

УДК 502.75:631.529

V.I. MELNYK

M.M. Gryshko National Botanical Garden, National Academy of Sciences of Ukraine
Ukraine, 01014 Kyiv, Timiryazevska Str., 1

PLANT CONSERVATION *IN SITU* AND *EX SITU* IN UKRAINE

Ukraine is characterized by high diversity of wild flora. Flora of Ukraine is one of the richest in Europe and includes 4523 species of vascular plants. Ukraine occupies 5.7 % of area of Europe and it contains 37 % of European vascular plants. 9 % of species of vascular plants of Ukraine are endemics. There are 611 species of vascular plants in the Red Data Book of Ukraine. The nature reserves funds of Ukraine included around 7790 objects, occupying around 5.7 % territory of Ukraine. Now Ukraine has a good perspective for improving the net of protected areas. All botanical gardens in Ukraine are involved in ex situ conservation of plants. The collection of rare and endangered species in M.M. Gryshko National Botanical Garden of National Academy of Sciences of Ukraine harbors 136 species included in Red Data Book. Modeling of the populations of rare and endangered species in artificial forest and steppe communities is an original method of ex situ plant conservation.

Kew words: plant conservation, flora, population, rare and endangered species, Ukraine.

Ukraine is a part of main European centre of plant diversity in the areas around the Mediterranean and the Black Seas. Ukraine is characterized by high diversity of wild flora. This richness in plant life owes to a wide variety of ecosystems, including coniferous pine and spruce forests, deciduous oak, beech and hornbeam forests, steppe grasslands, subalpine and alpine communities of the Carpathian Mountains and submediterranean communities of the Crimean Mountains. Flora of Ukraine is one of the richest in Europe and includes 4523 species of vascular plants from 997 genera and 189 families. Ukraine covering 5.7 % of area of Europe, houses 37 % of European vascular plants [9].

Ukrainian natural plant cover has been greatly altered by man's activity. Less than 32 % of country has natural or seminatural vegetation. Only 14.3 % of Ukrainian territory is covered by forests. The number of threatened native plant species has increased and, at the same time, many newcomers adventive species increased in number. Ukraine is a country with long tradition of nature conservation. The actual goal for modern Ukraine is integration in situ and ex situ conservation.

According to geobotanical division [1] the territory of Ukraine belongs to European deciduous

forest region, European forest-steppe region, European-Asiatic steppe region, Mediterranean forest region. Lowland part of Ukraine are occupied 85 % country territory. There are three geographical zones on the lowland part of Ukraine.

The zone of mixed forest occupies 19 % in northern part of Ukraine in Polissian lowland. Thank to the prevalence of sandy sediments in Polissya the pine and oak-pine forests are dominant in landscapes of Northern part of Ukraine. The oak and hornbeam oak forests are occupied more productive gley soil in southern part of Polissya. The alder forests cover flood-plains. Insular spruce forests are disposed in specific ecotons between forest and boggy ecosystems. Insular spruce forests and durmast oak-forests are rare communities of Polissya. Unusual forest community of this region is pine forest with *Rhododendron luteum* Sweet.

Southern from Polissya is lesosteppe (forest-steppe) zone characterized by rich soils. In the more humid area gray forest soil is supported for deciduous forests. The fertile chernozem soils are favorable for meadow steppe. Much of the forests and nearly all the steppe transformed into cultivated lands. Oak and hornbeam oak forests in plateaus and pine forests in the terraces of the rivers represent forest vegetations of Forest-Steppe zone of Ukraine. The insular beech forests in the eastern limit of area of *Fagus sylvatica* in Europe is

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rare forest community of the lowland of Ukraine.

South of Forest-Steppe is the steppe zone, broad grassland zone covering about 40 % of the territory of Ukraine. Perennial xerophyte sod grasses of such genera as *Stipa*, *Festuca*, *Poa*, *Koeleria*, *Agropyron* and *Cares humilis* prevail in the steppe of Ukraine. Desert steppe with domination of *Artemisia* grasses is presented on the saline soil in the south of the shores of Black and Azov Seas. Nowadays only in protected areas and unsuitable for agriculture places remain fragments of steppe vegetation.

