CYTOTAXONOMY OF YUGOSLAVIAN PLANTS: INTRODUCTORY REMARKS

by

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Yugoslavia is one of these European countries which are composed of numerous nationalities the culture of whom is connected with several languages and religions revealing the mixed origins of the inhabitants. The area itself, the Balkan Peninsula and the eastern Alps, is a young but variable grological formation the history of which still remains to be satisfactorily explained, though it is evident that the uplift of these mountains is relatively recent and closely connected with continental drift and the collision of Africa and Eurasia. Pleistocene glaciers affected some of the highest mountains somewhat, and the eroding effects of the Pleistocene rains are supposed to have been considerable, especially in the areas of the Karst which have given the name to similar formations elsewhere.

The geological history and the favorable climates of this very temperate region, past and present, have caused this land to become occupied by an unusually rich vegetation, which ascends verticql rocks, descends into waters, penetrates into subterranean caverns, and forces its way into every clump of earth and even floats in the air as an invisible aeroplankton. It successfully withstands the scorching heat of summer in the karst areas and in the semideserts of some mountain valleys in the south, and endures the severe climates of the high mountains, at the same time as it defies wind and avalanches, and lives in the rushing currents of streams, and in the mobile sand of dunes.

It is evident from numerous and thorough investigations of the phytogeography and ecology of Yugoslavia, that the vegetation that first invaded the country came from different directions. Some of its dispersal from the old coasts of the Tethys Sea, which were inhabited by a warm temperate or subtropical forest. Other plants came from the coastal mountains of this former Mediterranean Sea, as demonstrated by the relationships of some Yugoslavian and eastern Alpique plants to those of southern Asiatic mountains. According to a recent geological hypothesis connected with the theory of continental drift, much of the Balkan Peninsula may be geologically closely related to northeastern Africa and, indeed, there seem to be indications of botanical relationship between these areas. Much of the alpine vegetation of Yugoslavia is related to that of the eastern Alps and the Carpathians, and some arctic influence on the flora seems evident. A substantial part of the original vegetation may have dispersed at various times from the Hungarian-Russian plains, and the effects of the boreal and Siberian forests is as evident as is the influence of the forests of Asia Minor. All these and many more dispersals blended into vegetation associations that are more variable than in any other comparably sized region of Europe.

The species of plants that originally invaded Yugoslavia from various directions have since mixed and evolved under the influence of the geological and climatic conditions. Numerous endemic taxa have resulted from this process, and the variability below the species level of many species shows that the original gene pools have been greatly influenced by the new land so that its flora has become unusually rich in local races. Such species and races still are being discovered and described in profusion, and when the methods of cytotaxonomy and chemotaxonomy will be added to the classical approaches of the taxonomists of the area, such discoveries may be expected to be increased considerably.

Scandinavia and Britain are the only areas of a similar size that have been studied as intensely by botanists as Yugoslavia. Since the present frontiers of the country are quite different from previous political constellations in this part of Europe, a manual of the flora of the entire territory has not yet been composed, although two volumes of the "Catalogus Florae Jugoslaviae" and one volume of "The Analytical Flora of Yugoslavia" have recently been published. Hayek's "Prodromus Florae Peninsulae Balcanicae" does, however, consider the Yugoslav territories to a large extent, but it does not include Slovenia and those parts of Croatia and Serbia that are north of the rivers Sava and Donava. In spite of the mentioned obstacles, the knowledge of the flora of entire Yugoslavia is well documented by a number of local manuals, starting with the second edition of the classical "Flora Carniolica" by Scopoli (1772). Together with Wulfen's (1858) "Flora Norica Phanerogama", this classical work represents the basis of floristics in Slovenia which was further widened by Hacquet, Hladnik, Fleischmann, Freyer, Paulin, Pospichal, Marchesetti, Justin, and others, and more recently also by Piskernik (1951), Mayer (1952), Martinčič and Sušnik (1969), T. Wraber, and others. In Croatia, including Istria and Dalmatia, basic floristic studies were performed by Visiani, Neilreich, Schlosserand Vukotinović, Frey, Hirc, Rossi, Degen, Horvatić, Domac, and others. For the flora of Bosnia and Hercegovina classical works were published by Beck, Murbeck, K. Maly, and more recently by Bjelčić, Šilič and others. The floristical knowledge of Serbia is still based upon the fundamental work by Pančić, which has been enhanced later with more or less local manuals by Petrović, Fritsch, Vandas, Adamović, Košanin and others, and more recently by Diklić, Nikolić and others; lately two volumes of the new "Flora of Serbia" have been published. In Montenegro the work by Pančić has been followed by extensive floristic investigations which were synthesized by Rohlena (1942), and the old tradition is proceeding by aid of Blečić, Pulević and others. The classical floristical works in Macedonia are those by Grisebach, Wettstein, and Bornmüller, which are continued by recent research by Černjavski, Soška, Micevski and others.

A great number of botanists have contributed to the knowledge of the Yugoslav flora with an enormous number of reports which are scattered among almost all European periodicals. Before the first world war and shortly afterwards the major part of these studies were performed by foreign scientists, and consequently these initial investigations are closely associated with the names of a number of great botanists of that period, as Beck von Mannagetta, Bornmüller, Degen, Fritsch, Freyn, Gayer, Handel-Mazzetti, Hayek, Janchen, Javorka, Keller, Kerner von Marilaun, Koch, Marchesetti, Murbeck, Pospichal, Rechinger, Rohlena, Tommasini, Vandas, Vierhapper, Wettstein, Widder and others, to mention only a few. Later taxonomical investigations have been performed mainly by Yugoslav botanists as Košanin, Horvat, Horvatić, Maly, Pevalek, Gjurašin, Bošnjak, Kušan, Lindtner and others. During this period particularly extensive ecological investigations have taken place, based on the work by Horvat and Horvatić and continued by Tomažič, M. Wraber, Blečić, B. and R. Jovanović, Mišić, Janković, Micevski and Lakušic, who employed descriptive ecological methods in such an extent that in this respect Yugoslavia has become one of the best investigated regions in the world.

The most recent review on floristic-taxonomical activities in Yugoslavia was compiled by Mayer (1963, who also is the author of a checklist of the Slovenian flora with a thorough review of the literature of the past. The list of papers relevant to the flora of the northern parts of the country takes up 23 pages in Mayer's list from 1952, whereas in 1963 he adds 9 pages of references to publications printed 1945 - 1961 on the plants of various parts of the country. This compares very favorably with similar activities in northern and central Europe and widely surpasses the efforts in these fields in other countries of southern Europe.

Since an exact and modern checklist of all the plants of Yugoslavia still has not been compiled, an exact number of the species of the country is missing. A rough estimate, however, indicates that more than one-third of the approximately 17,000 species of higher plants which will be included in Flora Europaea covering entire Europe, are being met with in Yugoslavia, and a considerable number of these species are endemics met with nowhere else on the continent.

As mentioned above, intensive studies have been made on the ecology of the Yugoslavian vegetation during the past half a century, and these studies have also resulted in considerable taxonomical information. Studies of the evolution of this remarkable flora by aid of the modern methods of cytogenetics, cytotaxonomy, and chemotaxonomy have, however, been very scanty, because of lack of facilities rather than because of lack of interest. This has hampered developments in several theoretical and practical fields which are based on a firm knowledge of the biological species, and it has also contributed to the dwindling interest in botanical studies by the young generation, which everywhere wants to synthesize rather than describe. Only a few hundreds of the more than 6000 species of higher plants of Yugoslavia have so far been cytologically studied on indigenous material, all within the last few years and almost all by recent graduates and young botanists and several by visiting specialists from abroad. Of about 40,000 species of higher plants which have been cytologically studied in the entire world, less than one pro mille originated from Yugoslavia, if we exclude from these calculations several hundreds of recently determined numbers published by Sušnik (1962, 1967), Sušnik & Lovka (1970), Nilsson & Lassen (1971), Lovka, Sušnik, Löve & Löve (in Löve 1971, 1972), and Sušnik, Druškovic, Löve & Löve (in Löve 1972), the last three being the results of the present program.

