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CREATION OF A NETWORK OF SEED SITES FOR *IN-SITU* CONSERVATION OF MEDICINAL AND AROMATIC PLANT GENETIC RESOURCES IN LITHUANIA

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Abstract

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Twenty six seed (genetic) sites were established for long-term *in-situ* conservation of medicinal and aromatic plant (MAP) genetic resources in Lithuania over the period 2006–2017. The sites vary in size from 0.4 to 38.0 ha with an average of 7.2 ha. Most of the sites (73%) occur in the existing protected areas. They represent 10 of 22 physical geographical areas of Lithuania and accommodate 120 priority MAP species, which is about 89% of the national priority list. Prioritization of MAP species was based on the monographs of European Pharmacopoeia, European Medicines Agency, World Health Organization as well as German Phytotherapeutic Monographs and other regional and national medicinal plant references. A concept was followed of the dual function and perception of food as medicine, and, vice versa, an approach based on a co-evolutionary relationship between human food and medicine. It was established that only 46 priority species, or 34% of the national priority list, were represented by five and more populations, which is considered as minimum for long-term *in-situ* conservation. The future conservation planning efforts should focus on at least 15 unrepresented species, 49 species represented at 1–2 sites each and 25 species represented at 3–4 sites each. The MAP site network should expand by covering preferably the remaining 12 physical geographical areas of the country.

Keywords: checklist, distribution, European Pharmacopoeia, long-term conservation, MAP, physical geographical area, population, priority species.

INTRODUCTION

In the preamble of the Convention on Biological Diversity, it has been reaffirmed that "States are responsible for conserving their biological diversity and for using their biological resources in a sustainable manner" (UNEP, 1992). This responsibility has been gradually comprehended by the international community along with the increasing evidence of global climate change. Consistent observations on species distribution areas in relation to climate change predict their shift towards cooler ranges (Kelly & Goulden, 2008) with a threat of some species extinction, particularly those with restricted geographic range (Casazza et al., 2014), and arrival of newcomers including potentially invasive ones (Broennimann et al., 2007). Moreover, it has been recognized that invasive species is a second biggest threat to global biodiversity after habitat destruction (Sandilyan & van't Klooster, 2016).

European Red List assessment of selected 400 medicinal and aromatic plant (MAP) species (EC DG Environment, 2017) has revealed that the most significant threats are collection of wild plants, loss of habitats through residential and commercial development (including urbanization, industrialization, and tourism developments) as well as all forms of agriculture (livestock farming, annual and perennial non-timber crops, and plantation forestry). In other words, the threats, which are directly resulting from the intensive human activities. While the other threats, such as climate change and severe weather

(droughts), fire and fire suppression, invasive alien species, also are a consequence of human activities, although resulting indirectly. A loss of natural meadows and pastures due to their full abandonment from use for agricultural purposes could be considered a consequence of inadequate strategies of human activities. Thus, to somehow 'compensate' the impacts of these threats and prevent from negative consequences, it is necessary to enhance conservation efforts of wild plant species, particularly MAPs, which encompass not only wild harvested plants, but also some wild relatives of cultivated plants. Moreover, at the national scale, it has been recognized by the Fourth National Report of the Republic of Lithuania to the Convention on Biological Diversity that "in the field of *in-situ* species conservation, some progress has been made, but at the state level this progress is not sufficient" (Ministry…, 2009).

The Article 8 of the Republic of Lithuania Law on National Plant Genetic Resources states that "For the *in-situ* conservation of national plant genetic resources, genetic reserves, gene conservation areas, seed collection stands shall be established, or populations, groups or single trees shall be selected" (Seimas..., 2001a). To facilitate the implementation of the Article 8, the Regulations for Seed Sites Attributed to the National Plant Genetic Resources (Lietuvos..., 2003) have been issued. The purpose of establishment of seed (genetic) sites, as provided by the Regulations, is a long-term conservation of genetic resources and use of genetic material for breeding purposes, cultivation of medicinal and fruit-berry plants as well as propagation of ornamental and other categories of plantings. In line with these legal provisions, the research on *in-situ* conservation of medicinal and aromatic plant genetic resources was carried out at the Institute of Botany aimed at the establishment of a national network of seed (genetic) sites of MAPs in Lithuania. The aim of this paper was to overview the results achieved so far and discuss some implications for the future activities.