The vegetation of the mountains of Ukraine is very different. Carpathian Mountains characterized by rich diversity of wild flora. This richness in plant life owes a wide variety of ecosystems. Ukrainian Carpathians is characterized by five vegetation belts.

The upper limit of submontane belt, being a transition belt between the lowland and the mountains, varies from 200—600 m a.s.l. This area covered by forest communities, mainly oak (*Quercetum*) in dry, acid habitats and oak-hornbeam forest habitats. Natural woodlands have been replaced by meadows with *Arrehenatheretum elatioris* domination.

The lower mountain belt reaches 400—1400 m a.s.l. beechwoods (*Dentario glandulosa*-Fagetum) prevail and fir forests (*Galio-Abietum*) are also present. In poor habitats acidophilous fir-spruce forests (*Abieti-Piceetum*) is considerable. In the flooded valley bottoms along the river, the grey alder bod association (*Caltho-Alnetum*) occurs. The upper montane belt rang from 450—1450 m a.s.l. The spruce forests of the order *Vaccinio-Piceetalia* dominate in this belt.

The subalpine belt with *Pinus mugo*, *Duchekia viridis*, *Juniperus sibirica*, *Rhododendron kotschy* shrubs ranges from 1300—1550 m a.s.l. in Gorgany Mts and Chornogora massif.

The alpine belt ranges from 1800—1850 m a.s.l. in Chornogora massif. It is dominated by high-mountain grassland with *Festuca supina*, *Carex sempervirens*, *Juncus trifidus*.

Much smaller Crimean mountains along the Black Sea in the Crimean peninsula, an extraordi-

nary rich in floristic sense have three vegetation belt different in southern and northern slopes. The southern macroslopes of Crimean Mountains characterized of the three vegetation belts:

1. The lower submediterranean belt (up 400 m) of hemixerophytic *Quercus pubescens* forests, with *Juniperus exelsa* and *Pistacia mutica*;

2. The middle forest belt (400—800 m) of mesixerophyte and xeromsophyte woods with *Pinus pallasiana* and of *Quercus petraea*;

3. The upper forest belt (800—1300 m) of *Fagus sylvatica* and *Pinus kochiana*.

The northern macroslope supports a different group of plant communities:

1. The lower forest belt (up 400 m) is covered by *Quercus pubescens* and steppe with domination of *Stipa* and *Festuca species*;

2. The middle forest belt (400—800 m) with temperate broad-leaf forest (*Quercus petraea*, *Carpinus betulus*, *C. orientalis*, *Fraxinus excelsior*);

3. The upper forest belt (800—1300 m) with prevailing of beech *Fagus sylvatica*.

The Quaternary glaciations determined the current flora of Ukraine. The uplands of Ukraine were refuges for some species during glaciation. Many relict species (*Daphne sophia* Kalen., *D. cneorum* L., *Euonymus nana* Bieb., *Staphylea pinnata* L., *Sorbus torminalis* (L.) Crantz., *Rhododendron luteum* Sweet., *Gymnospermium odessanum* (D. C.) Takht.) remain to our days in these refuges. The old Tertiary flora of Ukraine was destroyed during glacial time. Some species have survived in Ukraine possibly from the older Pleistocene and they represent glacial relicts *Aconitum lasiocarpum* (Rchb.) Gayr., *A. moldavicum* Hacq., *Alnus incana* (L.) Willd., *Betula humilis* Schrank., *Crocus heuffelianus* Herb., *Linnaea borealis* L., *Salix lapponum* L., *S. myrtilloides* L., *Woodsia ilwensis* R. Br. are among them [8].