Although the flora of Yugoslavia certainly is well known, the classification of its species and races rests on various standards that were invented prior to the understanding of the evolutionary processes of adaptation and speciation. Most of the species included in recent manuals seem to belong to the sound Linnaean standard which is distinguished by aid of morphological characteristics but coincides with the cessation of miscibility by repeated hybridization. But others seem to be based on geographical discontinuity as advocated by the Kerner-Wettstein chorological definition, on Darwin's claim (1859) that the term species is "one arbitrarily given for the sake of convenience to a set of individuals closely resembling each other," or even on the intuition of the classifier as best defined by Regan (1926) who claimed the species to be "a community.... whose distinctive morphological characters are, in the opinion of a competent systematist, sufficiently definite to entitle it....to a specific name." Naturally, the acceptance of various concepts resulted in various standards, so that although some of the Yugoslav endemics may be as distinct by any standard as, e.g., *Favargera Froelichii* (Jan) Löve & Löve (cf. Löve & Löve 1972), some others may be better placed as races at lower levels, down to that of a small deme differing from the main taxon in a single mutation, as in the case of *Pastinaca Fleischmannii* Hladnik which once occurred on the slopes of the Castle Mountain in Ljubljana and now survives only in the Botanical Garden of the University in the same city (Sušnik & Druškovic 1968)

The material background of biological diversity and specific constancy became available by the invention of cytogenetical studies, making at last possible to apply a very similar standard for each of the taxonomical categories. This made it evident that a definition of the species category by aid of morphological variability is futile because this kind of diversity is created by gene mutation and genetic recombination which are processes that require interfertility, and natural selection which decides about the adaptability of the new combinations; all such morphological variations must inevitably belong to the same interfertile gene pool, which can be as variable as that of the Human species, as surmised by Linnaeus, and every such variation is easily reversible. Whereas the basic and common characteristic of the species as a whole, or its gene pool with all its various combinations of genes, is isolated from related species by some kind of an irreversible reproductive barrier, as observed by Linnaeus. The material basis for the important morphological and physiological variability within the species is the DNA which forms the genes and changes them in minute detail without changing other characteristics of the chromosomes. Whereas the material basis of the reproductive isolation is the chromosomes themselves and their recombination at meiosis. That recombination is conditioned by their pairing by aid of chiasmata which secure the equal division of their genes, and also by their number.

When two species with the same chromosome number can cross but do not mix, because their hybrids are sterile, then this is the result of linear differences between their parental chromosomes which, therefore, cannot form their chiasmata undisturbed. This is caused by the gradual accumulation of inversions and translocations of sizeable parts of the chromosomes, a slow and erratic process which is little known in plants but reasonably well understood in Drosophila. It has been named gradual speciation, and it certainly is the predominant process by which species differentiate. Another process, which is efficient in isolating gene pools, is polyploidy, or the sudden duplication of the chromosome set of an individual, usually a hybrid, a process which is termed abrupt speciation. Although small variations in chromosome number within a gene pool often can be tolerated, duplications of an entire chromosome set effectively isolate the new gene pool from the old, either by preventing all intercrossing because of incompatibility, or, more frequently, by making it impossible for the hybrid to reproduce because of difficulties in distributing evenly the chromosomes of an individual with unequal sets of chromosomes, as will be typical of the hybrid. Plants with different multiples of the same chromosome set are often able to cross, but their mixing of genes is made difficult or prevented by sterility of the hybrids. It is the genetical miscibility which is the most important characteristics of a good Linnaean and biological species.

It is this observation of the chromosomes as the material basis of evolution at the species level which has caused the success of the cytotaxonomical method. This approach was originally invented as a subsidiary to genetical studies of variation within the species. The success of the model in interpreting the most important entity of evolution, and in identifying this entity with the truly Linnaean species, in due course reinforced the initial advantage of the method. The greatest strength of the cytotaxonomical approach lies in the fact that it has given biologists the first universally applicable definition of this basic taxonomical category as it was understood by Linnaeus, at the same time as it has demonstrated that subspecific evolution is fundamentally distinct from speciation, for the simple reason that the former is exclusively genic and requires interfertility, whereas the latter is exclusively chromosomal and prevents interbreeding.

It is an old claim, often repeated, that a species may be characterized by several chromosome numbers. If we use the knowledge of the chromosomes as the material basis of the lack of miscibility required by the really Linnaean and biological species concept, then this claim is apparently illogical and incorrect. It is true, that some taxonomists have described species so wide that they may include two or more chromosome numbers in different parts of their areas, but such species are not Linnaean and include non-miscible gene pools. Usually, such taxa have been split into reproductively isolated units by taxonomists of the Linnaean school, although authors of flora manuals may have ignored their judgement, on basis of similarities in phenetic characters they regarded as more important. Also, claims of the possibility of several chromosome numbers in the same species are frequently based on non-confirmed reports by others or on reports by authors with little taxonomical training using manuals composed by conservative taxonomist of the past, or,perhaps most frequently, they may simply be caused by taxonomical misidentification of the material studied by the cytologists.

In fact, it is rare that more than one chromosome number is discovered within a well-defined taxon from areas that are taxonomically well known. It is more frequent that such observations are made on geographically different populations which have been identified only preliminarily as representing the same taxon. Because of this, chromosome counting has often been found to be a valuable tool in discovering the collective nature of such species or in correcting inexact identifications from areas which have not been thoroughly botanized.

Most chromosome studies have been performed on plants from the arctic and subarctic belts and from the nemoral vegetation regions of western Europe, eastern North America, and eastern Asia. It is, therefore, necessary to widen such studies to include also other kinds of plants in areas less well known from this point of view, in the belief that this may not only add to our understanding of chromosomal evolution but also clarify the taxonomy of the floras of these lands as a firmer basis for phytogeographical and practical evolutionary studies. The Mediterranean and semiarid types of floras still remain very insufficiently known in this respect, not only in Europe.

Since the flora of Yugoslavia certainly is well known, it is ideal as a subject of a consorted biosystematic study, which should aim at an evolutionary synthesis of the history of the entire flora. Such studies ought, primarily, to concentrate upon simple cytotaxonomical investigations of chromosome numbers and geographical-morphological diversity, since the results obtained from such an approach will clarify to a high degree the basic evolutionary processes that have shaped the flora and form a stable basis for its uniform classification. However, because of the assumed history of the plants of Yugoslavia and the variable conditions under which they seem to have developed, these taxa may also be better suited for cytogenetical and genecological studies of adaptive variation than are plants of any other region in Europe, not excluding those of areas directly affected by the Pleistocene glaciations. The great geographical variability of the flora also makes it ideal for an attempt to gain some understanding of the processes of evolution that are connected with various kinds of polyploidy, apomixis and, above all, autogamy and allogamy, which are phenomena of great importance from the point of view of evolutionary taxonomy. Such problems can only be solved by aid of intensive experimental studies of carefully selected species which are cultivated in carefully kept experimental gardens for a long period. Although our present plan is mainly for the basic and extensive cytotaxonomical approach, it would be unwise not to think also about the other two possibilities, since the first step, if successful, would logically lead to the two others, which could complete the solution of the most pertinent questions about the evolutionary history of this flora and its relatives elsewhere in the northern hemisphere. That such a solution of evolutionary and phytogeographical problems would become very beneficial for future agriculture in the country ought to be self-evident.