MATERIALS AND METHODS

A nationwide database of wild economic plants developed at the Laboratory of Economic Botany of the Institute of Botany over the period from 1979 to 1989 was used as a primary data source on distribution of medicinal and aromatic plants. Also, the data of field trips carried out by the researchers of the Laboratory during the subsequent years were used for the inventory of the potential sites. As an additional source, the data on inventory of natural and seminatural meadows, carried out by the Lithuanian Fund for Nature and the Institute of Botany in 2002–2005, were employed. The seed (genetic) sites were singled out based on the following major criteria: target species cover-abundance, number of target species, distinctive qualitative properties (phenotypic, genetic) of target species population(s), location of a site with respect to ecogeographic conditions and evidence of natural boundaries. The target species were predefined based on a well-established knowledge including some references (e.g. Jankevičienė, 1998) and the checklist of vascular plants created. Then, the prioritization of species was made by employing the monographs of the European Pharmacopoeia (European…, 2018), European Medicines Agency (EMA, 2018) and World Health Organization (WHO, 2018) as well as WHO Monographs on Medicinal Plants Commonly Used in the Newly Independent States (NIS). The other supranational sources included German Phytotherapeutic Monographs (Kommission E, 2018a, b), Russian Pharmacopoeia (Shikov et al., 2014), TRAFFIC network report (Lange, 1998), international catalogues, manuals, dictionaries and scientific research papers. At the national level, local surveys, personal interviews and authors' own knowledge on in-country uses of medicinal plants were used along with the registration data of the related medicinal products available from the State Medicines Control Agency (VVKT, 2018).

A concept was followed of the dual function and perception of food as medicine and vice versa, an approach based on a co-evolutionary relationship between human food and medicine (Etkin, 2008; Lindeberg, 2010; Pieroni, Price, 2006; Ullah, Khan, 2008). This approach has been used in the European Red List assessment of medicinal plants, stating that "the term 'medicinal plant' shall be understood in a wider sense to include such overlapping uses as spices, food, dietary supplements, and cosmetics" (EC DG Environment, 2017).

Site selection was limited to the state-owned land as provided by the Regulations for Seed Sites

Attributed to the National Plant Genetic Resources (Lietuvos..., 2003). The provision of the Regulations stating that seed sites shall be established in different natural areas of the country was implemented after Basalykas (1965).

Species cover-abundance was estimated by using Braun-Blanquet (1964) scale on a portion of 10 to 50% of total area of a site depending on its size and diversity of species. For the Latin names of species, The Plant List (2013) and POWO (2018) were consulted. Area sizes of sites were estimated by using GPS, a web application at the www.maps.lt and the forest inventory data (Valstybinė..., 2015). Considering the maintenance required by the *in-situ* sites, the existing protected areas were given priority when selecting seed (genetic) sites.

The information on selected sites was then presented for the approval to the Standing Committee on National Plant Genetic Resources and the Ministry of Environment of the Republic of Lithuania. The approved sites were included into the Database of the National Plant Genetic Resources at the Plant Gene Bank and assigned the identification numbers.

RESULTS AND DISCUSSION

Over the period of 2006–2017, a total of 26 seed (genetic) sites were selected, evaluated and approved for long-term conservation of MAP species (Table 1). Nineteen sites (73%) were established in existing protected areas including regional parks, land-

