

# *Crocus isauricus* SIEHE ex BOWLES (Liliiflorae, Iridaceae) and its relatives

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**Abstract:** Recent phylogenetic works on the genus *Crocus* proved several infra-generic units predominantly within section *Nudiscapus* to be para- or polyphyletic. An example for this is the former “*Crocus biflorus* aggregate” with more than 20 subspecies of *C. biflorus*. The subspecies of *C. biflorus* including subsp. *isauricus* turned out to be polyphyletic grouping in very different phylogenetic clades and sub-groups. Several series of this section established by Mathew either cannot be kept in their original version, or new series have to be introduced to arrive at a system of *Crocus* that closely reflects species relationships. This is e.g. the case for the former *C. biflorus* ssp. *isauricus*. Together with its relatives it assembles a distinct group in the recent phylogeny. Therefore it is necessary to raise it to species level (again) like this is done for all its close relatives. *Crocus isauricus* represents now the type species of the new series *Isauri* which is introduced in this article including all presently known species.

**Zusammenfassung:** Neue phylogenetische Arbeiten zur Gattung *Crocus* zeigen para- und polyphyletische Gruppierungen von Taxa, speziell in Sektion *Nudiscapus*. Ein Beispiel dafür ist das ehemalige *Crocus biflorus* Aggregat mit mehr als 20 Subspezies von *C. biflorus*, die sich in sehr verschiedenen phylogenetischen Gruppen und Untergruppen befinden. Einige der von Mathew etablierten Serien können entweder nicht in der ursprünglichen Art beibehalten werden oder neue Serien müssen definiert werden, die die realen Verwandtschaftsverhältnisse widerspiegeln. Dies ist z. B. der Fall für die ehemalige Subspezies *isauricus* von *C. biflorus*. Zusammen mit ihren Verwandten bildet sie eine homogene Gruppe innerhalb der Phylogenie. Es ist daher notwendig, diese Subspezies wieder in den Art-Status zu erheben, wie dies der Fall ist bei all ihren Verwandten. *Crocus isauricus* bildet nun die Typ-Spezies der neuen Serie *Isauri*, die in diesem Artikel vorgestellt wird, zusammen mit allen gegenwärtig bekannten Arten.

**Key words:** *Crocus*, phylogeny, new series *Isauri*, new species *Crocus rechingeri*, *Crocus concinnus*.

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## Introduction

Walter Erdmann Siehe was a German engineer who lived for more than 25 years in Turkey and belongs certainly to the most important personalities in studying Anatolian bulbous plants. He added much to the knowledge of Turkish crocuses and made many distributions to bulb specialists and enthusiasts in Europe. One crocus specimen of the British Museum was collected by him in the Cilician Taurus. This specimen is regarded as authentic material by MATHEW (1982) but it is unfortunately not the type specimen of *Crocus isauricus* which remains unknown.

Despite this fact it was used by Bowles (1924) to describe *Crocus isauricus* SIEHE ex BOWLES. In his revision of the genus *Crocus* Mathew transferred it to subspecific rank within *Crocus biflorus* MILLER which has a wide distribution in southern Turkey from the Lycian Taurus to the mountains north of Silifke (MATHEW, 1982).

However, recent phylogenetic analyses of the genus *Crocus* (PETERSEN et al. 2008; HARPKE et al. 2013) proved several

infra-generic units predominantly within section *Nudiscapus* to be para- or polyphyletic. An example for this is the former “*Crocus biflorus* aggregate” with more than 20 subspecies of *Crocus biflorus* including subsp. *isauricus*. The subspecies of *C. biflorus* turned out to group in very different phylogenetic clades and sub-groups. Those molecular findings clearly support a) a distinction of such taxa in the genus *Crocus* at species level and b) indicate that several series of this section established by MATHEW (1982) either cannot be kept in their original version, e.g., series *Reticulati* (HARPKE et al. 2014), or new series have to be introduced to arrive at a system of *Crocus* that closely reflects species relationships.

Consequently, in case of *C. isauricus*, we go back to the original status of this crocus and classify it again with species rank. Based on the molecular results of section *Nudiscapus* we are now able to draw a better resolved picture of this section as well as of the whole genus. In this article we discuss *C. isauricus* and its relatives. Detailed molecular-systematic results concerning these findings will be published elsewhere.



