

The following supplement accompanies the article

Bird arrival dates in Central Europe based on one of the earliest phenological networks

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Supplement

SOM 1: A KML file with locations of bird observation sites in Bohemia in years 1828–1847.

Table S1: A list of stations with available data. Given is the original German site name, current Czech site name, n – number of observations for the selected 27 species (i.e. those with > 50 observations), altitude, and coordinates (N, E).

German name	Czech name	n	altitude	latitude	longitude
Böhmischkamniß	Česká Kamenice	136	316	50 47 52	14 25 04
Březina	Březina	11	483	49 48 27	13 35 48
Ellbogen	Loket	358	417	50 11 10	12 45 17
Großmierzhöfen	Velké Dvorce	291	552	49 40 57	12 42 18
Hohenelbe	Vrchlabí	100	475	50 37 08	15 36 41
Hohenfurt	Vyšší Brod	168	576	48 36 58	14 18 43
Karlstein	Karlštejn	4	220	49 56 02	14 11 01
Klösterle	Kláštorec nad Ohří	44	319	50 23 04	13 10 17
Königgräß	Hradec Králové	307	238	50 12 37	15 49 31
Königswart	Lázně Kynžvart	55	674	50 00 38	12 37 29
Krumau	Český Krumlov	98	493	48 48 43	14 18 58
Liebeschiß	Libešice u Litoměřic	96	251	50 34 08	14 17 21
Nassaberg	Nasavrky	117	488	49 50 40	15 48 47
Neubistriß	Nová Bystrice	50	592	49 01 11	15 06 12
Neuhof	Nové Dvory	206	210	49 58 14	15 19 30
Perus	Peruc	16	345	50 20 33	13 57 36
Plaß	Plasy	152	329	49 56 04	13 23 25
Preitenstein	Nečtiny	3	416	49 59 31	13 14 00
Pürgliß	Křivoklát	136	259	50 02 17	13 52 12
Richtenberg	Rychmburk	9	443	49 49 54	16 02 18
Rothenhaus	Červený Hrádek	9	341	50 30 42	13 27 07
Seelau	Želiv	181	407	49 31 48	15 13 19
Sehuschiß	Žehušice	45	220	49 58 10	15 24 27
Schönhof	Krásný Dvůr	24	293	50 15 15	13 22 04
Schößl	Všestudy	37	315	50 27 27	13 30 27
Smetschna	Směčno	130	372	50 11 18	14 02 25
Starkenbach	Jilemnice	98	462	50 36 32	15 30 24
Tachlowiß	Tachlovice	11	360	50 00 52	14 14 26
Tetschen	Děčín	234	134	50 46 21	14 12 46
Winterberg	Vimperk	48	700	49 03 09	13 46 28
Wlaschim	Vlašim	16	372	49 42 23	14 53 56
Zbirow	Zbiroh	25	430	49 51 37	13 46 21
Zloniß	Zlonice	33	225	50 17 16	14 05 29

Table S2: Linear regressions and correlations between the annual mean first arrival day and the mean monthly temperature for the periods 1828–1847 and 1991–2010. Presented are numbers of years with records (n), migratory classification (mc; as in Table 2) mean arrival day (DOY), focal month with temperature series, slope and its standard error (SE). Significant results ($P \leq 0.05$) in bold

