in lowlands with an agricultural landscape characterized by small fields, orchards and meadows, and small

Table 6. Sympatric occurrence of Red Kites and Black Kites wintering in Dadia National Park in north-eastern Greece during 1998–2019.

Month	Year	No. of Red Kite	No. of Black Kite	Source
Nov	2012	2	19	WWF Greece unpubl.
Dec	2012	1	16	WWF Greece unpubl.
Feb	2018	2 (1 ad, 1 juv)	50–60	I. Literák, D. Horal, L. Sidiropoulos
Jan	2019	3 (2 ad, 1 juv)	62	I. Literák, M. Skyrpan

to medium-sized forest patches from 4 to 150 m a.s.l. (median 90, mean 87 ± 39 SD, $n = 11$ cases). Small villages to medium-sized cities were nearby Kite winter grounds (Table 3).

Two space utilization strategies were identified in wintering Red Kites: 1) birds staying at a single place for the whole winter with smaller winter home ranges, and 2) birds locally shifting their original positions over distances of several dozen kilometres and thus larger winter home ranges (Table 4). If we assume KDE 80% (area of main foraging and roosting activities) to be the most important marker of home range size, then we found that the size of a home range of birds staying at one place for the whole winter was from 10 to 108 km² (median 72, mean 60 ± 36 SD, $n = 12$ cases), whereas the home range size of birds with local shift(s) within winter grounds ranged from 344 to 620 km² (median 434, mean 466 ± 115 SD, $n = 3$ cases) (Fig. 3).

Wintering of Red Kites and Black Kites in SE Europe according to direct field observations

A number of winter observations (from Albania, Bulgaria, Greece, Hungary, Croatia, and Romania) which were unpublished or published only in various ornithological electronic databases were checked. Only one species of Kites was observed in most of the individual observations. Few cases of sympatric occurrences of Red Kites and Black Kites are shown in Table 5. Sympatric occurrence of both Kite species was noted in the Hungarian/Croatian border region Baranya/Baranja, as well as in the Evros Delta area of north-eastern Greece and (roughly 50 km distant) in Greece's Dadia-Soufli-Lefkimi National Park (Table 5 and Table 6). All observations from the locations revealed by the occurrence of satellite-tagged birds are included in Table 3, not in Table 5.

DISCUSSION

Red Kite winter grounds in SE Europe

Formerly, only a little information was available about wintering of Kites in south-east Europe, and nearly nothing was known about the origins of birds wintering in this area. According to the results from bird ringing, a