Table 1. Seed (genetic) sites of MAP species approved for *in-situ* conservation

No.	Site name	Plant Gene Bank ID	Protected area	Year of approval	Size, ha	Physical geographical area**	Coordinates, WGS-84
1	Veliuona MAP*	AGB01066	Panemuniai RP	2006	0.9	C XII	55.075160, 23.298258
2	Dusia MAP	AGB01067	Meteliai RP	2006	0.4	C XIII	54.286331, 23.669774
3	Labanoras Lingonberry	AGB01068	Labanoras RP	2006	30.0	D XV	55.155251, 25.808389
4	Dieveniškės MAP	AGB02488	Dieveniškės HRP	2007	5.0	F XXI	54.180743, 25.664132
5	Bestraigiškė Hazel	AGB02489	None	2007	17.5	D XVI	54.175336, 23.777243
6	Prienai Ramsons	AGB02490	Nemunas Loops RP	2007	19.0	C XIII	54.609260, 23.941761
7	Kasikas MAP	AGB02900	Natura 2000 site	2009	3.3	C XII	55.057773, 22.424651
8	Vorėnai MAP	AGB02968	Vorėnai Mound	2010	0.5	D XV	55.357477, 25.609699
9	Navikai MAP	AGB02969	None	2010	3.0	E XX	54.134711, 24.022141
10	Kernavė MAP	AGB02970	None	2010	0.5	C XIII	54.894639, 24.848816
11	Užšešuviai MAP	AGB03380	Jūra IR	2011	1.5	C XII	55.320247, 22.570576
12	Dovilai MAP	AGB03381	None	2011	1.0	B III	55.669162, 21.369379
13	Bitėnai MAP	AGB03382	Rambynas RP	2011	8.5	A II	55.061840, 22.044710
14	Giria MAP	AGB03977	Visinčia LR	2013	0.6	E XX	54.353919, 25.134953
15	Rūdninkai Heather	AGB03978	Zygmantiškės GMR	2013	3.8	E XX	54.396628, 25.083703
16	Pamerkys Forest MAP	AGB04236	None	2014	17.9	E XX	54.382769, 25.009704
17	Kernavė Forest MAP	AGB04237	Water body PZ	2014	1.5	C XIII	54.885253, 24.817136
18	Dūkstyna Forest MAP	AGB04238	None	2014	1.8	D XIV	55.269946, 24.815597
19	Rokantai MAP	AGB04374	Vilnia HGR	2015	1.2	E XIX	54.734882, 25.547949
20	Bernotai MAP	AGB04375	Bernotai Mound	2015	1.5	D XV	54.909472, 25.322453
21	Mikieriai MAP	AGB04376	Šventoji LR	2015	3.8	D XIV	55.661593, 25.197726
22	Kintai MAP	AGB04468	Kintai BR	2016	2.0	A II	55.426175, 21.254015
23	Priekulė MAP	AGB04469	Kliošiai LR	2016	38.0	A II	55.547127, 21.224193
24	Patramė Bilberry	AGB04619	Labanoras RP	2017	2.8	D XV	55.217098, 25.662331
25	Alka Forest MAP	AGB04620	Alka Forest GR	2017	20.2	C XIII	54.972433, 25.181711
26	Poliesė Bog Bilberry	AGB04621	None	2017	1.0	E XIX	55.051340, 25.754384

* Abbreviations: BR – Botanical Reserve; GMR – Geomorphological Reserve; GR – Genetic Reserve; HGR – Hydrographic Reserve; HRP – Historical Regional Park; IR – Ichthyological Reserve; LR – Landscape Reserve; MAP – medicinal and aromatic plants; PZ – protection zone; RP – Regional Park.

** Physical geographical area (*rajonas* in Lithuanian) after Basalykas, 1965.

scape reserves, mounds and other kinds of protected areas. Size of the sites varies from 0.4 to 38.0 ha with an average of 7.2 ha and total amount of 187.2 ha. Over 77% of the total acreage is within the existing protected areas.

A joint checklist of vascular plants, consisting of 392 taxa found at all 26 sites, was produced. After removal of the invasive alien species (those included into the national list of invasive species as defined in Lietuvos…, 2016), escapees from cultivation, some hybrid species and varieties, the checklist was reduced to 375 species. This made nearly 1/3 of the national crop wild relative checklist (Labokas et al., 2016), which was subjected to prioritization for medicinal and aromatic plant conservation. The prioritization was carried out in three major steps.

In the first step, matching the checklist of the species with those included into the European Pharmacopoeia (European…, 2018) narrowed it to 57 species. Similar procedures were sequentially carried out with the rest of species by employing each of the three other major references. Thus, 11 unique species were covered by EMA (2018), two – by WHO and two – by WHO-NIS (WHO, 2018). Summing up, the interim priority list provided 72 unique species.

In the second step, the checklist was compared to the pharmacopoeias or their equivalents from Germany (Kommission E, 2018a, b) and Russia (Shikov et al., 2014) as well as a TRAFFIC network report on medicinal and aromatic plants (Lange, 1998). Matching with the German Phytotherapeutic Monographs, we added 17 species, while matching with the Russian Pharmacopoeia, we added 14 more species. Another six species were selected based on Lange's (1998) report. All these species increased the priority list up to 109 species.

In the third step, the sources of information at the national level were analysed. Local surveys, personal interviews and authors' own experiences as well as data on registration of the related medicinal products obtained from the State Medicines Control Agency (VVKT, 2018) enabled to prioritize 18 more species, hereby increasing the total number of priority species up to 127.

In addition, some pragmatic considerations were applied regarding some other species. Thus, four *Allium* and two *Rubus* species were included as food (vitamin) plants for which abundant research data are available. And finally, two species, *Lithospermum officinale* L. and *Myrica gale* L., both Red Data Book of Lithuania category 3(R) (Rašomavičius, 2007), were included based on such medicinal plant references as Blaschek et al. (1998a, b) and Penso & Proserpio (1997). These eight species made the final priority list to contain a total of 135 species (see APPENDIX), which, however, should not be considered as an absolutely fixed one.

