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Long-term arrival trends of 54 avian species to Barguzinsky Nature Reserve in the northeastern Baikal area

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Abstract: Ananin, A.A. & Sokolov L.V. (2009): Long-term arrival trends of 54 avian species to Barguzinsky Nature Reserve in the northeastern Baikal area. Avian Ecol. Behav. 15: 31-46.

We analysed phenological observations on spring arrival of 54 avian species to Barguzinsky Nature Reserve in 1938-2001. Twenty-eight species (52%) showed a trend towards earlier arrival, 14 species (26%) showed a trend towards later arrival. In 12 species (22%) the timing of spring arrival did not change. Most avian species that started to arrive earlier were passerines (65% of species). Later arrival was mainly recorded in waterfowl and birds of prey. Earlier arrival recorded in roughly one-half of the species analysed, is probably due to climate warming recorded in the study region in the late 20th century. These species may be treated as phenological indicators illustrating climate change in the northeastern Baikal area.

Key words: spring migration, arrival date, long-term trends, climate, Baikal area

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1. Introduction

Long-term change in the timing of phenological events, spring arrival of birds including, has been recently reported from different regions of the Northern hemisphere, including Europe (Bulygin & Martynov 1992, Järvinen 1995, Moss 1996, 1998; Bairlein, Winkel 1998, Bergmann 1998, Loxton et al. 1998, Sokolov et al. 1998, 1999a; Ahas 1999, Loxton, Sparks 1999, Minin 2000, Bobretsov et al. 2001, Vengerov 2001, Volkov et al. 2001, Gilyazov 2001, Gordienko & Levanova 2001, Onufrenya & Goryantseva 2001, Osipov et al. 2001, Ryzhkov et al. 2001, Sparks & Mason 2001, Sueuer & Triplet 2001, Ahas et al. 2002, Gilyazov & Sparks 2002, Sparks & Loxton 2002, Sparks et al. 2002, Tryjanowski et al. 2002, Sokolov 2006) and North Asia (Kuchin 1996, 2001; Ananin 2000, 2002a, 2002b, 2003; Ananin et al. 2001, Paskhalny 2002). Such long-term fluctuations of arrival time usually are related with the overall global climate warming in the end of the 20th century (Moritz 1993, Berthold

1994, 1996; Mason 1995, Vogel & Moritz 1995, Kuchin 1996, Bairlein & Winkel 1998, Bergmann 1998, Moss 1998, Paskhalny 2002, Sokolov 2006), or to alternation of warm and cold periods when arrival time changes in different directions governed by the dynamics of spring air temperature (Mason 1995, Sokolov et al. 1998, Sokolov et al. 1999b, Askeyev et al. 2002).

Many authors showed that annual variation of the timing of spring arrival in birds is closely linked to spring air temperatures, primarily to mean monthly temperatures of March, April, and May (Mikheev 1964, Gavrilov 1979, Gavrin et al. 1980, Gubin & Levin 1980, Dzhurabaeva & Yanushevich 1980, Krivenko et al. 1980, Veromann 1981, Gordienko 1983, Sema 1989, Alerstam 1990, Huin, Sparks 1998, Sokolov et al. 1998, Sokolov 2000, Gilyazov, Sparks 2002, Sparks, Loxton 2002, Sokolov 2006). However, response of different avian species to climate change may differ considerably. Some species start to arrive earlier during warmer periods, whereas other do not alter their arrival time or even shift it towards later calendar periods (Mason 1995, Sokolov et al. 1998, Sparks et al. 2000, Bobretsov et al. 2001, Vengerov 2001, Gilyazov 2001, Gordienko & Levanova 2001, Osipov et al. 2001, Ryzhkov et al. 2001, Paskhalny 2002, Gilyazov & Sparks 2002).

The question arises, whether similar tendencies of shifting arrival time occur in the Baikal region (Eastern Siberia). This study analyses long-term changes in the dates of first spring records of birds in northeastern Baikal region.

2. Material and methods

Long-term observation data on the time of spring arrival of birds were performed in Barguzinsky Biosphere Reserve (54°01´–54°56´N, 109°31´–110°17´E). This Nature Reserve is situated along the eastern coast of Lake Baikal on the western slopes of Barguzinsky mountain range (54°01´–54°56´N, 109°31´–110°17´E). The current area of the Nature Reserve is 374,322 ha, and includes the strictly protected zone (263,176 ha) and a buffer zone (111,146 ha). From the west the Nature Reserve borders on Lake Baikal (110 km) and includes the 3-km offshore stripe. In the south the Nature Reserve borders on Zabaikalsky national park. The northern border runs 2 km south of the mouth of the Shegnanda river, and the eastern one along the Barguzinsky range.

