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Nikolay P. Karaivanov

Changes in composition and structure of breeding bird communities due to successive changes in ecosystems

Authors' address:
Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1000 Sofia, Bulgaria.

Correspondence:
Nikolay P. Karaivanov
Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1 Tsar Osvoboditel Blvd., 1000 Sofia, Bulgaria.
e-mail: nikkaraivanov@gmail.com

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ABSTRACT

Successive changes in ecosystems are due to natural and/or anthropogenic influences. These changes influence species richness and structure of phyto- and zoocenoses. Birds represent a good indicator for changes of habitats type. Four types of habitats were closely examined. Those habitats were low-grass stone steppe, high-grass steppe, steppe with presence of single shrubs, open areas with prevalence of Jeruselem thorn and low-grown trees and low forests. Species richness increases with the rising of both grass stature and thickness of shrubs. In the low-grass steppe ecosystems only 8 breeding species are present, whereas in low forests - 31. Highest density was observed in the open areas with shrubs – approximately 43 p/10ha, whereas in the low-stemmed forests it decreases to 14.66 p/ha. The percentage of dominant species decreases and those of satellite species increases from 3 in steppes to 25 in woods. The value of Sorensen's similarity coefficients (over 70%) shows high similarity between species richness of low-grass steppe and high-grass steppe. Similarity between open areas and low-grown woods is over 60%.

Key words: birds, breeding communities, Dobrudzha, dominant species, density, successive changes

Introduction

Most changes in the ecosystems are due to either natural or anthropogenic influences. These changes have great impact on the species richness and structure of the phyto- and zoocenoses. A considerable part of changes is due to the human activity. Typical examples of anthropogenic influence are desolated lands, which used to be under cultivation, pasture, conflagrations, woodcutting areas etc. At the same time, there are natural processes that lead to changes in vegetation structure and composition, and therefore to changes in structure of animal societies. Birds are a good indicator for changes of habitat types. Undoubtedly, successive changes in ecosystems, starting from steppe, through shrub-areas, to open steppe areas with low-grown trees also lead to changes in species richness, as well as in the structure of bird communities.

Investigations on the composition of ornithocenoses of the steppes at Kaliakra cape have been conducted by Ivanov & Nonev (1997), and along Northern Black Sea coast by Ivanov et al. (1998). Ecological studies on the ornithofauna have been performed in the low forests in Dobrudzha, as well as in the region of Suha reka (Karaivanov et al., 2006).

The aim of the current study was to establish the species composition, number, density and dominant structure of breeding bird communities in ecosystems at different stages of succession, as well as to determine the influence of grass-stature on species density.

The steppe phytocenoses along the Northern Black Sea coast between Balchik and Durankulak lake as well as open grass areas and low-grown woods in the region of Balchik and Suha reka were investigated during the period 1996-2007. The investigated region includes the natural steppe areas along the Northern Black Sea coast.

Five main working sites were set:

1. An open low-grass steppe area without bushes, with significant anthropogenic influence. The size of this site is 60 ha.

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2. An open high-grass steppe area without bushes. The grass-stature of this site is from 20 to 40 cm and its size is 120.2 ha.

3. Open steppe areas with presence of single Jeruselem thorn (*Paliurus spina-christi* Mill., Gard., Dict.), oriental hornbeam (*Carpinus orientalis* Mill.), smoke-tree (*Cotinus coggygria* SCOP.), dog rose (*Rosa canina* L.), common howthorn (*Crataegus monogyna* L.) with total area of 119 ha.

4. Open areas with low-grown trees and shrubs - oriental hornbeam, oak tree (Quercus sp. L.), flowering ash (*Fraxinus ornis* L.), European black pine (*Pinus nigra* ARN.), Jeruselem thorn. The height of the trees is 2 to 6 m and the total surface of these areas is 72.3 ha.

Low forests with prevalence of oriental hornbeam, Mahaleb cherry (*Prunus mahaleb* L.), flowering ash, smooth-leaved elm (*Ulmus campestris* L.) with total area of 118 ha.

Materials and Methods

Our field investigations were conducted between 1996 and 2007. They included bird-breeding season in the regions mentioned above.

For establishing of species composition, number and density of breeding birds the line transects method was used (Bibby et al., 1992). This method gives the investigator an opportunity to study a larger area and estimate the species richness and parameters of breeding bird communities in open monotonous areas with a high degree of accuracy.

