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Variety of habitats associated with common juniper (*Juniperus communis* L.) growing in Lithuania

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Common juniper (*Juniperus communis* L.) is an important conifer from the ecological and economical point of view. In some areas of the distribution range, it is a widely studied species. Up till now insufficient attention has been paid to junipers growing in the Baltic countries where it is one of three natural conifers and important forest tree species. Recently, molecular markers-based diversity of Lithuanian populations of *J. communis* was determined, although related biological and ecological variables remain undisclosed. The present study is aimed at the evaluation of biotic and abiotic environment of *J. communis* according to plant species composition. Fourteen sites with *J. communis* were selected in the territory of Lithuania. At each site undergrowth trees and shrubs, herbaceous species, dwarf shrubs, and mosses were recorded and the abundance of each species was evaluated. Abiotic environment characteristics were obtained using Ellenberg's indicator values (EIV) of the plant species neighbouring junipers. In the sites with *J. communis*, 80 species of herbs and dwarf shrubs belonging to 18 families were registered. The largest variety of herbaceous species and dwarf shrubs (18–22 per site) was registered for sites representing xero-thermophile fringes. Species coverage data recorded in the sites in most cases allowed to group sites according to their habitats. Despite rather small territory of the present survey (latitude (N) 56°07'–54°11', longitude (E) 21°06'–26°30'), the ranges of indexes for environment factors of juniper sites were rather wide: 6.0–7.3 for light, 3.0–5.8 for temperature, 3.7–5.3 for continentality, 4.2–7.8 for soil moisture, 2.7–7.4 for soil reaction, and 2.7–4.4 for soil nitrogen. Among the sites selected by us, the most contrasting in terms of EIV were locations representing coastal brown dunes covered with natural Scots pine forests and xero-thermophile fringes.

Keywords: conifers, Ellenberg's indicatory values, EIV, habitats, species abundance, herbaceous plants

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INTRODUCTION

Juniperus species are substantial elements of present-day forests (Garcia et al., 2000; Adams, 2011) and some of them are on the border of extinction (Lima et al., 2010; Rumeu et al., 2011; Silva et al., 2011). This historically old genera is important for providing information about evolution of plants in Late Glacial period (Koller et al., 2005; Li et al., 2011, Veski et al., 2012). *Juniperus* contains economically valuable species used for medicinal purposes (Muto et al., 2008; Kusari et al., 2009), perfume industry (Lawrence, 1984), flavoring of food and alcoholic beverages (Maarse, 1991; Vichi et al., 2007). These circumstances point out the need of comprehensive knowledge about *Juniperus* species.

Juniperus communis is widely distributed over the Northern hemisphere, growing in Europe and three other continents. Junipers have been examined by molecular and biochemical markers in various regions of their natural occurrence (Canary Islands, Greece, Germany, UK, Russia, Japan, China, Kazakhstan, Nepal, Ethiopia, Guatemala, Cuba, Mexico, Utah, Texas, etc. (Adams et al., 2003; Adams, 2011). Examination of variables of environment extends information complementary to biological data. Broad geography of this species is inevitably related to various conditions of abiotic and biotic environment. Wide range of temperature, light and continentality conditions are characteristic of this plant (Clifton et al., 1997). It may grow in a wide range of soils of varying acidity, moisture and nutrients (Barkman, 1985; Thomas et al., 2007).

Various juniper-associated habitat types are documented for Europe (Helsinki Commission, 1998; Devillers et al., 2001; Davies et al., 2004; Hill et al., 2004a; 2004b; ILE SAS, 2005a; 2005b; 2006). Due to wide geography, juniper shrubs belong to many associations and even to different classes (*Vaccinio-Piceetea*, *Querco-Fagetea*, *Rhamno-Prunetea* and *Festuco-Brometea*). Most comprehensive diversity studies of European *J. communis* were performed only in some countries of Western Europe (Rosen, 1982; Barkman, 1985; Van Der Merwe et al., 2000). Species composition in *J. communis* associations is described fragmentally and concerns only a small part of its distribution range (Barkman, 1985; Thomas et al., 2007). In order to obtain broader knowledge about this species, different areas of its distribution range should be investigated.