As a first step in the study of the Yugoslavian flora and its cytotaxonomy, we have selected to concentrate upon the flora of Slovenia and also on the endemic of the Slovenian mountains. This flora is better known taxonomically than that of other parts of the country, and it is covered by recently published manuals; it is also an integral part of the well known Central European flora (cf. Ehrendorfer & alii 1967). Although we would prefer to study various populations of every species, this is neither practical nor wise, since the majority of the taxa have already been thoroughly investigated from these points of view from other parts of their distribution areas. Therefore, we have compiled a critical chromosome atlas of the flora of Slovenia, which is at the same time a taxonomical checklist, including informations on distribution within the country (Löve & Löve 1972b). In the printouts of the more than 40,000 cards it comprises it is easy to see not only what taxa bevar within the area, but also where they are met with and, above all, if and how often and by whom their chromosome number has been determined. On basis of this information it is possible to concentrate upon collecting mainly species still cytotaxonomically unknown or taxa which have been reported to have more than one chromosome number in other regions. It ought to be emphasized that this atlas places the Slovenian flora among the best known floras of the world, surpassed only by Central and Northwestern Europe (Löve & Löve 1961) and Iceland (1956) as far as species with known chromosome numbers are concerned, although much work still has to be done before its species have been studied thoroughly from indigenous material.

Although the investigations on the cytotaxonomy of the Yugoslavian flora will utilize current taxonomical manuals in determining the taxa, relying heavily on Flora Europaea as far as published, this does not prevent us from selecting names different from those commonly used, and a few taxonomical changes are likely to be proposed during the progress of the investigations. Such changes and our judgement in general will be based on weighted considerations of the morphology, geography, ecology, cytology, etc., of the material in question and they will demonstrate our attempt to apply the Linnaean and biological species concept, as defined by Mayr (1940, 1942) and Löve (1964) and clarified by Lehman (1971), to the historical study of this flora. Therefore, we want to emphasize that we regard as subspecies taxonomically closely related populations, which differ in part or as a whole in minor morphological characters and occupy relatively large areas which are partially or completely isolated geographically. Subspecies are potentially capable of interbreeding without reduction in fertility or vitality, and they are major geographical races corresponding to those of the human species (Hultén 1967, 1968). It follows that species are defined by their incapability or difficulty of interbreeding or by their lack of even potential miscibility (Löve & Löve 1942; van Steenis 1957; Löve 1964), and that morphologically somewhat different populations occupying smaller areas are regarded as varieties (cf. Löve 1970), whereas apparent ecotypes (or ends of clinal variations), local populations or demes as redefined by Mayr (1963) and Langlet (1971), and clines are not given taxonomical recognition. At the intraspecific level, this may result in the reduction of several socalled subspecies to varietal rank. Since chromosome number differences are the most obvious indicator of reproductive isolation and barriers to miscibility, we regard them as a sufficient warning against including such populations under the same species name, and use them as an argument of the need for a more close taxonomical study of the material in question whenever we discover more than a single number within any such taxon.

This project is supported by grant No. SFG-i-5484 from the Foreign Currency Grant of the Smithsonian Institution of Washington, U.S.A. for which we express our gratitude. It is a cooperative effort administered by the four authors of the present paper, although the authors of subsequent papers under the grant may be different.

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Chromosome numbers of Yugoslavian plants. I.

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Abstract.

Chromosome counts are given for Yugoslavian material of the following 25 taxa, with some remarks on their taxonomy and distribution:

Crocus malyi Vis. (2n = 30); *Iris macedonica* Horvat (2n = 48); *Colchicum arenarium* W. & K. (2n = 54); *Colchicum hungaricum* Janka (2n = 52); *Colchicum doerfleri* Halacsý (2n = 54); *Colchicum visiani* Parl. (2n = 72); *Allium kermesinum* Rchb. (2n = 16); *Fritillaria degeniana* J.Wagner (2n= 18+0-3B); *Tulipa scardica* Bornm. (2n = 24); *Tofieldia calyculata* (L.) Wg. (2n = 30); *Veratrum nigrum* L. (2n = 16); *Festuca laxa* Host (2n = 42); *Degenia velebitica* (Degen) Hayek (2n = 16); *Draba simonkaiana* Jáv. var. *korabensis* (Kümmerle & Degen) Lovka (2n = 32); *Anthyllis jacquinii* Kerner (2n = 14); *Tithymalus villosus* (W. & K.) Pascher (2n = 20); *Astrantia major* L. ssp. *carinthiaca* (Hoppe) Arcang. (2n = 28); *Portenschlagiella ramosissima* (Portenschl.) Tutin (2n = 22); *Athamantha turbith* (L.) Brot. var. *turbith* and var. *haynaldii* (Borbas & Uechtr.) Sušnik (2n = 22); *Grafia golaka* (Hacq.)Rchb. (2n = 22); *Hladnikia pastinacifolia* Rchb. (2n = 22); *Seseli malyi* Kerner (2n = 22); *Carduus crassifolius* Willd. (2n = 22); *Achillea serbica* Nym. (2n = 18); *Amphoricarpus neumayeri* Vis. (2n = 24).

New combinations validated:

Draba simonkaiana Jáv. var. *korabensis* (Kümmerle & Degen) Lovka; *Athamantha turbith* (L.) Brot. var. *haynaldii* (Borbas & Uechtr.) Sušnik, and var. *hungarica* (Borbas) Sušnik.

Classification of plants into a system that indicates the true relationships of all the taxa has long been the aim of plant taxonomists. Although much in this field has been achieved by aid of observations of morphological and geographical characteristics in the past, great difficulties have frequently been met with in deciding upon the level of some taxa, and then especially in distinguishing between the category of species as contrasted to the intraspecific units of subspecies and variety. The biological definition of these categories that considers the occurrence of an internal reproductive barrier to be an essential attribute of the species and the lack of such a barrier between its subunits has greatly clarified this matter, although the disclosure of such a barrier between two taxa sometimes requires the applications of methods other than those of classical taxonomy.

It has been known for nine decades that the chromosomes and their number are of an immense significance for studies of reproductive barriers, because every well-defined species is characterized by only a single chromosome number. When related species are characterized by the same chromosome number, differences in chromosome morphology may indicate the occurrence of reproductive difficulties, but hybridization experiments are usually required to clarify their nature and importance. In the case of polyploidy reflected in differences in chromosome number, however, the case is much simpler, because thousands of experiments have clearly shown that taxa with different chromosome numbers either are completely incompatible or their more or less rare crosses are unable to reproduce.

Because of these observations, it has long been evident that a knowledge of the chromosome numbers of the taxa of a flora is an important contribution to the correct evolutionary classification of its species and their subunits.

Although much such information has resulted from more or less casual investigations of taxa collected at random, or from detailed cytogenetical investigations of groups of related taxa, general and planned studies of entire floras have become increasingly frequent since the initiation of the critical chromosome checklists by Löve & Löve (1942, 1948, 1961). These studies stimulated interest in cytotaxonomy as a whole, which is reflected among others in the fact that all the taxa in the Icelandic flora (Löve & Löve 1966; Löve 1970), most of the taxa of the floras of the other Nordic countries and Central Europe (Löve & Löve 1961) and almost all the taxa in the flora of Greenland (Böcher, Holmen & Jakobsen 1968) have become known in this respect. The increased interest in this approach has also resulted in the inclusion of chromosome number reports in most modern flora manuals all over the world, the compilation of similar chromosome checklists for other areas, and, especially, in teamwork for systematic studies of chromosome numbers of the entire floras of many lands, most recently those of Bulgaria, Czechoslovakia, France, Italy, Poland, the Soviet Union, Spain, and Yugoslavia. Canadian cytotaxonomists have investigated a considerable part of the large Canadian flora during the past decades, whereas the United States flora is known onlyb spotwise in this respect.

