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IRIS MEDITERRANEA spec. nov. - A NEW MEMBER OF NATIVE BALKAN FLORA AND VEGETATION

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Iris mediterranea species nova is a fertile natural species, similar to the vegetatively propagated, limited-fruiting cultural species *Iris germanica* L. (*Iris x germanica* auct. p.p.). The species have similar flowers, blue-purple, but with *Iris mediterranea* there do not occur the dark reddish-purple shades which are present in a significant number of clones of *Iris germanica*. In contrast with *Iris germanica*, except one clone found in culture, there are no known white-flowered plants of *Iris mediterranea* yet. In contrary, photos published in public discussions show samples of *Iris mediterranea* from distanced places in Greek mountains with bicolor flowers: standards are pure white, falls blue or even deep purple. Such color combination is not known in *Iris germanica*. Habitus is similar in both species, but *Iris mediterranea* has more abundant branching in many of its clones.

The majority of *Iris mediterranea* plants are similar in coloration to the known clones of *Iris trojana* Kerner ex Stapf, which correspond in flower size to selected large-flowered clones of *Iris mediterranea* known from culture. *Iris trojana* usually has also a larger number of flowers per stem.

In flowering time, *Iris mediterranea* is intermediate between *Iris germanica* and *Iris trojana*.

Key words: *Iris mediterranea*; new species; Balkan; flora

INTRODUCTION

In the Botanical Garden of the Botanical Institute of the Czechoslovak (later Czech) Academy in Průhonice, since the establishment of the garden and joining of Milan Blažek in this department (1963), a program of studying the relationships between the variability of wild and cultivated Irises has been carried out. The aim was to create study and exhibition collections of living plants with documentation leading to strictly systematic collections and to the conservation of endangered taxa [1]. The solution of the problem was associated with the corresponding gained experience and development of the necessary knowledge, based on gradually acquired representative study material.

Experimental hybridization was one of the basic working methods in the first decades, with the aim of explaining the relationships between species, together with the verification of breeding possibilities as interspecific hybridization has played an important role in the development of the genus *Iris*.

Particular attention was paid to the genetic resources of garden Irises and their botanical and genetic characteristics. This has resulted in one of the world's largest institutional collections, characterizing the complete historical development, and the largest collection of archaic cultivated Irises of the *Iris* section in relation to their natural resources. Maintaining this section of the collections is an ongoing priority for the garden.

There is a wealth of information in the literature on plants in this category - taxa on the boundary between wild and cultivated plants. Due to inconsistent interpretation of certain species names and their occasional misinterpretation, it has been and continues to be necessary to obtain as much rich, largely even unidentified living material as possible from all available sources. One of the key areas of interest was of course *Iris germanica* as a symbol of cultural Irises, the botanical nature of which was and is still inconsistently understood.

Iris germanica is the type species of the genus *Iris*. It is a name with a confusing interpretation since there are three biologically distinct groups to which the name *Iris germanica* is applied:

A - This view was supported by a series of cytological studies done in the previous century. If we here use the name *Iris germanica*, or *Iris germanica* sensu stricto, our interpretation of the name is that which we consider to be the closest to C. Linné's conception. This specification was supported by a series of cytological studies which confirmed its specifics. *Iris germanica* is a group of aneuploid sterile hybrids ($2n = 44$) [2, 3] that have been in culture throughout the world since ancient times. *Iris germanica* is one of the three names that C. Linné used for historical hybrid species of the genus *Iris*. The others are *I. sambucina* and *I. squalens*. These have $2n=24$ and different ancestry [2, 4–11].

B - Many botanists use the name *Iris germanica* L. also for similar, but fertile tetraploids having $2n = 48$. These were imported Irises from the East Mediterranean area, and awoke high interest in western Europe around 1900 and later. Many of them were collected as cultivated plants whose geographic origin is difficult to pinpoint. We treat them as *Iris germanica* sensu lato.

Views on the taxonomic value of them vary. Some authors treat these tetraploids as autonomous species, others refer to them as synonyms of *Iris germanica* L. This concept is mainly reflected in publications dealing with wild Irises [12–15]. In our work, we divide these tetraploid Irises into two groups, i.e., "germanicoids" and "aphylloids," according to their proximity to either *I. germanica* L. or *I. aphylla* L. [16].

C - Some practicing *Iris* growers use the name "*Iris germanica*" for all the tall bearded Irises, mostly with $2n = 48$, and also for genetically distinct diploid ($2n = 24$) cultivars. By their origin, those diploids have little in common with *I. germanica* L., both *I. germanica* sensu stricto or sensu lato. They are close to *I. pallida* Lam. and *I. variegata* L.

Information on the origin of all known *Iris* cultivars is periodically compiled by the American *Iris* Society in the Alphabetical Check List. The first edition covers the history up to 1939, new registrations are now published annually.

Before 1900, diploid bearded Irises made up the majority of the tall bearded Irises in cultivation. Some of these cultivars were even the selected individuals of the original species, *I. pallida* Lam. or *I. variegata* L., not their hybrids.

Many other species were added to the hybridizing program later. Specialized gardeners call them *Iris x barbata* hort., and restrict using the name *Iris germanica* name to certain antique cultivated clones only. Naming them "*Iris germanica*" is improper. This is not in accordance with C. Linné's conception of the concerned species.

Most of present time tall bearded cultivars have in their pedigree *Iris germanica* sensu lato but extremely rarely *Iris germanica* sensu stricto.

NEW SPECIES

In the countryside of North Macedonia, Greece, and Albania, there is a native tall species of the genus *Iris*, which, due to its similarity to *Iris germanica* L. and known tetraploid species, is often identified as Linnaeus's *I. germanica* [14, 15].