Up until now, insufficient attention has been paid to junipers growing in the Baltic countries where it is one out of three naturally growing conifers as important species of forest trees. Near the Baltic Sea, *J. communis* is represented by two vegetation forms (tree or shrub) and belongs to one (ssp. *communis* (Syme)) out of four subspecies (ssp. *nana* (Hook), ssp. *hemisphaerica* (J. & C. Presl) Nyman, ssp. *depressa* (Pursh) Franko; Thomas et al., 2007). Scarce data about junipers is opposite to extensive information collected for *Pinus sylvestris* and *Picea abies* of this region (Ozolinčius, 1999; Žvingila et al., 2002; Areškevičienė et al., 2005; Kupčinskienė, 2006; Danusevičius et al., 2015). In Lithuania, the biggest attention has been paid to essential oils of the needles and seeds of *J. communis* (Butkienė et al., 2006; Labokas, Ložienė, 2013), some aspects of morphology and anatomy were taken into account (Vaitkevičiūtė et al., 2011a; 2011b), and the role of junipers in surface fires in pine forests has been analyzed (Marozas et al., 2007; 2013). Recently, ISSR markers-based molecular diversity of Lithuanian populations of *J. communis* was determined (Vilcinskas et al., 2016), although related biological and ecological variables remain undisclosed. The present study is aimed at the evaluation of biotic and abiotic environment of the Lithuanian *J. communis* in relation to the abundance of neighbouring herbaceous plant species.

MATERIALS AND METHODS

Selection of sites was based on former dendrological and biochemical surveys of Lithuanian junipers (Vaitkevičiūtė et al., 2011a; 2011b; Labokas, Ložienė, 2013). Fourteen locations with *Juniperus communis* L. were included into the study in order to represent habitat variety and to cover distinct parts of Lithuania, although this species is abundant only in the south-eastern part of the country. The study area comprised sites within following geographical ranges: 56°07'–54°11' (North-South) for latitude, 21°06'–26°30' (West-East) for longitude, and 25–187 m for altitude (Vilcinskas et al., 2016). Climate parameters of population sampling sites were as follows: 7.2–8.8 °C for annual mean temperature, 12.8–14.0 °C for vegetation period mean temperature, 632–835 mm for annual rainfall, and 419–502 mm for rainfall of vegetation period (climate characteristics were obtained from the meteorological stations closest to the sampling site). Populations were titled according to the location (the number) and the habitat type (the first letter of the habitat code, following the classification of Davies et al., 2004; Fig. 1).

Records of associated species in the sites with *J. communis* were done within the last decade of June, 2012. For species documentation, 100 m^2 plots were used at each site. The composition of species of undergrowth trees and shrubs, herbaceous plants, dwarf shrubs, and mosses