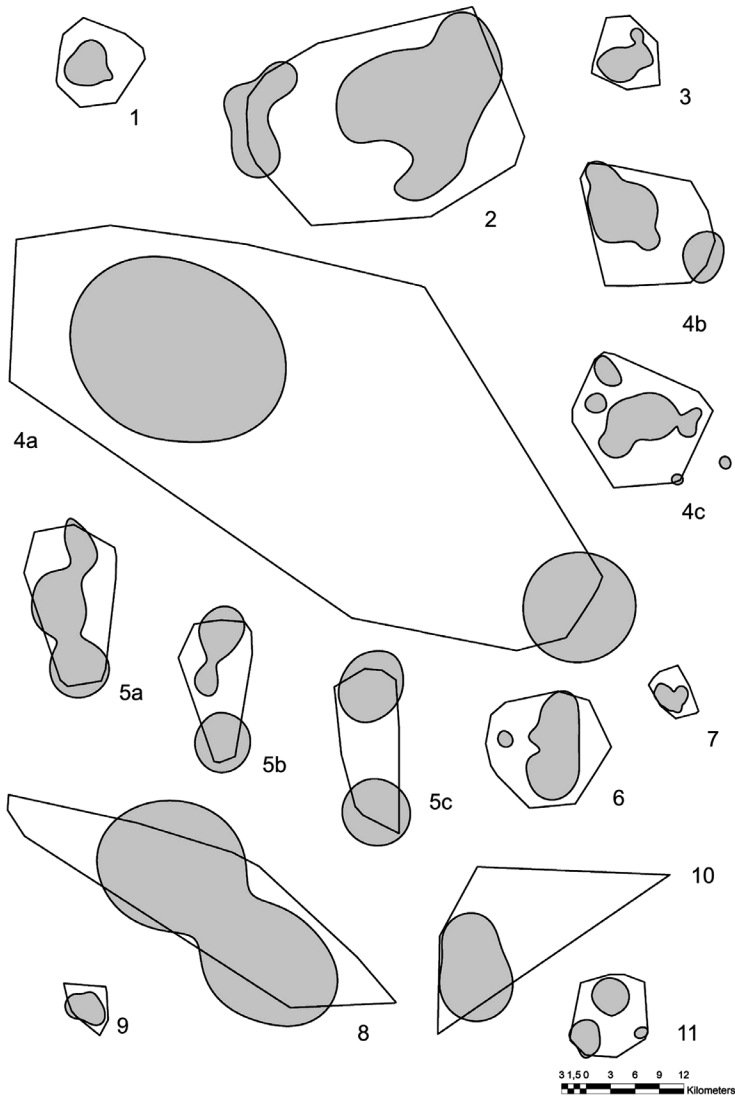


Fig. 3. Home ranges as minimum convex polygon 95% (empty polygons) and core areas as kernel density estimates 50% (in grey) of Red Kites in SE Europe (for details, see Tables 2–4)

Red Kite wintering near Edessa, northern Greece and found freshly dead on 2 February 1989 had been ringed as pullus in north-eastern Slovakia on 16 June 1984 (the distance between these places was 911 km) (SCHRÖPFER 2008, Jaroslav Cepák, Bird Ringing Center of the National Museum in Prague, Czech Republic, ID Z3671632).

According to our results, in south-east Europe, Red Kites arrived to winter grounds, usually in October, and they departed from winter grounds usually, in March, staying at winter grounds for an average of 161 days. In Portugal, they arrive to winter grounds at the end of September and depart between February and the beginning of April (CARTHY *et al.* 2010). In Spain, Red Kites arrived to winter grounds between 3 October and 15 December and departed from February to April (PFEIFFER & MEYBURG 2009, AEBISCHER 2009, VIDAL-MATEO *et al.* 2015).

Red Kites followed for more than one winter in Spain showed winter grounds site fidelity (PFEIFFER & MEYBURG 2009, VIDAL-MATEO *et al.* 2015). In our study, winter site fidelity was well documented in three successive years by 2 Red Kites in south-east Europe: D5605 at Greek Ochtia/Lepenou and D5603 at Croatian Punitovci. Red Kites with fidelity to winter grounds usually arrived at and departed earlier from the same winter grounds. This pattern of behaviour was also observed in a Lesser Black-backed Gull (*Larus fuscus intermedius*) tracked for six wintering periods. Its arrivals and departures from the wintering area on the Algerian coast occurred progressively earlier, from early December to early November and from late May to late March, respectively (PÜTZ *et al.* 2008).

Usually, Red Kites wintering in Southeast Europe occupied winter grounds areas of about 60 km² (KDE 80%). Sometimes, they moved in winter, and hence, their home ranges were larger (in these cases, average home range measured as KDE 80% was 466 km²). These values were substantially higher than those of home ranges from other areas (i.e. UK, Germany, and Spain) where wintered Red Kites were studied formerly, but the results were based on less precise methods of direct observations (WEIR 1973), radio-tracking and sightings of wing-tagged individuals (HEREDIA *et al.* 1991, HIRALDO *et al.* 1993, 1995, HELLMANN 1996, CARTER & GRICE 2000, NACHTIGALL *et al.* 2003).

Red Kite is a highly social species in winter when large numbers gather every evening at communal roost sites, often remaining faithful to the same site for many years (HEREDIA *et al.* 1991, CARTER & GRICE 2000, AEBISCHER 2009, FERREIRA *et al.* 2014–2015, DE ROSA 2015). It seems that usually smaller groups of Red Kites winter in south-east Europe compared to what is seen at winter grounds on the Iberian Peninsula, Switzerland and Italy (HEREDIA *et al.* 1991, AEBISCHER 2009, FERREIRA *et al.* 2014–2015, DE ROSA 2015).