Species	mc	1828–1847								1991–2010							
		n	DOY	month	slope (°C)	SE	R ²	P	r	n	DOY	month	slope (°C)	SE	R ²	P	r
<i>Alauda arvensis</i>	S ^a	20	50	Feb	-1.796	0.712	0.261	0.021	-0.511	20	62	Feb	-1.765	0.337	0.604	<0.001	-0.777
<i>Anser</i> spp.	S	20	66	Feb	-1.099	0.698	0.121	0.133	-0.348								
<i>Apus apus</i>	L ^a	20	119	Apr	-0.652	0.593	0.063	0.286	-0.251	20	123	Apr	-0.511	0.631	0.035	0.429	-0.187
<i>Ardea cinerea</i>	S	20	93	Mar	-1.386	0.686	0.185	0.058	-0.430								
<i>Certhia</i> spp.	S	20	77	Mar	-1.501	1.083	0.097	0.182	-0.311								
<i>Columba oenas</i>	S ^a	20	74	Mar	-1.688	0.465	0.423	0.002	-0.650	18	81	Mar	-3.120	1.292	0.267	0.028	-0.485
<i>Columba palumbus</i>	S ^a	20	78	Mar	-1.832	0.504	0.424	0.002	-0.651	20	75	Mar	-2.217	0.838	0.280	0.016	-0.529
<i>Coturnix coturnix</i>	L ^a	20	132	Apr	-2.380	0.773	0.345	0.007	-0.587	19	134	Apr	-0.668	0.910	0.031	0.473	-0.169
<i>Cuculus canorus</i>	L ^a	20	113	Apr	-1.227	0.346	0.411	0.002	-0.641	20	120	Apr	-0.273	0.340	0.035	0.433	-0.186
<i>Cyanistes caeruleus</i>	S	19	71	Feb	-2.942	1.174	0.270	0.023	-0.516								
<i>Delichon urbicum</i>	L ^a	20	106	Apr	-0.470	0.528	0.042	0.385	-0.205	20	113	Apr	-1.195	0.480	0.256	0.023	-0.506
<i>Luscinia megarhynchos</i>	L ^a	20	117	Apr	-1.255	0.723	0.144	0.100	-0.379	20	118	Apr	-0.773	0.429	0.153	0.088	-0.391
<i>Motacilla alba</i>	S ^a	20	71	Mar	-1.906	0.408	0.548	<0.001	-0.740	20	76	Mar	-1.670	0.278	0.667	<0.001	-0.817
<i>Oriolus oriolus</i>	L ^a	20	105	Apr	-1.388	1.115	0.079	0.229	-0.281	20	128	Apr	-0.325	0.333	0.050	0.342	-0.224
<i>Parus major</i>	S	20	72	Feb	-2.402	0.909	0.279	0.017	-0.529								
<i>Periparus ater</i>	S	20	68	Feb	-1.391	1.139	0.076	0.238	-0.277								
<i>Phoenicurus ochruros</i>	S ^a	20	94	Mar	-1.484	0.564	0.278	0.017	-0.527	20	86	Mar	-1.678	0.519	0.367	0.005	-0.606
<i>Phoenicurus phoenicurus</i>	L ^a	20	96	Mar	-1.182	0.640	0.159	0.081	-0.399	20	109	Apr	-0.900	0.493	0.157	0.084	-0.396
<i>Scolopax rusticola</i>	S	20	88	Mar	-2.151	0.473	0.534	<0.001	-0.731								
<i>Streptopelia turtur</i>	L ^a	20	113	Apr	-0.368	0.605	0.020	0.550	-0.142	20	119	Apr	-0.302	0.739	0.009	0.687	-0.096
<i>Sturnus vulgaris</i>	S ^a	20	68	Feb	-0.979	0.639	0.115	0.143	-0.340	20	61	Feb	-1.408	0.324	0.512	<0.001	-0.715
<i>Sylvia</i> spp.		20	112	Apr	-0.691	0.699	0.051	0.336	-0.227								
<i>Turdus philomelos</i>	S ^a	20	74	Mar	-2.481	0.680	0.425	0.002	-0.652	20	73	Mar	-1.997	0.638	0.353	0.006	-0.594
<i>Turdus pilaris</i>	S	20	297	Oct	0.556	1.452	0.008	0.706	0.090								
<i>Turdus viscivorus</i>	S ^a	20	55	Feb	-2.464	0.750	0.375	0.004	-0.612	17	62	Feb	-2.832	0.633	0.571	<0.001	-0.753
<i>Upupa epops</i>	L	20	104	Apr	0.059	1.036	0.000	0.956	0.013								
<i>Vanellus vanellus</i>	S ^a	19	76	Mar	-2.211	0.504	0.531	<0.001	-0.730	20	70	Mar	-2.652	0.770	0.397	0.003	-0.630

^aIncluded in estimation of the mean slope for short- and long-distance migrants

Table S3: Site-specific relationships between first arrival date and the mean monthly temperature for the period 1828–1847. Number of years with available records per site (n), the mean day of the year of the first arrival (DOY), slope and its standard error (SE), and Pearson correlation coefficients. Only true migrants with ≥ 14 years of data were included. Significant results in bold.