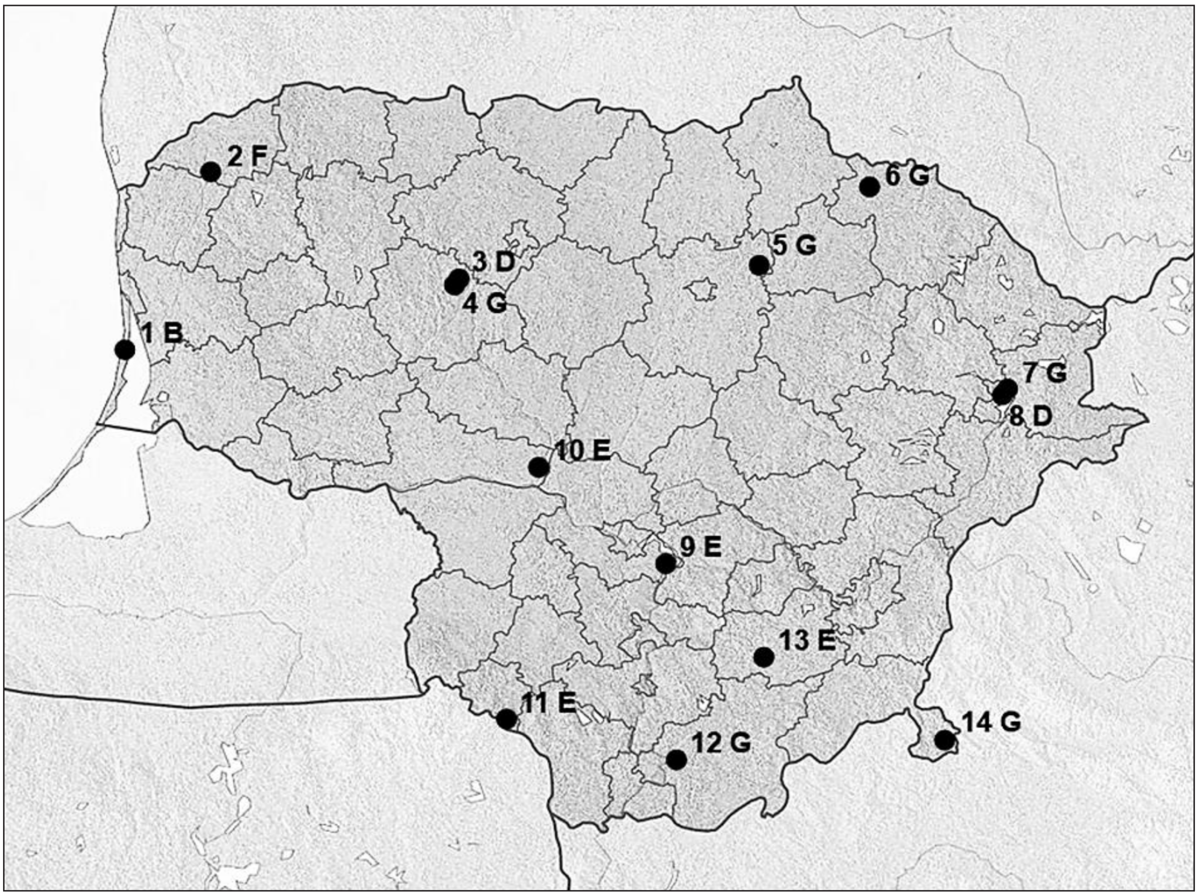

Fig. 1. Study sites of *Juniperus communis* L. growing in Lithuania. Explanation of site codes: 1 – Neringa (N55°30'; E21°06'); 2 – Skuodas (N56°07'; E 21°35'); 3 – Kelmė (N 55°46'; E 22°58'4); 4 – Kelmė (N55°46'; E 22°58'4); 5 – Panevėžys (N55°51'; E24°40'); 6 – Rokiškis (N56°05'; E25°17'); 7 – Ignalina (N55°23'; E26°03'); 8 – Ignalina (N55°23'; E26°03'); 9 – Kaunas (N54°48'; E24°10'); 10 – Jurbarkas (N55°08'; E23°27'); 11 – Kalvarija (N54°15'; E23°17'); 12 – Alytus (N54°09'; E24°12'); 13 – Trakai (N54°30'; E24°42'); 14 – Šalčininkai (N54°11'; E25°42'). E – xero-thermophile fringes; D – transition mires and quaking bogs; G – subcontinental moss Scots pine forests; F – *Juniperus communis* shrubs; B – coastal brown dunes covered with natural Scots pine forests

were recorded and abundance of each species was evaluated by percentage cover as described earlier (Marozas, 2004; 2005). The values of the environment (light, temperature, continentality, soil moisture, reaction and nitrogen) at the sites were estimated using species indicator values (Ellenberg et al., 1991) in proportion to the species percentage cover, applying weighted average method (Jongman et al., 1995) and summarizing separate factor data by STATISTICA v. 7.0 (StatSoft Inc., USA, 2004). Species and sites were evaluated by two-way cluster analyses using PC-ORD 6.0 software (McCune et al., 2011).

RESULTS AND DISCUSSION

There were differences in plant species number, composition and coverage among the Lithuanian sites with *J. communis*. Coverage of *J. communis* was not equal across the sites: this parameter ranged in the interval from 3% (7 G) to 60% (2 F), mean being 18.5%. Coverage by juniper depended on the habitat type, the smallest being for D (transition mires and quaking bogs) habitat (5% as a mean) and the highest for E (xero-thermophile fringes) habitat (36% as a mean). In half of the sites (the B site and all G sites) 1st stand layer with *Pinus sylvestris* was characteristic. Scots pine was the prevailing tree in B and in subcontinental moss Scots pine forest (G habitat) sites, where coverage by pine was 70% (5 G site was an exception, with pine coverage of 40%). For two sites (1 B, 7 G) *Betula pendula* with 10–15% coverage was documented.

In the 2nd stand layer *Picea abies* was found in two sites of subcontinental moss Scots pine forests (G type habitat). Trees and shrubs of the 2nd stand layer were registered for all sites, the number of species per site ranged in the interval 3–7. Among 17 species representing this layer, *Frangula alnus, Quercus robur*, and *Sorbus aucuparia* were the most common ones for most of the sites, except the E habitat type. Coverage higher than 1% was characteristic of the following trees: *Betula pendula* (15% – 1 B; 10% – 7 G), *Picea abies* (5% – 4 G, 7 G), *Malus sylvestris* (2% – 13 E), *Salix cinerea* (5% – 8 D; 30% – 3 D).

