

## BREEDING BIRD DYNAMICS IN THE YENISEI MIDDLE TAIGA: A 13-YEAR STUDY

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**ABSTRACT** The dynamic patterns of a passerine breeding bird community were studied in 1978–91 in the Yenisei middle taiga (Central Siberia) on 15 sample plots of 420 ha in total. The variation of total numbers was intermediate between those of North and South Finnish communities. Species wintering not far from the breeding sites showed in general a slight increasing tendency, while migrants showed declining trends, that were most obvious in the long-distance migrants of the western sector. In contrast to European birds, the majority of species did not have any particular trend but fluctuated considerably from year to year. Changes in weather and snowcover conditions in the spring were the main source of these fluctuations. After warm springs some southern species penetrated into the north while after cool and late springs the numbers of northern species tended to increase. The latter heavily influenced the totals, due to the high densities and the instability of northern populations. Wintering conditions, such as the size of the seed crop of conifers in the temperate zone and the duration of the dry season in the tropics, were important factors in determining the breeding population size.

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### INTRODUCTION

The aim of the study is to monitor the dynamics of a bird community in the weakly disturbed conditions of the Siberian taiga. In this paper, some aspects of the annual and long-term changes in bird numbers are considered in comparison with theoretical predictions and with data of other communities.

### METHODS

The dynamic patterns of the passerine breeding bird community were studied in the Yenisei middle taiga (Central Siberia) on 15 sample plots of 420 ha in total. A mapping census was carried out here in 1978–91

### RESULTS

#### **Fluctuations**

The variance of the overall total (table 1) was intermediate between those of North and South Finnish communities (Jarvinen 1979; Solonen 1986) what is in accordance to the latitudinal position. Despite the high species diversity and the wide ecological range of the study area, particular species populations fluctuated in a parallel rather than in a compensating manner. In 15 species (23% of the total) these fluctuations were significantly ( $P < 0.05$ ) greater than in a random sample, whereas 7 species (11% of the total) were significantly stable. This ratio is opposite to the South Finnish community (8% and 16% respectively) and suggests a more strict environmental density-independent limitation in Siberia.

Table 1. Bird populations variance.

