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Variability of Migration in Sõrve Bird Observatory from 2001–2010

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Sõrve Bird Observatory is located in the southern peak of Saaremaa on Sõrve Peninsula (57°55′N, 22°03′E). Bird observations have been performed in Sõrve Bird Observatory since 1998 and up to the present over 33 million birds have been registered of whom 20 million are transit migrants, and the rest staging during migration, breeding or nomadic birds. Before 2001, birds were only registered during the autumn period but since 2010, observations were also registered during spring migration.

The most numerous species during spring migration are Common Scoter *Melanitta nigra,* Barnacle Goose *Branta leucopsis* and Long-tailed Duck *Clangula hyemalis* (Table 1). Ten out of the twenty most numerous species head towards the arctic breeding grounds in Northwest Russia upon transit migration. The most numerous species during autumn migration are the Chaffinch *Fringilla coelebs*, Eurasian Siskin *Carduelis spinus* and Common Wood Pigeon *Columba palumbus* (Table 1). Twelve out of the twenty most numerous species are Passeriformes. Seasonal difference of migrant species (Table 1) is due to the location of the bird observatory. For instance, during spring migration more Passeriformes are encountered in Salme (58°09′N, 22°14′E) and Kabli (58°01′N, 24°27′E), whereas more arctic migrants can be encountered in Põõsaspea during autumn migration (59°14′N, 23°30′E; see Ellermaa *et al.* 2010).

The present paper focuses only on the species passing through Sõrve bird observatory, the numerical data on the entire migration period of which existed in full. There were a total of 99 of such species during spring migration and 110 during autumn migration (Table 1). Periods from 01.03–15.06 and 01.07–11.11 were omitted from the observation as during the aforementioned periods it was difficult to differentiate transit migrants from mass staging individuals. In total, the paper covers the data of 2088 days of observation (from March to June 245, 241, 250, and 129 respectively; from July to November 222, 301, 297,295 and 108).

First, the average dates of migration timing were calculated. In case of each species, the observation data were added with the pace of five days from 2001–2010 and the average amount of transit migrants per day was calculated on the basis thereof. On the basis of the received figures, dates were calculated on which 25%, 50% and 75% of the number of birds had passed through the bird observatory, separately in case of spring and autumn migration (Table 1).

Table 1. Numerical data on the migration periods of some bird species at Sõrve Bird Observatory 2001-2010 (N = number of birds, Q25, Q50, Q75 = date when 25%, 50%, 75% of migration has passed, SD = standard deviation of yearly average dates).
Tabel 1. *Sõrve linnujaama rändeperioodide andmestik 2001–2010 (N-arvukus, Q25,Q50,Q75 – kuupäevad, mil 25%, 50% või 75% liigi isenditest oli läbi rännanud, SD – aastate keskmiste rändekuupäevade standardhälve).*