The European flora is supposed to include more than 17,000 species of higher plants. Of these species about 10,000 are supposed to occur in Yugoslavia and other countries of the Balkan peninsula, where a considerable portion seems to be more or less local endemics. Since this very rich flora has hardly been touched by cytotaxonomists, except by occasional visitors, the present writers have organized a cooperative team to study the chromosome conditions of as many as possible of its species (cf. Löve, Löve, Mayer & Sušnik 1972). Although our efforts aim at studying the flora of this region as a whole, and, ultimately, that of the entire Balkan peninsula as far as time and facilities permit, the first two years of the study have been spent mainly to compile a critical chromosome checklist of the flora of Slovenia, which has been computerized for a more easy retrieval (Löve & Löve 1972a) and to fill some of the essential gaps in that list. However, some members of the team have also collected material from other Yugoslavian areas. At the time of writing this paper, more than 600 taxa have been cytologically studied from Yugoslavia, several of which have been published by Lovka, Sušnik, Löve & Löve (in Löve 1971, 1972) and by Sušnik, Druskovic, Löve & Löve (in Löve 1972), whereas the majority of the counts are being prepared for publication. It is anticipated that only a selected number of these observations will require a discussion or publication in a more detailed form; two such papers involving problems of generic evaluation have been published by Löve & Löve (1972b,c), and the first paper in a series of nomenclatural adjustments of some taxa has been compiled by Löve, Löve & Sušnik (1972).

The present paper is intended as the first in a series of concise reports on species which require more detailed information and discussion of limited observations on some of the critical species of the Yugoslavian flora, with a reference to the actual observer of the chromosome number. These observations are less preliminary than those included in the chromosome number reports mentioned above; nevertheless, the numbers here reported may be utilized in more detailed separate studies when this seems appropriate and so are not necessarily the final report for the taxa in question. The series will appear irregularly, and following issues will not necessarily be preceded by an introduction.

These reports are a part of a cooperative project on the cytotaxonomy of the Yugoslavian flora, jointly supported by foreign currency grants from the Smithsonian Institution in Washington, D. C., U.S.A. and by grants from the Sklad Borisa Kidriča, Jugoslavija.

1. Crocus malyi Vis. (Iridaceae).

2n = 30. Determined by Milan Lovka. (Fig. 1).

Voucher: Croatia: Velebit, in an alpine meadow. Collected by V. Strgar, June 27, 1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU.......

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This species is an endemic of the Dalmatian region, where it grows in alpine situations, frequently on stony slopes or in meadows. It is characterized by its white flowers with a ring of golden-yellowish hairs at the throat of the perigon. Its chromosome number was reported to be 2n = 24 by Mather (1932), but since his material was garden plants of unknown origin, we are inclined to believe that it may have been incorrectly identified. We suggest that the species is a hexaploid of the basic number x = 5, which occurs in some other taxa of the genus, and that it is only remotely related to other Crocus species of the Balkan peninsula.

2. Iris macedonica Horvat (Iridaceae).

2n = 48. Determined by Milan Lovka. (Fig. 2).

Voucher: Macedonia: between Debar and Struga, in Ostryeto-Carpinetum. Collected by F. Sušnik and M. Lovka, September 25, 1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 76935.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This endemic taxon from Macedonia was described by Horvat (19...) as a species. It was included in the I. reichenbachii Heuff. complex by Randolph & Rechinger (1954), and Randolph & Randolph (1961) found it to have the diploid chromosome number 2n = 24 which is typical of that complex. However, our observations on material that indisputably belongs to the taxon as originally conceived by Horvat (l.c.) show not only that its chromosome number is tetraploid, or 2n = 48, but also that it is morphologically very closely related to the species I. croatica Horvat & Horvat, which is endemic further north on the Balkan peninsula (Horvat & Horvat 1962). There may be some slight differences in the length and morphology of the chromosomes of these two taxa. However, these minor differences are of less significance than several morphological characters that indicate a close relationship, whereas the distinction in ploidy levels between these two taxa and other taxa included in I. reichenbachii by Randolph & Rechinger (1954) seems much more significant.

3. Colchicum arenarium W. & K. (Colchicaceae).

2n = 54. Determined by Milan Lovka. (Fig. 3).

Voucher: Serbia: Deliblatska Peščara, in a sandy meadow with Iris pumila, Eranthis hiemalis, Tithymalis, etc. Collected by F. Sušnik and M. Lovka, September 15, 1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 61283.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This endemic species of the sandy steppes in the Danube valley from Hungary, through Serbia to Bulgaria and the Banat area of Romania, shares certain morphological characteristics with C. alpinum Lam. of the western Alps and with its var. parvulum Richt. of southern Italy. D'Amato (1956) found garden material identified as C. arenarium to have 2n = 38 chromosomes, whereas our count of 2n = 54 apparently represents the same hexaploid number as D'Amato (1956) reported for typical C. alpinum.

4. Colchicum hungaricum Janka (Colchicaceae).

2n = 52. Determined by Milan Lovka. (Fig. 4).

Voucher: Montenegro: Titograd, in a stony meadow with Asphodelus albus, Gladiolus paluster, Salvia officinalis, Crocus tommasinii, etc. Collected by V. Pulević, January 29, 1971, and cultivated in the experimental plots ön the Botanical Garden in Ljubljana. Herbarium number LJU 76885.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This is a first chromosome count for this species. It is r related to C. montanum L., garden material of which was reported to have 2n = 54 chromosomes by Levan (1940).

5. Colchicum doerfleri Halácsy.(Colchicaceae).

2n = 54. Determined by Milan Lovka. (Fig. 5).

Voucher: Macedonia: Skopje, in a wet meadow. Collected by..........
and cultivated in the experimental plots of the Botanical Garden
in Ljubljana. Herbarium number LJU.....

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This is the first chromosome count for this southern Balkan taxon. It is sometimes regarded as a race only of C. hungaricum, but even the slight difference in chromosome number here observed may indicate that such a treatment could be doubtful and that it is safer to keep both taxa at the species level at least until further studies and hybridization experiments indicate a closer relationship.

6. Colchicum visiani Parl. (Colchicaceae).

2n = 72. Determined by Milan Lovka. (Fig. 6).

Voucher: Serbia: Tresibaba, in a meadow. Collected by F. Sušnik and M. Lovka, September 19, 1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU.....

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This species is sometimes included in C. bivonae Guss., which according to Levan (1940) has 2n = 36 chromosomes, whereas D'Amato (1956) reported it to have 2n = 54. Since the present species has 2n = 72 chromosomes, it seems apparent that these taxa represent a polyploid series of which the Balkan plant is octoploid, whereas the taxonomy of the tetraploid and hexaploid species remains unclear.

7. Allium kermesinum Rchb. (Alliaceae).

2n = 16. Determined by Milan Lovka. (Fig. 7).

Voucher: Slovenia: Krvavec, in an alpine meadow. Collected by F. Sušnik, August 17, 1968, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 55918.

Methods: Squashes in acetocarmine of flower buds that were fixed in acetic-alcohol (1:3).

Observations: This endemic of the alpine regions of the eastern Alps has not been previously studied by cytologists. It is apparently closely related to A. globosum Red. from which it differs in numerous characters, although hybridization experiments only will reveal the real nature of their relationship.