Species	N	CVc	tb	CVrc	Species	N	CVc	tb	CVrc
<i>Phyllos. inornatus</i>	4.321	1.413*	1.568	1.255*	<i>Phylloscopus ruscatus</i>	0.109	0.361	0.053	0.356
<i>Parus montanus</i>	2.459	0.494*	2.051	0.406	<i>Passer domesticus</i>	0.107	0.284	0.005	0.284
<i>Frin. montifringilla</i>	2.252	0.882*	-1.098	0.832	<i>Tarsiger cyanurus</i>	0.105	0.355	1.384	0.232
<i>Anthus hodgsoni</i>	1.206	0.308	-1.208	0.287	<i>Emberiza chrysophrys</i>	0.098	0.178	0.318	0.177
<i>Turdus ruficollis</i>	1.082	0.413	0.879	0.398	<i>Bombycilla garrulus</i>	0.085	0.367	1.254	0.340
<i>Sylvia curruca</i>	0.685	0.442	-0.188	0.441	<i>Turdus pilaris</i>	0.050	0.559	0.916	0.537
<i>Locustella certhiola</i>	0.675	0.243	-1.444	0.219	<i>Carduelis spinus</i>	0.048	0.964	0.543	0.950
<i>Aero, dumetorum</i>	0.621	0.441	-0.762	0.428	<i>Emberiza schoeniclus</i>	0.045	0.253	0.012	0.253
<i>Muscicapa sibirica</i>	0.609	0.389	-0.739	0.378	<i>Motacilla alba</i>	0.043	0.207	0.576	0.204
<i>Emberiza aureola</i>	0.575	0.353	-3.643*	0.203	<i>Aegithalos caudatus</i>	0.043	0.498	1.497	0.447
<i>Phyllos. borealis</i>	0.554	0.262	-2.356*	0.203	<i>Passer montanus</i>	0.040	0.571	0.824	0.552
<i>Luscinia calliope</i>	0.502	0.203*	1.128	0.191	<i>Turdus philomelos</i>	0.033	0.264	0.617	0.259
<i>Sitta europaea</i>	0.466	0.782*	0.730	0.761	<i>Phylloscopus trochilus</i>	0.029	0.512	0.037	0.512
<i>Zoothera sibirica</i>	0.435	0.310	0.730	0.302	<i>Cocco. coccothraustes</i>	0.029	0.370	0.461	0.366
<i>Pyrrhula pyrrhula</i>	0.425	0.476*	0.450	0.472	<i>Certhia familiaris</i>	0.024	0.449	2.005	0.237
<i>Emberiza pusilla</i>	0.390	0.692*	0.032	0.692	<i>Luscinia svecica</i>	0.019	0.316	0.568	0.311
<i>Phyllos. collybita</i>	0.388	0.346	-1.842	0.294	<i>Muscicapa mugimaki</i>	0.019	0.244	1.007	0.232
<i>Emberiza rustica</i>	0.388	0.173*	-0.290	0.172	<i>Sylvia borin</i>	0.019	0.247	0.681	0.241
<i>Locustella lanceolata</i>	0.340	0.368	1.515	0.330	<i>Lanius cristatus</i>	0.019	0.429	0.827	0.415
<i>Ficedula parva</i>	0.302	0.471*	1.599	0.417	<i>A. novaeseelandiae</i>	0.017	0.392	3.780*	0.217
<i>Carduelis flammea</i>	0.297	1.098*	-0.104	1.097*	<i>Motacilla cinerea</i>	0.014	0.344	0.472	0.340
<i>Phyllos. proregulus</i>	0.273	0.203*	-1.357	0.185	<i>Fringilla coelebs</i>	0.012	0.380	0.094	0.380
<i>Turdus iliacus</i>	0.247	0.305	-1.044	0.289	<i>Pinicola enucleator</i>	0.012	0.155	1.217	0.144
<i>Phoeni. phoenicurus</i>	0.245	0.377	-1.496	0.338	<i>Zoothera dauma</i>	0.007	0.360	1.460	0.325
<i>Carp. erythrinus</i>	0.245	0.459	0.463	0.454	<i>Luscinia cyane</i>	0.007	0.311	1.423	0.282
<i>Saxicola lorquala</i>	0.221	0.351	-3.001* <sup>1</sup>	0.236	<i>Muscicapa latirostris</i>	0.007	0.347	0.525	0.342
<i>Turdus obscurus</i>	0.185	0.297	-0.041	0.297	<i>Sturnus vulgaris</i>	0.007	0.335	0.882	0.322
<i>Aero, schoenobaenus</i>	0.145	0.601*	-1.830	0.512	<i>Emberiza citrinella</i>	0.005	0.389	1.008	0.370
<i>Anthus trivialis</i>	0.131	0.162*	1.094	0.153	<i>Lanius collurio</i>	0.005	0.335	0.704	0.327
<i>Phyllos. trochiloides</i>	0.128	0.452	-0.757	0.439	<i>Muscicapa striata</i>	0.005	0.408	2.201*	0.324
<i>Parus ater</i>	0.128	0.681*	2.370*	0.526	<i>Emberiza leucocephala</i>	0.002	0.445	0.982	0.424
<i>Carpodacus roseus</i>	0.114	0.348	-0.249	0.347	<i>Saxicola rubetra</i>	0.001	0.357	0.738	0.347
<i>Luscinia sibilans</i>	0.112	0.425	-0.992	0.405					
					TOTAL	22.195	0.695	0.866	0

N = mean number of pairs/100 ha;

CVc = coefficient of variation in numbers, corrected to a common sample size (N=10), based on Svensson's prediction;

tb = Student's significance test of the population trend (regression of numbers by years); P < 0.05;

CVrc = coefficient of variation in residual numbers (without the effect of the trend), corrected to a common sample size (N=10), based on Svensson's prediction;

\* = significance of the deviation from Svensson's prediction at P < 0.05.