The first encountered sample of it was from the University Botanical Garden in Zagreb, where it was then designated *Iris macedonica* Horvat. Unfortunately, the name *macedonica*, regardless of its factual rightness, could not be accepted for formal reasons.

These plants are not identical with any of the known species. This fact became the reason for the description under the new name - *Iris mediterranea* spec. nova. It is an endemic of the Prespa Tri-border.

MATERIALS AND METHODS

After the receipt of the first specimens from the Botanical Gardens of Zagreb (origin at Galičica, North Macedonia) and Sofia (origin at Ostravica, Albania) in the first years of the existence of the Prùhonice Botanical Garden, this species, under the working name "*Iris macedonica*", was included among the open working problems of the working program.

The long processing time results from the necessity of obtaining sufficient samples of concerned plants in a region distanced from their place of occurrence, both in nature and in culture. With the long-

time limitation of possibilities to move outside our own national territory, maximum use was made of communication with botanical and horticultural specialists at the international level. In the course of time, we gradually obtained additional rich, representative collection of plants both from culture and nature.

Our successful sampling of these Irises *in situ* was only in the summer and autumn without the chance to see them in bloom and to select outstanding individuals. Nevertheless, our collected Irises, when they later bloomed, indicated that they came mostly from quite variable populations.

Samples of similar clones originating from Balkan countries were in the meantime obtained also from specialists of the American Iris Society and from European private collectors. The result was a collection that allowed long-term comparisons of plants of different origins at one workplace.

In the course of the research, significant monographic publications on the genus *Iris*, which refer to the territory of the Balkan Peninsula and Europe, were used [31–35].

This final, summarizing publication is realized in cooperation with Prof. Dr. Vlado Matevski, representative of the Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje, and Macedonian Academy of Sciences and Arts.

RESULTS AND DISCUSSION

The specific name *Iris mediterranea* was chosen in view of the geographically-sounding common names of a number of related species of the genus *Iris*, in order to emphasize their home area. This is the case of wild species, described according to their natural habitat, such as *Iris bohemica* Schmidt, *Iris bosniaca* Beck, *Iris croatica* Horvat, *Iris cypriana* Foster et Baker, *Iris hellenica* Mermygkas, *Iris hungarica* Waldst. et Kit., *Iris illyrica* Tommasini or *Iris kashmiriana* Baker, as well as of a species of clearly hybrid origin such as *Iris x germanica* L. In this case, however, Germany was the country of origin of the plants described, not the place of actual historical origin.

In contrast, *Iris mediterranea* is a species with a corresponding natural character, but it is commonly referred to in the botanical literature by the name of *Iris germanica*, a similar ancient hybrid with an unknown place of true origin. As a result, it has never been given enough attention, even though it can hardly be the *Iris* that has been described as *I. germanica* by C. Linné.

***Iris mediterranea* Blažek & Matevski spec. nova** (Figures 1–4)



Figure 1. The new species *Iris mediterranea* Blažek & Matevski on natural habitat in locality Matka near Skopje (N. Macedonia) – habitus (photo V. Matevski)

Description

Rhizome stout, horizontal. Stems 40–80 cm tall, stout, green, always branched, sometimes the lowest branch is below the middle of the stem and is further branched. *Leaf* length 30–60 cm, the dry leaf apices brown. *Inflorescences* with 4–8 flowers. *Bracts* at the apex of the inflorescences always with a dry, non-green terminal part; the mean length of the bracts at the top of the stem is about 30 mm, the width slightly less than half that. *Flowers* basically bicolored. Generally, *standards* are light blue or purplish blue, the *falls* are slightly or, more often, distinctly darker with a purple tinge (see Figures 7 and 8). *Standards* obovate 75 × 45 mm with a short haft (13 mm). *The beard* (a narrow band of about 3 mm long hairs) is darker toward the center of the flower, and usually pale yellow at the tip. Only occasionally the ends of the hairs are distinctly deep yellow. Sometimes faint blue tints are found in the bases of hairs in the beard. *Falls* slightly longer and narrower than standards, 80 × 45 mm wide. The beard reaches from the base to a third of the falls. *Stamens* 30–32 mm, filaments and anthers with equal length. *Ovary* 14–20 mm long. *Style* ca. 35 (38) mm long, with 8–9 mm long stigma lobes. *Fruits* oblong-oval 40–60 (75) mm long with a rounded, only slightly triangular cross-section and a pointed apex. *Seeds* usually 6–7 × 5 mm, bronze-brown to deep brown.

HOLOTYPE: North Macedonia, Skopje, Matka - gorge of the river Treska, on the left side of the artificial lake "Matka", on limestone rocks, 41.943199 N; 21.304656 E; 317 m.s.m. 07.05.2023 (Holotype: MKNH 00 – 90; Isotype: Prùhonice) (Figure 4).

Distribution in North Macedonia: Skopje: Matka-Gorge of the Treska River; Struga: Gorge of Crni Drim River, between Struga and Debar; Prespa: Stenje village, near the stone beach.

Ecology of *Iris mediterranea*

From a geobotanical point of view, the typical population of the species *Iris mediterranea* in the nature develops on a carbonate substrate related to the communities of the dry grasslands which phytocoenologically belong to the newly described vegetation alliance *Diantho haematocalycis-Festucion hirtovaginatae* Matevski et al. 2018 [17].

At the same time, this species often occurs in crevices of calcareous rocks, which is part of the chazmophytic vegetation from the alliance *Ramondion nathaliae* Horvat ex Simon 1958, order *Potentilletalia speciosae* Quezel 1964 and the class *Asplenietea trichomanis* (Br.-Bl. In Meier et Br. -Bl. 1934) Oberd. 1977 (Fig. 1–3).