Further, 120 of 135 priority (89%) species were found at 26 seed sites. They represented 49 families and 97 genera (Table 2). As sorting of the list by species number indicates, three families, *Rosaceae* Juss., *Asteraceae* Bercht. & J.Presl and *Lamiaceae* Martinov, were the most species-rich ones. They covered a total of 42 species, which was more than one third (35%) of all species.

As seen in Table 2, three groups of families can be distinguished by species numbers covered at 26 seed sites: 1) three families with 11–20 species (35% of total species); 2) 16 families with 2–6 species (40%); 3) 30 single species families (25%).

For the analysis of priority species distribution across the seed (genetic) sites, a 9-grade species frequency scale was applied with the range from very rare (found at 1–2 sites) to very frequent (found at 17–18 sites) species preceded by a zero-frequency group, i.e., the unrepresented species. Plotting of the species distribution data (Fig. 1) provides evidence that a substantial portion of the species are unrepresented and insufficiently represented. For the *in-situ* conservation it has been suggested that five populations is a minimum to ensure long-term species

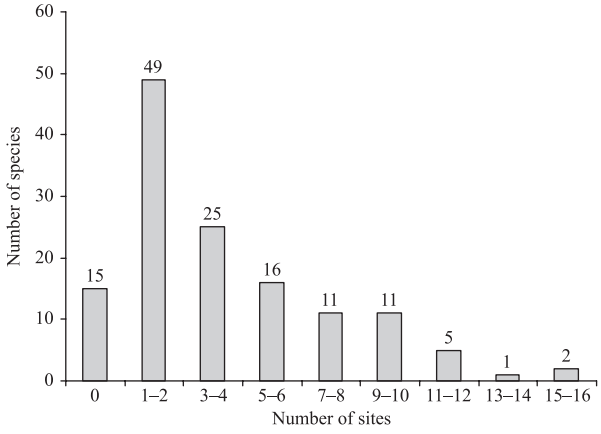

Fig. 1. Distribution of priority MAP species across seed (genetic) sites

Table 2. Taxonomic distribution of priority MAP species found at 26 seed (genetic) sites

Family	Genera	Species	% species	Family	Genera	Species	% species
Rosaceae	13	20	16.7	*Cyperaceae*	1	1	0.8
Asteraceae	10	11	9.2	*Crassulariaceae*	1	1	0.8
Lamiaceae	9	11	9.2	*Cupressaceae*	1	1	0.8
Ericaceae	4	6	5.0	*Dryopteridaceae*	1	1	0.8
Amaryllidaceae	1	5	4.2	*Elaeagnaceae*	1	1	0.8
Betulaceae	3	5	4.2	*Equisetaceae*	1	1	0.8
Plantaginaceae	4	5	4.2	*Fabaceae*	1	1	0.8
Polygonaceae	2	4	3.3	*Fagaceae*	1	1	0.8
Salicaceae	2	3	2.5	*Geraniaceae*	1	1	0.8
Apiaceae	2	2	1.7	*Grossulariaceae*	1	1	0.8
Boraginaceae	2	2	1.7	*Lycopodiaceae*	1	1	0.8
Caryophyllaceae	2	2	1.7	*Lythraceae*	1	1	0.8
Gentianaceae	2	2	1.7	*Malvaceae*	1	1	0.8
Hypericaceae	1	2	1.7	*Myricaceae*	1	1	0.8
Onagraceae	2	2	1.7	*Oleaceae*	1	1	0.8
Pinaceae	2	2	1.7	*Papaveraceae*	1	1	0.8
Ranunculaceae	2	2	1.7	*Poaceae*	1	1	0.8
Rhamnaceae	2	2	1.7	*Polemoniaceae*	1	1	0.8
Scrophulariaceae	2	2	1.7	*Primulaceae*	1	1	0.8
Acoraceae	1	1	0.8	*Rubiaceae*	1	1	0.8
Apocynaceae	1	1	0.8	*Solanaceae*	1	1	0.8
Asparagaceae	1	1	0.8	*Urticaceae*	1	1	0.8
Berberidaceae	1	1	0.8	*Viburnaceae*	1	1	0.8
Cannabaceae	1	1	0.8	*Violaceae*	1	1	0.8
Caprifoliaceae	1	1	0.8	Total: 49	97	120	100

conservation (Dulloo et al., 2008). A more recent research (Whitlock et al., 2016) suggests that the *in-situ* conservation of plant genetic diversity of relatively widespread species may need a minimum of 10 populations. In any case, it is evident that conserving larger numbers of populations or habitats increases the probability of long-term species persistence by reducing stochastic extinction threats and maintaining ecological processes (Neel and Cummings, 2003). The current study showed that 15 priority MAP species were unrepresented, 49 species were represented at 1–2 sites and 25 species – at 3–4 seed sites. Only the remaining 46 species, which was about 34% of the national priority list, met the lower criterion of five and more populations.