Nine percents of species of vascular plants of Ukraine are endemics. The richest centers of plant diversity of Ukraine are mountain regions: Crimean Mountains, occupying only 1.2 % territory of Ukraine, occurs 2400 species of vascular plants, and Carpathian Mountains occupying 15 % territory of Ukraine, with 2050 species. Both mountain regions are characterized by high endemism.

There are 240 endemic species in the flora of Crimean Mountains, and 133 endemic species in the flora of Ukrainian Carpathians [3]. There are many narrow endemics, known from single localities, for example, *Lepidium turczaninowii* Lipsky endemic of Crimean Mountains. It is known only from one locality in the vicinity of Feodosia town in extreme east of Crimean Mountains by the shore of Black Sea. This local population accounts to 5000 individuals only.

Some endemic species of Ukraine and adjacent territories are tertiary relicts. Unical shrub species *Daphne sophia*, known from 20 localities from Middle-Russian Upland (Ukraine, Russia); *Syringa josikala* J. Jacq. ex Rchb., known from 32 localities from Eastern and Southern Carpathians (Ukraine, Romania) are among its. There are some rare species of Ukraine, not endemics, absent in others region of Europe represent *Spiranthes sinensis* (Persl.) Ames, known from one locality in Lviv region of Ukraine, has large distribution in Asiatic part of area [7, 8].

826 species of plant and mushrooms are included in Red Data Book of Ukraine [4]: 611 species of vascular plants, 46 species of mosses, 60 species of algae, 52 species of lichens and 51 of mushrooms.

The history of plant conservation in Ukraine goes back to 1886, when first Ukrainian natural reserve was founded for protection of the virgin beech forest in Podolian Upland. Famous steppe reserve Askania-Nova was founded in 1889. The Natural Reserve fund of Ukraine consists of about 77 400 objects cupying around 5.7 % of the territory of Ukraine and include 17 reserves, 4 biosphere reserves, 23 national natural parks, 305 reserves of national importance with 2997 monuments of nature of state level. Small protected territories occupied 80 % by quantity from all protected areas.

The most of the small protected areas are used as a good reserves to protected rare and threatened species of plants. 77 rare species including in Red Data Book of Ukraine are protected only in small areas. There are *Selaginella helvetica* (L.) Spring., *S. selaginoides* (L.) Beauv. ex Mart. et Shrank., *Woodsia ilwensis* (L.) R. Br., *Aconitum bessermanianum* Andr., *Aquilegia transilvanica* Shur, *Delphinium*

elatum L., *Gymnospermium odessanum* (DC) Tacht., *Androsace kozo-poljanski* Ovcz., *Cyclamen coum* Mill. s.l., *Daphne sophia*, *D. taurica* Kotov, *Spiraea polonica* Blocki, *Doronicum hungaricum* Rchb. f., *Leontopodium alpinum* Gass., *Ligularia sibirica* Cass., *Colchicum fominii* Bordz., *Eremerus spectabilis* M. Bieb s.l., *Galanthus elwesii* Hook. f., *Leucojum aestivum* L., *L. vernum* L., *Iris pineticola* Klokov. Protected areas occupy 5,7 % territory of Ukraine. It is a very low index for country with high plant diversity. As a result, only 2/3 of plant species from Red Data Book of Ukraine [4], are under protection *in situ*.

Crimean mountains along the Black Sea in the Crimean peninsula, an extraordinarily rich in floristic sense, has one of the best net of protected territories in Europe, including six reserves (Karadage, Krimskij, Mis Martyan, Jaltinskij, Kazantypskij, Opukskij and 179 small protected areas. For regret, now Crimean peninsula under Russian occupation is a grey spot in geographical maps. In such circumstance plant protected territories in peninsula are required protection and monitoring from international organization, such as Planta Europa.

Now Ukraine has good perspective to improve the net of protect areas by mean of organization reserves and national parks in hunting territories of former president V. Yanukovich.