The population of this species on the territory of North Macedonia develops under the influence of the modified sub-Mediterranean climate, which penetrates to the Skopje Valley, through the famous phytogeographic corridor of the Vardar River, as well as in the Ohrid-Prespa region, where the sub-Mediterranean influence reaches through the Black Drim and Shkumba rivers. It is known that the valley of the Vardar river functioned as a phytogeographical corridor during the Pleistocene period, when the Demirkapija gorge was formed, with the descent of the Thessaloniki Lake, which connects to the Aegean Sea [18].



Figure 2. The new species *Iris mediterranea* Blažek & Matevski on natural habitat in Matka near Skopje N. Macedonia – flowers (photo V. Matevski)



Figure 3. The new species *Iris mediterranea* Blažek & Matevski on natural habitat in Matka (near Skopje, N Macedonia) – flower (photo V. Matevski)



Figure 4. *Iris mediterranea* Blažek & Matevski – Holotype (photo I. Blažev)

Characteristics of *Iris mediterranea*

Iris mediterranea spec. nova. belongs to the Eurasian species of the genus *Iris*, Section *Iris* (bearded Irises), with a branched stem whose height varies between 50 and 80 (up to 120) cm. The color of the flowers, as in similar species, is blue-purple. The shades vary from almost pure blue to deep purple flowers. Two-colored (bicolor) forms predominate, with the falls being darker and more purple in tone.

The yellow basic color is absent in this species. It is found only in hybrids with shorter local species. The occurrence of white-flowered individu-

al of *Iris mediterranea* has so far been confirmed by only one record in culture. Occasionally, very rare individuals with white standards may be found.

The flowers of *Iris mediterranea* and similar species are generally similar in shape to each other in the proportions of the size of the individual parts. The visible and definable differences between them are mainly in the branching of the stems and the time of flowering. The bracts (spathe valves) of all these species are roughly two-thirds herbaceous at the time of peak flowering whilst the upper part is scarious, brownish.



Figure 5. *Iris mediterranea* from Vikos, blind collected, does not show any basic difference from the samples from Matka (photo M. Blažek in the home)



Figure 6. *Iris mediterranea* Blažek & Matevski – Botanical garden in Průhonice, Czech Republic (photo M. Blažek)

Stem height and leaf size vary in the given range, as in related species. Even differences in additional coloring of bracts give the impression of individual variation only. Some are slightly to strongly purple suffused, some not. Leaf coloration is uniform in *Iris mediterranea*. As in closely related Irises (*Iris germanica* or *Iris trojana*), a distinctive purple basal leaf color was not observed. It is, however, known among certain individuals of *Iris nyárádyana* [19], which is close to *Iris croatica* [20].

An important characteristic of each of these species is their position in nature. Among the taller tetraploid species, *Iris mediterranea* is the only species among the known plants of this category where the natural occurrence clearly prevails over the occurrence in culture.

In contrast, other species except *Iris croatica* predominate in culture. Thus, their names are based on descriptions of individuals from secondary habitats, with no subsequent possibility to study natural variability.

Basic features of *Iris mediterranea*

Flower color

The flowers are basically bicolored, where the standards have a light blue or purplish blue color, while the falls are slightly or, more often, distinctly darker with a purple tinge. The beard is usually pale yellow.

There is also variation in the veining on the sides of the beards, which varies from thin dark purple veins to heavy veining, sometimes accentuated by an obvious brown tinge on a yellowish ground.

Flower size

The standards are obovate with a short haft (13 mm), with a total length of 77 mm and a width of 48 mm. The falls are slightly longer and narrower, 82 mm long and 47 mm wide. The beard reaches from the base to a third of the falls.



Figure 7. *Iris mediterranea* Blažek & Matevski, dimensions of flower elements - Botanical garden in Průhonice, Czech Republic (photo M. Blažek)



Figure 8. *Iris mediterranea* Blažek & Matevski, flower variability - Botanical garden in Průhonice, Czech Republic (photo M. Blažek)

The ovary is 14–20 mm long, and the corresponding perianth tube is the same length.

The style arms are 36–38 mm long, followed by 8–9 mm long stigma lobes. The width of the arms is 14–16 mm.

Stamens 30–32 mm, filament and anther are of equal length.

Bracts

The bracts at the apex of the inflorescence always have a dry, non-green terminal part. As flowering progresses, its roughly one-quarter to one-third proportion increases at the expense of the herbaceous part. The latter is either green only or slightly to very strongly colored purple on a green ground.

The mean length of the bracts at the top of the stem is about 30 mm, the width slightly less than half that.

Leaves

The leaves do not show any distinctive specific features in shape and size. Leaf length varies between 30 and 60 cm. The most common summer length is between 40–50 cm, and depending on the condition of the plant, there may be a difference of 15–20 cm between low and high fans within a clump. Winter leaves are short, but not completely lost.

The dry leaf apices are brown. Purple coloration of the leaf bases, as commonly encountered in Europe in, e.g., *Iris variegata* or *Iris aphylla*, has not been observed in this species.



Figure 9. *Iris mediterranea* Blažek & Matevski, branching - Botanical garden in Průhonice, Czech Republic (photo M. Blažek)

Stem

The stem, 40–80 cm tall, always branched and usually bears 4–8 flowers. Sometimes the lowest branch is below the middle of the stem and may be further branched. The number of flowers varies, of course, between individual stems of the same clone and often within a clump.