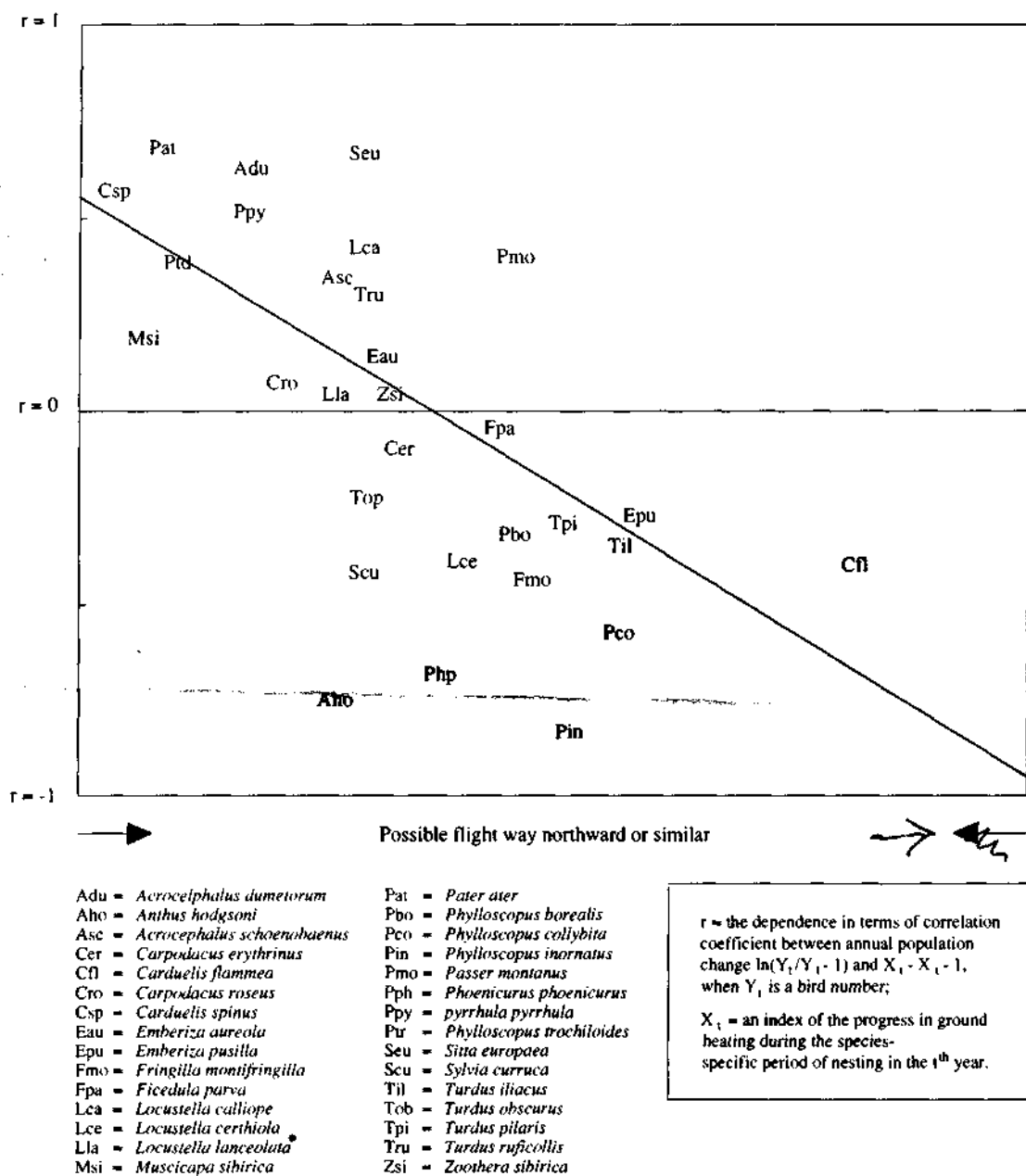
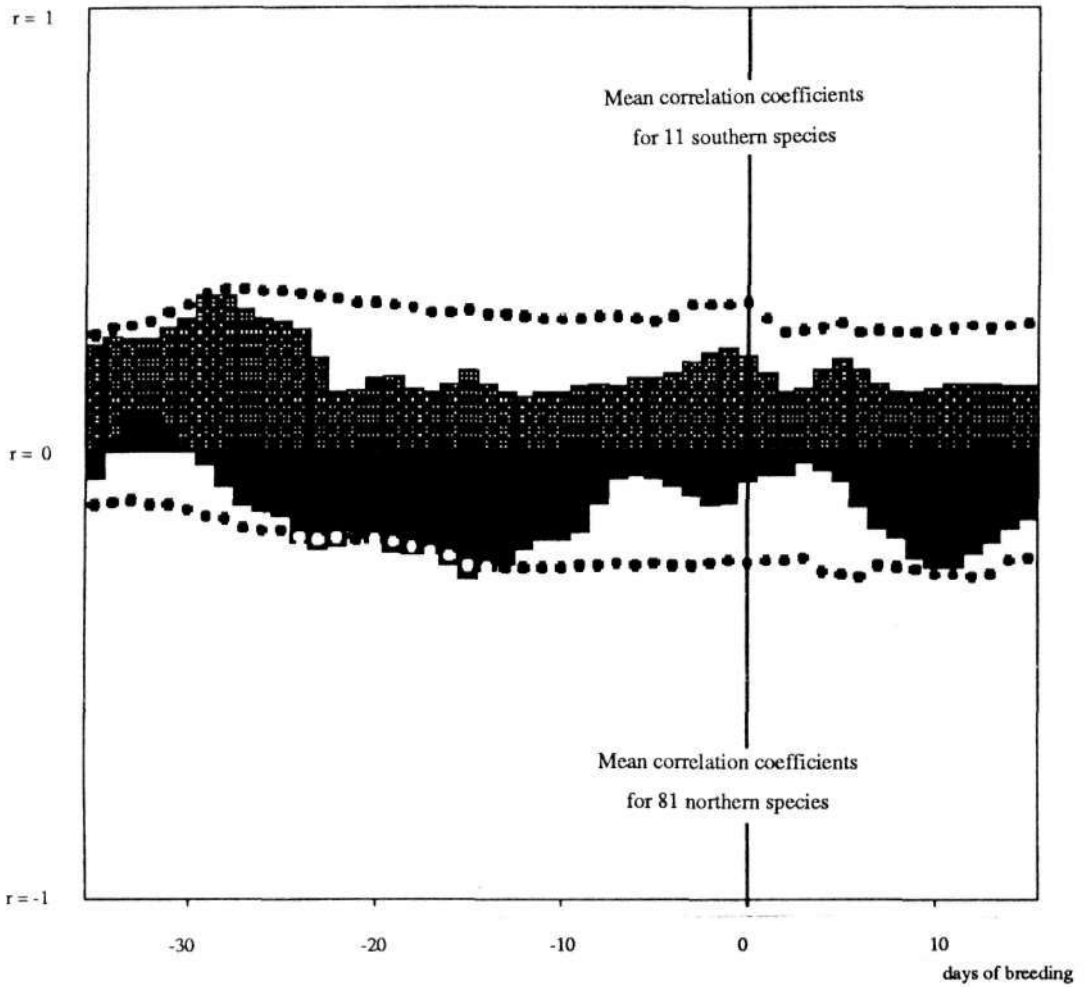