Site / species	n	DOY	month	slope (°C)	SE	R ²	P	r
Hradec Králové								
<i>Alauda arvensis</i>	16	49	Feb	-2.373	0.871	0.346	0.017	-0.589
<i>Apus apus</i>	18	117	Apr	-1.552	0.756	0.208	0.057	-0.445
<i>Columba oenas</i>	15	77	Mar	-1.538	0.590	0.344	0.022	-0.576
<i>Columba palumbus</i>	15	82	Mar	-0.949	0.581	0.170	0.126	-0.417
<i>Coturnix coturnix</i>	16	122	Mar	-1.606	0.596	0.341	0.018	-0.579
<i>Cuculus canorus</i>	17	114	Apr	-0.997	0.568	0.171	0.099	-0.391
<i>Delichon urbicum</i>	18	98	Apr	-0.693	0.478	0.116	0.166	-0.325
<i>Luscinia megarhynchos</i>	17	119	Apr	-1.148	0.822	0.115	0.183	-0.331
<i>Motacila alba</i>	18	73	Feb	-0.733	0.588	0.088	0.231	-0.301
<i>Phoenicurus ochruros</i>	15	97	Mar	0.707	0.921	0.043	0.456	0.226
<i>Phoenicurus phoenicurus</i>	16	100	Mar	0.657	1.010	0.029	0.526	0.174
<i>Scolopax rusticola</i>	18	81	Mar	-1.614	0.455	0.441	0.003	-0.662
<i>Streptopelia turtur</i>	15	111	Apr	0.057	0.590	0.001	0.924	0.018
Loket								
<i>Alauda arvensis</i>	18	49	Feb	-2.121	0.695	0.368	0.008	-0.606
<i>Columba oenas</i>	18	79	Mar	-2.907	0.741	0.491	0.001	-0.700
<i>Columba palumbus</i>	17	84	Mar	-2.247	0.740	0.381	0.008	-0.641
<i>Coturnix coturnix</i>	18	148	Apr	-2.232	1.243	0.168	0.092	-0.410
<i>Cuculus canorus</i>	18	119	Apr	-2.780	0.729	0.476	0.002	-0.690
<i>Delichon urbicum</i>	19	114	Apr	-2.421	0.817	0.341	0.009	-0.572
<i>Motacila alba</i>	18	73	Mar	-2.563	0.799	0.391	0.006	-0.626
<i>Phoenicurus phoenicurus</i>	18	98	Mar	-2.666	0.867	0.371	0.007	-0.609
<i>Scolopax rusticola</i>	17	106	Apr	-3.068	1.738	0.172	0.098	-0.407
<i>Sturnus vulgaris</i>	18	57	Feb	-2.319	0.758	0.369	0.008	-0.607
<i>Turdus philomelos</i>	18	66	Feb	-1.965	0.676	0.346	0.010	-0.588
<i>Turdus viscivorus</i>	18	72	Feb	-1.826	0.755	0.268	0.028	-0.517
<i>Vanellus vanellus</i>	18	83	Mar	-3.239	1.246	0.297	0.019	-0.545
Velké Dvorce								
<i>Alauda arvensis</i>	18	50	Feb	-2.231	1.196	0.179	0.081	-0.423
<i>Apus apus</i>	16	115	Apr	-2.431	2.363	0.070	0.321	-0.265
<i>Columba oenas</i>	18	62	Feb	-2.582	0.728	0.440	0.003	-0.664
<i>Columba palumbus</i>	18	74	Feb	-2.805	0.824	0.420	0.004	-0.648
<i>Cuculus canorus</i>	18	111	Apr	-1.000	0.775	0.094	0.216	-0.307
<i>Delichon urbicum</i>	17	102	Mar	-1.455	1.291	0.078	0.278	-0.279
<i>Motacila alba</i>	17	66	Mar	-2.647	0.809	0.416	0.005	-0.645
<i>Phoenicurus ochruros</i>	16	83	Mar	-3.095	1.690	0.193	0.088	-0.430
<i>Scolopax rusticola</i>	16	86	Mar	-2.663	2.094	0.104	0.224	-0.339
<i>Sturnus vulgaris</i>	17	61	Feb	-1.575	0.891	0.173	0.097	-0.415
<i>Turdus philomelos</i>	18	71	Feb	-1.846	0.713	0.295	0.020	-0.543
Vyšší Brod								
<i>Alauda arvensis</i>	16	48	Feb	-1.122	0.997	0.083	0.280	-0.288
<i>Cuculus canorus</i>	14	112	Apr	-1.572	0.627	0.344	0.027	-0.587
<i>Delichon urbicum</i>	16	100	Apr	-0.794	1.135	0.034	0.496	-0.184

Table S4: Cross-correlations of arrivals among four sites for 12 true migrant species. n – number of years with available arrival data at each site for a given bird species. **Significant values in bold.**