	Spring / *Kevad*					**Autumn** / *Sügis*				
Species /*Liik*	**N**	**Q25**	**Q50**	**Q75**	**SD**	**N**	**Q25**	**Q50**	**Q75**	**SD**
CYGCOL	4 050	29.3.	3.4.	9.4.	9.3	5 760	13.10.	22.10.	30.10.	4.1
ANSFAB	1 640	26.3.	29.3.	1.4.	13.6	8 800	26.9.	1.10.	7.10.	6.5
ANSALB	1 570	30.3.	2.4.	8.4.	14.7	27 300	5.10.	9.10.	14.10.	6.9
BRALEU	208 000	7.5.	16.5.	19.5.	4.9	96 300	7.10.	14.10.	20.10.	6.4
BRABER	9 480	23.5.	25.5.	28.5.	5.0	2 600	8.10.	16.10.	25.10.	4.8
ANAACU	5 840	8.4.	20.4.	30.4.	5.6	24 600	13.9.	25.9.	4.10.	3.9
ANAQUE	1 070	28.4.	9.5.	26.5.	11.2	304	1.8.	9.8.	26.8.	16.2
AYTMAR	10 900	19.4.	23.4.	26.4.	7.5	11 400	30.9.	20.10.	2.11.	8.7
GAVARC	19 800	14.5.	19.5.	24.5.	5.2	7 960	10.9.	23.9.	8.10.	8.0
CIRCYA	67	18.4.	26.4.	4.5.	10.7	1 110	22.9.	30.9.	10.10.	2.2
ACCNIS	688	14.4.	27.4.	6.5.	8.8	23 900	19.9.	27.9.	7.10.	4.1
BUTBUT	1 210	10.4.	23.4.	3.5.	10.5	4 490	29.9.	9.10.	18.10.	6.2
BUTLAG	590	8.4.	17.4.	26.4.	10.5	167	4.10.	16.10.	25.10.	7.1
PANHAL	153	22.4.	2.5.	20.5.	6.2	254	1.9.	10.9.	17.9.	7.2
FALTIN	224	24.4.	5.5.	22.5.	9.4	1 540	3.9.	17.9.	24.9.	5.8
FALCOL	55	9.4.	21.4.	6.5.	16.8	959	20.9.	27.9.	5.10.	2.8
FALSUB	241	15.5.	27.5.	4.6.	6.5	1 040	2.9.	14.9.	21.9.	5.3
FALPER	31	21.4.	8.5.	18.5.	9.5	269	23.9.	2.10.	10.10.	4.5
GRUGRU	39 100	8.4.	14.4.	19.4.	6.7	72 200	27.9.	1.10.	10.10.	4.6
CHADUB	203	9.5.	19.5.	26.5.	4.4	182	13.7.	6.8.	21.8.	11.4
CHAHIA	7 620	12.5.	23.5.	30.5.	5.3	8 740	13.8.	24.8.	6.9.	5.2
PLUAPR	281	18.4.	4.5.	14.5.	16.1	3 020	28.8.	17.9.	28.9.	6.6
PLUSQU	12 900	26.5.	29.5.	31.5.	2.0	6 350	25.8.	26.9.	11.10.	8.0
CALCAN	35 100	29.5.	3.6.	7.6.	3.0	2 560	2.8.	21.8.	6.9.	9.6
CALALB	98	19.5.	23.5.	29.5.	4.0	1 060	13.8.	27.8.	11.9.	8.9
CALUTA	106	25.5.	30.5.	5.6.	4.9	1 150	25.8.	30.8.	3.9.	9.4
CALTEM	453	14.5.	19.5.	22.5.	7.3	259	31.7.	10.8.	20.8.	7.0
CALFER	36	27.5.	30.5.	3.6.	4.1	1 870	22.7.	31.7.	18.8.	10.5
CALALP	50 200	22.5.	27.5.	31.5.	2.6	40 900	29.7.	12.8.	19.9.	9.7
LIMFAL	232	28.5.	1.6.	3.6.	1.9	135	13.7.	17.7.	13.8.	11.5