8. Fritillaria degeniana J. Wagner (Liliaceae).

2n = 18 + 0 - 3B. Determined by Milan Lovka. (Fig. 8).

Voucher: Serbia: Deliblatska Peščara, in a sandy meadow. Collected by.... ..... ,and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 61295.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This is one of the more or less locally endemic taxa around F. orientalis Adams which are met with in various regions from the Alps to the Caucasus. Since they are apparently all characterized by the diploid chromosome number 2n = 18 (Honsell 1961), experimental studies are needed to elucidate their real taxonomical significance. In the material here reported we found up to three B-chromosomes.

9. Tulipa scardica Bornm. (Liliaceae).

2n = 24. Determined by Milan Lovka. (Fig. 9).

Voucher: Macedonia: Orlova Brdo....

Collected by........

Herbarium number LJU 76892.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This seems to be the first report of the chromosome number of this southern endemic.

10. Tofieldia calyculata (L.) Wg. (Melanthiaceae).

2n = 30. Determined by Milan Lovka. (Fig. 10).

Voucher: Slovenia: Jelenk near Idrija, in an alpine meadow. Collected by M. Lovka and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 76878.

Methods: Flower buds were fixed in acetic-alcohol (1:3) and squashed in acetocarmine.

Observations: According to Miller (1930) and Skalińska (in Skalińska, Pogan & alii 1971), this species has 2n = 28 chromosomes, although other species of the genus are characterized by the number 2n = 30. We found only 2n = 30 in the Slovenian material of T. calyculata.

11. Veratrum nigrum L. (Melanthiaceae).

2n = 16. Determined by Milan Lovka. (Fig. 11).

Voucher: Slovenia: Škocjanske jame, on a rocky slope. Collected by M. Lovka, June 3, 1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU.....

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: The only previous chromosome number report for this species is that by Miller (1930), who counted 2n = 32 chromosomes in cultivated material of unknown origin. There seems to be a reason to doubt the identification of his plants, since our material of the species from various localities in Yugoslavia always has been found to be diploid with 2n = 16 chromosomes.

12. Festuca laxa Host (Poaceae).

2n = 42. Determined by Milan Lovka. (Fig. 12).

Voucher: Slovenia: Turska gora, on a slope with debris. Collected by T. Wraber, August 11, 1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU.....

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen method.

Observations: This species, in its strict sense, is an endemic of the Karavanken, Julian Alps and the Sanntaler Alps in Slovenia and Austria. It is morphologically somewhat related to F. dimorpha Guss. of the French and Italian Alps, but although that taxon is sometimes named F. laxa ssp. dimprpha (Guss.) St. Yves, we doubt the wisdom of such a treatment. Reports of the chromosome numbers 2n = 14 (Zickler 1967) and 2n = 28 (Tombal 1968) for F. laxa were based on F. dimorpha from Campo Imperatore in the Gran Sasso area and from Col de la Cayolle in the Alpes-Maritimes and not on the species in its strict sense, and 2n = 28 reported for F. laxa by Hill (1965) from garden material may also have been F. dimorpha from the western Alps.

The chromosome number 2n = 28 determined by Gervais (1965), however, was counted on plants from the Hochstuhl in the Karavanken, where the species certainly is met with. Since there is no doubt that our plants with 2n = 42 chromosomes also were correctly identified, it is apparent that a closer study of both proveniences and vouchers is needed in order to solve the problem created by these different reports from F. laxa s.str.

13. Degenia velebitica (Degen) Hayek (Brassicaceae).

2n = 16. Determined by Milan Lovka. (Fig. 13).

Voucher: Croatia: Velebit, on a stony slope. Collected by F. Sušnik.....
.... and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 55578.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This monotypic, endemic genus of the Velebit region in northwestern Yugoslavia is closely related to Alyssum L. Its single species is diploid with 2n = 16 chromosomes, as previously reported by Voričeć (?) (1937?)....

14. Draba simonkaiana Jáv. var. korabensis (Kümmerle & Degen) Lovka (Brassicacea

2n = 32. Determined by Milan Lovka. (Fig. 14).

Voucher: Serbia: Starac.....
Collected by F. Sušnik and M. Lovka,...................1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 76890.

Methods: Flower buds were fixed in acetic-alcohol (1:3) and stained and squashed in acetocarmine.

Observations: The tentative classification of the white-flowered arctic-alpine species of the Leucodraba section of the genus Draba by Walters (in Tutin & alii 1964) was greatly improved by Buttler (1967), who grouped this polyploid series (diploid to octoploid) into six reasonably well defined complexes. Of these, the D. korabensis group of the mountains of southern Europe is clearly distinct. It includes four taxa, three of which, D. subnivalis Br.-Bl., D. simonkaiana Jáv. and D. kotschyi Stur, had been found to be tetraploid with 2n = 32 chromosomes by Buttler (1967) and Favarger & Küpfer (1968); our report of the same number for the taxon D. korabensis Kümmerle & Degen fits well into this picture. Buttler (l.c.) concluded, we believe quite correctly, from morphological comparison of these and the diploid species of the section, that these four tetraploid taxa must be of an alloploid origin and that there is no direct genomic relationship between the Pyrenean endemic D. subnivalis and the Romanian-Carpathian endemic D. kotschyi, or between these two species and the southern Carpathian endemic D. simonkaiana and the northern Balkan endemic D. korabensis respectively. The two last-mentioned taxa, however, are very closely related and differ mainly in the hairiness of the valves. Buttler (1967) lacked the information we now have of the identical chromosome numbers. That and the morphological similarities is an ample reason to conclude that they are most correctly regarded as conspecific races that are only geographically isolated. Since their areas are not very distinct so they have hardly been separated for a long period of time, we believe that their evolutionary relationship is most correctly expressed in their classification as two varieties only of the nomenclaturally older (1910) species Draba simonkaiana Jáv., i. e. var. simonkaiana and var. korabensis (Kümmerle & Degen) Lovka, var. nov based on Draba korabensis Kümmerle & Degen, in Jávorka, Bot. Közl. 19 (1921), p. 22.

15. Anthyllis jacquinii Kerner (Fabaceae).

2n = 14. Determined by Milan Lovka. (Fig. 15).

Voucher: Slovenia: Trnovski gozd, Čaven, in a meadow. Collected by M. Lovka, July 19, 1970, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 76914.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: Cullen (in Tutin & alii 1968) regards the eastern Alpique and Balkan taxon A. jacquinii as one of three subspecies of the polymorphic A. montana L. The other two taxa so classified are A. montana s.str. of the Alps from France to Austria and the Apennines, and A. hispanica Degen & Hervier of southern Spain. The complex is

also met with in the Pyrenées (cf. Küpfer & Favarger 1967) as a taxon apparently related to that of the Jura mountains, although its place in the classification by Cullen (l.c.) remains obscure. This classification ignores the fact that geographically distinct taxa of the complex have been found to differ also in chromosome number. Prior to the present report, diploids (2n = 14) of the A. montana complex had been reported from the Alpes-Maritimes (2n = 12, Guinochet & Logeois 1962, probably a mistake for 2n = 14), from the western Alps (Küpfer & Favarger 1967; Favarger & Küpfer 1968), from the Pyrenées (Küpfer & Favarger 1967), and from central Italy (Pogliani 1971). Tetraploids (2n = 28), however, have been reported from natural populations in the Pyrenées and the Jura (Favarger & Küpfer 1968), but also from material from various Botanical Gardens (Favarger 1965; Gilot 1965). It is apparent, that the classification by Cullen (l.c.) is premature and that strong reproductive barriers separate at least some of his subspecies, which thus cannot be true geographical races. Therefore, we prefer to ignore it and retain the taxon that is endemic in the eastern Alps, the Apennines and the Balkan as the species A. jacquinii Kerner, which apparently is a diploid plant.