In the sites with *J. communis*, 80 species of herbs and dwarf shrubs representing 18 families were registered. The species number for a separate family was as follows: *Asteraceae* – 12, *Poaceae* – 9, *Fabaceae* – 8, *Rosaceae* – 7, *Ericaceae* – 7, *Cyperaceae* – 5, *Equisetaceae* – 3, *Plantaginaceae* – 3, *Apiaceae* – 3. Such data show that Dicots are more spread compared to Monocots and agree with the results obtained in some places of Sweden (Rosen, 1982).

Coverage higher than 1% was characteristic for such herbs and dwarf shrubs as *Calluna vulgaris* (5% – 4 G; 20% – 2 F), *Carex lasiocarpa* (5% – 3 D; 40% – 8 D), *Daucus carota* (5% – 11 E; 3% – 13 E), *Deschampsia flexuosa* (2% – 12 G; 30% – 1 B), *Festuca ovina* (5% – 2 F, 6 G), *Filipendula ulmaria* (5% – 3 D), *Galium mollugo* (3% – 13 E), *Melampyrum pratense* (5% – 1 B, 12 G; 10% – 7 G; 30% – 6 G), *Menyanthes trifoliata* (5% – 3 D), *Molinia coerulea* (3% – 8 D), *Potentilla palustris* (5% – 3 D, 8 D), *Vaccinium myrtillus* (3% – 12 G; 5% – 14 G; 10% – 1 B; 20% – 4 G, 7 G), *Vaccinium vitis-idaea* (5% – 1 B, 6 G, 12 G; 10% – 4 G; 40% – 2 F). Our study is in agreement with the data about other juniper areas where the *Ericaceae* family species were documented as important undergrowth components of conifer forests with *J. communis* (Moir, Ludwig, 1979; DeVelice et al., 1986).

Coverage by mosses was characteristic of juniper sites of B, F, and G habitats, the most spread species were *Dicranum polysetum* (5% – 2 F, 4 G, 6 G, 7 G), *Hylocomium splendens* (5% – 2 F, 4 G; 10% – 14 G; 20% – 6 G, 7 G, 12 G), *Pleurozium schreberi* (10% – 5 G; 30% – 4 G, 7 G, 12 G; 40% – 14 G; 50% – 2 F, 6 G; 60% – 1 B), *Ptilium crista-castrensis* (10% – 4 G), for D habitat type sites *Sphagnum* sp. was documented (10% – 8 D; 50% – 3 D). *J. communis* demonstrates a wide variety of undergrowth types; species registered in our study coincided in general with the list of main species characteristic of related Lithuanian habitats (Rašomavičius, 2012).

In our study, the biggest variety of herbaceous species and dwarf shrubs was registered for xero-thermophile fringes (E type habitats;

18–22 per site), the second was transition mires and quaking bogs (D habitat; 13–15 per site), sites belonging to the other habitats (B, F or G) were less rich in species (6–12 per site). Our results about the number of species in xero-thermophile fringes (E type habitat) were in agreement with 20–25 differential species registered in East Germany, South Sweden, or Central Netherlands (Barkman, 1985).

Employing two-way cluster analysis for the species coverage data in the sites, all species neighbouring junipers were classified into two main clusters (Fig. 2). One, the most distinct cluster comprised 40 species (their list is provided in Fig. 2 title explanations), the second cluster consisted of two subdivisions: 2a contained 34 species, and 2b contained 28 species. In respect to species composition, all juniper sites were also subdivided into two branches: one of them (I) comprised sites of transition mires and quaking bogs (D habitat) as the most distinct habitat, which corresponded to the first cluster of the species. The second site cluster (II) consisted of two subclusters: one of them (II-1) contained the sites belonging to xero-thermophile fringes (E habitat) and one site of subcontinental moss Scots pine forests (5 G), the other subcluster (II-2) formed a branched structure. The branches have subdivided sites according to their habitats into two groups (II-2a and II-2b), the most distinct one was site representing *Juniperus communis* shrubs (F habitat; II-2a). In the II-2b cluster the branches of the next order separated site of