Wintering Red Kites using roost sites feed more often on prey prelocated by others, although lone roosters also forage and discover food alone. After

finding food, Red Kites tend to shift to a new roost site and foraging area (HIRRALDO *et al.* 1993). This could explain why some Red Kites wintering within some areas in south-east Europe shifted their winter grounds and substantially enlarged their home ranges during the winter season (cases of D5605 in 2016/2017, D5603 in 2015/2016 and 2016/2017, and CT1682 in 2016/2017). In south-east Europe, Kites choose for wintering locations in lowlands. These are usually agricultural landscapes with small fields and meadows, small to medium-sized forest patches, and small villages around. Red Kites wintering in Spain occupied an extensive agricultural landscape with cowherds, small fields, and occasionally, a rubbish dump was used for foraging (PFEIFFER & MEYBURG 2009).

Sympatric occurrence of wintering Red Kites and Black Kites in SE Europe

Based on telemetry tracking of Red Kites tagged in Austria, Czech Republic and Slovakia, we were able to reveal winter grounds of Red Kites in south-east Europe, which were occupied often and used sympatrically by Black Kites. Other sympatric winter grounds of these Kites were revealed by direct observations independent of telemetry tracking.

In south-east Europe, it seems that Greece is the most important country for sympatric wintering of Red Kites and Black Kites. Croatia, Hungary, and Bulgaria are also important countries from this point of view (see also LITERÁK *et al.* 2017, BSPB 2017).

In Greece, there have been fewer than 40 Red Kite records since the mid-19th century. These have been mostly in winter from November to March (HANDRINOS & AKRIOTIS 1997). In February 2004 and February 2009, respectively, 1 and 1 Red Kite were observed on the Evros Delta (MILLS 2011). In winter, Black Kites were rare but local in Greece (MAKATSCH 1948, HANDRINOS & AKRIOTIS 1997). The newly observed dozens of Black Kites wintering in Greece constitute a new phenomenon (LITERÁK *et al.* 2017). Sympatric wintering of Red Kites and Black Kites was found in Ochtia/Lepenou area during 2015/2016 and repeatedly confirmed in 2016/2017 (LITERÁK *et al.* 2017). It seems that sympatric wintering of Red Kites and Black Kites in Greece near the Turkish border (the Evros Delta and Dadia-Lefkimi-Soufli National Parks) is also relatively new and supposedly first registered in early January 2000, when about 20 Black Kites and at least 2 Red Kites were observed in the Evros Delta. Sympatric occurrence of about 30 Black Kites and 2 Red Kites (1 juvenile and 1 adult) at the artificial feeding place for vultures near Dadia were also observed in early February 2018, and quite recently, on 30 January 2019, 2 adult and 1 juvenile Red Kites have been observed among 62 Black Kites at the feeding place in Dadia (for details, see Tables 5 and 6).

Red Kites rarely nested in the north-eastern part of Croatia (Croatian Baranja) until the 1960s (BARIŠIĆ 2013). Wintering of Red Kites in Croatian Baranja was noted from the year 2002 (BARIŠIĆ 2013). Recently, 7 Red Kites were observed in Jagodnjak in Croatian Baranja during 26–27 January 2015, together with 1 Black Kite (LITERÁK *et al.* 2017). Eight wintering Red Kites were observed at the same place in Jagodnjak on 22 January 2017. In Punitovci, location in Croatian East Slavonia, 11 and 2 wintering Red Kites were observed on 21 January 2016 and on 23 January 2017, respectively (for details, see Table 3). Although Black Kites are rarely seen wintering guests in both Croatia and Hungary, they nevertheless have relatively often been observed together with Red Kites. Moreover, surprisingly, 1 Black-eared Kite (*Milvus milvus lineatus*) was observed in Jakuševac near Zagreb, Croatia, on 18 February 2012 (KRALJ & BARIŠIĆ 2013).