The climate of the Nature Reserve is continental with some marine features. The temperature regimen is alleviated by the influence of the Baikal, so that winter is milder, and summer cooler than in adjacent areas. The cooling impact of Lake Baikal is especially apparent in spring and summer, therefore the mean annual temperature in Barguzinsky Nature Reserve is the lowest in the whole Baikal area. The mean temperature of the warmest month (August) is +13 °C, of the coldest one (February) -23 °C, the mean annual temperature is -3.7 °C. Of this area, a relatively high annual precipitation sum is typical: 300 to 650 mm on the coast, and more than 1000 mm in the mountains (Ananin & Ananina 2002).

Regular phenological observations in Barguzinsky Nature Reserve cover the period since the late 1930s, but the most complete data were obtained in the latter half of the 20th century (Ananin 1998, 2000, 2001, 2002a, b, 2003). The bulk of data on spring arrival of birds was obtained by A.A. Ananin in 1984-2001 at constant transects and stationary study plots within Barguzinsky state biosphere reserve at the galleries within 10-15 from the Baikal coast. Additionally, we used the data from the 'Annals of Nature' of Barguzinsky Nature Reserve in 1938-1983, and of the data of the second class weather station in the Davsha village since 1955. The birds with winter records were excluded from the analysis of first spring registrations. Complete and regular data are given for 54 species. The periods of seasonal events in northeastern Baikal coast follow Filonov (1967, 1978).

Several author have previously shown that first observations or captures are reliable estimates of the timing of migration in a particular year (Sokolov et al. 1999a, Sparks et al. 2002).

Statistical analysis of long-term trends in the timing of spring arrival and seasonal air temperatures was performed by regressions analysis. We used the statistical package Statistica 5.0.

3. Results and discussion

Over the recent 50 years, climate has considerably changed in the northeastern Baikal area. Air temperature in spring and summer months increased, causing higher mean annual temperature, longer frost-free period, earlier ice melting in the protected part of Lake Baikal and change in other parameters (Ananin et al. 2001, Ananin & Ananina 2002). Temperature regimen of winter (except of February) and autumn months (except of September) did not change. Precipitation remain unchanged, too. Taken together, climate changes increased the aridity of climate and somewhat emphasized its continental nature.

Dynamics of mean annual temperature and mean monthly temperatures showed significant positive near-linear trends (Fig. 1). However, a detailed analysis shows a more complex pattern. A considerable rise in temperatures has started in the 1970s and continues into present, even though since the late 1990s a tendency of stabilisation of temperatures is recorded. The time of ice melting in the Davshe bay on the northeastern Baikal coast has significantly changed (Fig. 2).

Climate changes were reflected in the shifts in timing of many seasonal events. During the period of our study (1984-2001), as compared with the data by Filonov (1978) collected in 1939-1961, starting dates of many seasons and subseasons and their duration have changed substantially (Tab. 1). Mid winter, late winter, high summer and early autumn started in the recent decades on the average later, and early spring, mid spring, late spring and early summer commenced earlier than in the 1940s-1950s (Fedorov & Ananin 2002).

The analysis of long-term trends of first spring records in 54 avian species showed that 28 species (52%) showed a trend towards earlier arrival (Tab. 2, 3, Fig. 3). In six of them (Northern Harrier *Circus cyaneus*, Lapwing *Vanellus vanellus*, House Martin *Delichon urbica*, Barn Swallow *Hirundo rustica*, Skylark *Alauda arvensis,* Brambling *Fringilla montifringilla*) this trend was most apparent (Fig. 3). The Starling *Sturnus vulgaris* showed a tendency towards earlier arrival in the 1970s-1980s (the difference