Fruits and seeds

The oblong-oval capsules with a rounded, only slightly triangular cross-section and a pointed apex are 40–60 (36–75) mm long and 20–28 mm wide. The ripe fruits open in the first half of August by opening the carpels from the top to the middle. The bronze-brown seeds begin to dry and darken to deep brown. An average number in a pod is about 50. Although the seeds are primarily ovoid in shape, the greater number of seeds growing in the capsule leads to being crowded and depressed. The ripe seeds are then mostly flattened on the sides and finally they develop in two rows in each of the thirds of the capsule. The dry seeds are usually $6\text{--}7 \times 5$ mm in size.

In culture, this species is not essentially different from related species. *Iris mediterranea* is evenly unproblematic, like *Iris germanica*, in contrast with *Iris albicans*, which is tender in colder climates.

Relation of *Iris mediterranea* to similar species - its position among similar Eurasian Irises

When describing *Iris mediterranea* as a species with its own name, it was necessary to define its position among other Irises, to analyze relationships, not only to *Iris germanica*, but also to other similar species, and also to compare it with known historical cultivars which occasionally give the impression of being native plants when they become naturalized.

In practice, by having to concentrate on the obvious, visible characters, the possibility of identification is quite limited. Conclusions depend on whether the species is judged by appearance of a chance sample or as a biological unit.

Reliable species identification requires a broader knowledge and cannot be made without comparisons. A simple, basic description of *Iris mediterranea* is sufficient for reliable identification only when considering a flowering natural population of the species within its native range. Identifying a single plant, removed from its natural habitat, is problematic for those who lack knowledge of re-

lated species. Here it is necessary to allow for the possibility of confusion with similar species, and to concentrate on their differences, which are essential but not readily apparent at first sight.

The flowering periods of *Iris mediterranea* and similar species do not completely overlap. *Iris mediterranea* fills the time space between the flowering of *Iris germanica* and *Iris trojana*.

These species are united not only by similar proportions but also by the color of their flowers: in a common sample of a medium-sized flower of *Iris mediterranea*, the flower size varies between the average size of *Iris germanica* or *Iris pallida* and that of *Iris trojana*. The shades of color are always just blue to purple in all of them, but the color shades vary within each species; they all contain only the basic colors of anthocyanin origin.

Generally, the standards tend to be blue and the falls purple shades. In this *Iris mediterranea* is close to *Iris germanica*, but even more so to *Iris trojana*, which some individuals of *Iris mediterranea* may strongly resemble.

All of these mutually similar species lack yellow flowers. White-flowered plants are commonly found only in *Iris germanica*, not in similar species.

Absence of yellow-flowered plants among all *Iris germanica* - like Irises is one of facts suggesting their distant genetic relationship to *Iris variegata*, although it is the only taller species occurring near natural localities of *Iris mediterranea* (in its northernmost areal).

The significant and clear, but not directly visible, unifying and separating element is in the *cytological sphere*. In all the taller species of the *Iris* section, the basic chromosome number is 12. With exception of *I. germanica* s.str. and *I. albicans* ($2n = 44$), other species are partly diploid, with $2n = 24$, partly tetraploid, where $2n = 48$ [11].

Both groups, diploids and tetraploids, are fully fertile, and the respective species interbreed readily.

Crossing occurs not only in culture but also in nature when two compatible species come into proximity with each other. The morphological character of interspecific hybrids and flowering time are usually intermediate.

However, it is not easy to interbreed diploids with tetraploids. In more distant hybrids, where species based on base numbers 8 and 12 are combined, fertility is limited [11, 21, 22]. Of the botanically described hybrids, *Iris germanica* L. ($2n = 44$) [2, 3] is such a basic distant hybrid.

Its close relative *Iris albicans* Lange, which is at the lower limit of the height of the Irises discussed here, has the same cytological problem.

Comparison of *Iris mediterranea* and *Iris germanica* L.

Characteristics of *Iris germanica* L.

Iris germanica L. is a small group of hybrids with limited fertility [3, 6, 11, 21, 23].

During 50 years of work on the completion of the Průhonice collection by collecting plants from various sources and obtaining them from all internationally active growers, after eliminating numerous duplicates, fewer than 30 clones could be found that can be unambiguously identified as *Iris germanica* L. Of the other Irises, described as species, is in the Mediterranean countries abundantly cultivated only *Iris albicans* Lange which is closest to it.

On the basis of published cytological analyses [11, 22], *Iris germanica* is the result of a cross between dwarf, early flowering west-Mediterranean *Iris lutescens* / $2n = 40$ / s. l., and a tall, later flowering *Iris* ($2n = 24$ or $2n = 48$). Our verification cross of *Iris* 'Macrantha' \times *Iris lutescens* produced white seedlings that had all the basic parameters of the collected *Iris germanica* clones where white is also common.

Iris albicans seems to have originated from more southern parents. It freezes in winter in central European environments. It is shorter and earlier than *Iris germanica*, and is widely known in only two clones. Its white-flowered form is widespread in Mediterranean climates. The blue-flowered form, called the 'Madonna' cultivar, is much more rare.



Figure 10. *Iris germanica* L. – Botanical garden in Průhonice, Czech Republic (photo M. Blažek)

Differences between *Iris germanica* L. and *Iris mediterranea*

The hue of the flower colors is little different. In particular, the color of the standards of *Iris mediterranea* is closer to pure blue, while *Iris germanica* is more often purple toned. Two-toned to bicolor flowers are found in both species. Monochromatic flowers, found occasionally in *Iris mediterranea*, may be so close to those of *Iris pallida*, that the flowers without green parts are confusable. Such cases are unknown in *Iris pallida* and *I. germanica*.