Fig. 1. The dependence of the population growth index on the spring phenology in bird species with different breeding ranges.



$r$  = the dependence in terms of correlation coefficient between annual population change  $\ln(Y_t/Y_{t-1})$  and weather change  $X_t - X_{t-1} - 1$ , when  $Y_t$  is a bird number;  
 $X_t$  = a index of the progress in snow melting and ground heating (dots) or daily mean air temperature (bars) on a certain day of the species-specific breeding season in the  $t^{\text{th}}$  year.

Fig. 2. The dependence of the population growth index on weather conditions during arrival and the beginning of nesting period.

An analysis of variance of the Siberian species, in which a correction was made for a trend, a tendency to increase instability in the early nesting species ( $r=0.219$ ,  $t=1.353$   $P<0.05$ ) with more northern breeding range ( $r=0.233$ ,  $t=1.445$ ,  $P<0.05$ ) could be distinguished. Early arriving species and species wintering not far from the breeding sites showed significantly larger fluctuations ( $r=0.387$ ,  $t=2.486$ ,  $P<0.05$  and  $t_{djr}=2.063$ ,  $P<0.05$  respectively). Thus, those species which spend more time at higher latitudes, have heavily fluctuating numbers, though this trait alone does not provide an exhaustive explanation (e.g., Von Haartman 1971).