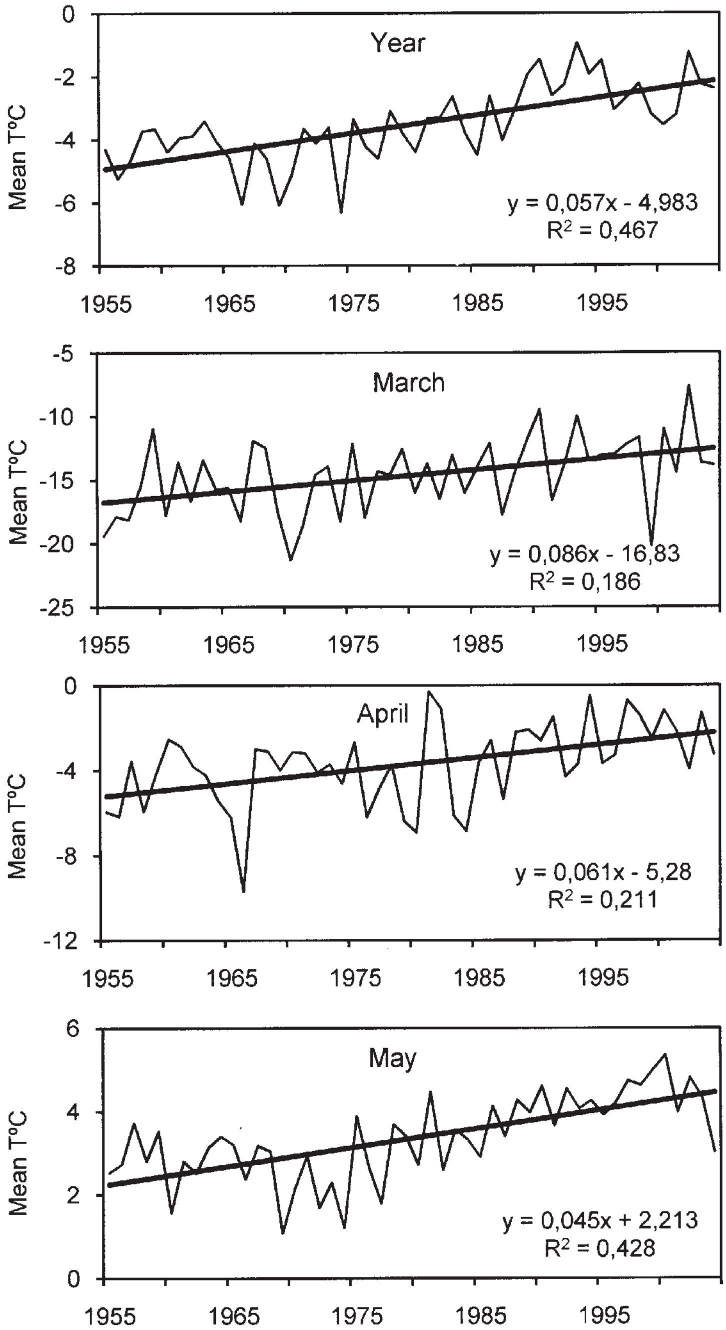

Figure 1. Long-term trends in the mean annual and monthly air temperatures in the northeast Baikal area (Kirensk – dashed line; Barguzinsky Nature Reserve – solid line).

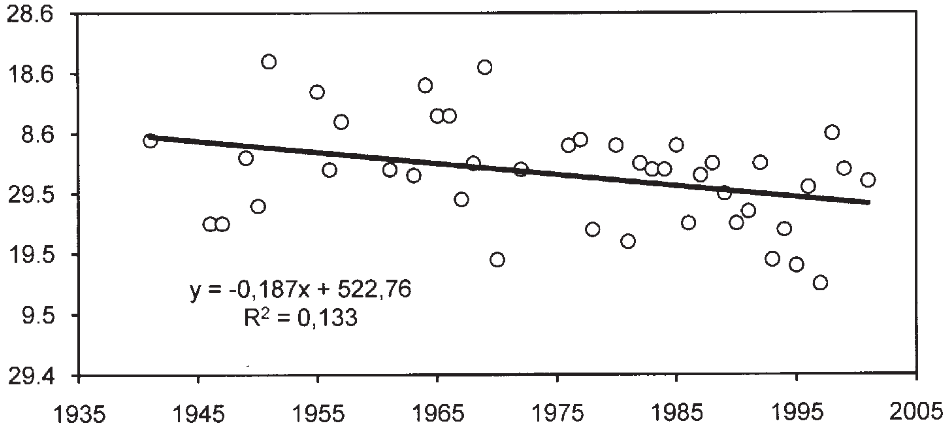

Figure 2. Time of ice melting in Davshe Bay (northeast Baikal coast).

Table 1. Timing of seasonal evenets on the northeastern Baikal coast during different part of the study period. * Data by Filonov (1978), ** data by Ananin (this study).

Season	Subseason	1939-1961*		1984-2001**		Difference (days)
		Onset	Duration (days)	Onset	Duration (days)	
Winter	Early winter	27.10	61	30.10	70	+3
	Mid winter	27.12	71	8.01	66	+12
	Late winter	7.03	25	14.03	14	+7
Spring	Beginning of spring	31.03	20	28.03	15	-3
	Early spring	21.04	16	12.04	16	-9
	Mid spring	7.05	17	28.04	11	-9
	Late spring	25.05	23	9.05	30	-16

Table 2. Numbers and proportion (%) of avian species that showed trends towards earlier and later arrival to Barguzinsky Nature Reserve in 1939-2001.