16. Tithymalus villosus (W. & K.) Pascher (Euphorbiaceae).

2n = 20. Determined by Milan Lovka. (Fig. 16).

Voucher: Slovenia: Borovniški pekel, in a wet meadow. Collected by M. Lovka, June 15, 1970, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 58229.

Methods: Flower buds were fixed in acetic-alcohol (1:3) and stained and squashed in acetocarmine.

Observations: This is a confirmation of a recent report by Polatschek (1971), also from a natural population. Löve & Löve (1961) gave the number 2n = 16, on the authority of Modilewski (1910) and Perry (1943), who reported that number from Botanical Garden material of Euphorbia procera M.B., which is a synonym of T. villosus according to Prokhanov (1949). We believe that was a mistake.

17. Astrantia major L. ssp. carinthiaca (Hoppe) Arcang. (Saniculaceae).

2n = 28. Determined by Milan Lovka. (Fig. 17).

Voucher: Slovenia: Podljubelj. Collected by F. Sušnik and M. Lovka,....

...... Herbarium number LJU 76916.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: Although the first report for A. major, by Wanscher (1932), gave its chromosome number as 2n = 14, this seems to have been a mistake caused by incorrectly identified Botanical Garden material. The same is true for a similar report by Delay (1947). Håkansson (1953) also used garden material as the basis for his report of 2n = 28 for a taxon identified as A. major ssp. biebersteinii (Trautv.) Grintzesco; actually, it seems to be wiser to accept it as a species in its own right, A. trifida Hoffm. from the Caucasus (Bobrov 1950). Tutin (in Tutin & alii 1968) divides A. major proper into two subspecies, ssp. major which is met with in central and certain parts of southern and eastern Europe and characterized by the bracteoles equalling the umbel, and ssp. carinthiaca of higher mountains from the eastern Alps to northwestern Spain and characterized by that the bracteoles are twice as long as the umbel. The chromosome number of ssp. major is known to be 2n = 28, according to Baksay (1957), Favarger (1965), Kordyum (1967), Favarger & Küpfer (1968), and Malecka (in Skalińska, Jankun, Woislo & alii 1971). Our material of ssp. carinthiaca is characterized by having the same tetraploid number.

18. Portenschlagiella ramosissima (Portenschl.) Tutin (Apiaceae).

2n = 22. Determined by Milan Lovka. (Fig. 18).

Voucher: Montenegro: Lovčen......

Collected by F. Sušnik and M. Lovka,......

Herbarium number LJU 50458.

Methods: Flower buds were fixed in acetic-alcohol (1:3) and stained and squashed in acetocarmine.

Observations: This seems to be the first report for this endemic species of southern Italy, western Yugoslavia, and northwestern Albania.

19. Athamantha turbith (L.) Brot. (Apiaceae).

var. turbith

2n = 22. Determined by Franc Sušnik. (Fig. 19a).

Voucher: Slovenia: Divača.............. Collected by F. Sušnik,.... .... Herbarium number LJU......

var. haynaldii (Borbas & Uechtr.) Sušnik

2n = 22. Determined by Franc Sušnik. (Fig. 19b).

Voucher: Croatia: Velebit,........ Collected by F. Sušnik,..... .... Herbarium number LJU......

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: The southeast European species A. turbith includes three morphologically and geographically distinct races, which previously were regarded as separate species but Tutin (in Tutin & alii 1968) classified as three subspecies. The present report of the chromosome number of two of these taxa confirms that of Sušnik (1967). It is our opinion, that the taxa in question are only minor geographical races and, thus, classified at a too high level if given a subspecific status. Therefore, we propose the following new combinations:

Athamantha turbith (L.) Brot.) var. haynaldii (Borbas & Uechtr.) Sušnik, stat. nov., based on Athamantha haynaldii Borbas & Uechtritz, Term. Füz. 1 (1877), p. 30, and var. hungarica (Borbás) Sušnik, stat. nov., based on Athamantha hungarica Borbás, Term. Tud. Közl. 9 (1877), p. 436.

20. Grafia golaka (Hacq.) Rchb. (Apiaceae).

2n = 22. Determined by Franc Sušnik. (Fig. 20).

Voucher: Slovenia: Trnovski gozd, Čaven,......

Collected by F. Sušnik,........

Herbarium number LJU......

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This is a confirmation of a previous report by Sušnik (1967) for this endemic of the southeastern Alps and adjacent calcareous mountains of Italy and Yugoslavia.

21. Hladnikia pastinacifolia Rchb. (Apiaceae).

2n = 22. Determined by Franc Sušnik. (Fig.21).

Voucher: Slovenia: Trnovski gozd, Čaven,.......

Collected by F. Sušnik,.......

Herbarium number LJU.......

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This is a confirmation of a report by Sušnik (1962) of the chromosome number of this monotypic genus, which is endemic on the Trnovski gozd mountain range in northwestern Slovenia (cf. Pawlowski 1970).

22. Seseli malyi Kerner (Apiaceae).

2n = 22. Determined by Franc Sušnik. (Fig. 22).

Voucher: Croatia: Velebit,.......

Collected by F. Sušnik,......... and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU......

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This is a confirmation of an earlier report by Sušnik (1967) for this endemic species of the mountains of western Yugoslavia.

23. Carduus crassifolius Willd. (Asteraceae).

2n = 22. Determined by Milan Lovka. (Fig. 23).

Voucher: Slovenia: Triglav,......

Collected by F. Sušnik and M. Lovka,.....

and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU.....

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This taxon has frequently been identified with C. defloratus L. var. defloratus (Janchen 1956 - 1967), or it has been included in C. defloratus var. summanus (Poll.) DC. (Favarger & Küpfer 1970; Niklfeld 1969). According to Kazmi (1964), however, it is a species in its own right, including also the ssp. glaucus (Baumg.) Kazmi.

Because of the nomenclatural confusion prior to the revision by Kazmi (l.c.), it is not possible to decide if some of the chromosome reports previously published either as C. defloratus (Reese 1952; Favarger 1969; Favarger & Küpfer 1970) or as C. glaucus (Kazubowska 1955; Baksay 1958; Moore & Frankton 1962) could have been determined on specimens belonging to C. crassifolius ssp. crassifolius. If not, this is the first report for that taxon.

24. Achillea serbica Nym. (Asteraceae).

2n = 18. Determined by Milan Lovka. (Fig. 24).

Voucher: Macedonia: Mala Matka, on a rocky slope. Collected by M. Lovka, May 11, 1971, and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 76917.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This seems to be the first report of the chromosome number of this endemic of the southern Balkan peninsula.

25. Amphoricarpus neumayeri Vis. (Asteraceae).

2n = 24. Determined by Milan Lovka. (Fig. 25).

Voucher: Monenegro: Orjen, on a rocky slope. Collected by........... .... and cultivated in the experimental plots of the Botanical Garden in Ljubljana. Herbarium number LJU 76937.

Methods: Squashes of root-tips that were pretreated in a saturated solution of paradichlorobenzene for four hours, fixed in acetic-alcohol (1:3) and stained according to the Feulgen technique.

Observations: This is the first chromosome report for this small genus of two species, the present one from western Yugoslavia, and A. elegans Alb. from about 2000 m.s.m. in the Caucasus range (Linchevskiy 1962).