Therefore, further surveys should focus on establishing new seed (genetic) sites for 15 unrepresented and 74 underrepresented species.

It should be noted that not all priority species will be represented with minimum five populations as there are some rare species either occurring in very few locations or widely scattered very small populations. Particularly, this is the case with some of the species of the Red Data Book of Lithuania (Table 3).

Table 3. Distribution of priority MAP species of the Red Data Book of Lithuania (RDBL) across seed (genetic) sites

No.	Species	RDBL category	Number of sites
1.	*Allium angulosum* L.	3 (R)	1
2.	*Allium scorodoprasum* L.	3 (R)	3
3.	*Allium ursinum* L.	5 (Rs)	1
4.	*Allium vineale* L.	2 (V)	2
5.	*Arnica montana* L.	2 (V)	1
6.	*Gentiana cruciata* L.	2 (V)	2
7.	*Gratiola officinalis* L.	1 (E)	1
8.	*Hedera helix* L.	1 (R)	0
9.	*Lithospermum officinale* L.	3 (R)	1
10.	*Myrica gale* L.	3 (R)	1
11.	*Polemonium caeruleum* L.	2 (V)	2
12.	*Prunus spinosa* L.	2 (V)	1
13.	*Quercus petraea* (Matt.) Liebl.	3 (R)	0

Two groups of sites distinguished in terms of the initial selection focus on (1) single species/variety/ecotype or (2) multiple species. The first group hereafter is referred to as the single-species sites, while the second – as the multispecies sites. A total of nine single-species sites were established (Table 4). The first of this kind was Labanoras Lingonberry site established to protect a rare white-fruited variety of lingonberry, *Vaccinium vitis-idaea* var. *leucocarpum* Asch. et Magnus, found in 1993 (Labokas et

Table 4. Single- and multispecies sites with their main and major priority MAP species and their total numbers