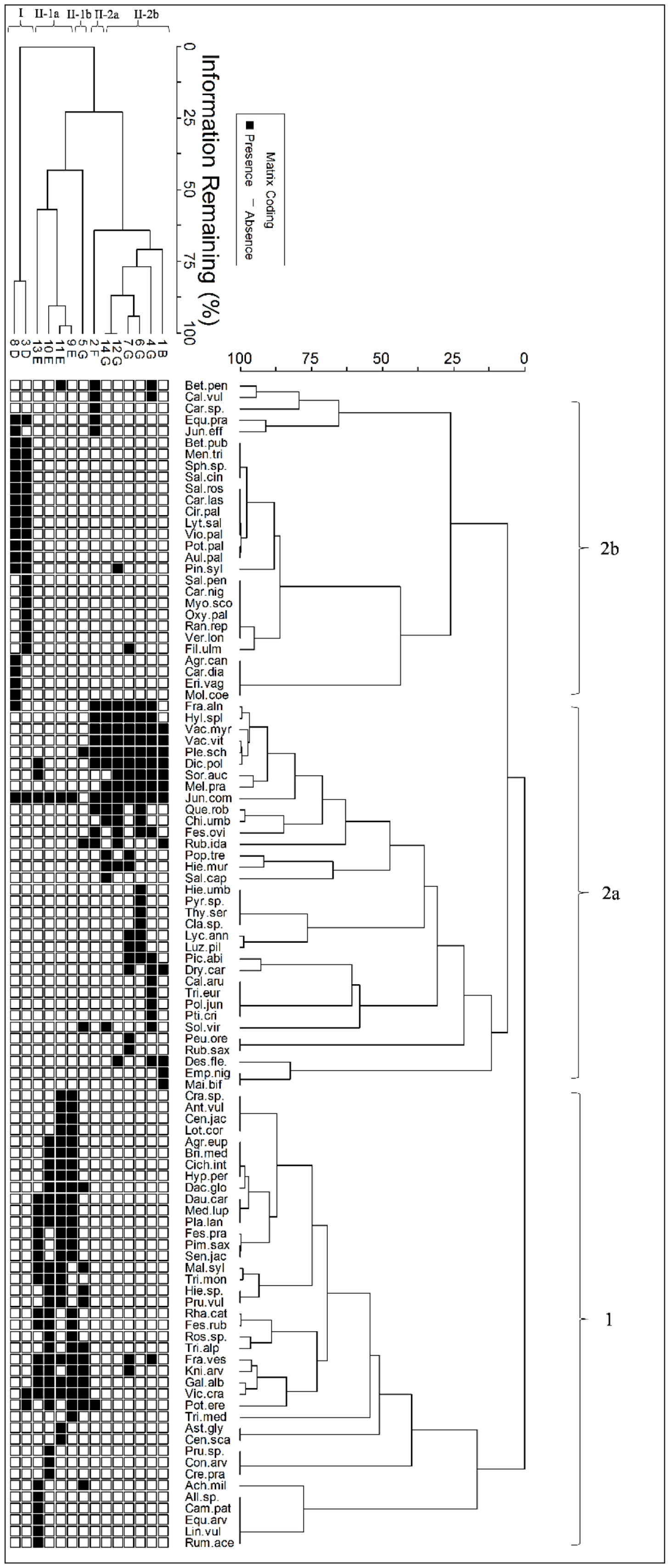

Fig. 2. The species diversity of trees, shrubs, herbs and mosses in sites with *J. communis*.