It now seems that Red Kites do not breed in Bulgaria (BIRDLIFE INTERNATIONAL 2004, 2015) or that its breeding is extremely rare and not extending beyond 1 breeding pair (IANKOV 2007, DAVID 2009, GOLEMANSKI 2011). Red Kites wintering in Bulgaria are also rare (STOYNOV *et al.* 2014). Some Black Kites have, in the past, stayed to overwinter in Bulgaria (PATEV 1950, KUMERLOVE 1956, BAUMGART 1971, SIMEONOV *et al.* 1990). GOLEMANSKI (2011), nevertheless define Black Kite as a breeding summer visitor, passage migrant, and partly winter visitor because the number of winter records increased after 2000. Seven Black Kites sympatric along with 5 Red Kites were observed in Bulgaria during January 2015 in the Upper Thracian Plain (BSBP 1917). Bulgaria could become an important place for wintering Kites in the near future, similarly as Croatia and Greece became important from that point of view quite recently. This idea can also be supported by the finding of a new Black Kite communal roost site near a garbage dump at Shishmantsi close to the city of Plovdiv in February 2018, with 8–11 roosting birds (I. LITERÁK and D. HORAL, personal observation) and by the fact that next winter, 16 Black Kites sympatric along with 1 Red Kite were observed in Manole between Shishmantsi and Plovdiv on 23 January 2019 (I. LITERÁK and M. SKYRPAN, personal observation).

It seems the breeding population of Red Kites is increasing in some areas on the eastern edge of its breeding distribution (the Czech Republic, for example, see RAK 2013). Hence the number of Red Kite's wintering and communally roosting in south-east Europe (the eastern edge of Red Kite's winter distribution today) is increasing, too. Communal roosts of Red Kites in South-east Europe can be a base for newly appearing sympatric roosting of Black Kites wintering in some parts of Southeast Europe (Greece, for example, see LITERÁK *et al.* 2017). The opposite may also be true, as a higher concentration of commonly wintering (roosting) Black Kites in south-east Europe can attract Red Kites for sympatric wintering.

*

Acknowledgements – We would like to thank H. Alivizatos (GR), V. Arkumarev (BG), T. Bino (AL), A. Chalivelentzios (GR), R. Clarke (UK/GR), Sz. Dároczi (RO), S. Delipoulou (GR), D. Demerdzhiev (BG), V. & D. Dobrev (BG), M. Dudás (H), G. Gradev (BG), M. Gubacsi (H), L. Haraszthy (H), M. Horváth (H), P. Iankov (BG), G. Iliadis (GR), S. Konyhás (H), J. Kralj (HR), D. Laczik (H), J. Ledínšćak (HR), M. Literáková (CZ), B. Maderič (SK), Z. Meiszterics (H), Š. Mikiara (SK), L. Németh-Bóka (H), G. Papp (H), V. Pečeňák (SK), L. Peške (CZ), R. Petro (CZ), L. Profirov (BG), N. Probonas (GR), B. Raab (A), E. Shogolev (UA/GR), L. Sidiropoulos (GR), S. Stoychev (BG), K. Tsiandikoudis (GR), I. Tziambazis (GR) and D. Vasilakis (GR), who helpfully cooperated with us in this study. The study was supported by the project FVHE/Literák/ITA2019 from the University of Veterinary and Pharmaceutical Sciences, Brno, Czech Republic