GALGAL	1 210	7.4.	23.4.	3.5.	7.1	4 940	10.8.	2.9.	1.10.	10.1
LIMLAP	15 500	27.5.	30.5.	2.6.	5.3	1 490	29.7.	14.8.	16.9.	18.9
NUMPHA	854	30.4.	5.5.	10.5.	5.6	462	20.7.	3.8.	9.8.	7.2
TRIERY	2 460	4.5.	8.5.	11.5.	3.2	596	7.8.	19.8.	29.8.	7.9
TRINEB	4 700	29.4.	3.5.	8.5.	2.4	4 580	16.7.	28.7.	12.8.	5.8
TRIGLA	1 780	7.5.	11.5.	16.5.	3.7	7 220	24.7.	4.8.	11.8.	5.5
ACTHYP	321	6.5.	15.5.	21.5.	3.1	1 850	27.7.	7.8.	18.8.	4.5
AREINT	354	18.5.	21.5.	27.5.	4.5	551	16.8.	26.8.	3.9.	7.6
PHALOB	392	27.5.	31.5.	3.6.	2.6	161	17.7.	24.7.	8.8.	13.9
HYDMIN	2 890	21.4.	4.5.	24.5.	15.8	20 100	10.9.	4.10.	25.10.	11.3
LARFUS	252	15.4.	21.4.	1.5.	7.7	421	31.8.	18.9.	28.9.	9.1
HYDCAS	117	18.4.	22.4.	1.5.	6.4	172	1.8.	17.8.	29.8.	12.5
STESAN	896	22.4.	27.4.	7.5.	5.6	10 400	21.8.	5.9.	17.9.	9.0
COLOEN	2 750	28.3.	4.4.	17.4.	9.9	5 120	26.9.	5.10.	14.10.	6.0
COLPAL	7 910	8.4.	20.4.	1.5.	11.8	386 000	29.9.	3.10.	9.10.	3.3
CUCCAN	22	4.5.	12.5.	26.5.	11.2	94	22.8.	31.8.	8.9.	22.3
ASIOTU	25	9.4.	21.4.	26.4.	11.6	73	24.9.	5.10.	9.10.	15.4
ASIFLA	35	1.4.	25.4.	17.5.	15.9	96	24.9.	27.9.	14.10.	11.6
LULARB	857	30.3.	10.4.	29.4.	14.9	9 600	24.9.	1.10.	10.10.	4.2
ALAARV	4 940	23.3.	26.3.	5.4.	6.0	7 440	1.10.	9.10.	14.10.	4.1
RIPRIP	418	17.5.	23.5.	29.5.	6.2	2 430	12.8.	20.8.	31.8.	7.2
HIRRUS	4 180	9.5.	17.5.	23.5.	6.8	74 400	1.9.	10.9.	18.9.	9.1
DELURB	1 320	7.5.	14.5.	21.5.	7.4	14 200	22.8.	30.8.	3.9.	10.1
ANTTRI	1 860	3.5.	8.5.	18.5.	4.5	92 700	22.8.	27.8.	2.9.	3.5
ANTPRA	1 960	7.4.	16.4.	24.4.	10.2	65 400	22.9.	29.9.	7.10.	2.7
MOTFLA	1 370	17.5.	20.5.	25.5.	4.1	66 900	22.8.	27.8.	1.9.	4.0
MOTALB	1 580	16.4.	20.4.	24.4.	7.0	23 800	11.9.	18.9.	25.9.	3.5
BOMGAR						41 400	21.10.	28.10.	8.11.	
TROTRO	821	5.4.	17.4.	29.4.	7.5	3 960	26.9.	6.10.	16.10.	4.7
PRUMOD	757	9.4.	18.4.	30.4.	6.5	25 000	20.9.	25.9.	30.9.	1.9
ERIRUB	8 580	11.4.	18.4.	27.4.	5.3	14 500	21.9.	28.9.	9.10.	2.4
LUSSVE	32	12.5.	15.5.	19.5.	5.7	77	12.9.	20.9.	27.9.	9.4
PHOPHO	429	5.5.	11.5.	19.5.	5.4	1 520	2.9.	16.9.	25.9.	3.8
SAXRUB						1 120	20.8.	24.8.	30.8.	
OENOEN	45	22.4.	28.4.	7.5.	19.4	1 200	29.8.	8.9.	19.9.	7.6
TURMER	211	24.3.	27.3.	31.3.	21.2	1 350	2.10.	10.10.	20.10.	4.8
TURPIL	6 750	29.3.	8.4.	18.4.	8.2	191 000	16.10.	22.10.	28.10.	6.2
TURPHI	5 840	15.4.	24.4.	30.4.	3.8	14 700	27.9.	2.10.	7.10.	2.8
TURILI	3 420	9.4.	15.4.	24.4.	7.6	26 900	30.9.	2.10.	11.10.	6.2
TURVIS	1 200	30.3.	7.4.	17.4.	10.3	28 000	4.10.	10.10.	17.10.	4.2
LOCNAE	71	21.5.	29.5.	9.6.						
SYLCUR	1 950	17.5.	25.5.	3.6.	2.7	3 970	4.8.	20.8.	3.9.	5.7
SYLBOR	1 050	28.5.	4.6.	10.6.	3.8	1 470	20.8.	26.8.	4.9.	7.1
PHYCOL	2 240	3.5.	16.5.	2.6.	4.5	6 690	11.9.	19.9.	27.9.	3.7
PHYLUS	2 540	13.5.	22.5.	2.6.	3.1	9 930	18.8.	28.8.	12.9.	7.3
REGREG	1 480	4.4.	11.4.	22.4.	9.1	99 700	28.9.	1.10.	5.10.	3.2
MUSSTR	1 020	25.5.	30.5.	6.6.	3.5	2 400	21.8.	28.8.	6.9.	7.0