Species / Site	n		Hradec Králové	Loket	Velké Dvorce	Vyšší Brod
<i>Alauda arvensis</i>	16	Hradec Králové	–	0.798	0.682	0.604
	18	Loket	–	–	0.798	0.536
	18	Velké Dvorce	–	–	–	0.508
	16	Vyšší Brod	–	–	–	–
<i>Apus apus</i>	18	Hradec Králové	–	–	0.174	–
	16	Velké Dvorce	–	–	–	–
<i>Columba oenas</i>	15	Hradec Králové	–	0.468	0.218	–
	18	Loket	–	–	0.397	–
	18	Velké Dvorce	–	–	–	–
<i>Columba palumbus</i>	15	Hradec Králové	–	0.289	0.007	–
	17	Loket	–	–	0.335	–
	18	Velké Dvorce	–	–	–	–
<i>Coturnix coturnix</i>	16	Hradec Králové	–	0.724	–	–
	18	Loket	–	–	–	–
<i>Cuculus canorus</i>	17	Hradec Králové	–	0.312	0.316	0.692
	18	Loket	–	–	0.080	0.547
	18	Velké Dvorce	–	–	–	0.366
	14	Vyšší Brod	–	–	–	–
<i>Delichon urbicum</i>	18	Hradec Králové	–	0.330	0.143	0.113
	19	Loket	–	–	0.264	0.339
	17	Velké Dvorce	–	–	–	-0.220
	16	Vyšší Brod	–	–	–	–
<i>Motacilla alba</i>	18	Hradec Králové	–	0.088	0.225	–
	18	Loket	–	–	0.803	–
	17	Velké Dvorce	–	–	–	–
<i>Phoenicurus ochruros</i>	15	Hradec Králové	–	–	-0.254	–
	16	Velké Dvorce	–	–	–	–
<i>Phoenicurus phoenicurus</i>	16	Hradec Králové	–	-0.460	–	–
	18	Loket	–	–	–	–
<i>Sturnus vulgaris</i>	18	Hradec Králové	–	–	–	–
	17	Velké Dvorce	–	0.342	–	–
<i>Turdus philomelos</i>	18	Loket	–	–	0.759	–
	18	Velké Dvorce	–	–	–	–

Table S5: Reconstructed mean arrival dates (day of the year) of particular bird species to Bohemia for the period 1828–1847. **Species abbreviations:** *Alauda arvensis* (alaarv), *Anser* spp. (anser), *Apus apus* (apuapu), *Ardea cinerea* (ardea), *Certhia* spp. (certhia), *Columba oenas* (coloen), *Columba palumbus* (colpal), *Coturnix coturnix* (cotcot), *Cuculus canorus* (cuccan), *Cyanistes caeruleus* (cyacae), *Delichon urbicum* (delurb), *Luscinia megarhynchos* (lusmeg), *Motacilla alba* (motalb), *Oriolus oriolus* (oriori), *Periparus ater* (perate), *Parus major* (parmaj), *Phoenicurus ochruros* (phooch), *Phoenicurus phoenicurus* (phopho), *Scolopax rusticola* (scorus), *Streptopelia turtur* (strtur), *Sturnus vulgaris* (stuvul), *Sylvia* spp. (sylvia), *Turdus philomelos* (turphi), *Turdus pilaris* (turpil), *Turdus viscivorus* (turvis), *Upupa epops* (upuepo), *Vanellus vanellus* (vanvan).