REFERENCES

- AEBISCHER, A. (2009): Migration and wintering of Swiss Red Kites assessed by satellite telemetry. Pp. 48–51. In: DAVID, F. (ed.): *Proceedings of the Red Kite International Symposium, October 17-18, 2009, Montbéliard, France*. – LP Mission Rapaces and LPO Franche-Comté, Paris.
- BARŠIĆ, S. (2013): Crvena lunja Red Kite *Milvus milvus* Linnaeus, 1758. Pp. 75–76. In: TUTIŠ, V., KRALJ, J., RADOVIĆ, D., ČIKOVIĆ, D. & BARŠIĆ S. (eds): *Crvena Knjiga Ptica Hrvatske, Red Data Book of Birds of Croatia*. – Ministarstvo zaštite okoliša i prirode, Državni zavod za zaštitu prirode, Republika Hrvatska, Zagreb.
- BAUMGART, W. (1971): Beitrag zur Kenntnis der Greifvögel Bulgariens. – *Beiträge zur Vogelkunde* 17: 33–70.
- BIRIČIK, M. & KARAKAŞ, R. (2011): Black Kites (*Milvus migrans*) winter in Southeastern Anatolia, Turkey. – *Journal of Raptor Research* 45: 370–373. <https://doi.org/10.3356/JRR-10-109.1>
- BIRDLIFE INTERNATIONAL (2004): *Birds in Europe: Population estimates, trends and conservation status*. BirdLife Conservation Series No. 12. – BirdLife International, Cambridge, 172 pp.
- BIRDLIFE INTERNATIONAL (2015): *European Red List of Birds. The IUCN red list of threatened species*. – Office for Official Publications of the European Communities, Luxembourg, 75 pp.
- BIRDLIFE INTERNATIONAL (2017): *Milvus milvus* (amended version of 2016 assessment). – *The IUCN Red List of Threatened Species 2017*: e.T22695072A110921280. <https://doi.org/10.2305/IUCN.UK.2017-1.RLTS.T22695072A110921280.en>
- BOSCH, R., REAL, J., TINTÓ, A., ZOZAYA, E. L. & CASTELL, C. (2010): Home-range and patterns of spatial use in territorial Bonelli's Eagles *Aquila fasciata*. – *Ibis* 152: 105–117. <https://doi.org/10.1111/j.1474-919X.2009.00985.x>
- BSPB (Bulgarian Society for the Protection of Birds) (2017): New temporary settlement area of Imperial Eagles and other rare species discovered. [In Bulgarian] <http://bspb.org/bg/news/Otkrito-novo-miasto-za-vremenno-prebivavane-na-tsarski-orli-i-drugi-redki-vidove.html>
- CARTER, I. & GRICE, P. (2000): Studies of re-established Red Kites in England. – *British Birds* 93: 304–322.
- CARTRY, P., COSTA, H., ELIAS, G. & MATIAS, R. (2010): *Aves de Portugal. Ornitologia do território continental* [Birds of Portugal – the Ornithology of the continental territory]. – Assírio and Alvim, Lisboa, Portugal, 944 pp. [in Portuguese]