FICPAR	53	20.5.	26.5.	2.6.	5.3	364	3.9.	16.9.	24.9.	8.7
FICHYP	308	5.5.	16.5.	25.5.	6.7	558	14.8.	20.8.	27.8.	6.1
PANBIA						377	12.10.	16.10.	22.10.	
AEGCAU	352	1.4.	14.4.	6.5.	18.0	20 800	7.10.	17.10.	30.10.	4.9
POEMON						2 800	19.9.	27.9.	6.10.	
PERATE						19 700	18.9.	26.9.	2.10.	
CYACAE						73 300	27.9.	3.10.	10.10.	
PARMAJ						236 000	25.9.	28.9.	3.10.	
CERFAM						1 290	24.9.	6.10.	18.10.	
LANCOL	1 630	27.5.	2.6.	8.6.	2.3	2 470	8.8.	14.8.	22.8.	4.0
LANEXC	194	30.3.	10.4.	18.4.	10.1	856	1.10.	8.10.	19.10.	3.7
GARGLA						34 100	24.9.	27.9.	1.10.	
NUCCAR						11 600	28.8.	3.9.	12.9.	
CORMON	5 960	8.4.	27.4.	12.5.	10.7	15 100	16.10.	20.10.	24.10.	2.6
CORFRU	1 530	18.3.	9.4.	28.4.	12.8	5 870	7.10.	13.10.	21.10.	7.3
CORNIX	767	14.3.	22.3.	3.4.	17.2	16 500	16.10.	21.10.	26.10.	2.5
CORRAX	43	15.3.	24.3.	17.4.	10.0	144	24.9.	2.10.	8.11.	10.6
PASDOM						108	5.10.	11.10.	18.10.	
PASMON	77	18.4.	23.4.	26.4.	15.8	942	5.10.	16.10.	26.10.	8.9
FRICOE	61 300	7.4.	14.4.	29.4.	9.7	10 800 000	22.9.	26.9.	30.9.	2.9
FRIMON	11 000	18.4.	24.4.	3.5.	6.3	472 000	30.9.	4.10.	8.10.	4.1
CHLCHL	855	6.4.	16.4.	27.4.	13.8	23 800	13.10.	20.10.	27.10.	5.8
CARCAR	810	4.4.	18.4.	27.4.	14.1	8 330	4.10.	17.10.	25.10.	3.8
CARSPI	14 400	24.3.	9.4.	24.4.	14.8	442 000	21.9.	27.9.	4.10.	7.0
CARCAN	1 430	7.4.	19.4.	28.4.	10.5	8 320	30.9.	7.10.	18.10.	6.8
CARMEA						30 400	18.10.	26.10.	2.11.	
CARERY	2 570	26.5.	1.6.	7.6.	2.5	2 030	21.7.	31.7.	13.8.	8.1
PYRPYR	1 680	15.3.	22.3.	2.4.	10.5	47 600	13.10.	23.10.	27.10.	5.3
COCCOC	201	8.4.	21.4.	17.5.	17.1	2 070	24.9.	2.10.	9.10.	6.4
CALLAP	53	18.4.	22.4.	29.4.	6.1	315	15.9.	22.9.	2.10.	6.9
PLENIV	1 330	19.3.	27.3.	31.3.	7.1	2 040	28.10.	1.11.	5.11.	3.5
EMBCIT	560	5.4.	14.4.	20.4.	12.8	8 560	8.10.	21.10.	27.10.	9.3
EMBHOR	48	11.5.	19.5.	24.5.	3.9	826	21.8.	25.8.	30.8.	4.6
EMBSCH	1 460	5.4.	18.4.	3.5.	10.3	8 210	29.9.	3.10.	12.10.	6.6