Right side cladogram.
Cluster 1: Cra.sp – *Crataegus* sp.; Ant.vul – *Anthyllis vulneraria* L.; Cen.jac – *Centaurea jacea* L.; Lot.cor – *Lotus corniculatus* L.; Agr.eur – *Agrimonia eupatoria* L.; Bri.med – *Briza media* L.; Cich.int – *Cichorium intybus* L.; Hyp.per – *Hypericum perforatum* L.; Dac.glo – *Dactylis glomerata* L.; Dau.car – *Daucus carota* L.; Med.lup – *Medicago lupulina* L.; Pla.lan – *Plantago lanceolata* L.; Fes.pra – *Festuca pratensis* Huds; Pim.sax – *Pimpinella saxifraga* (L.) Moench.; Sen.jac – *Senecio jacobaea* L.; Mal.syl – *Malus sylvestris* (L.) Mill.; Tri.mon – *Trifolium montanum* L.; Hie.sp – *Hieracium* sp.; Pru.vul – *Prunella vulgaris* L.; Rha.cat – *Rhamnus catharticus* L.; Fes.rub – *Festuca rubra* L.; Ros.sp – *Rosa* sp.; Tri.alp – *Trifolium alpestre* L.; Fra.ves – *Fragaria vesca* L.; Kni.arv – *Knautia arvensis* (L.) Coult; Gal.alb – *Galium album* Mill.; Vic.cra – *Vicia cracca* L.; Pot.ere – *Potentilla erecta* (L.) Rausch.; Tri.med – *Trifolium medium* L.; Ast.gly – *Astragalus glycyphyllos* L.; Cen.sca – *Centaurea scabiosa* L.; Pru.sp – *Prunella vulgaris* L.; Con.arv – *Convolvulus arvense* L.; Cre.pra – *Crepis praemorsa* (L.) Taush; Ach.mill – *Achillea millefolium* L.; All.sp – *Allium* sp.; Cam.pat – *Campanula patula* L.; Equ.arv – *Equisetum arvense* L.; Lin.vul – *Linaria vulgaris* (L.) Mill.; Rum.ace – *Rumex acetosa* L.
Cluster 2a: Fra.aln – *Frangula alnus* Mill.; Hyl.spl – *Hylocomium splendens* (Hedw.) B.S.G.; Vac.myr – *Vaccinium myrtillus* L.; Vac.vit – *Vaccinium vitis-idaea* L.; Ple.sch – *Pleurozium schreberi* (Brid.) Mitt.; Dic.pol – *Dicranum polysetum* Sw.; Sor.auc – *Sorbus aucuparia* L.; Mel.pra – *Melampyrum pratense* L.; Jun.com – *Juniperus communis* L.; Que.rob – *Quercus robur* L.; Chi.umb – *Chimaphila umbellata* (L.) W. Bart.; Fes.ovi – *Festuca ovina* L.; Rub.ida – *Rubus idaeus* L.; Pop.tre – *Populus tremula* L.; Hie.mur – *Hieracium murorum* L.; Sal.cap – *Salix caprea* L.; Hie.umb – *Hieracium umbellatum* L.; Pyr.sp – *Pyrola* sp.; Thy.ser – *Thymus serpyllum* L.; Cla.sp – *Cladonia* sp.; Lyc.ann – *Lycopodium annotinum* L.; Luz.pil – *Luzula pilosa* (L.) Willd; Pic.abi – *Picea abies* (L.) Karst.; Dry.car – *Dryopteris carthusiana* (Vill.) H.P. Fuchs; Cal.aru – *Calamagrostis arundinacea* (L.) Roth.; Tri.eur – *Trientalis europaea* L.; Pol.jun – *Polytrichum juniperinum* Hedw.; Pti.cri – *Ptilium crista-castrensis* (Hedw.) De Not.; Sol.vir – *Solidago virgaurea* L.; Peu.ore – *Peucedanum oreoselinum* L. Moench.; Rub.sax – *Rubus saxatilis* L.; Des.fle – *Deschampsia flexuosa* (L.) Trin.; Emp.nig – *Empetrum nigrum* L.; Mai.bif – *Maianthemum bifolium* (L.) F.W. Schm.
Cluster 2b: Bet.pen – *Betula pendula* Roth; Cal.vul – *Calluna vulgaris* (L.) Hull; Car.sp – *Carex* sp.; Equ.pra – *Equisetum pratense* Ehrh.; Jun.eff – *Juncus effusus* L.; Bet.pub – *Betula pubescens* Ehrh.; Men.tri – *Menyanthes trifoliata* L.; Sph.sp – *Sphagnum* sp.; Sal.cin – *Salix cinerea* L.; Sal.ros – *Salix rosmarinifolia* L.; Car.las – *Carex lasiocarpa* Ehrh.; Cir.pal – *Circium palustre* (L.) Scop.; Lyt.sal – *Lythrum salicaria* L.; Vio.pal – *Viola palustris* L.; Pot.pal – *Potentilla palustris* (L) Scop.; Aul.pal – *Aulacomnium palustre* (Hedw.) Schwaegr.; Pin.syl – *Pinus sylvestris* L.; Sal.pen – *Salix pentandra* L.; Car.nig – *Carex nigra* (L.) Reichard; Myo.sco – *Myosotis scorpioides* L.; Oxy.pal – *Oxycoccus palustris* Pers.; Ran.rep – *Ranunculus repens* L.; Ver.lon – *Veronica longifolia* L.; Fil.ulm – *Filipendula ulmaria* (L.) Maxim.; Agr.can – *Agrostis canina* L.; Car.dia – *Carex diandra* Schrank; Eri.vag – *Eriophorum vaginatum* L.; Mol.coe – *Molinia coerulea* (L.) Moench.
Explanation of the site codes in the top side cladogram is provided in Figure 1.

B habitat from 5 sites of subcontinental moss Scots pine forests (G habitat). Hereby, the coverage data of herbs and dwarf shrubs recorded for the sites allowed, in most cases, to group the sites according to their habitats, the only exception being one site of subcontinental moss Scots pine forests (5 G).