year	alaarv	anser	apuapu	ardea	certhia	coloen	colpal	cotcot	cuccan	cyacae	delurb	lusmeg	motalb	oriori
1828	45.5	73.0	116.1	82.7	99.6	81.3	72.0	120.2	107.4	83.3	107.8	109.5	71.5	101.2
1829	55.3	67.1	120.6	89.4	107.0	80.3	76.1	128.7	108.6	91.3	103.2	107.6	74.8	111.6
1830	57.2	67.3	122.8	86.4	73.5	78.6	81.7	120.3	114.0	119.0	107.5	105.6	68.9	100.7
1831	44.2	58.6	111.4	81.9	76.3	68.7	73.4	122.1	107.3	68.2	98.6	114.4	67.1	96.6
1832	45.8	65.8	117.1	85.3	66.2	72.7	72.9	135.5	110.6	61.8	105.0	116.6	69.8	95.8
1833	39.3	56.7	107.6	86.1	78.6	72.6	74.3	130.6	115.6	53.5	96.0	112.7	66.1	111.6
1834	29.9	50.4	124.4	84.2	67.3	67.6	70.9	128.2	115.5	45.5	107.7	111.7	60.5	109.8
1835	43.1	53.8	119.9	90.0	69.3	66.8	71.5	134.3	117.9	63.9	108.0	114.0	63.3	120.6
1836	49.0	63.4	124.6	91.4	68.8	68.7	73.5	136.8	114.4	–	110.2	119.8	68.7	86.1
1837	41.7	58.5	115.6	94.1	79.5	77.1	78.8	126.6	114.7	63.4	105.3	115.8	75.3	121.2
1838	53.4	65.3	122.2	96.1	70.5	72.9	81.8	134.6	116.5	61.6	107.1	122.0	67.6	109.6
1839	55.5	67.1	123.7	98.3	71.7	80.2	86.8	143.3	117.2	64.2	111.3	121.0	76.4	100.9
1840	56.2	76.0	120.1	105.7	76.4	76.5	87.7	143.8	113.2	58.0	106.3	119.1	82.5	100.8
1841	52.5	67.2	120.6	104.7	77.7	79.9	81.7	133.4	113.4	79.0	112.1	118.5	73.2	109.0
1842	50.1	63.2	121.3	103.9	67.3	68.8	74.8	136.7	115.8	72.3	105.7	123.0	66.8	102.0
1843	46.6	61.3	116.5	91.0	73.0	71.8	76.1	127.2	109.9	62.0	106.1	116.9	69.5	105.6
1844	61.6	71.3	123.6	102.1	94.6	75.4	91.1	141.7	116.8	83.8	110.6	114.6	74.7	110.5
1845	78.5	88.8	114.0	101.4	83.4	89.1	89.4	138.2	114.0	79.1	107.5	125.3	83.1	103.7
1846	48.6	75.1	119.6	89.9	67.1	64.0	68.0	129.4	109.8	67.8	104.0	121.5	62.3	97.8
1847	52.1	74.6	120.1	91.5	67.7	75.4	77.0	134.7	110.9	71.4	109.9	127.1	75.4	97.0

year	perate	parmaj	phooch	phopho	scorus	strtur	stuvul	sylvia	turphi	turpil	turvis	upuepo	vanvan
1828	81.1	96.6	102.5	97.3	82.1	115.6	79.1	117.7	63.6	299.67	64.7	97.1	70.3
1829	88.0	88.6	98.0	100.2	88.2	120.3	72.6	114.0	82.1	283.22	75.4	105.9	–
1830	92.0	91.0	88.8	91.9	85.6	113.8	65.4	114.3	71.5	284.87	53.1	96.0	72.8
1831	86.6	71.5	97.2	99.2	79.1	116.0	68.9	107.0	68.0	281.04	55.5	100.7	73.0
1832	68.1	62.7	93.8	97.6	84.5	112.5	65.1	114.0	71.2	317.36	42.7	112.9	70.7
1833	80.2	61.4	96.1	99.3	90.7	115.8	50.9	110.8	65.6	301.22	49.4	106.7	69.4
1834	66.8	46.1	107.5	90.9	82.8	117.1	63.0	107.5	59.6	285.48	42.5	101.3	71.6
1835	76.8	61.9	95.1	94.5	86.6	119.7	78.2	110.8	74.5	286.02	45.4	110.1	63.9
1836	83.3	63.3	85.4	94.8	83.0	109.7	68.0	116.8	72.6	287.22	41.8	96.1	70.1
1837	73.8	66.6	104.3	95.7	96.9	110.7	62.6	116.8	79.4	297.64	54.1	93.7	75.3
1838	74.8	64.3	88.5	100.5	94.9	116.7	66.7	117.5	70.7	298.64	56.5	93.1	76.7
1839	46.8	61.3	97.1	104.6	99.2	115.0	63.0	116.9	80.6	296.6	63.7	98.4	83.8
1840	47.8	55.7	101.7	106.9	100.7	114.6	74.7	115.3	91.8	293.75	53.1	115.7	92.0
1841	60.0	71.6	87.8	96.6	88.6	115.3	65.1	115.1	74.4	290.6	65.5	116.3	79.5
1842	58.3	62.0	86.0	98.5	86.6	117.2	62.6	113.4	67.8	298.49	52.0	107.9	73.9
1843	51.9	54.4	89.7	87.2	90.8	109.4	61.7	107.4	61.7	300.32	39.8	112.4	74.7
1844	93.6	77.4	92.6	98.4	91.9	101.4	76.5	111.7	84.2	297.29	77.7	113.9	78.8
1845	76.3	75.1	97.2	95.9	95.8	109.5	88.2	113.6	92.1	306.68	69.1	104.1	92.5
1846	62.0	59.3	83.4	72.8	72.8	108.7	67.4	96.7	73.3	320.12	44.2	96.6	77.2
1847	71.2	63.5	91.6	94.2	87.2	109.8	68.6	104.6	77.9	306.85	60.6	104.7	74.7