Also, attention was paid to the variability of the timing of migration by years. For this purpose, first the average arithmetical date was calculated separately for each species by years and by migration periods. On the basis of the received mean, the average and standard deviations were calculated separately for each species with the pace of one year. It appeared that early spring migrants leave later in autumn and late spring migrants leave earlier in autumn (Figure 1a). In addition, it appeared that the variability of average dates of early spring migrants by years is considerably higher than in case of late spring migrants (Figure 1b). The same trend could be noticed in case of autumn migration: the variability of average dates of early autumn migrants by years was higher than in case of late autumn migrants (Figure 1c).

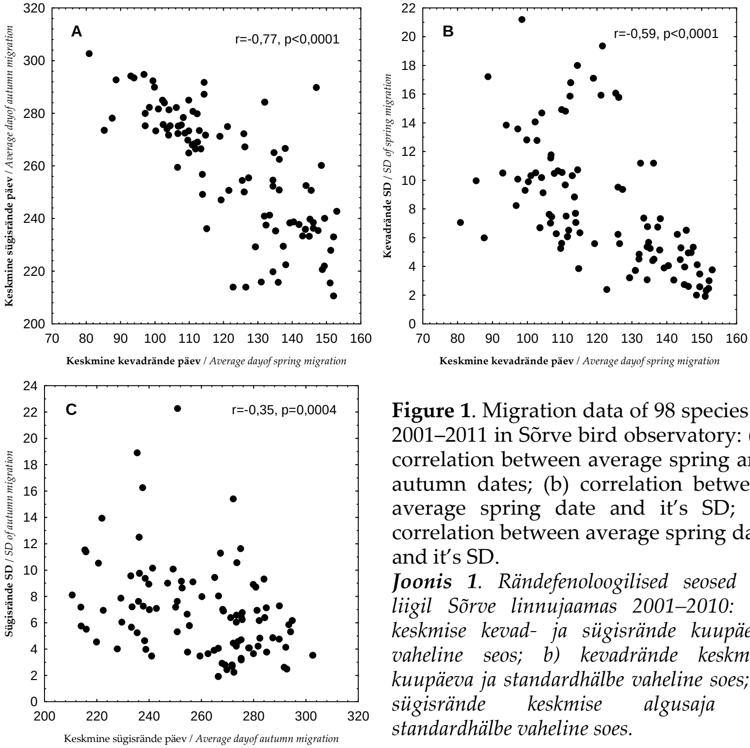

Figure 1. Migration data of 98 species in 2001–2011 in Sõrve bird observatory: (a) correlation between average spring and autumn dates; (b) correlation between average spring date and it's SD; (c) correlation between average spring date and it's SD.
Joonis 1*. Rändefenoloogilised seosed 98 liigil Sõrve linnujaamas 2001–2010: (a) keskmise kevad- ja sügisrände kuupäeva vaheline seos; b) kevadrände keskmise kuupäeva ja standardhälbe vaheline soes; c) sügisrände keskmise algusaja ja standardhälbe vaheline soes.*

From earlier studies it is known that in case of species arriving early in spring, the time of arrival of the first individuals varies considerably more than in case of species arriving later (Hildén *et al*. 1979, Lehikoinen & Rainio 2009, Palm *et al.* 2009). The reason is thought to be the greater variability of weather in early spring and the effect thereof to the permanence of snow and availability of food. Although earlier studies have focused more on single first arrivals and this study comprises the entire migration period, the results are quite similar as well as are probably the general reasons.

In autumn, snow and ice cover the ground relatively late and thereby the unavailability of food also occurs rather late. If similar phenomena caused by the weather would explain the timing of both spring and autumn migration, we might assume that the timing of species starting their migration early in autumn would be much less variable that in case of late species. Nevertheless, this is not the case, vice versa: the timing of early autumn migrants is much more variable than in case of late autumn migrants. There are no grounds to assume that the variability of the timing of spring migration would affect the variability of autumn migration as the species migrating early in autumn arrive late in spring and the variability of their timing is the smallest.

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