Order	Number of species			
	Total	Earlier arrival	Later arrival	No trend
Anseriformes	5		4 (80.0)	1 (20.0)
Falconiformes	6	1 (16.7)	4 (66.7)	1 (16.7)
Gruiformes	1	1		
Charadriiformes	9	3 (33.3)	2 (22.2)	4 (44.4)
Columbiformes	1	1		
Cuculiformes	2	2		
Coraciiformes	1	1		
Passeriformes	29	19 (65.5)	4 (13.8)	6 (20.7)
Total	54	28 (51.9)	14 (25.9)	12 (22.2)

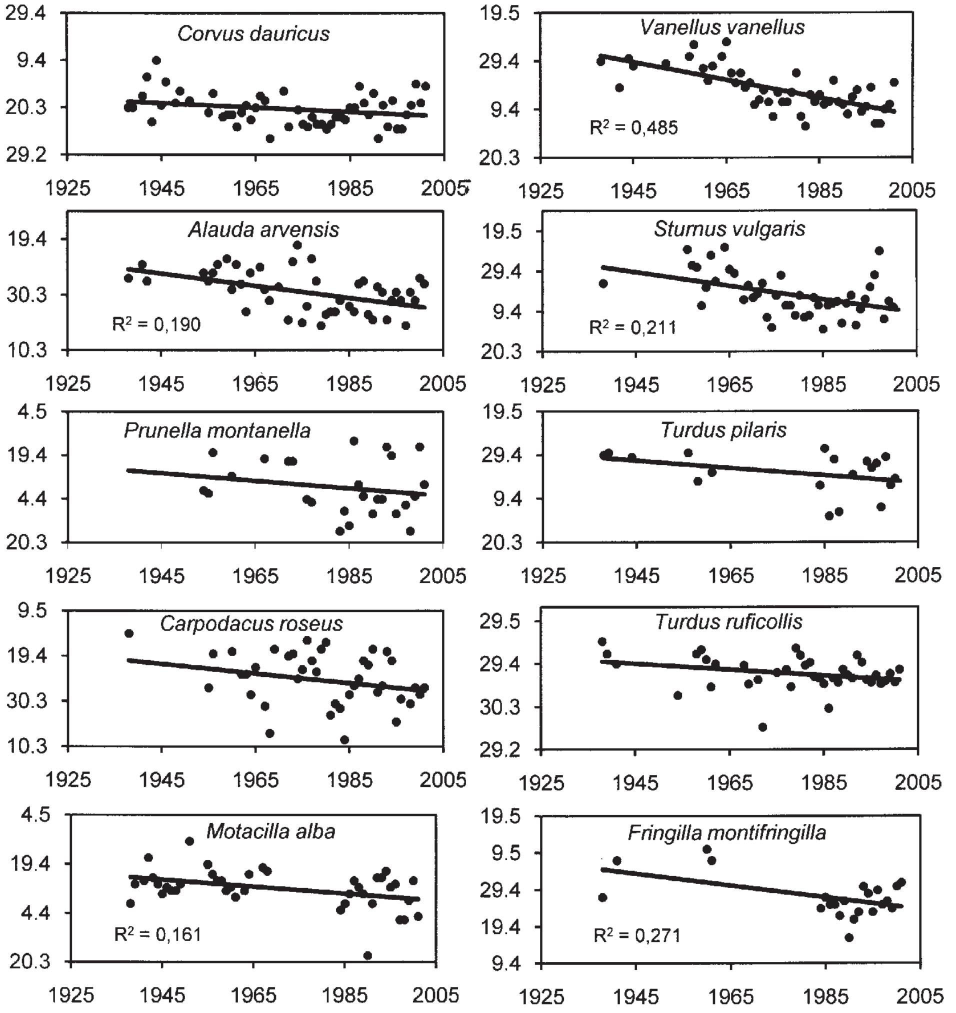

Figure 3. Species which showed a tendency towards earlier arrival to Barguzinsky Nature Reserve. R value are shown when $P < 0.05$.

between the 1970s and late 1980s was on average ca. 10 days).However, in the 1990s this tendency changed (Fig. 3).

At the same time, 14 species (26%) started to arrive later (Tab. 2, 3, Fig. 4). The strongest shift towards later dates was recorded in the recent decades in the Common Merganser *Mergus merganser,* Osprey *Pandion haliaetus*, White-tailed Eagle *Haliaeetus albicilla*, Common Kestrel *Falco tinnunculus* and Lapland Longspur *Calcarius lapponicus* (Fig. 3). Most later arriving bird species are waterfowl, shorebirds and birds of prey (Tab. 2). Changes in the timing of spring arrival and passage of Lapland Longspur are of special interest. This species started to occur in April in the