Yet in 1956 famous Ukrainian botanist S.S. Kharkevich [2], proposed to organize *ex situ* plant protection in botanical gardens of Ukraine. In 1970 this initiative was put into effect and first in Ukraine plot of rare and endangered plants was opened in M.M. Gryshko National Botanical Garden of National Academy of Sciences of Ukraine in Kyiv. Now each of 31 Ukrainian botanical gardens has collection of rare and endangered species.

According to Target 8 of the Global Strategy for Plant Conservation adopted by the Convention on Biological Diversity (2002), 60 % of threatened plant species should be accessible in *ex situ* collections, preferably in country of origin [10]. About 81% of species from Red Data Book of Ukraine [4] are represented in collections of rare and endangered plants in Ukrainian botanical gardens.

The largest centre of *ex situ* plant protection in Ukraine is M.M. Gryshko National Botanical Garden of National Academy of Sciences of Ukraine in Kyiv. Into its collections of rare and endangered plants 136 species from Red Data Book of Ukraine [4] are included. Special aim of creation of this collection was to represent the plants with high risk of extinction in natural habitats. So far, as a great value has the narrow endemics of Ukraine, species known from single localities in Ukraine and from margins of areas. They are represented in living collection (*Euphorbia wolhynica* Besser ex Racib., *Lonicera caerulea* L., *Iris germanica* L., *Aconitum lasiocarpum* (Rchb.) Gayer, *Galanthus plicatus* M. Bieb., *G. elwesii* Hook., *Fritillaria montana* Hoppe).

In M.M. Gryshko National Botanical Garden in Kyiv rare and endangered species are represented not only in plot 'Rare and endangered species of Ukraine', but also in phytogeographical plots "Forest of lowland part of Ukraine", "Steppe of Ukraine", "Ukrainian Carpathians", and "Crimean Mountains", "Caucasus", "Middle Asia", "Altai Mountains", "Far East" occupying 52 ha. These plots are little copies of Ukrainian and European landscape ecosystems, where the diversity of forest and steppe vegetation of Ukraine are represented. The 60-years old cultivated forest and steppe phytocoenoses are very similar to natural Ukrainian forest and steppe communities. Collection of living plants in phytogeographical plots consists of 1178 species of Ukrainian flora, and floras of adjacent territories, and include many rare and endangered species.

Important aspect of *ex situ* plant protection is modeling the population of rare and endangered species. Unique 60 years cultivated forests and steppe phytocoenoses in M.M. Gryshko National Botanical Garden are suitable habitats for many rare and endangered species of Ukrainian flora. Rare forest species of Ukrainian flora — *Galanthus nivalis* L., *G. elwesii*, *G. plicatus*, *Erythronium dens-canis* L., *Euonymus nana*, *Leucojum vernum* L., *Lunaria rediviva* L., *Tulipa quercetorum* Klokov et Zoz. and rare steppe species *Adonis vernalis* L., *Paeonia tenuifolia* L. formed, during many years, stable introduced populations with homeostatic age struc-

ture. The populations are very similar in age structure to populations of these species in natural habitats [3].

The achievements of M.M. Gryshko National Botanical Garden are an evidence of perspectives for plant populations modeling in cultivated forest and steppe communities for protection of floristic diversity *ex situ*. Special attention is given to plant reintroduction. *Dianthus hypanicus* Andr. and *Silene hypanica* Klokov. were reintroduced from botanical garden to former natural habitats in the slopes of Southern Bug river in Mykolaivskiy region. Now populations of recovered species occupy large place in National Park *Busky Hard* in south of Ukraine.