- DAVID, F. (ed.) (2009): *Proceedings of the Red Kite International Symposium, October 17–18, 2009, Montbéliard, France*. – LPO Mission Rapaces and LPO Franche-Comté, Paris, 164 pp.
- DE LA PUENTE, J. & DE LA TORRE, V. (eds) (2015): *Abstracts Book of the II International Symposium on the Red Kite*. – Binaced (Huesca), Spain, Edit Grupo Ornitológico SEO-Monticola and Fondo de Amigos del Buitre, 81 pp.
- DE ROSA, D., DE LISIOP, L., LOY, A., SENESE, A., BUCCI, C. & CECCOLINI, G. (2015): Red Kite in Molise: Monitoring of roosts and estimates of breeding population. Pp. 58–59. In: DE LA PUENTE, J. & DE LA TORRE, V. (eds): *Abstracts Book of the II International Symposium on the Red Kite*. – Binaced (Huesca), Spain, Edit Grupo Ornitológico SEO-Monticola and Fondo de Amigos del Buitre.
- FERGUSON-LEES, J., CHRISTIE, D. A. (2001): *Raptors of the World*. Helm Identification Guides. – Christopher Helm, London, 992 pp.
- FERREIRA, R., ZINA, H., MARQUES, A. T., DELGADO, A., VENADE, D. & COSTA, H. (2014–2015): Wintering population of Red Kite *Milvus milvus* in the Castro Verde SPA (Portugal). – *Airo* **23**: 55–60.
- GÉNSBOL, B. & THIEDE, W. (2008): *Collins Birds of Prey*. – HarperCollins Publishers, London, 416 pp.
- GLUTZ VON BLOTZHEIM, U. N., BAUER, K. & BEZZEL, E. (1971): *Handbuch der Vögel Mitteleuropas*. Bd. 4: *Falconiformes*. – Akademische Verlagsgesellschaft, Wiesbaden, 943 pp.
- GOLEMANSKI, V. (ed.) (2011): *Red data book of the Republic of Bulgaria. Volume 2. Animals*. – IBEI – BAS & MOEW, Sofia, 383 pp.
- HANDRINOS, G. & AKRIOTIS, T. (1997): *The birds of Greece*. – Christopher Helm, London, 336 pp.
- HELLMANN, M. (1996): Untersuchungen an Schlafplätzen von Rotmilan und Schwarzmilan (*Milvus milvus*, *M. migrans*) im nördlichen Harzvorland. – *Ornithologische Jahresberichte des Museum Heineanum* **14**: 111–132.
- HEREDIA, B., ALONSO, J. C., HIRALDO, F. (1991): Space and habitat use by Red Kites *Milvus milvus* during winter in the Guadalquivir marshes: a comparison between resident and wintering populations. – *Ibis* **133**: 374–381. <https://doi.org/10.1111/j.1474-919X.1991.tb04585.x>
- HIRALDO, F., HEREDIA, B. & ALONSO, J. C. (1993): Communal roosting of wintering Red Kites *Milvus milvus* (Aves, Accipitridae): Social feeding strategies for the exploitation of food resources. – *Ethology* **93**: 117–124. <https://doi.org/10.1111/j.1439-0310.1993.tb00983.x>
- HIRALDO, F., BUSTAMANTE, J., VIÑUELA, J. (1995): Überwinterung des Rotmilans (*Milvus milvus*) in Spanien. – *Zeitschrift für Vogelkunde und Naturschutz in Hessen, Vogel und Umwelt, Sonderheft*, pp. 53–58.
- LANKOV, P. (ed.) (2007): *Atlas of breeding birds in Bulgaria*. Conservation Series, Book 10. – Bulgarian Society for the Protection of Birds, Sofia, 680 pp.
- KRALJ, J. & BARIŠIĆ, S. (2013): Rare birds in Croatia. Third report of the Croatian Rarities Committee. – *Natura Croatica* **22**: 375–396.
- KUMERLOEVE, H. (1956): Der Schwarzmilan als Wintergast in Bulgarien. – *Vogelwelt* **77**: 2.
- LITERÁK, I., HORAL, D., ALIVIZATOS, H. & MATUŠÍK, H. (2017): Common wintering of Black Kites (*Milvus migrans migrans*) in Greece, and new data on their wintering elsewhere in Europe. – *Slovak Raptor Journal* **11**: 91–102. <https://doi.org/10.1515/srj-2017-0001>
- MADERIČ, B. & SVETLÍK J. (2016): Správy pracovných skupín za rok 2015: Haja červená (*Milvus milvus*) [Reports of working groups 2014: Red Kite (*Milvus milvus*)]. *Birds of Prey and Owls – Journal of Raptor Protection of Slovakia* **12**: 19–20. [in Slovak]
- MAKATSCH, W. (1948): Der Schwarze Milan als Wintergast in Griechenland. – *Ornithologische Berichte* **1**: 143–145.