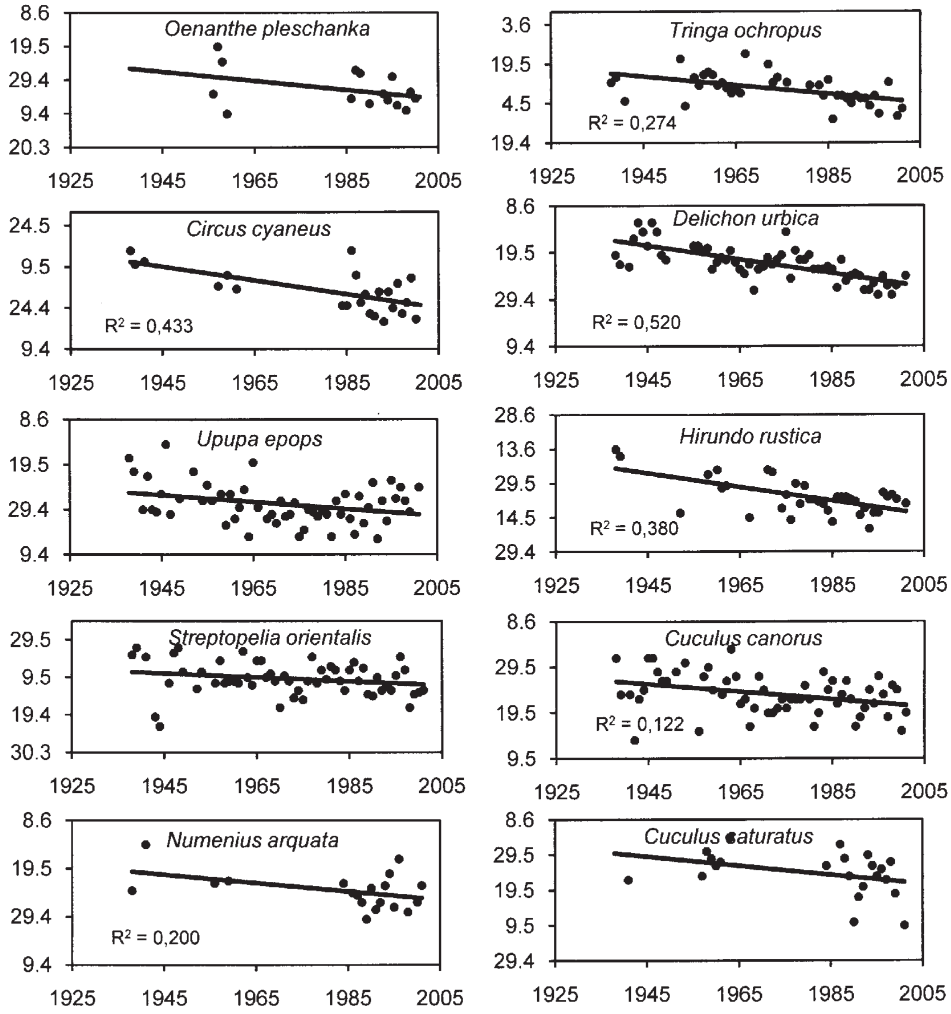

Figure 3 (*continued*). Species which showed a tendency towards earlier arrival to Barguzinsky Nature Reserve. R value are shown when P < 0.05.

1940s-1950s, but arrived in May in the 1980s-1990s, on average 17 days later (Fig. 4, Tab. 3). This development went in parallel with a significant decrease of numbers of passage Lapland Longspurs. We cannot rule out that due to dropping numbers it became more difficult to recorded the arrival of the earliest birds in the recent decades. Phenology of autumn migration and the numbers on autumn passage underwent no significant change (Ananin 2002b).

Timing of spring arrival of 12 species (22%) showed no significant trend (Fig. 5, Tab. 3). Some of these species arrive early (Mallard *Anas platyrhynchos,* Black Kite *Milvus migrans,* Yellow-legged Gull *Larus cachinnans,* Güldenstädt's Redstart *Phoen-*

Table 3. Difference in the timing of spring arrival of birds on the northeastern Baikal coast in 1938-1962 and 1984-2002. The species are ranked by the date of arrival, n is the number of years with observations. * Data by Filonov (1978), ** data by Ananin (this study). C.V. (%) – coefficient of variation.