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PLANT	LOCALITY	COLLECTED	CHROMOSOME NUMBER
Aconitum anthora L.	Škocjanske jame	Lovka	2n=32
~~Aconitum anthora~~	~~Slavnik~~	~~Sušnik-Lovka~~	~~2n=16~~
Aconitum vulparia Rchb.	Snežnik	Lovka	2n=16
Allium roseum L. f. bulbiferum	Orjen/Montenegro/	Lovka	2n=16
Aquilegia gratta	Višegrad/Bosnia/	Sušnik-Lovka	2n=16
Arum italicum Mill.	Sv. Dionizije nad Mirno /Croatia/	Lovka	2n=84
Asphodeline lutea (L.) Rchb.	Mostar/Bosnia/	Sušnik-Lovka	2n=28
Asphodelus microcarpus	Titograd/Montenegro/	Pulević	2n=28
Asphodelus albus Mill.	Orjen/Montenegro/	Pulević-lovka	2n=28
Asplenium trichomanes L.	Grosuplje	Lovka	2n=144
Aster linosyris (L.) Bernh.	Deliblatska Peščara/Serbia/	Sušnik-Lovka	2n=18
Ceterach javorkeanum (Willd.) Soó	Črni kal	Lovka	2n=72
Ceterach javorkeanum	Socerb	Lovka	2n=72
Ceterach javorkeanum	Škocjanske jame	Lovka	2n=72
Ceterach javorkeanum	Vreme	Lovka	2n=72
Ceterach javorkeanum	Predjama	Lovka	2n=72
Ceterach javorkeanum	Ajdovščina	Lovka	2n=72
Ceterach javorkeanum	Vipava	Lovka	2n=72
Ceterach javorkeanum	Adlešiči	Martinčič	2n=72
Ceterach officinarum	Piran	Lovka	2n=144
Ceterach officinarum Lam.	Miren pri Gorici	Strgar	2n=144
Ceterach officinarum	Trstelj	Strgar	2n=144
Ceterach officinarum	Dutovlje	Strgar	2n=144
Ceterach officinarum	Dekani	Lovka	2n=144
Ceterach officinarum	Rižana	Lovka	2n=144

Crocus dalmaticus	Orjen/Montenegro/	Pulević	2n=24
Crocus tommasinianus Herb.	Orjen/Montenegro/	Pulević	2n=16
Crocus variegatus = [illegible] Stev.?	Korita	Wraber-Lovka	2n=12
Crocus veluchensis	Skopje/Macedonia/	Strgar	2n=14
Cyclamen neapolitanum Ten.	Višegrad/Bosnia/	Sušnik-Lovka	2n=34
Ficaria calthifolia Rchb.	Klanec na Krasu	Wraber-Lovka	2n=16
Ficaria calthifolia	Sv. Dionizije nad Mirno /Croatia/	Lovka	2n=16
Fritillaria meleagris L.	Kopanj	Lovka	2n=24
Fritillaria tenella M.B.	Buzet/Croatia/	Sušnik-Lovka	2n=18
Galanthus nivalis L.	Matavun	Lovka	2n=24
Galanthus nivalis L.	Tabor na Dolenjskem	Lovka	2n=24
Galanthus nivalis L.	Crmnica/Montenegro/	Pulević	2n=24
Galanthus nivalis L.	Piperi/Montenegro/	Pulević-Lovka	2n=24
Gladiolus italicus	Mostar/Bosnia/	Sušnik-Lovka	2n=12o
Gladiolus imbricatus L.	Lokve	Wraber-Lovka	2n=6o
Gymnadenia odoratissima (L.) Rich.	Turska gora	Lovka	2n=4o
Himantoglossum hircinum (L.) Sprengel	Goražde/Bosnia/	Sušnik-Lovka	2n=36
Homogyne sylvestris (Scop.) Cass.	Okrešelj	Lovka	2n=6o
Leucojum aestivum L.	Livade/Croatia/	Lovka	2n=22
Leucojum aestivum L.	Kopanj	Lovka	2n=22
Muscari comosum (L.) Mill.	Klanec na Krasu	Wraber-Lovka	2n=18
Muscari neglectum Guss.	Strunjan	Wraber	2n=43
Muscari racemosum	Dragonja	Sušnik-Lovka	2n=45
Narcissus ramiflorus	Piperi (Montenegro)	Pulević-Lovka	2n=14
Ophrys bertolonii	Limski Kanal/Croatia/	Lovka	2n=36
Ophrys aranifera Huds. = sphegodes Mill. ssp. [illegible]	Motovun/Croatia/	Lovka	2n=36
Ophrys cornuta Stev. [illegible]	Mostar/Bosnia/	Lovka	2n=36
Orchis coriophora L.	Rab/Croatia/	Lovka	2n=36

Orchis tridentata Scop.	Buzet/Croatia/	Sušnik-Lovka	2n=42
Paeonia decora Anders.	Štimlje/Kosmet/	Lovka	2n=2o
Plantago major L.	Jahorina/Bosnia/	Sušnik-Lovka	2n=12
Plantago reniformis G. Beck	Jahorina/Bosnia/	Sušnik-Lovka	2n=12
Primula wulfeniana Schott	Turska gora	Lovka	2n=66
Romulea bulbocodium (L.) Seb. & Maur.	Sv. Dionizije nad Mirno /Croatia/	Lovka	2n=42
Scabiosa leucophylla	Jahorina/Bosnia/	Sušnik-Lovka	2n=16
Scilla bifolia L.	Gorjanci	Sušnik-Lovka	2n=36
Scilla bifolia L.	Rižana	Lovka	2n=36
Scilla bifolia L.	Boštanj na Dolenjskem	Lovka	2n=18
Serapias vomeracea Briq. (?)	Titograd/Montenegro/	Pulević	2n=36
Tulipa griesebachiana Pant. (?)	Piperi/Montenegro/	Pulević-Lovka	2n=24
Veratrum nigrum L.	Snežnik	Lovka	2n=16
Veratrum nigrum L.	Peručica/Bosnia/	Sušnik-Lovka	2n=16
Aristolochia pallida	Škocjanske jame	Lovka	2n=8
Euphorbia glabriflora	Višegrad/Bosnia/	Sušnik-Lovka	2n=14
Linum austriacum L.	Štimlje/Kosmet/	Lovka	2n=18
Orchis morio L.	Buzet/Croatia/	Sušnik-Lovka	2n=36
Ornithogalum gussonei Ten.	Štimlje/Kosmet/	Lovka	2n=36
Ornithogalum divergens Boreau (?)	Ronek pri Strunjanu	Wraber	2n=54

The material was collected in the last year and is not yet numerated in our herbarium. All chromosome number were determined in root tips by F. Sušnik and M. Lovka.

The program is financial supported by Smitsonian Institute /USA/ and Sklad Borisa Kidriča/Jugoslavija/.

(Lovka z Sušnik:) Sušnik z Lovka (in Love 1973c).

Aspleniaceae 420

v *Asplenium trichomanes* L. 2n = 144. Yugoslavia: Slovenia, Grosuplje. Lovka, s.n.

v *Ceterach javorkeanum* (Vida) Soó. 2n = 72. Yugoslavia: Slovenia, Črni kal. Lovka, s.n. Seven other localities in Slovenia.

v *Ceterach officinarum* DC. 2n = 144. Yugoslavia: Slovenia, Piran. Lovka, s.n. Five other localities in Slovenia.

Araceae 290

v *Arum italicum* Mill. 2n = 84. Yugoslavia: Croatia, Sv. Dionigije nad Mirno. Lovka, s.n.

Melianthaceae 540

v *Veratrum nigrum* L. 2n = 16. Yugoslavia: Slovenia, Snežnik, Lovka, s.n.; Bosnia, Perućica, Sušnik z Lovka, s.n.