Composition of plant species is considered a good indicator of habitat edaphic and aerial properties, which are frequently quantified using species indicator values (Ellenberg et al., 1991). For our study sites, light index range was an in the interval 6.0–7.3, and, according to this value, it was an obvious separation of sites into two groups – transition mires and quaking bogs (D habitat), xero-thermophile fringes (E habitat), and remainders (Fig. 3). Light index for all sites was higher than the middle value (5) and reflected a higher demand of *J. communis* for irradiation, despite some sites being forested areas. It shows that the forest sites of *J. communis* selected by us

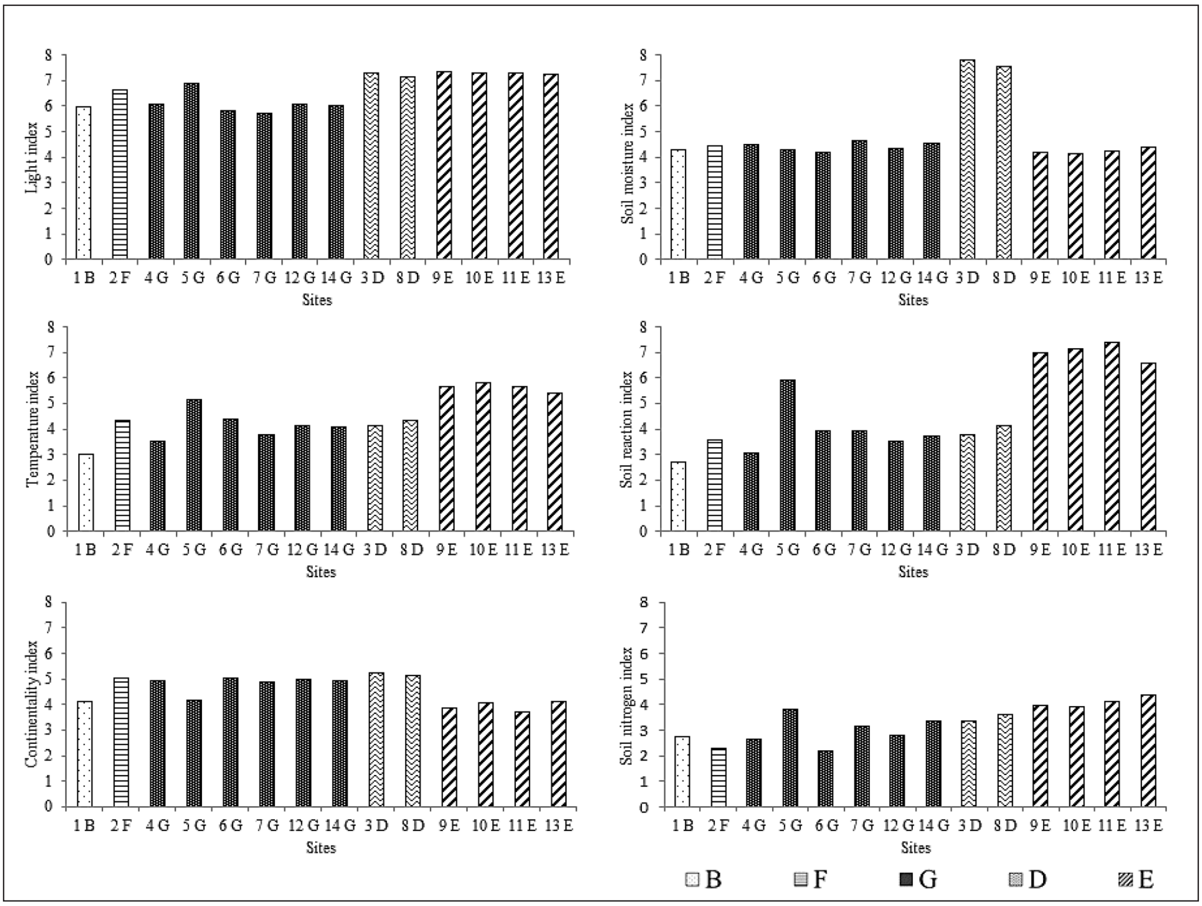

Fig. 3. Ellenberg (1991) indicatory values of herbaceous species in sites with *J. communis*.
B – coastal brown dunes covered with natural Scots pine forests; F – *J. communis* shrubs; D – transition mires and quaking bogs; G – subcontinental moss Scots pine forests; E – xero-thermophile fringes