For comparison of the faunistic similarity between the studied communities, Sorensen index was used. Renkonnen's index was used for measuring similarity between communities, based on their dominant structure. To determine the dominance of single groups in the community we adopted the values used by Muehlenberg (1993).

Results and Discussion

After examination of the five types of habitats (Figure 1) along the Black Sea coast (low-grass stony steppe, high-grass steppe, steppe with single shrubs, open grass areas with presence of Jeruselem thorn and low-grown trees and small woods), the following results were obtained:

Species richness of breeding birds rises with the increase of both grass stature and thickness of shrubs. On the steppe (Site 1), which is used as pasture and is therefore low-grass-stature area, hardly 8 breeding species were established, whereas in the low-grown woods were found 31.

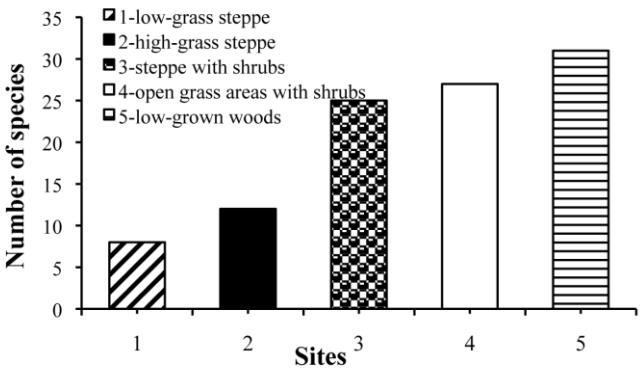

Figure 1. *Number of breeding bird species on the five investigated sites.*

The species density (Figure 2) is also rising as both grass stature and thickness of shrubs increases. It was nearly equal in both high-grass steppe and steppe with presence of single shrubs. The highest density was established in the open grass areas with single trees and shrubs – approximately 43 p/ha. In low-grown woods the density decreases sharply to 14.66 p/ha.

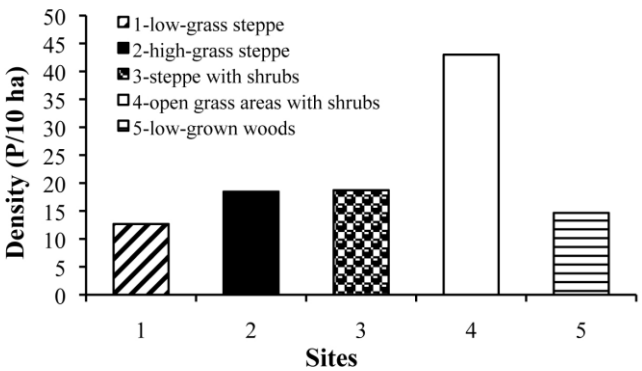

Figure 2. *Density of breeding birds (p/10ha).*

The established species were divided into dominant, subdominant and satellite, according to their percentage of the total number of individuals from all species. Figure 3 shows the total presence of each category in the five investigated areas. The highest percentage show three species of Larks, which dominate in low-grass steppes. They show total presence of 80%. In the steppe areas with shrubs, the part of dominant species is about 50%. In low forests, the percentage of satellite species increases to approximately 40%.