Stems and branching

The branching of *Iris germanica*, with one- or double-flowered apex and two to three single-flowered branches (4 flowers on the stem in total), is the minimum branching of *Iris mediterranea*. Branching is usually more abundant in *Iris mediterranea*. Similarly like with *I. germanica*, there is one flower between the bracts at the apex, or two. The two apical flowers are in *Iris mediterranea* sometimes slightly offset (1–2 cm), not consistently opposing each other between the supporting bracts.

Single flower at the top of the stem is in this species quite common.

A typical feature of the branching of *Iris mediterranea* is the secondary branching of the lower stem branches of the strongest individuals, so that the maximum branching on a single stem can be twice the minimum number of flowers compared to the four-flowered *Iris germanica* (up to 8). This brings *Iris mediterranea* close to *Iris trojana*.

Another difference is the somewhat later flowering of *Iris mediterranea*. It blooms in culture about a week after *Iris germanica*, thus following it and filling the time gap before *Iris trojana* blooms.

Fertility

The significant difference is in the cytology and the associated possibility of generative reproduction. Both species spontaneously produce fruits, but while in *Iris mediterranea* the ripe capsules are full of normally developed and germinating seeds after pollination by any compatible species, in *Iris germanica* a capsule full of seeds is not encountered. There are at most ten, and even these are often not viable. An exception is *Iris germanica* var. *Kharput*, where over 20 good seeds have been found in one fruit. This variety also has other specific features that distinguish it from other clones of *Iris germanica*.

The seeds of *Iris germanica* ripen in Central Europe in the first third of August, a few days earlier than those of *Iris mediterranea*. There is a small difference between concerned species.

Both have oval fruits but those of *Iris germanica* are more triangular in cross-section. The size of its capsules is 40-70 mm, the most common length is 50-60. Width varies proportionally from 14 to 24 mm, with 18 to 20 being common.

There is a considerable difference in the development of the seeds from the pollinated flowers of two species. In these experiments we have used widely the method received from P. Werckmeister. In *Iris germanica*, regardless of the pollinator, only a few of the large number of eggs (currently over 50 eggs in a single fruit) will produce viable seeds. Some of resulting, normal looking seeds have a properly formed embryo but a watery endosperm. When the embryo dries, it dies and the seed flattens to a thickness of just over 1-2 mm. Even in those seeds where a solid endosperm has formed, only a small number are able to germinate. Interestingly, some of the fresh endosperm-less seeds are visibly larger than those with a normal solid endosperm. They can be easily identified by the fact that they can be cut in half with a soft object. Well-developed seeds will not allow this.

The fruits open mostly by opening from the apex of the pod about halfway. There are different transitions between the different clones of *Iris germanica* to opening through the slits under the closed apex of the capsule, similar to the dwarf Irises of *Iris pumila* and *Iris lutescens* group. The basic shape of the seeds is ovoid, and because of their small number are uncrowded, so that this shape persists until the fruit is mature. Otherwise, the well-formed seeds do not differ from those of *Iris mediterranea*.

Table 1. Comparison of the differences between *Iris mediterranea* sp. nov. and *Iris germanica*

Feature	<i>Iris mediterranea</i>	<i>Iris germanica</i>
measurements	similar	similar
blooming time	a week later	a week earlier
prevailing purple shades of flowers	blue-purple	red-purple
flowers resembling <i>I. pallida</i>	occasionally	never
occurrence of albinos	extremely rare	almost 20% of known clones
white standards, colored falls	extremely rare	never
count of flowers per stem	varying between 4 and 8	stable 4
more flowers on lower branches	occasionally	rarely
forming pods	abundantly	occasionally
quality of seeds	normal	mostly malformed
known obviously wild populations	frequent	not proved
geographic area in wild	limited to MK, AL, GR	unlimited
variability in wild populations	high	none
assumed territory of origin	South-Eastern Mediterranean	South-Western Mediterranean
assumed hybrid origin	not known	confirmed by cytological analyses
occurrence in culture	occasionally cultivated	exclusively cultivated (or escaped)
history of culture	till 1900 Mediterranean only	start not detectable, now world-wide

Hypothetical possibility of genetic relationships between *Iris germanica* and *Iris mediterranea*

Respecting *I. mediterranea* as a distinct species may facilitate the explanation of relationships of species whose phylogenetic development has been putatively subject of hybridization. From this point of view, it is possible to develop a new version of the explanation of the origin of the aneuploid hybrid *Iris germanica* sensu stricto ($2n = 44$): whether its tall parent from the $x = 12$ group was *Iris pallida* with $2n = 24$ [3, 29] or one of 48-chromosome forms of "*Iris germanica*" (= *Iris germanica* sensu lato) [11, 22, 24].

In *Iris germanica*, when comparing various clones, there are indications that, as a hybrid with limited fertility, it did not evolve continuously from a single common base, but that it arose in multiple locations from different combinations of two types of parents: one from the group with $2n = 40$ (*Iris lutescens* s. l.) by crossing with a tall diploid *Iris* with $2n = 24$, or, more likely, with a tetraploid species with $2n = 48$.

The character of the cultivated clones of this largely blind evolutionary branch suggests the likelihood that these Irises have repeatedly arisen from several shorter taxonomic units with some of the taller Irises. Only two native tall species are known in the wild of southern Europe: *Iris pallida* and *Iris mediterranea*.

The cytological barriers make the possibility of *Iris germanica* originating in *Iris pallida* less likely, but conversely the involvement of *Iris mediterranea* in the origin of hybrids with dwarf species is easily reproducible in practice at any time. At present, the ranges of these *Iris* species do not overlap, but this is an area with several thousand years of extensive human intervention in nature. If it were the case that the ancestor of *Iris germanica* was *Iris mediterranea*, it would be incorrect to refer to the original species (*Iris mediterranea*) by the name of its hybrid (*Iris germanica*).