were in forest gaps. It is in agreement with what is known from other surveys (Thomas et al., 2007). The temperature index varied in a broader interval, 3.0–5.8, compared to the light parameter. In respect to temperature, the warmest sites belonged to the opened area habitat xero-thermophile fringes (E), the differences of the habitat of other type were not expressed. The continentality index varied in the interval of 3.7–5.3 and neither showed relation to the geography, nor to the habitat type of the sites. For our study sites, the soil moisture index ranged between 4.2 and 7.8, separating sites of transition mires and quaking bogs (D habitat) from remainders. Moist summers are needed to enable juniper seedlings to develop, and an extreme drought during one summer may cause dieback of junipers (Rosen, Van Der Maarel, 2000). The ranges of soil reaction index for Lithuanian junipers were also very wide, fitting into the interval of 2.7 and 7.4. The most distinct were sites belonging to calcareous habitat xero-thermophile fringes (E habitat). According to this parameter, sites were subdivided into two groups (5 G site was an exception). In another study of juniper-related sites (the set of sites was not the same as in our study) of Lithuania, chemical analyses of the soil pH revealed a different interval – 4.1–7.7 (Vaičiulytė, Ložienė, 2013). The soil nitrogen index showed low fertility of soils, for all sites; this index was lower than the middle value (5) and ranged in the interval 2.7–4.4. Ellenberg et al. (1991) data indicates a wide range requirement for nitrogen. Protected by EUNIS, the habitat of *Juniperus communis* shrubs (site 2 F) did not have any marginal values of abiotic environment. For junipers of this site the highest polymorphism was defined employing some molecular markers (Vilcinskas et al., 2016). Among the juniper sites selected by us the most contrasting ones according to Ellenberg indicatory values of herbaceous species was the site representing coastal brown dunes covered with natural Scots pine forests (B habitat), and the sites of xerothermophile fringes (E habitat).

Despite the rather small territory of Lithuania, our data are in support to other studies which indicate that junipers occur in a wide range of climates and on a wide variety of soils (Barkman, 1985; Rosen, Van Der Maarel, 2000), including acid and calcareous sands, loam, both wet and dry habitats.

CONCLUSIONS

1. The coverage data of herbs and dwarf shrubs recorded for the sites with junipers in most cases allowed clusteringof the sites according to their habitats.

2. Among the juniper sites selected by us, the most contrasting ones, according to Ellenberg indicatory values of herbaceous and wooden species, were habitats entitled as coastal brown dunes covered with natural Scots pine forests (B) and xero-thermophile fringes (E).

3. For junipers from the habitat protected by EUNIS and entitled *Juniperus communis* shrubs, no marginal values of abiotic environment were documented despite the fact that a former study revealed the highest polymorphism by some molecular markers.

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LIETUVOS PAPRASTOJO KADAGIO (*JUNIPERUS COMMUNIS* L.) BUVEINIŲ ĮVAIROVĖ

Santrauka

Paprastasis kadagys (*Juniperus communis* L.) ekologiniu ir ekonominiu požiūriu yra svarbi spygliuočių rūšis, išsamiai išnagrinėta kai kuriose arealo srityse. Rytų Baltijos šalių kadagiams, kaip vienai iš trijų natūraliai augančių spygliuočių rūšių, iki šiol skirta nepakankamai dėmesio. Pastaruoju metu *J. communis* Lietuvos populiacijos įvertintos pagal kai kuriuos molekulinius žymenis, tačiau genetiniai duomenys išlieka nesusieti su kitomis biologinėmis, ypač ekologinėmis, savybėmis. Tyrimų tikslas buvo įvertinti Lietuvos kadagių biotinę ir abiotinę aplinką pagal augančių pomiškio ir trako, krūmokšnių, žolinių augalų ir samanų rūšių įvairovę ir gausą. Lietuvoje buvo parinkta 14 vietovių su kadagiais. Abiotinės aplinkos savybės buvo nustatytos pagal augalų rūšių, augančių kartu su kadagiu, Elenbergo indikatorines vertes (EIV). Vietovėse, kuriose auga kadagiai, buvo aptikta 18-os šeimų 80 rūšių žolinių augalų ir krūmokšnių. Didžiausia žolinių augalų įvairovė rasta šlaitų pievose (18–22 rūšys). Remiantis rūšių gausa, vietovės su kadagiais sugrupuotos pagal buveinių tipą. Nors mūsų darbe nagrinėjama gana maža teritorija (š. platuma 56°07'–54°11', rytų ilguma 21°06'–26°30'), aplinkos indeksai vietovėse su kadagiais svyravo gana plačiose ribose: šviesos – 6,0–7,3, temperatūros – 3,0–5,8, žemyniškumo – 3,7–5,3, dirvožemio drėgnumo – 4,2–7,8, dirvožemio rūgštumo – 2,7–7,4, dirvožemio azoto – 2,7–4,4. Pagal EIV, labiausiai išsiskyrė šlaitų pievos ir kopų pušynai.

Raktažodžiai: spygliuočiai, Elenbergo indikatorinės vertės (EIV), buveinės, rūšių gausa, žoliniai augalai