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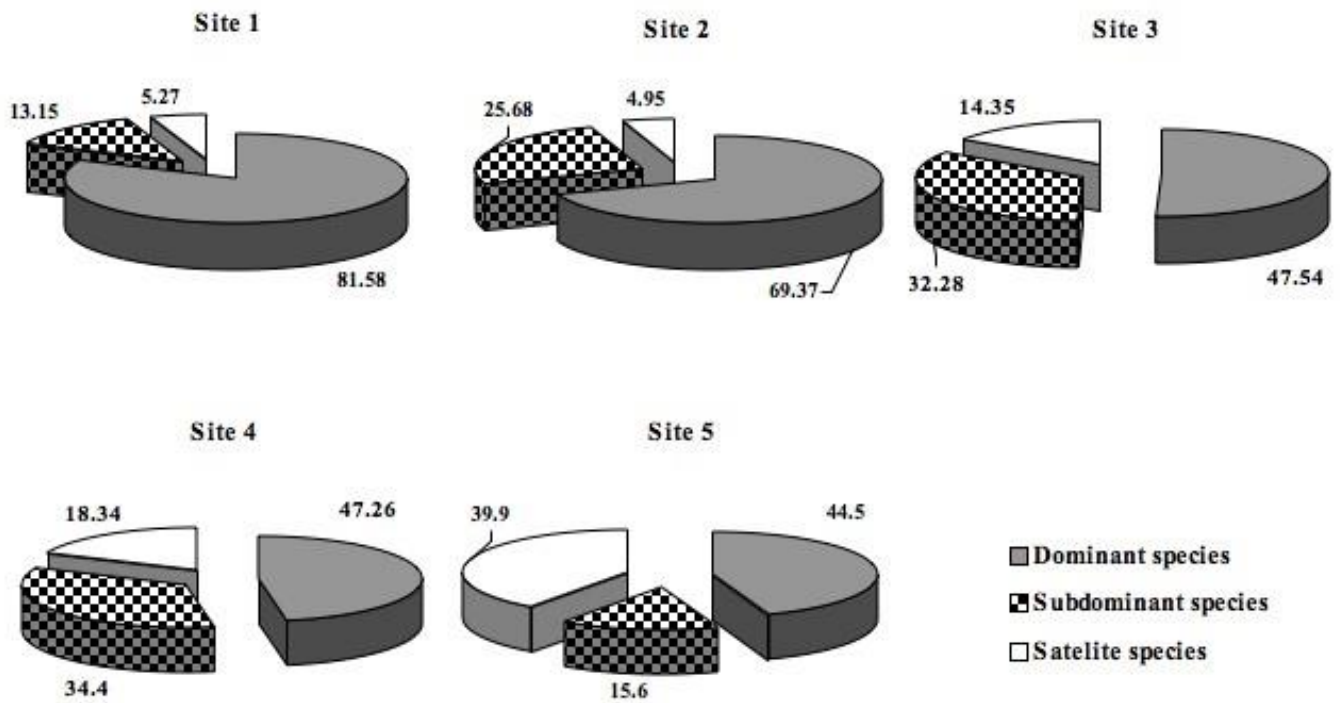

Figure 3. *Dominant structure of breeding-bird communities of different sites (%).*

The dominant structure of ornithocenoses according to the number of species in each category (dominant, subdominant and satellite species) is shown in Figure 4. The number of dominant species in all sites was equal – 3 species, with the exception of the site No 2, with 2 dominant species.

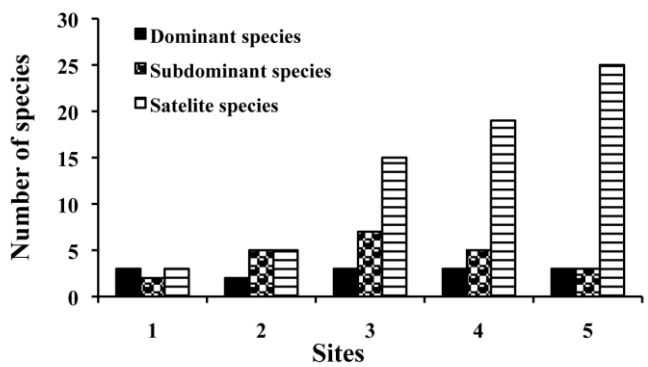

Figure 4. *Dominant structure of breeding-bird communities of different sites (number of species).*

In the steppe areas, dominant species were larks. In the open areas with shrubs and single trees, dominant species were red-backed shrike (*Lanius collurio* L.), corn bunting (*Miliaria calandra* L.) and barred warbler (*Sylvia nisoria* BECHSTEIN). In low-grown woods dominant species were golden oriole (*Oriolus oriolus* L.), blackbird (*Turdus merula* L.) and nightingale (*Luscinia megarhynchos* BREHM). The number of satellite species (species with presence up to 3%) increases gradually to 25% in low-grown woods.

Larks were dominant in the three different steppe areas, but the proportion between the three species shows differences in each type of the steppe areas. In low-grass steppes, which are used as pastures, skylark (*Alauda arvensis* L.), and short-toed Lark (*Calandrella brachydactyla* LEISLER) predominated in percentage (Figure 5). In high-grass steppe as dominant species appears the calandra lark (*Melanocorypha calandra* L.), which constituted 48.2% of all individuals. In areas with shrubs, the total presence of the tree species larks decreased, due to the presence of other species – buntings, shrikes, etc. Despite that, the percentage of calandra lark remained twice as high as those of the other two species larks. Skylark showed a trend toward decrease in percentage.

If the density of the dominant species is considered, it is obvious that at sites with low grass stature (up to 10 cm), skylark and short-toed lark predominate (Figure 6).