#### **Influence of weather conditions**

The search for a relationship between the annual population changes and weather conditions failed for the few most abundant and typical species of the middle taiga but it was fruitful for species of more northern or southern origin. Indeed, southern species showed a positive correlation between their numbers and positive spring events (e.g., early warm temperatures), while northern species were likely negatively correlated (figure 1). The progress of snow melting and consequently the heating of the ground reflected best the large and constant influence of spring phenology (figure 2), probably due to the direct relation with vegetation development.

Weather conditions as such only played a role in certain periods. Southern species were most sensitive to weather conditions just prior to their arrival. Their appearance often followed an invasion of warm air. Great numbers of northern species were connected with the return of cold weather during their mass migration, what could lead to a loss of migration condition and the development of mating behavior, as was evidently shown by experiments (Shumakov *et al.* 1975).

One more critical point was apparently the beginning of hatching, when birds often left their

clutches and breeding sites directly due to bad weather.

#### **Changes in bird numbers related to food**

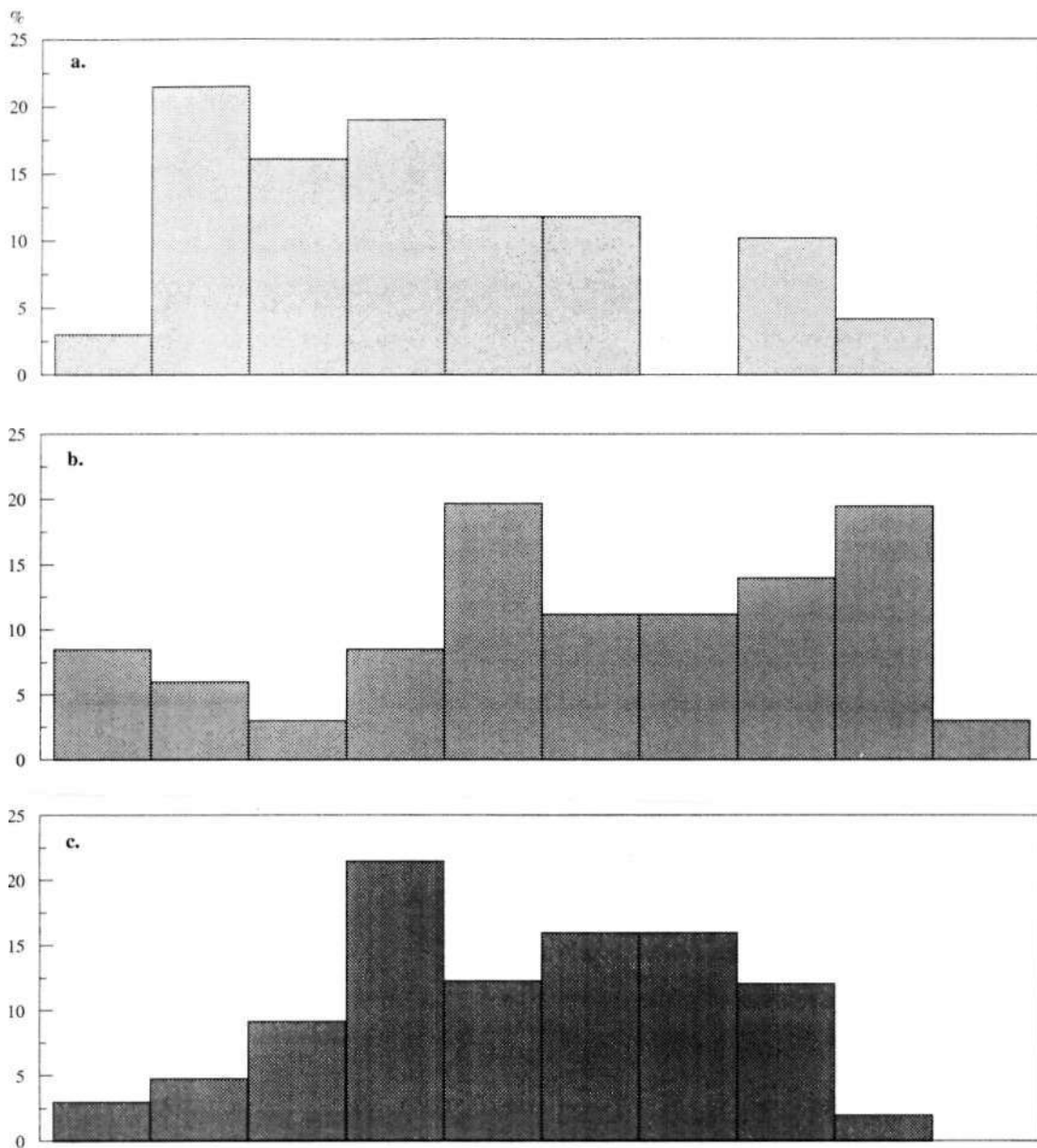
Population changes in granivorous species depended on the crop of particular food item. Seeds of cedar *Cedrus spec.*, and spruce *Picea spec.*, were the most important cause for fluctuations of Nuthatch *Sitta europaea*, Willow Tit *Parus montanus* and Coal Tit *P. ater*. Dynamic patterns of local populations of *Acrocephalus* and *Locustella spp.* were affected by spring floodtime length, though more often it touched their habitat replacement only.