Similarly, *Iris mediterranea* may also serve to studies concerning further species and hybrids occurring in Balkans.

The question arises as to why this simple hypothesis could not have been advanced by the authors of the cytological analyses of the middle of the last century explaining the origin of *Iris germanica*. The answer is simple: *Iris mediterranea* was not known at that time as a separate species.

Comparison of *Iris mediterranea* with *Iris trojana* Kerner ex Stapf

The difference in external similarity is slightly less than the difference between *Iris mediterranea* and *Iris germanica*, but there is considerable agreement in the characters linked to cytological conditions and underlying generative reproduction.

The practical problem is the lesser possibility of studying in detail the corresponding number and corresponding botanical reliability of compared plants. Obtaining an original individual of *Iris trojana* required an effort spanning several decades, yet resulted in only four clones that can be considered *Iris trojana*. One matches the description and portrait in the W. R. Dykes monograph, three were obtained under different names, one nameless [5, 23].

It has never been possible to verify the existence of an original natural population of *Iris trojana*, although a secondary occurrence is very likely in this species that has been cultivated for several centuries. In view of the full reproductive capacity of *Iris trojana*, the establishment of a generatively active natural population cannot be excluded.



Figure 11. *Iris trojana* Kerner ex Stapf – in Parc Floral in Paris, France (photo M. Blažek)

Therefore, an objective, full comparison with *Iris mediterranea* is not possible without further study. It can only be stated that *Iris trojana* known from gardens is, except for the height of the stem, slightly larger in size than the common wild plants of *Iris mediterranea*. Moreover, *Iris trojana* has more often double-flowered lateral branches and flowers a few days later. The classic clone of *Iris trojana* [8, 25] is also distinguished from most similar Irises by its unusually long bracts. These are reminiscent of the Asian species of the *Iris* section, the bracts of *Iris biliotti*, which is, however, poorly known as a natural species, although it is common in culture in the eastern Mediterranean.

Comparison of *Iris mediterranea* with *Iris pallida* Lam.

The relationship of *Iris mediterranea* to *Iris pallida* Lam., which is the only other native tall *Iris* species in the Balkans, is relatively easy to define, although the flowers of some exceptional individuals may at first sight strongly resemble each other: certain plants of *Iris mediterranea* have monochromatic blue flowers, sometimes with lavender tinge that cannot be distinguished from *Iris pallida* without seeing bracts. This situation is similar to the case in the past of *Iris sicula* Todaro, which was considered a form of *Iris pallida* by the flowers, not the other parts of the plant [6, 12].

However, introgression of *Iris pallida* does not seem very realistic due to the low ease of hybrid-

ization with *Iris mediterranea*. Pollination of *Iris pallida* with *Iris mediterranea* pollen (and vice versa) produces fruit filled with normal-looking seeds during opening of pods, but with a watery endosperm that dries out together with the embryo. These watery seeds tend to be slightly larger than normal, viable seeds. This is a common phenomenon when diploid and tetraploid tall Irises are crossed.

The size of the range of indisputably wild *Iris mediterranea* and that of indisputably wild *Iris pallida* is comparable, but geographic locations of wild populations of the two species do not overlap, which is a barrier to eventual contemporary natural hybridization. The two species meet only in culture at present, but we cannot speak about distanced past.

The clear difference from *Iris pallida* is the number of flowers per stem. The number of lateral branches is similar, but the difference is in the number of flowers in all bud sockets. In *Iris pallida* there are three and rarely four (or even five) flowers on the top of the stem and two or three on the side branches. Here, too, the lower branches may have secondary branching.

The dry leaf apices of *Iris mediterranea* are, as in most species, brown rather than silvery. This distinguishes them all from the grey-green leaves of *Iris pallida* with silvery leaf tips. And the most important characteristic that distinguishes *Iris pallida* from all other species of the genus (except related *I. illyrica*) is that the bracts (spathe-valves) are already dry before the first flower opens, without any chlorophyll-containing tissue.



Figure 12. *Iris mediterranea* (left) can be easily confused with *I. pallida* (right). In order to identify the species, it is necessary to examine the vegetative parts (photo M. Blažek)



Figure 13. *Iris mediterranea* can be easily confused with *I. pallida*. In order to identify the species, it is necessary to examine the vegetative parts (photo M. Blažek)

Relationship of *Iris mediterranea* to *Iris croatica* Horvat

More similar to *Iris mediterranea* than *Iris pallida* is another tall Balkan species, *Iris croatica* [20].

These two species bloom at the same time, but the flowers of *Iris croatica* are slightly smaller and

stalks are shorter than tallest individuals of *Iris mediterranea*. Some clones of *Iris croatica* can be confused with dark self-colored individuals of *Iris germanica*, but not with *Iris mediterranea*. *Iris croatica* has mostly darker, nearly self-colored flowers, never distinctly bicolored. Other differences are the very low or basal stem branching of *Iris croatica* and its bracts, which have a smaller proportion of non-green apical parts.



Figure 14. *Iris germanica* L., *Iris pallida* Lam. and *Iris croatica* Horvat – Botanical garden in Průhonice, Czech Republic Most individuals of *I. pallida* are not yet blooming (photo M. Blažek)

Relationship of *Iris mediterranea* to the *Iris sicula* group

Our new species, *Iris mediterranea*, is also related to a group of South-Eastern Mediterranean thermophilic Irises with different branching and generally taller growth (over 1 m) described from southernmost Europe and the Middle East: *Iris sicula* Tod. (1858), *Iris cypriana* Foster & Baker (1888), and *Iris mesopotamica* Dykes (1913).