Plant protection in Ukraine is a part of Pan-European biodiversity conservation. Evidently, rare species of European importance are priority species for protection in Ukraine and every European country. So far as, the composition of European Red Lists is very difficult goal, so far as European flora is rich and different conception concerning extend of biological species. In this connection many rare endemic species of Ukraine flora are absent in "European Red List of Globally Threatened Animals and Plants" [5]. Some endemic plant species of Ukraine and adjacent territories (such as *Achillea glaberrima* Klok., *Colchicum fominii* Bordz., *Daphne sophia* Kalen., *Dianthus hypanicus* Andr., *Diplotaxis cretacea* Kotov., *Genista tatragona* Bess., *Lepidium turczaninowii* Lipski, *Pulsatilla grandis* Wenter., *Syringa josikala* J. Jacq. ex Rchb.) are present in "European Red List of Vascular Plants" [6]. For regret this list has many mistakes and blunders. Including to European Red List many weed plants with large ranges and aggressive behavior, such as, *Armoracia rusticana* Gaertn., Mey. et Kit, *Festuca oviana* L., *Melilotus albus* Medik., *M. officinalis* (L.) Pall., *Ranunculus flammula* L., *R. repens* L., *Raphanus raphanistrum* L., *Urtica dioica* L., many common hydrophilous plants, such as *Alisma plantago-aquatica* L., *Lemna minor* L., *Lythrum salicaria* L., *Phragmites australis* (Gav.) Trin. ex Steud., *Typha angustifolia* L., and ignoring many rare species, destroyed the idea of plant conservation in all. In such circumstances improvement of "European

Red List” is very actual problem for plant conservation in Paneuropean level.

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Рекомендував до друку П.А. Мороз

Надійшла до редакції 14.01.2015 р.

В.І. Мельник

Національний ботанічний сад
ім. М.М. Гришка НАН України,
Україна, м. Київ

ОХОРОНА РОСЛИН IN SITU ТА EX SITU В УКРАЇНІ

Україна характеризується різноманіттям природної флори. Флора України — одна з найбагатших в Європі, вона включає 4523 види судинних рослин. Площа країни становить 5,7 % території Європи. У флорі України представлено 37 % європейських вищих судинних рослин. 9 % видів — ендеміки флори України, 611 видів судинних рослин занесено до Червоної книги України. До складу природоохоронного фонду входять 7790 об’єктів, які займають площу близько 5,7 % території України. Нині в країні поліпшується мережа природоохоронних територій. У всіх ботанічних садах України проводиться робота з охорони рослин *ex situ*. До складу колекції рідкісних та зникаючих видів рослин Національного ботанічного саду ім. М.М. Гришка НАН України входять 136 видів, занесених до Червоної книги України. Моделювання популяцій рідкісних та зникаючих видів у штучно створених лісових та степових фітоценозах — оригінальний метод їх охорони *in situ* та *ex situ*.

Ключові слова: охорона рослин, флора, популяція, рідкісні та зникаючі види, Україна.

В.И. Мельник

Национальный ботанический сад им. Н.Н. Гришко
НАН Украины, Украина, г. Киев

**ОХРАНА РАСТЕНИЙ
IN SITU И EX SITU В УКРАИНЕ**

Украина характеризуется значительным разнообразием природной флоры. Флора Украины — одна из наиболее богатых в Европе, она включает 4523 вида сосудистых растений. Площадь страны составляет 5,7 % территории Европы. Во флоре Украины представлены 37 % европейских высших сосудистых растений. 9 % видов — эндемики флоры Украины, 611 видов сосудистых растений включены в Красную

книгу Украины. В состав природоохранного фонда входят 7790 объектов, занимающих площадь около 5,7 % территории Украины. Сейчас в стране улучшается сеть природоохранных территорий. Во всех ботанических садах Украины ведется работа по охране растений *ex situ*. Коллекция редких и исчезающих видов растений Национального ботанического сада им. Н.Н. Гришко НАН Украины состоит из 136 видов, занесенных в Красную книгу Украины. Моделирование популяций редких и исчезающих видов в искусственных лесных и степных фитоценозах — оригинальный метод их охраны *in situ* и *ex situ*.

Ключевые слова: охрана растений, флора, популяция, редкие и исчезающие виды, Украина.