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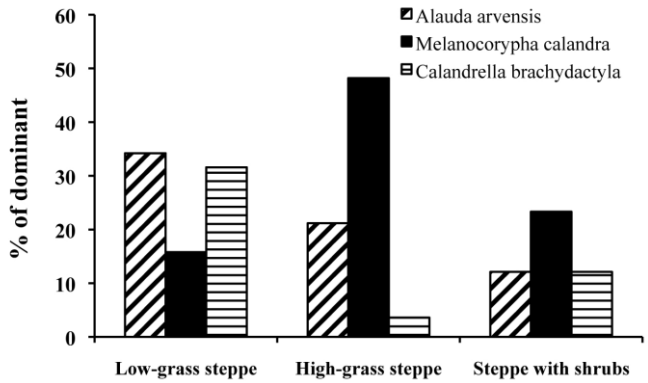

Figure 5. *Part of dominant species of larks in steppes.*

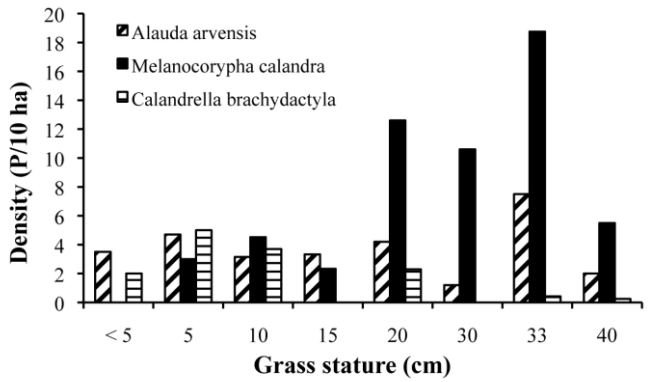

Figure 6. *Dependence of density of larks on the grass stature.*

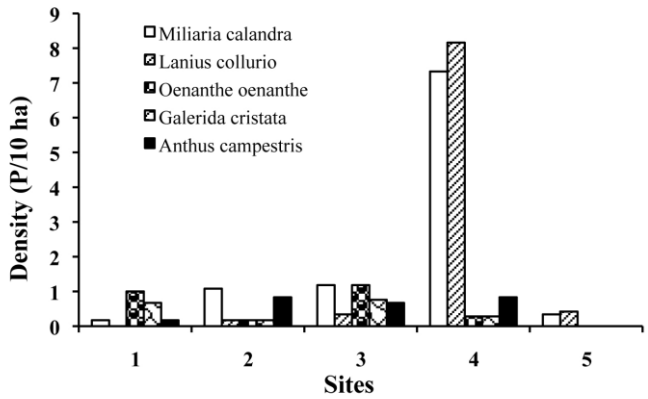

Figure 7. *Density of some frequent species.*

As grass stature increases these two species are being succeeded by calandra lark, which sharply dominated in the areas with grass stature from 20 to 30 cm. Skylark shows a good density in all types of habitats examined, but the values are the highest in habitats with grass stature above 30 cm. In comparison to calandra lark however, the density of skylark is more than twice as low. Short-toed lark shows a clear trend toward decrease of density as grass-stature increases.

Besides larks being frequent as species, red-backed shrike, northern wheatear (*Oenanthe oenanthe* L.), crested lark (*Galerida cristata* L.), tawny pipit (*Anthus campestris* L.) were present in almost all areas studied. All of these species were established in 4 out of 5 sites, except for corn bunting, which were found in all sites.

The densities of these species vary widely (Figure 7). Despite being found in all ecosystems, corn buntings prefer open grass phytocenoses with presence of shrubs and trees. In these areas, red-backed shrike shows high density as well. The northern wheatear prefers steppes and avoids fields with high grass stature.

The values of Sorensen's similarity coefficient (over 70%) showed high likeness in species richness of low-grass steppe and high-grass steppe (Table 1). Similarity between open areas and low-grown woods is over 60%. Altogether, 18 species are common for the two sites. These are mainly species connected to the shrubby and woodland assemblages.

Table 1. *Similarity between communities shown by the values calculated for Sorensen's and Rennkonen's coefficients.*

Plots	1	2	3	4	5
1	Qs Re	45	55.59	3.92	1.32
2	70		60.15	19.3	3.21
3	48.5	59.46		21.1	12.91
4	22.86	41.02	53.85		37.73
5	5.13	9.3	42.86	62.07	

Rennkonen's similarity coefficient showed resemblance between steppes with shrubs and both low- and high-grass steppe. For the other sites, this index showed very low values. This is due to the absence of the main dominant species for steppes – larks, in sites 4 and 5.

Acknowledgement

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