Site name	Site type	Main (boldface) and major species and their abundance estimated on Braun Blanquet scale	Total no of genera/species
Veliuona MAP	Multispecies	*Crataegus monogyna* 3, *Fragaria viridis* 2, *Rhamnus catharctica* 2, *Berberis vulgaris* 1	15/16
Dusia MAP	Single-species	***Crataegus monogyna*** 4, *Fragaria viridis* 2, *Rhamnus catharctica* 2, *Primula veris* 1	18/19
Labanoras Lingonberry	Single-species	***Vaccinium vitis-idaea*** (incl. *var. leucocarpum*) 3, *Pinus sylvestris* 4	8/10
Dieveniškės MAP	Multispecies	*Calluna vulgaris* 2, *Vaccinium vitis-idaea* 2, *Frangula alnus* 1, *Potentilla erecta* 1	18/20
Bestraigiškė Hazel	Single-species	***Corylus avellana*** 4, *Pinus sylvestris* 4, *Betula pendula* 2, *Frangula alnus* 1	19/22
Prienai Bear Garlic	Single-species	***Allium ursinum*** 4, *Picea abies* 4, *Ribes nigrum* 1, *Tilia cordata* 1	12/12
Kasikas MAP	Multispecies	*Allium* (3 species) 2, *Symphytum officinale* 2, *Angelica archangelica* 1	14/16
Vorėnai MAP	Multispecies	*Origanum vulgare* 3, *Fragaria vesca* 1, *Plantago lanceolata* 1, *Allium oleraceum* 1	17/17
Navikai MAP	Multispecies	*Origanum vulgare* 3, *Agrimonia eupatoria* 2, *Achillea millefolium* 2, *Acorus calamus* 1	39/40
Kernavė MAP	Multispecies	*Helichrysum arenarium* 3, *Pilosella officinarum* 3, *Fragaria vesca* 2	21/21
Užšešuviai MAP	Multispecies	*Filipendula ulmaria* 4, *Persicaria bistorta* 2, *Sanguisorba officinalis* 2	16/16
Dovilai MAP	Multispecies	*Fragaria viridis* 4, *Elymus repens* 4, *Crataegus monogyna* 2	15/16
Bitėnai MAP	Multispecies	*Allium angulosum* 2, *A. oleraceum* +, *A. scorodoprasum* 1, *A. vineale* +, *Achillea millefolium* 2, *Fragaria viridis* 2, *Elymus repens* 1	15/19
Giria MAP	Multispecies	*Filipendula ulmaria* 2, *Polemonium caeruleum* 2, *Urtica dioica* 2	13/13
Rūdninkai Heather	Single-species	***Calluna vulgaris*** 5, *Vaccinium vitis-idaea* 2, *Thymus serpyllum* 1	18/18
Pamerkys Forest MAP	Multispecies	*Alnus glutinosa* 4, *Ribes nigrum* 2, *Urtica dioica* 1, *Betula pubescens* 1	12/12
Kernavė Forest MAP	Multispecies	*Fragaria viridis* 3, *Thymus serpyllum* 2, *Achillea millefolium* 2, *Rubus caesius* 1	34/37
Dūkstyna Forest MAP	Multispecies	*Origanum vulgare* 3, *Fragaria vesca* 2, *Betula pendula* 2, *Rosa canina* 1	36/37
Rokantai MAP	Multispecies	*Filipendula ulmaria* 3, *Achillea millefolium* 2, *Persicaria bistorta* 2, *Urtica dioica* 2	27/28
Bernotai MAP	Multispecies	*Thymus pulegioides* 2, *Pinus sylvestris* 2, *Solidago virgaurea* 1, *Elymus repens* 1	16/17
Mikieriai MAP	Multispecies	*Fragaria viridis* 4, *Saponaria officinalis* 3, *Agrimonia eupatoria* 1, *Elymus repens* 1	31/34
Kintai MAP	Multispecies	*Angelica archangelica* 1, *Rubus plicatus* 3, *Hypericum perforatum* 2, *Alnus glutinosa* 2	24/27
Priekulė MAP	Single-species	***Myrica gale*** 4, *Frangula alnus* 3, *Betula pubescens* 2, *Alnus glutinosa* 1	8/8
Patramė Bilberry	Single-species	***Vaccinium myrtillus*** (incl. *var. leucocarpum*) 4, *Pinus sylvestris* 4	10/14
Alka Forest MAP	Single-species	***Tilia cordata*** 4, *Corylus avellana* 3, *Quercus robur* 1, *Fraxinus excelsior* 1	14/14
Poliesė Bog Bilberry	Single-species	***Vaccinium uliginosum*** (highbush ecotype) 4, *Pinus sylvestris* 4, *Betula pubescens* 3	6/9

al., 1997). Dusia MAP site was established because of high phenotypic diversity of common hawthorn, *Crataegus monogyna* Jacq., population identified there (Labokas, 2002). Bestraigiškė Hazel site was established as representing one of the largest populations of *Corylus avellana* L. in Lithuania. Prienai Ramsons site was chosen as representing one of the most productive populations of *Allium ursinum* L. (Karpavičienė, 2003). Rūdninkai Heather site represents a unique to Lithuania population of *Calluna vulgaris* (L.) Hull. Priekulė MAP site was established largely for bog myrtle, *Myrica gale* L., found only in western Lithuania. The population of a rare variety of white-fruited bilberry, *Vaccinium myrtillus* var. *leucocarpum* Koch., was selected as Patramė Bilberry site. Similarly, the population of highbush ecotype of bog bilberry, *Vaccinium uliginosum* L. was identified at Poliesė Bog Bilberry site. Finally, a unique population of small-leaved lime, *Tilia cordata* Mill., presenting nearly pure stand of the trees, was selected as Alka Forest MAP site. The remaining 17 sites were considered multispecies sites established to conserve natural collections of multiple MAP species.

The single- and multispecies approaches should be considered when monitoring and maintaining seed (genetic) sites. These procedures are part of an overall evaluation of seed (genetic) sites, the guidelines for which have been developed (Labokas, Karpavičienė, n.d.).

Analysis of the priority species lists at all the sites showed that their numbers varied within the range of 8–40 species per site (Table 4). Priekulė MAP site contained the minimal number of eight species, while Navikai MAP site amounted to the maximum of 40 species. Similarly, the numbers of genera varied from six at Poliesė Bog Bilberry site to 39 at Navikai MAP site.

Mapping of the sites (Fig. 2) showed their highest concentration along the Baltic Highlands in the eastern and south-eastern parts of Lithuania and along the lower reaches of the River Nemunas in the western and south-western parts of the country representing 10 out of 22 physical geographical areas as defined by Basalykas (1965) (Table 1).