Asphodelaceae 570

v *Asphodeline lutea* (L.) Rchb. 2n = 28. Yugoslavia: Bosnia, Mostar. Sušnik z Lovka, s.n.

v *Asphodelus albus* Mill. 2n = 28. Yugoslavia: Montenegro, Orjen. Pulević z Lovka, s.n.

Asphodelus microcarpus Salzm. & Viv. 2n = 28. Yugoslavia: Montenegro, Titograd. Pulević, s.n.

Liliaceae 590

✓ Fritillaria meleagris L. 2n = 24. Yugoslavia: Slovenia (Kopanj. Lovka, s.n.

✓ Fritillaria tenella M.B. 2n = 18. Yugoslavia: Croatia, Buzet. Sušnik & Lovka, s.n.

Tulipa grisebachiana Pant. (= T. silvestris L. ssp. g. (Pant.) Hayek. 2n = 24. Yugoslavia: Montenegro, Piperi. Pulević & Lovka, s.n.

Scillaceae 600

✓ Leopoldia comosa (L.) Parl. 2n = 18. Yugoslavia: Slovenia, Klanec na Krasu. Wraber & Lovka, s.n.

✓ Muscari neglectum Guss. 2n = 45. Yugoslavia: Slovenia, Strunjan. Wraber, s.n.

✓ Muscari racemosum (L.) Mill. 2n = 45. Yugoslavia: Slovenia, Dragonja. Sušnik & Lovka, s.n.

~~Scilla bifolia L. 2n =~~

✓ Ornithogalum divergens Boreau 2n = 54. Yugoslavia: Slovenia, Ronek pri Strunjanu. Wraber, s.n.

Keep: ~~Ornithogalum gussonei Ten. 2n = 36. Yugoslavia, Slovenia, Kornet, Štimlje. Lovka, s.n.~~

✓ Scilla bifolia L. 2n = 18. Yugoslavia: Slovenia, Boštanj na Dolenjskem. Lovka, s.n.

✓ 2n = 36. Yugosl.: Slovenia, Gorjanci & Rižana. Sušnik & Lovka, s.n.

~~Alliaceae. 720~~

~~Allium roseum L. (f. bulbiferum). 2n = 16. Yugoslavia: Montenegro, Orjen. Lovka, s.n.~~

Amaryllidaceae. 730

✓ Galanthus nivalis L. 2n = 18. Yugoslavia, Slovenia, Matavun, ~~Lovka, s.n., Two other loc.~~ Tabor na Dolenjskem. Lovka, s.n. Two other localities in Montenegro.

✓ Leucojum aestivum L. 2n = 22. Yugoslavia: Slovenia, Kozanji Croatia, Livade, Lovka, s.n.

? Narcissus radiiflorus Salisb. (ramiflorus) 2n = 14. Yugoslavia: Montenegro, Piperi, Pulević & Lovka, s.n.

Iridaceae 830

Crocus dalmaticus Vis. 2n = 24. Yugoslavia: Montenegro, Orjen. Pulević, s.n.

Crocus tommasinianus Herb. 2n = 16. Yugoslavia: Montenegro, Orjen. Pulević, s.n.

✓ Crocus variegatus Hoppe & Hornsch. (= C. reticulatus Stev.?) 2n = 12 (10 or 11?). Yugoslavia: Slovenia, Korita, Wraber & Lovka, s.n.

? Crocus veluchensis Schott (= banaticus?) 2n = 14. Yugoslavia: Macedonia, Skopje. Strgar, s.n.

Spain? Gladiolus imbricatus L. 2n = 60. Yugoslavia: Slovenia, Lokve, Wraber & Lovka, s.n.

✓ Gladiolus italicus Mill. 2n = 120. Yugoslavia: Bosnia, Mostar, Šušnika & Lovka, s.n.

Romulea bulbocodium (L.) Seb. & Maur. 2n = 42. Yugoslavia: Croatia, Sv. Dionizije nad Mirno. Lovka, s.n.

Paeoniaceae 1100

Paeonia decora Anders. 2n = 20. Yugoslavia: Kosmet, Štimlje.
Lovka, s.n.

Helleboraceae 1250

✓ Aconitum anthora L. 2n = 32. Yugoslavia: Slovenia,
Škocjanske jame. Lovka, s.n.

✓ Aconitum vulgare Rchb. 2n = 16. Yugoslavia: Slovenia,
Snežnik. Lovka, s.n.

Ranunculaceae 1300 + 1350.

Aquilegia grata F. Maly. 2n = 16. Yugoslavia: Bosnia,
Višegrad. Sušnik & Lovka, s.n.

✓ Ficaria calthaefolia Rchb. 2n = 16. Yugoslavia: Slovenia,
Klanec na Krasu. Wraber & Lovka, s.n.;
Gradina, Sv. Dionizije nad Mirno. Lovka, s.n.

Linaceae 2400

✓ Linum austriacum L. 2n = 18. Yugoslavia: Kosmet, Štimlje.
Lovka, s.n.

Euphorbiaceae 2600

Euphorbia glabriflora Vis. 2n = 14. Yugoslavia: Bosnia,
Višegrad. Sušnik & Lovka, s.n.

Primulaceae 4500

Cyclamen neapolitanum Ten. $2n = 34$. Yugoslavia: Bosnia, Višegrad. Sušnik & Lovka, s.n.

Primula wulfeniana Schott. $2n = 66$. Yugoslavia: Slovenia, Turska gora. Lovka, s.n.

Plantaginaceae 5400

Plantago major L. $2n = 12$. Yugoslavia: Bosnia, Jahorina. Sušnik & Lovka, s.n.

Plantago reniformis G. Beck. $2n = 12$. Yugoslavia: Bosnia, Jahorina. Sušnik & Lovka, s.n.

Dipsacaceae 5700

Scabiosa leucophylla Borbás. $2n = 16$. Yugoslavia: Bosnia, Jahorina, Sušnik & Lovka, s.n.

Asteraceae 5900

Aster linosyris (L.) Bernh. $2n = 18$. Yugoslavia: Serbia, Deliblatska Peščara. Sušnik & Lovka, s.n.

Homogyne sylvestris (Scop.) Cass. $2n = 60$. Yugoslavia: Slovenia, Ohrešelj. Lovka, s.n.

Orchidaceae 970

✓ Gymnadenia odoratissima (L.) Rich. 2n = 40. Yugoslavia: Slovenia, Turska gora. Lovka, s.n.

✓ Himantoglossum hircinum (L.) Spreng. 2n = 36. Yugoslavia: Bosnia, Goražde. Šušnik & Lovka, s.n.

✓ Ophrys bertolonii Mor. 2n = 36. Yugoslavia: Croatia, Limski Kanal. Lovka, s.n.

Ophrys aranifera Huds. 2n = 36. Yugoslavia: Croatia, Motovun. Lovka, s.n.

Ophrys cornuta Stev. 2n = 36. Yugoslavia: Bosnia, Mostar. Lovka, s.n.

✓ Orchis coriophora L. 2n = 36. Yugoslavia: Croatia, Rab. Lovka, s.n.

✓ Orchis morio L. 2n = 36. Yugosl.: Croatia, Buzet. Šušnik & Lovka, s.n.

✓ Orchis tridentata Scop. 2n = 42. Yugoslavia: Croatia, Buzet. Šušnik & Lovka, s.n.

✓ Serapias vomeracea (Burm.) Briq. 2n = 36. Yugoslavia: Montenegro, Titograd. Pulević, s.n.

Aristolochiaceae 650

✓ Aristolochia pallida Willd. 2n = 8. Yugoslavia: Slovenia, Škocjanske jame. Lovka, s.n.