Species	Date of the first record				
	1938-2001*		1984-2002*		Dif-ference, days
	mean data ± SE	C.V. (%)	mean data ± SE	C.V. (%)	
Eremofila alpestris	9.3±4.0 (n=41)	18.9	9.3±7.8 (n=16)	23.0	0
Plectrophenax nivalis	10.3±5.5 (n=38)	24.7	13.3±7.1 (n=13)	17.8	+3
Corvus dauuricus	19.3±1.8 (n=54)	8.5	19.3±3.1 (n=18)	8.4	0
Emberiza cioides	24.3±3.1 (n=43)	12.1	22.3±5.8 (n=15)	13.9	-2
Alauda arvensis	30.3±2.4 (n=47)	9.2	27.3±3.5 (n=18)	8.7	-3
Emberiza leucocephala	5.4±2.3 (n=45)	8.2	5.4±3.8 (n=17)	8.3	0
Haliaeetus albicilla	6.4±4.1 (n=32)	12.0	15.4±6.8 (n=11)	10.9	+9
Phoenicurus erythrogaster	7.4±4.3 (n=17)	9.1	8.4±4.7 (n=12)	8.4	+1
Carpodacus roseus	8.4±3.8 (n=41)	12.6	5.4±5.0 (n=17)	10.9	-3
Prunella montanella	8.4±3.6 (n=26)	9.4	6.4±4.8 (n=16)	10.1	-2
Motacilla alba	11.4±1.8 (n=41)	5.7	8.4±3.0 (n=18)	6.5	-3
Emberiza rustica	12.4±2.1 (n=43)	6.9	11.4±3.3 (n=18)	7.1	-1
Emberiza pallasi	13.4±5.5 (n=19)	11.7	12.4±5.5 (n=11)	5.5	-1
Oenanthe isabellina	14.4±2.0 (n=45)	6.5	17.4±2.6 (n=17)	5.1	+3
Sturnus vulgaris	17.4±3.2 (n=44)	9.8	13.4±4.5 (n=17)	9.0	-4
Accipiter gentilis	18.4±4.3 (n=29)	10.8	20.4±5.1 (n=18)	9.9	+2
Vanellus vanellus	18.4±3.0 (n=50)	9.9	11.4±2.3 (n=18)	4.9	-7
Turdus pilaris	20.4±4.2 (n=19)	8.4	18.4±5.5 (n=13)	9.2	-2
Oenanthe oenanthe	20.4±3.0 (n=21)	6.2	20.4±3.4 (n=17)	6.3	0
Turdus ruficollis	22.4±3.6 (n=39)	10.1	19.4±3.5 (n=18)	6.8	-3
Calcarius lapponicus	24.4±9.0 (n=21)	18.2	11.5±7.4 (n=10)	9.0	+17
Oenanthe pleschanka	23.4±5.8 (n=15)	10.0	21.4±4.8 (n=11)	7.2	-2
Bucephala clangula	24.4±1.8 (n=54)	5.9	24.4±2.4 (n=18)	4.5	0
Anas platyrhynchos	24.4±1.7 (n=59)	5.8	24.4±1.9 (n=17)	3.6	0
Tarsiger cyanurus	25.4±3.1 (n=19)	5.9	26.4±3.4 (n=15)	5.7	+1
Fringilla montifringilla	27.4±2.3 (n=22)	4.7	25.4±1.7 (n=19)	3.2	-2
Larus cachinnans	27.4±3.8 (n=28)	8.7	26.4±4.0 (n=16)	6.9	-1
Mergus merganser	27.4±2.5 (n=55)	7.9	29.4±2.5 (n=18)	4.5	+2
Grus grus	27.4±1.8 (n=57)	5.8	26.4±1.8 (n=16)	3.1	-1
Cygnus cygnus	28.4±3.5 (n=34)	8.7	28.4±5.3 (n=11)	7.5	0
Milvus migrans	28.4±4.3 (n=27)	9.5	28.4±5.7 (n=18)	10.3	0

Species	Date of the first record				
	1938-2001*		1984-2002*		Difference, days
	mean data ± SE	C.V. (%)	mean data ± SE	C.V. (%)	
Anser fabalis	30.4±5.9 (n=16)	10.0	7.5±5.7 (n=4)	4.5	+7
Circus cyaneus	30.4±3.2 (n=23)	6.4	27.4±3.2 (n=17)	5.7	-3
Upupa epops	1.5±2.3 (n=56)	7.3	30.4±3.7 (n=17)	6.4	-1
Phoenicurus auroreus	2.5±4.9 (n=20)	9.0	1.5±5.4 (n=17)	9.2	+1
Falco tinnunculus	6.5±4.6 (n=16)	7.4	10.5±5.0 (n=10)	6.1	+4
Pandion haliaetus	7.5±3.7 (n=28)	7.7	11.5±5.2 (n=16)	8.0	+4
Streptopelia orientalis	8.5±2.3 (n=57)	6.9	6.5±3.3 (n=18)	5.7	-2
Motacilla cinerea	9.5±4.6 (n=24)	8.8	9.5±4.4 (n=17)	7.1	0
Tringa ochropus	9.5±1.8 (n=39)	4.3	5.5±2.0 (n=16)	3.3	-4
Numenius arquata	10.5±3.4 (n=19)	5.8	8.5±3.3 (n=15)	5.1	-2
Actitis hypoleucos	12.5±1.8 (n=45)	4.7	12.5±3.0 (n=17)	4.8	0
Delichon urbica	14.5±1.9 (n=57)	5.5	7.5±2.0 (n=17)	3.3	-7
Scolopax rusticola	15.5±2.7 (n=17)	4.2	15.5±3.6 (n=12)	4.7	0
Saxicola torquata	15.5±3.0 (n=20)	5.1	14.5±3.1 (n=17)	4.8	-1
Gallinago stenura	16.5±2.1 (n=21)	3.5	16.5±2.9 (n=14)	4.0	0
Charadrius dubius	17.5±2.1 (n=21)	3.6	18.5±3.3 (n=12)	4.2	+1
Sterna hirundo	19.5±1.4 (n=19)	2.3	19.5±1.6 (n=15)	2.3	0
Emberiza aureola	20.5±1.6 (n=37)	3.5	21.5±2.3 (n=17)	3.4	+1
Hirundo rustica	23.5±2.5 (n=37)	5.4	19.5±2.2 (n=17)	3.3	-4
Cuculus canorus	23.5±1.1 (n=58)	3.1	21.5±1.6 (n=18)	2.5	-2
Cuculus saturatus	23.5±2.6 (n=22)	4.3	22.5±3.3 (n=15)	4.6	-1
Lanius cristatus	24.5±2.2 (n=37)	4.6	23.5±2.1 (n=15)	2.8	-1
Carpodacus erythrinus	25.5±1.2 (n=25)	2.1	25.5±1.2 (n=13)	1.5	0