- MILLS, S. (2011): *Birdwatching in Northern Greece*. A site guide. – BirdWING Books, 158 pp.
- NACHTIGALL, W., STUBBE, M., HERRMANN, S. (2003): Aktionsraum und Habitatnutzung des Rotmilans (*Milvus milvus*) im Winter – eine telemetrische Studie im Nordharzvorland. – *Journal of Ornithology* **144**: 284–294. <https://doi.org/10.1007/BF02465628>
- ORTLIEB, R. (1998): *Der Schwarzmilan*. Die Neue Brehm-Bücherei Bd. 100. – Westarp Wissenschaften, Hohenswarsleben, 176 pp.
- PATEV, P. (1950): *Pticite v Balgarija* [Birds of Bulgaria]. – BAN Publishing, Sofia, 364 pp. [in Bulgarian]
- PFEIFFER, T. & MEYBURG, B. U. (2009): Satellitentelemetrische Untersuchungen zum Zug- und Überwinterungsverhalten thüringischer Rotmilane *Milvus milvus*. – *Vogelwarte* **47**: 171–187.
- PÜTZ, K., HELBIG, A. J., PEDERSEN, K. T., RAHBEK, K. T., SAUROLA, P. & JUVASTE, R. (2008): From fledging to breeding: long-term satellite tracking of the migratory behaviour of a Lesser Black-backed Gull *Larus fuscus intermedius*. – *Ringing and Migration* **24**: 7–10. <https://doi.org/10.1080/03078698.2008.9674376>
- RAAB, R., LITERÁK, I., SCHÜTZ, C., SPAKOVSKY, P., STEINDL, J., SCHÖNEMANN, N., TARJÁNYI, S. G., PEŠKE, L., MAKOŇ, K., MRÁZ, J., MADERIČ, B., PEČEŇÁK, V., MATUŠÍK, H. & SCHULZE, C. H. (2017): GPS-basierte Telemetriestudien an mitteleuropäischen Rotmilanen *Milvus milvus* – methodische Schwierigkeiten und analytische Möglichkeiten basierend auf ersten Ergebnissen. – *Ornitologische Mitteilungen* **69**: 245–260.
- RAK, D. (2013): Luňák červený (*Milvus milvus*) [Red Kite (*Milvus milvus*)]. – *Zpravodaj Skupiny na ochranu a výzkum dravců a sov* **13**: 36–38. [in Czech]
- SARÀ, M. (2003): The colonization of Sicily by the Black Kite (*Milvus migrans*). – *Journal of Raptor Research* **37**: 167–172.
- SCHRÖPFER, L. (2008): Luňák červený *Milvus milvus* Haja červená Red Kite. Pp. 278–279. In: CEPÁK *et al.* (eds): *Atlas migrace ptáků České a Slovenské republiky* [Czech and Slovak Bird Migration Atlas]. – Aventinum, Praha. [in Czech, with an English summary]
- SHIRIHAI, H., YOSEF, R., ALON, D., KIRWAN, G. M. & SPAAR, R. (2000): *Raptor migration in Israel and the Middle East*. – International Birdwatching Centre Eilat, IBRCE, IOC, SPNI, Eilat, 192 pp.
- SIMEONOV, S. D., MICHEV, T. M. & NANKINOV, D. N. (1990): *Fauna na Balgarija (Fauna of Bulgaria 20, Aves Vol. 1)*. – BAN Publishing, Sofia, 350 pp. [in Bulgarian]
- STOYNOV, E., PESHEV, H. & GROZDANOV, A. (2014): Rare birds of prey observations in Kresna Gorge in Bulgaria. – *Vulture News* **66**: 56–59.
- ŠŤASTNÝ, K., BEJČEK, V. & HUDEC, K. (2006): *Atlas hnízdního rozšíření ptáků v České republice 2001–2003* [Atlas of Breeding Birds in the Czech Republic 2001–2003]. – Aventinum, Praha, 464 pp. [in Czech, with an English summary]
- VALET, G. (1975): La sédentarisation du Milan royal *Milvus milvus* en Auxois. – *Alauda* **43**: 263–269.
- WEIR, D. N. (1973): Winter range of a Red Kite in East Inverness-shire. – *Scottish Birds* **7**: 257–258.
- VIDAL-MATEO, J., DE LA PUENTE, J., MELLONE, U., BERMEJO, A. & URIOS, V. (2015): Migration routes and wintering areas of wintering Red Kites in Spain. P. 25. In: DE LA PUENTE, J., & DE LA TORRE, V. (eds): *Abstracts Book of the II International Symposium on the Red Kite*. – Edit Grupo Ornitológico SEO-Monticola and Fondo de Amigos del Buitre, Binaced.
- ZUNA-KRATKY, T., KALIVODOVÁ, E., KÜRTHY, A., HORAL, D. & HORÁK, P. (2000): *Die Vögel der March-Thaya-Auen*. – Distelverein, Deutsch Wagram, 285 pp.

Received February 22, 2019, accepted August 25, 2019, published November 22, 2019