Correlation between species number and homogeneity in plant communities of the Lithuanian seacoast

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Peculiarities of two characteristics (species number and homogeneity) describing plant communities of the Lithuanian seacoast are discussed. A correlation between these characteristics and their importance for distinguishing the stage and climax of communities are evaluated. An inverse correlation was defined between species number and homogeneity in the communities. Two maximum peaks of homogeneity were determined in the successional sequence of seacoast plant communities. This phenomenon is related with edaphic climax conditions in the communities of white dunes (*Elymo-Ammophiletum arenariae* Br.–Bl. et de Leeuw 1936) and climate climax in an old mixed forest near Juodkrantė.

Key words: Lithuanian seacoast, plant communities, succession

INTRODUCTION

The geomorphologic structure, soil peculiarities, as well as the species composition and structure of plant communities are rapidly developing in the zone of the Lithuanian seacoast [1]. Coastal plant communities are affected by many biotic and abiotic factors, and their balance determines the stability and continuity of community structure. The ecotope heterogeneity determines the diversity of plant communities. The gradient of climatic and geomorphologic conditions (affected by the sea) predetermines the distribution sequence of successional stages in the direction from west to east. Undoubtedly, the monodominant swards of *Ammophila arenaria, Calamagrostis epigejos, Leymus arenarius* and *Honckenya peploides* developing the accumulative sand mounds are the initial stage in the succession of coastal plant communities. However, it is rather difficult to assess what is the final (climax) stage of this succession [2]. Investigations of community structure, soil characteristics, their change, and estimation of their effect on vegetation could help to elucidate the peculiarities of the initiation and further development of plant communities situated in the Lithuanian seacoast.

The aim of this work was to reveal a correlation between species abundance and homogeneity of the plant communities in the coastal zone of Lithuania and to evaluate the importance of these characteristics for distinguishing successional stages.

MATERIALS AND METHODS

The investigations were provided in the Curonian Spit and the coastal zone between Klaipėda and Šventoji. Phytosociologic relevés and classification of communities were provided according to the principles of J. Braun-Blanquet school [3]. The names of syntaxa correspond to and fulfil the requirements of the "Code of Phytosociologic Nomenclature" [4].

The Koch index for biologic dispersion (Koch coefficient, K_k) was employed to evaluate the homogeneity of plant communities [5]:

$$K_k = \frac{T-S}{(n-1)S}, \text{ where } S \text{ is a species number in}$$

a community; $T = \sum_{i=1}^{n} S_1 + S_2 + ... + S_n$; n is the number of relevés.

For more convenience, the Koch coefficient was expressed in percentage.

RESULTS AND DISCUSSION

The number of species in plant communities of the Lithuanian seacoast changes according to a cascade principle (Figure). In the initial stages of succession (*Elymo-Ammophiletum* subass. *typicum, Elymo-Ammophiletum* subass. *festucetosum sabulosae, Elymo-Ammophiletum* subass. *artemisietosum*) the number of species is continuously growing. New plant species settle down in the communities as the impact
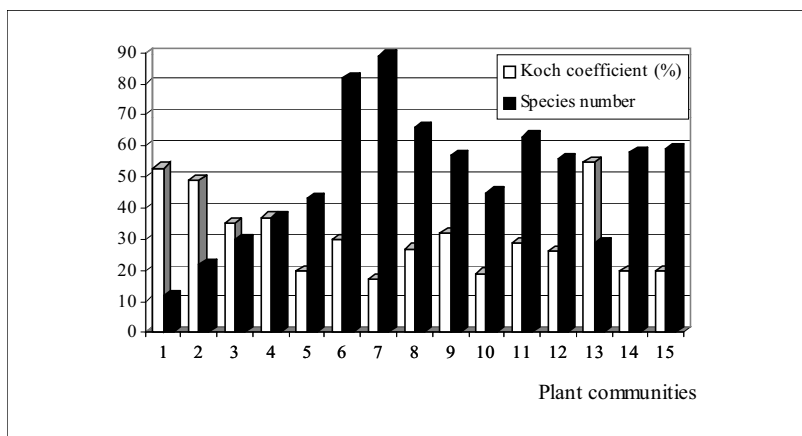
Figure. Correlation between species number and Koch coefficient.
1–15 – communities: 1 – *Elymo-Ammophiletum* subass. *typicum*; 2 – *Elymo-Ammophiletum* subas. *patasitetosum*; 3 – *Elymo-Ammophiletum* subass. *festucetosum sabulosae*; 4 – *Elymo-Ammophiletum* subass. *artemisietosum*; 5 – *Carex arenaria* stage communities; 6 – *Helichryso-Jasionetum*; 7 – *Empetrum nigrum* stage communities; 8 – *Betula pendula* stage communities of the seaside palve; 9 – *Empetro nigri-Pinetum* subas. *typicum*; 10 – *Empetro nigri-Pinetum* subass. *cladonietosum*; 11 – *Empetro nigri-Pinetum* subass. *pyroletosum*; 12 – *Betula pendula* stage communities of the lagoon-side palve; 13 – *Querco-Piceetum*; 14 – *Alnus glutinosa* stage communities of the seaside palve; 15 – *Alnus glutinosa* stage communities of the lagoon-side palve