#### **Clustering of species**

Annual changes were obviously synchronized in birds with common winter quarters and migration routes, despite of many prevailing local influences. By means of ANOVA it was revealed that species grouping in three clusters (residents, migrants of west and of east sectors) accounts for 7.4% of the variance in annual changes ( $F=2.78$ ,  $P<0.01$ ), while the integrity of each particular cluster was also sufficient. Grouping in 8 regional clusters explained up to 28.2% of this variance. In general, there were both many species with prominent fluctuations and few species with clear long-term trend in Yenisei taiga. Species wintering not far from their breeding sites showed a slight tendency to increase their numbers, while migrants showed declining trends that were more obvious in long-distance migrants of the western sector.

## **DISCUSSION**

Despite the weakness of any particular trend, their relationship with both remoteness and latitude is highly significant ( $f=4.1$ ,  $P<0.05$  and  $f=3.5$ ,  $P<0.05$  respectively). This one more time points out the apparent threatening conditions in the African winter quarters and, perhaps, in some regions in South Asia. Comparison of trends



**Fig. 3.** Frequency distribution of trends in passerine species (correlation of numbers by years).

*a. 36 migration species trapped in the eastern Baltic in 1960-1981 (Payevsky1985);*

*b. 37 breeding species censused in southern Finland in 1970-1980 (Solonen1986);*

*c. 65 breeding species censused in the Yenisei middle taiga in 1970-1991 (own data).*

distribution in three selected samples (figure 3) indicates that the Siberian passerine community is less stable on a short-term scale but more stable on a long-term scale.

Both European samples have huge extreme frequency classes, wherein decreasing or increasing species predominate. The Finnish picture seems to be due to the relatively local effects of forest structure succession, while the Baltic situation, with few common species increasing and most of others declining, seems to be more representative (due to the method and numbers) and realistic. Thus the Siberian community looks optimistic, taking into account that extremely deviating species are meadow birds undergoing a local succession.

However, slight trends exist and it is remarkable that there is a significant correlation

between positive trend expression and year-to-year instability ( $r=0.292$ ,  $t=2.372$ ,  $P<0.05$ ). Such correlation is in accordance to the evolutionary theory that progressive species are more likely to be r-strategists, thus being numerous, weakly specialized, less stable and able to occupy new unstable resources. I think it is really so in at least the Yellow-browed Warbler *Phylloscopus inornatus*, which is placed in the very upper right corner. Arctic Warbler *P. borealis* has an opposite position and opposite traits, accompanying with high breeding site tenacity, like the neighboring species. If so, the last species (with small fluctuations and maybe slightly declining) are special subjects for nature conservation.