icurus erythrogaster, Northern Wheatear *Oenanthe oenanthe,* Pine Bunting *Emberiza leucocephala,* Meadow Bunting *E. cioides*, Snow Bunting *Plectrophenax nivalis*), some arrive later (Common Sandpiper *Actitis hypoleucos,* Pin-tailed Snipe *Gallinago stenura,* Common Tern *Sterna hirundo*). Arrival dates of these species in northeastern Baikal region are not correlated with phenological and climatic changes (Ananin 2002a, b).

It should be noted that the time of ice melting in Davshe bay (northeastern coast of Lake Baikal) in the study area was shifted towards earlier dates across the period of study (1939-2001), but it was not accompanied by earlier arrival of most

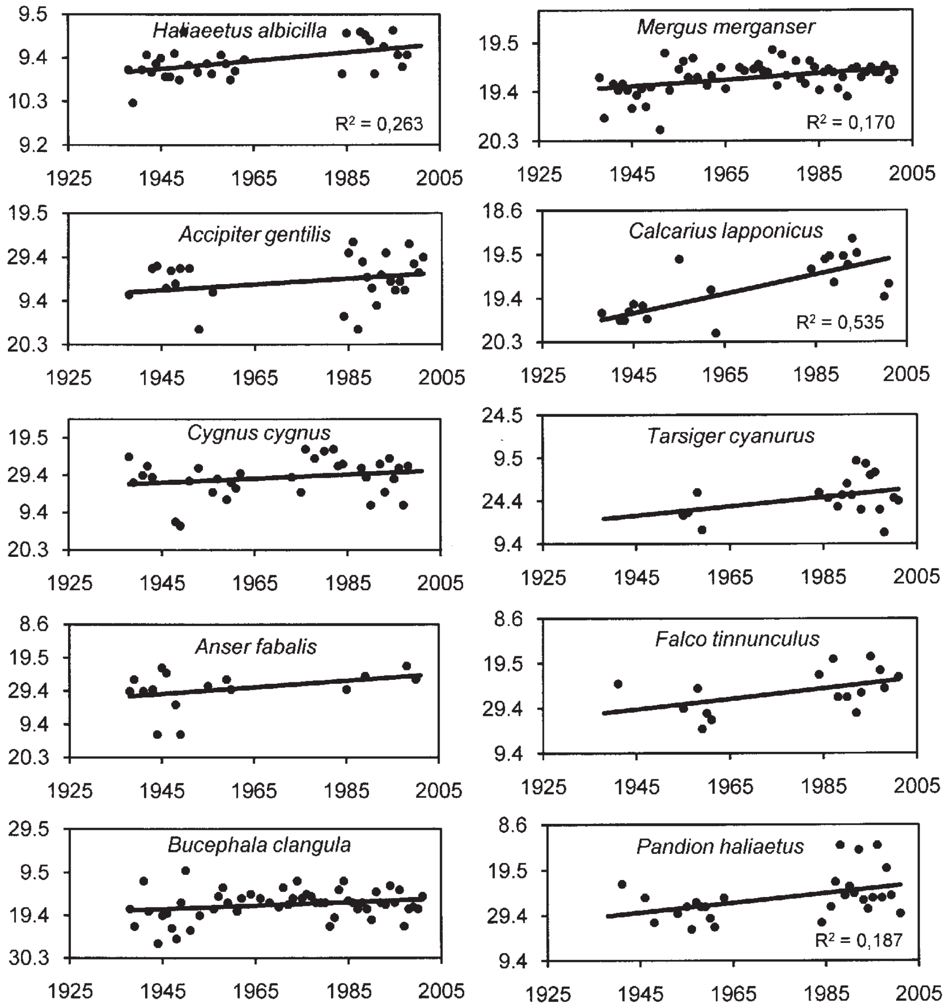

Figure 4. Species which showed a tendency towards later arrival to Barguzinsky Nature Reserve.

waterfowl (Tab. 2). Arrival dates of these species are probably governed by the ice conditions in more southern areas, and not directly in the Nature Reserve.