of this or that abiotic factor (wind, shifting sand, changes in temperature or humidity) decreases. The *Helichryso-Jasionetum* and *Carex arenaria* communities that develop in the palve ecological belt represent the following stages of succession. The number of species in these communities rapidly increases almost two times, because the psammophyte species characteristic of white dune vegetation are found together with the species typical for grey dune vegetation. The largest number of species is present in the communities of the *Empetrum nigrum* stage. These communities represent both the spatial and successional ecotope between two different types of vegetation (open sand grasslands and forests). In forest, the species number rapidly decreases as compared to the adjacent *Calluna vulgaris* communities, and within the forest communities the variation of species number is insignificant. Discussions among ecologists and geobotanists still continue on a problem if species abundance is characteristic of climax stage communities. There are opinions that this feature is characteristic of the initial stage communities, or it is an ordinary adaptation to the diversity of ecotopes [6, 7]. To provide more objectivity, the homogeneity degree of communities was additionally analysed (Figure). Homogeneity was measured using the Koch coefficient.

The analysis revealed that the homogeneity of coastal vegetation is inversely proportional to the species number of communities (Figure).

The largest homogeneity has been measured in the communities of coastal foredune. In the communities situated further from the coastline homogeneity decreases, and the minimum value is reached in *Empetrum nigrum* communities which are richest in species. Homogeneity increases again in the forest communities developed further inland and reaches its maximum in the oldest forest. Thus, there are two homogeneity peaks (in the first and the last stage) in the succession of Lithuanian coastal vegetation. These stages extremely differ from each other: they have no common species, differ in ecotope characteristics, and belong to different vegetation types.

Open sand vegetation is an azonal vegetation type in Lithuania. The *Elymo-Ammophiletum arenariae* communities developing on the foredunes of the Lithuanian seacoast result from the influence of marine conditions on the inland vegetation. In the areas closely attached to the sea the impact of marine conditions is the highest, that is why the communities are very homogeneous, and the number and composition of species is optimal. According to the polyclimax theory developed by R. H. Whittaker [7, 8], these communities represent an edaphic climax.

In the areas situated further inland the direct impact of the sea is weaker. Communities of these areas include less psammophyte and more xerophyte and mesophyte species characteristic of the zonal vegetation type (mixed forest). In palve plains covered with *Empetrum nigrum* stage communities, abiotic environmental conditions and the character of their influence cardinally change. The species characteristic of two different vegetation types intermix in these communities, that is why the species number is highest and the homogeneity is lowest there. In the communities developed further inland, the succesion is directed towards the zonal vegetation type which is represented by the mixed forest. The second peak of homogeneity is observed in the old mixed forest near Juodkrantė. These communities represent a climax stage of the Lithuanian climatic zone according to monoclimax theory [7].

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RŪŠIŲ SKAIČIAUS IR HOMOGENIŠKUMO KORELIACIJA LIETUVOS PAJŪRIO AUGALŲ BENDRIJOSE

S a n t r a u k a

Straipsnyje nagrinėjami dviejų (iš daugelio) Lietuvos pajūrio augalų bendrijas apibūdinančių parametrų, rūšių skaičiaus ir bendrijų homogeniškumo, kitimo dėsningumai, jų koreliacija bei įtaka stadijinėms ir klimaksinėms bendrijoms nustatyti. Nustatyta, kad tarp rūšių skaičiaus ir bendrijų homogeniškumo yra atvirkštinė koreliacija. Lietuvos pajūrio augalų bendrijų sukcesinėje sekoje bendrijų homogeniškumo atžvilgiu yra du maksimumai, baltųjų kopų *Elymo-Ammophiletum arenariae* bendrijose jos atspindi edafinį klimaksą ir senojo Juodkrantės mišraus miško bendrijose, kurios atitinka mūsų klimatinės juostos augalijos klimaksą.