In order to extend the coverage of MAP network, new seed (genetic) sites should be established in unrepresented and underrepresented physical geographical areas of Lithuania located predominantly in the central, north-western, northern and north-eastern parts of the country.

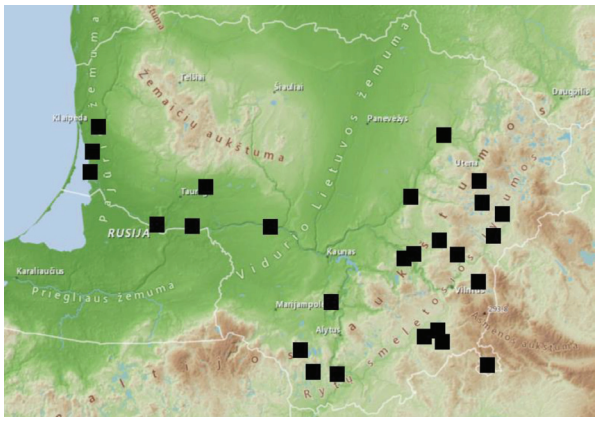

Fig. 2. Geographic distribution of 26 seed (genetic) sites of MAP species

CONCLUSIONS

The established 26 seed (genetic) sites of medicinal and aromatic plants accommodate 120 priority MAP species, which is about 89% of the national priority list. However, only 46 species, or about 34% of the national priority list, are represented by five and more populations considered as minimum for long-term *in-situ* conservation. The future efforts should primarily focus on conservation planning of (1) at least 15 unrepresented national priority species, (2) 49 species represented at 1–2 sites each, and (3) 25 species represented at 3–4 sites each. To date, less than half, i.e., 10 of 22, physical geographical areas of Lithuania are covered by the seed (genetic) sites. However, considering that the remaining part of the country consists largely of agricultural lands, the network of MAP sites might not cover all the natural areas adequately. Another obstacle to develop a fully representative network is the legal provision permitting seed (genetic) site establishment on the state-owned land only. Hopefully, this limitation will be repealed with the upcoming amendments of the Law on National Plant Genetic Resources.

Among the topical issues are the monitoring and maintenance of the established sites. The implementation of these tasks should be administered by the Ministry of Environment of the Republic of Lithuania, as the Paragraph 12 of the Article 27 of the Law

on Protected Areas provides that "Supervision of restorative and genetic plots and zones of ecological protection shall be exercised by the institutions responsible for designation of these zones" (Seimas…, 2001b).

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SĖKLINIŲ SKLYPŲ TINKLO SUKŪRIMAS LIETUVOS VAISTINIŲ IR AROMATINIŲ AUGALŲ GENETINIŲ IŠTEKLIŲ IŠSAUGOJIMUI *IN-SITU*

Juozas Labokas, Birutė Karpavičienė

Santrauka

Per 2006–2017 metų laikotarpį buvo atrinkti, įvertinti ir įsteigti 26 vaistinių aromatinių augalų sėkliniai (genetiniai) sklypai ilgalaikiam genetinių išteklių išsaugojimui *in-situ*. Sklypų plotai varijuoja nuo 0,4 iki 38,0 ha, vidutinis plotas – 7,2 ha. Saugomose teritorijose – regioniniuose parkuose, draustiniuose ir kt. – yra 73% sklypų. Lietuvos fizinio geografinio rajonavimo atžvilgiu įsteigti sklypai reprezentuoja 10 iš 22 gamtinių rajonų. Remiantis Europos Farmakopėjos, Europos vaistų agentūros, Pasaulio sveikatos organizacijos, kaimyninių šalių farmakopėjų vaistinių augalų monografijomis bei kitais tarptautiniais ir nacionaliniais šaltiniais, sudarytas 135 prioritetinių vaistinių ir aromatinių augalų rūšių sąrašas, iš kurio 89% rūšių patenka į sėklinius sklypus. Darbe laikytasi bendros maistinių ir vaistinių augalų evoliucijos sąryšiu pagrįstos koncepcijos, kad daugelis vaistinių augalų yra ir maistiniai bei atvirkščiai. Įvertintas prioritetinių rūšių pasiskirstymas sėkliniuose sklypuose. Nustatyta, kad tik 46 rūšys, t. y. šiek tiek daugiau negu 1/3 šalies prioritetinio sąrašo rūšių, yra saugoma 5-iuose ir daugiau sklypų. Ateities tyrimai turėtų koncentruotis įtraukiant į vaistinių ir aromatinių augalų *in-situ* tinklą naujus sklypus likusiuose 12-oje Lietuvos fizinių geografinių rajonų ir apimti iki šiol nereprezentuotas bei nepakankamai reprezentuotas prioritetines vaistinių ir aromatinių augalų rūšis.