An earlier analysis of long-term trends in the dates of the first spring records of birds showed no relationship between the shifts in timing of spring arrival and winter quarters and length of migratory routes. Varying trends are recorded in both short- and long-distance migrants (Ananin 2002a).

Coefficients of variation show that annual fluctuations in the timing of arrival are considerably higher in the species that arrive early than in those that arrive late (Tab. 3). This is in agreement with the data reported from Europe (Mason 1995,

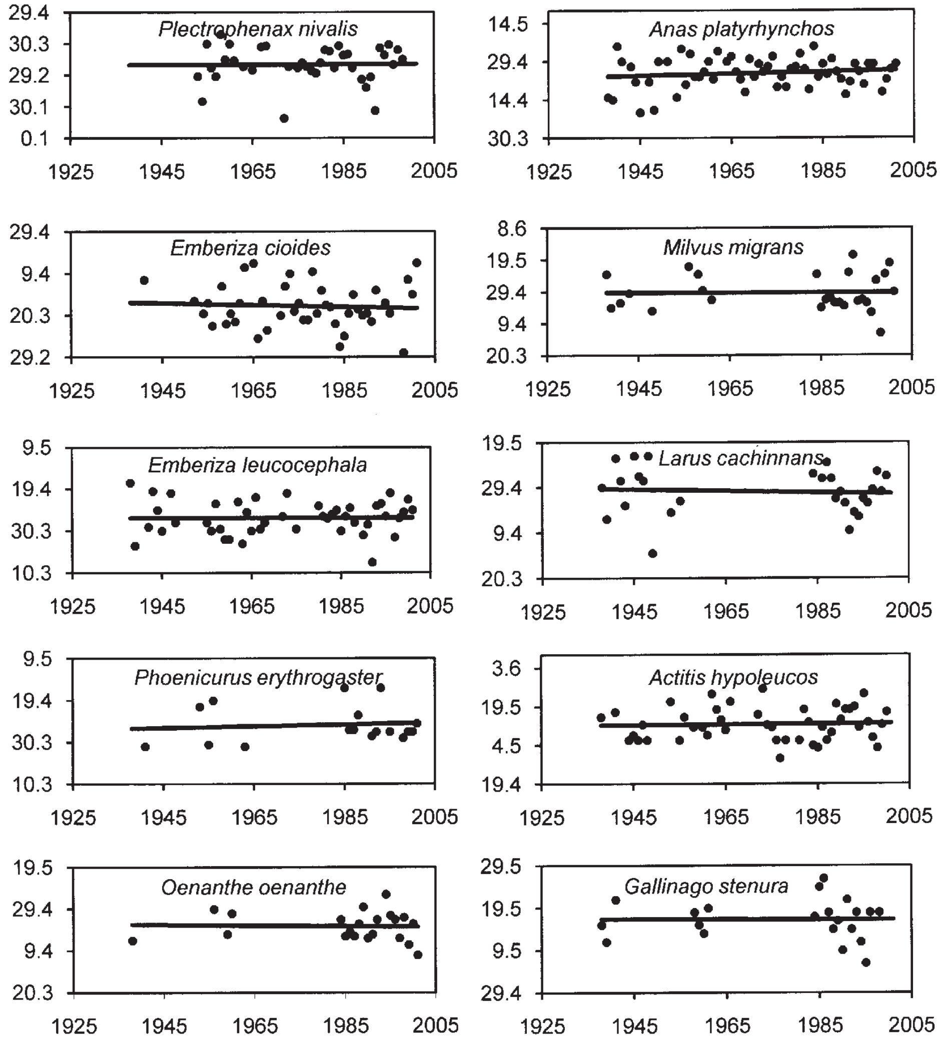

Figure 5. Species which showed no tendency in arrival time to Barguzinsky Nature Reserve.

Sokolov et al. 1999a, Sparks & Mason 2001, Hüppop & Hüppop 2005). The reason for this is probably that in the beginning of spring variation of air temperatures are much higher than later in the seasons (Fig. 1).

Therefore, climate change in the study region caused a considerable shift in the timing of spring arrival of many avian species. Most passerines started to arrive earlier. At the same time, the pattern of arrival is probably governed by more complex relationships that cannot be reduced to the temperature factor alone. Geographic position of winter quarters, weather in the winter range and on the route of migration, species-specific biology, their origin and history of expansion may play a role (Gladkov 1937, Manteufel 1949, Dinesman 1954, Erskine 1985, Syroechkovsky et al. 1987, Sokolov 2006).

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