No reliably identified living plants could be found for study and for objective comparison, nor sufficient convincing references of their original natural occurrence. Comparing the published differences between these three species indicates smaller differences than those which are evident in the high variation of wild *Iris mediterranea*. In flower color, *Iris sicula* with its relatives is close to monochromatic individuals of *Iris mediterranea*, and thus resembles *Iris pallida*. This in history has probably led to the association of *Iris sicula* with *Iris pallida*: *Iris pallida* subsp. *sicula* (Tod.) K. Richt. (1890), or supposing synonymy [2, 3, 6, 8, 10, 26].

Iris sicula Irises are highly important for the study of the phylogeny of tall species of section *Iris* with blue and purple flower color. While for a number of dwarf as well as taller *Iris* species it is possible to assume hybrid origin, for *Iris sicula*, just as for *Iris variegata*, we simply cannot find any eventual parent species for hybridization, leading to forming them as new species.

Comparison of *Iris mediterranea* and related species in frost hardiness and flowering time

Due to their ability to thrive in a relatively wide climatic range, neither *Iris mediterranea* nor related Irises, except *Iris albicans*, show any evidence of extremely southern origin in Europe. In Průhonice, Czech Republic, they bloom in mid-May and precede the mass flowering of tall Irises, included under the name *Iris barbata* of the *Elatior* group, by 1-2 weeks. Contrarily, they coincide with the *Intermedia* group, where the older purple cultivars cannot be distinguished from *Iris germanica*. The

original *Intermedia* group corresponds also by count of chromosomes (44) [1, 2, 4, 16, 23].

Flowering time alone, without comparison, is of relatively little help in species identification. Only the relative flowering time in one spot is of informative value. Since the difference in the onset of flowering of similar species is about a week backwards and forwards from *Iris mediterranea*, we are only able to compare them where they occur together in the same place. Only then is the species specificity visible.

After *Iris albicans*, *Iris germanica* is the first to flower among comparable species. It is followed by the tetraploid species. First is *Iris croatica*, then in close succession *Iris mediterranea* of wild origin and a few days later *Iris mediterranea* starts to flower. These are followed by *Iris trojana* and the latest is *Iris biliotti*, which is probably related to *Iris trojana* more than to European species. There is a similar order (except for the first and last species) in flower size. Of course, independently, besides the extreme individual variations, fluctuations depending on the condition of the plants are also observable.

Irises of the *Iris sicula* group bloom later than *Iris mediterranea*. They are not hardy enough in Central Europe, and probably not even in the territory where wild *Iris mediterranea* is at home. The latter peculiarity links them to *Iris albicans*, a close partner of *Iris germanica* (again a matter for study based in laboratory methods and experimental hybridization).

Study material of *Iris mediterranea* in institutions

In addition to the numerous populations in the three Balkan countries bordering Lake Prespa, there is a representative collection of wild-collected specimens and their seedlings in the Botanical Garden of the Botanical Institute of the Academy of Sciences of the Czech Republic. Individual plants of natural origin are maintained in other botanical gardens under the name *Iris macedonica* Horvat or *Iris germanica* s. l., or cultivar names 'Amas' and 'Macrantha', or eventually under local names according to their origin in Greece (Vikos etc.).

The oldest among all the nameless collections of garden specimens in the Průhonice collection is an *Iris* from the Romanian countryside and another, very similar clone, from the vicinity of Sofia.

A very similar clone reached the USA in the mid-20th century, where it was identified as *Iris varbosania*. In gardens it still spreads under the name *Iris varbossiana* [2, 13, 26]. However, this is a misidentification. *Iris varbosania* [27] is a diploid

Iris described from Sarajevo. Unfortunately, the author K. Malý had no information about the cultivated Balkan *Iris* described earlier, which is identical and which the Danish botanist Jens Wilken Hornemann called *Iris neglecta*. *Iris neglecta* has its ancestry among hybrids of diploid species *Iris pallida* Lam. and *Iris variegata* L. [2, 5, 8].

There are other such cultivated clones of tetraploid Irises in historical human settlements in the Balkans. Their number is not large, but they are a significant element of traditional local garden culture. These Irises have long been the privilege of southern Europe. It was only as a result of increased introductory interest that new southern European tetraploid Irises began to be cultivated in other parts of Europe and the USA in the middle of the last century. These added to the small number of archaic tetraploid garden Irises introduced from the Middle East around 1900 and cultivated now worldwide.

The first of the new introductions (in 20th century) was the aforementioned "*Iris varbossiana*" - false *Iris varbosania* Malý. It has been spreading under this modified name ever since. Shortly afterwards, other clones of tetraploid - large-flowered archaic garden Irises, were coming not from breeders but from occasional collections in Greece. They were introduced as anonymous plants, named by original localities and entered the range of the world's *Iris* growers.

Of all the species described, they are next to *Iris trojana*, which is the closest to the newly described *Iris mediterranea*. Unlike the common specimens of natural *Iris mediterranea*, these historical garden clones show traces of selection. They probably originate from local natural populations or from selection among spontaneous seedlings in culture. At present it is no longer possible to assign them to wild plants, from which they differ qualitatively and quantitatively. They have often distinctive colors and, in particular, larger flowers than common specimens in nature. Their origin can no longer be deduced except by assuming that they are the result of non-professional selection in natural populations of *Iris mediterranea*.