APPENDIX

List of 135 priority MAP species

Achillea millefolium L.
Acorus calamus L.
Agrimonia eupatoria L.
Alchemilla vulgaris L.
Allium angulosum L.
Allium oleraceum L.
Allium scorodoprasum L.
Allium ursinum L.
Allium vineale L.
Alnus glutinosa (L.) Gaertn.
Alnus incana (L.) Moench
Angelica archangelica L.
Antennaria dioica (L.) Gaertn.
Arctium lappa L.
Arctostaphyllos uva-ursi (L.) Spreng.
Arnica montana L.
Artemisia absinthium L.
Artemisia vulgaris L.
Berberis vulgaris L.
Betula pendula Roth
Betula pubescens Ehrh.
Calluna vulgaris (L.) Hull
Carex arenaria L.
Carum carvi L.
Centaurium erythraea Rafn
Chelidonium majus L.
Cichorium intybus L.
Comarum palustre L.
Convallaria majalis L.
Corylus avellana L.
Crataegus monogyna Jacq.
Drosera rotundifolia L.
Dryopteris filix-mas (L.) Schott
Elymus repens (L.) Gould
Epilobium angustifolium L.
Epilobium parviflorum Schreb.
Equisetum arvense L.
Filipendula ulmaria (L.) Maxim.
Fragaria vesca L.
Fragaria viridis Weston
Frangula alnus Mill.
Fraxinus excelsior L.

Galium odoratum (L.) Scop.
Gentiana cruciata L.
Geranium robertianum L.
Geum rivale L.
Geum urbanum L.
Glechoma hederacea L.
Gratiola officinalis L.
Hedera helix L.
Helichrysum arenarium (L.) Moench
Hepatica nobilis Mill.
Herniaria glabra L.
Hippophae rhamnoides Crantz
Humulus lupulus L.
Hypericum maculatum L.
Hypericum perforatum L.
Juniperus communis L.
Lamium album L.
Ledum palustre L.
Leonurus cardiaca L.
Leonurus quinquelobatus Gilib.
Linaria vulgaris L.
Lithospermum officinale L.
Lycopodium clavatum Mill.
Lycopus europaeus L.
Lythrum salicaria L.
Melilotus officinalis (L.) Pall.
Mentha aquatica L.
Mentha arvensis L.
Menyanthes trifoliata L.
Myrica gale L.
Oenothera biennis L.
Origanum vulgare L.
Persicaria bistorta (L.) Samp.
Picea abies (L.) H.Karst.
Pilosella officinarum Vaill.
Pinus sylvestris L.
Plantago lanceolata L.
Plantago major L.
Polemonium caeruleum L.
Polypodium vulgare L.
Populus tremula L.
Potentilla anserina L.
Potentilla erecta (L.) Raeusch.
Primula veris L.
Prunella vulgaris L.
Prunus padus L.
Prunus spinosa L.
Pulsatilla pratensis (L.) Mill.
Quercus petraea (Matt.) Liebl.
Quercus robur L.
Rhamnus cathartica L.
Ribes nigrum L.
Rosa canina L.
Rosa majalis Herrm.
Rubus caesius L.
Rubus idaeus L.
Rubus nessensis Hall
Rubus plicatus Weihe & Nees
Rumex acetosa L.
Rumex crispus L.
Rumex thyrsiflorus Fingerh.
Salix × *fragilis* L.
Salix alba L.
Salix purpurea L.
Sambucus nigra L.
Sanguisorba officinalis L.
Saponaria officinalis L.
Scrophularia nodosa L.
Sedum acre L.
Solanum dulcamara L.
Solidago virgaurea L.
Sorbus aucuparia (L.) Trevis.
Stachys officinalis L.
Symphytum officinale L.
Tanacetum vulgare L.
Taraxacum campylodes G.E.Haglund
Thymus pulegioides L.
Thymus serpyllum L.
Tilia cordata Mill.
Trifolium pratense L.
Tussilago farfara L.
Urtica dioica L.
Vaccinium microcarpum (Turcz. ex Rupr.) Schmalh.
Vaccinium myrtillus L.
Vaccinium oxycoccos L.
Vaccinium uliginosum L.
Vaccinium vitis-idaea L.
Valeriana officinalis L.
Verbascum thapsus L.
Veronica officinalis L.
Viburnum opulus L.
Vincetoxicum hirundinaria Medik.
Viola tricolor L.