In reality, surprisingly, they are less variable in color than wild forms. Mostly only two-toned clones are known, combining light blue standards with darker purple falls. The flowers are larger than the common specimens of *Iris mediterranea*, but otherwise show no signs of belonging to another species. In gardens they are commonly known as Vikos Irises or Skamnili (Skamneli) or Monodendri Irises [2, 9]. These probably in their history selected clones are not entirely identical to those with an obviously natural origin. On the other hand, wild spec-

imens from the rocks of Vikos Canyon do not show any specific difference from specimens originating from natural sites in Northern Macedonia or from Albanian territory.

Monochromatic – self-colored – Irises of these garden forms are almost not yet known, but in the Greek countryside in 2019 we found an attractive cultivated white-flowered specimen that resembles *Iris florentina*, the well-known albino *Iris germanica*, in its bluish hue and branching. But it has larger flowers of a slightly different shape, and testing pollination by different partners suggests that it is a tetraploid, not an aneuploid *Iris germanica* with limited fertility. When pollinated by any tetraploid *Iris*, it produces normal fruits, filled with good quality seeds.

Amas and Macrantha

Since the last century and before, Irises similar to *Iris germanica*, but with larger flowers, have become important in western Europe. These include the pair 'Amas' (collected by M. Foster, named 1885) and 'Macrantha' (named by van Tubergen 1907) [8, 10, 23, 25, 28, 30].

They were introduced into western Europe from Asia Minor, from secondary sites in a territory where there had been an interchange of inhabitants and cultures for several centuries. It is therefore not excluded that these Irises originated in the Balkans.

We acquired the first of them for the collection in the 1960s as a garden *Iris* in Zelenikovo (south of Skopje). The first identification led to the name 'Amas', but after comparison with plants from other specialists, it turned out to be 'Macrantha'. The two clones are very similar to each other. Although they were described as two different plants long ago, they were not distinguished from each other in horticulture for many years.

In basic characteristics they are both slightly different from *Iris germanica*, as well as from known tetraploids of taller growth. They have the same kind of branching as *Iris germanica*, but larger flowers. Genetically, being fertile tetraploids, they are closer to *Iris mediterranea*.

CONCLUSIONS

The taxonomic evaluation of plants on the boundary between spontaneous wild plants and anthropogenic taxa tends often to be associated with inconsistent attitudes due to the different viewpoints of the authors.

Iris mediterranea sp. n. is not a new species in terms of biology. Its natural status is more convinc-

ing than that of the very similar species *Iris germanica* L. and *Iris trojana* Kern.

It belongs to the wild flora of all three countries bordering Lake Prespa and locally has reached a prominent position in Balkan in garden culture.

Only its name is new.

Current knowledge suggests moreover that *Iris mediterranea* most probably took an important position in the phylogeny of wild species and among natural as well as garden hybrids in the genus *Iris* of the section *Iris*, and thus becomes valuable working material for further study by modern laboratory methods.

We would be pleased if this work would also contribute to a more unified understanding of related species, valuable both botanically and culturally.

Acknowledgement. I am grateful to my colleagues from North Macedonia for their cooperation and help in closing this phase of work. I trust that the issue will be continued and developed further.

The collection of extensive plant material and discussions in search of answers to countless questions in the interest of understanding the group of closely related species necessarily required personal communication with many interested experts on international level. Without them, the work would not have been possible.

This work, apart from international partners, could hardly have also come into being without the long-term support and the considerable work of my parents, my wife Uljana, and the longstanding work of the gardeners and colleagues at the botanical garden in Prùhonice.

My appreciation and thanks to all of those for their help. Each of them has contributed their part to make it possible to reach corresponding conclusions.

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Hungary: Priszter Szaniszló

Russia: Rodionenko Georgi

Sweden: Höpfner Lars

USA: Edinger Phil, McDonald Nancy, Randolph Lowell Fitz, Warburton Beatrice

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IRIS MEDITERRANEA spec. nov. - НОВ ЧЛЕН НА ПРИРОДНАТА БАЛКАНСКА ФЛОРА И ВЕГЕТАЦИЈА

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Iris mediterranea spec. nova е фертилен природен вид, сличен со ограничено фертилниот култивиран вид *Iris germanica* L. (*Iris* x *germanica* aust. p.p.). Двата вида имаат слични цветови, но кај *Iris mediterranea* не се појавуваат темноцрвени виолетови нијанси кои се присутни во значителен број на клонови од *Iris germanica*. За разлика од *Iris germanica*, освен еден клон пронајден во културата, кај *Iris mediterranea* сè уште не се познати растенија со бела боја на цветови. Хабитусот е сличен и кај двата вида, но *Iris mediterranea* има пообилно разгранување во многу од неговите клонови.

Поголемиот дел од растенијата на *Iris mediterranea* се слични во бојата на цветовите со познатите клонови на *Iris trojana* Kerner ex Stapf, кои одговараат во големината на цветот на избраните клонови со големи цветови на *Iris mediterranea* познати од културата. Но, *Iris trojana*, обично има и поголем број на цветови по стеблото.

Во периодот на цветање, *Iris mediterranea* е интермедиерна помеѓу *Iris germanica* и *Iris trojana*.

Помеѓу трите сродни видови - *Iris mediterranea*, *Iris germanica* и *Iris trojana*, новоопишниот вид *Iris mediterranea* е единствениот од трите наведени видови каде што постојат повеќекратни и променливи, генеративно репродуктивни природни популации, со јасно дефиниран географски ареал, кој вклучува и ненаселени оддалечени планински локации. Поради тоа, *I. mediterranea*, за разлика од сличните видови, не претставува таксон, кој во текот на неговата историска и сегашна дистрибуција, бил под антропогено влијание.

Клучни зборови: *Iris mediterranea*, нов вид за науката, *Iris germanica* L., Балкански Полуостров, флора