Fig. 1: Asia Minor under the Greeks and Romans.

## General aspects on *C. isauricus* and its relatives

“Isauria” was an ancient inland district of south-central Anatolia (Fig. 1). Greco-Roman authors described the inhabitants as war-like and uncivilized mountain people conquered by the Roman general Publius Servilius Vatia “Isauricus” in a three-year campaign, 76–74 B.C. Their country with its capital Isaura Palaia (appr. 40 km west of Karaman, near the modern village of Güneysınır), was united with Cilicia by Pompey; and under the emperor Augustus (27 B.C. – ad 14) it became part of the Roman province of Galatia.

Most important in case of *C. isauricus* is that the population from the Sertavul pass in the Isaurian Taurus, which can be recognised as from “near type” locality, is genetically and morphologically quite different to other allegedly “*C. isauricus*” from more westerly localities, especially in Lycia and Caria. Indeed, genetic analyses revealed a clearly separable group of species in which *C. isauricus* and its relatives appear (Fig. 2). *Crocus isauricus* from “near type” of which we define and describe an epitype of this species has its main distribution area in the Isaurian Taurus with a center to the south of the city of Karaman and its larger vicinity.

Its closest relative is *C. taseliensis* of the central Taurus plateau (Taseli Yarımadası). Surprisingly, two *C. chrysanthus* sensu

lato from the coastal mountains of the Isaurian Taurus (HKEP 1110 and 1116) are closely related to *C. mersinensis* (Fig. 2) another near relative of *C. isauricus*, which also occurs in the Isaurian Taurus (Pusatlı Dağları). In addition, there are several more distant geographical exclaves inhabited by close relatives, namely *C. abraeteolus* in the Cilician Taurus (Bolkar Dağları), *C. mawii* and *C. concinnus* in the Pisidian Taurus (Kuyucak Dağları), *C. fauseri*, *C. caricus*, and *C. antherotes* in Caria (Kavak Dağları, Menteşe Dağları), *C. rechingeri* in the Lycian Taurus (Babadağ) with a relative in the Isaurian Taurus (*C. karamanensis*), and *C. tauricus* in the mountains of the Crimean peninsula. The latter two exclaves are rather unexpected because of the large distance separating them from their nearest relatives (Tab. 1).

The well known, recently by the Hellenic Database (STRID, 1996) confirmed Rechinger line, separates in the Aegean floral elements of Asia Minor from European ones. Different to the adopted floristic divisions of Greece (STRID, 1996) RECHINGER & RECHINGER-MOSER (1951) also separate the main islands of the south Aegean island arc (Kithira, Crete, Karpathos and Rhodes) from the Cyclades and the east Aegean islands. In case of crocus this is very interesting, as, e.g., relatives of *C. biflorus* from Rhodes and Karpathos genetically have closer relatives in Italy and Greece than on the western Turkish mainland or the east Aegean islands. This confirms DAVIS (1971) who sees significant floristic



links between the mountain flora of the Taurus and mainland Greece, even stronger than between the mountain floras of west Anatolia and Greece.

For this reason one can draw another border-line on the Turkish mainland right across the Babadağ in west-east direction. At least in the case of *C. isauricus* and its relatives this line separates to the north those taxa belonging genetically to western Anatolia and to the south those which have relatives in the Taurus as well as in Greece and Italy. Indeed, the present phytogeographical borders inside Turkey between the two Mediterranean districts "West Anatolia" and "Taurus" coincides with this line (DAVIS, 1971). If prolonged westwards to the north of Rhodes it joins the separation line of the south Aegean island arc from the Cyclades and the east Aegean islands.

On the northern part of the Anatolian phytogeographical border (north of the Babadağ) grows *C. rechingeri* (HKEP 0115, Tab. 1) a relative of *C. isauricus*. On its southern side occurs *Crocus babadagensis* (KERNDORFF et al. 2013), which has a relation to *C. biflorus* sensu lato of Italy (GAT 7198) and Greece (DB 4387). For the time being this result supports and extends Rechinger's findings at least for some members of the genus *Crocus*. To honour Karl-Heinz Rechinger for his outstanding botanical work concerning the Aegean flora we name the new crocus from the Babadağ *Crocus rechingeri*. The closest known relative of this one lives rather far away in the Isaurian Taurus (*C. karamanensis*, HKEP 0108).

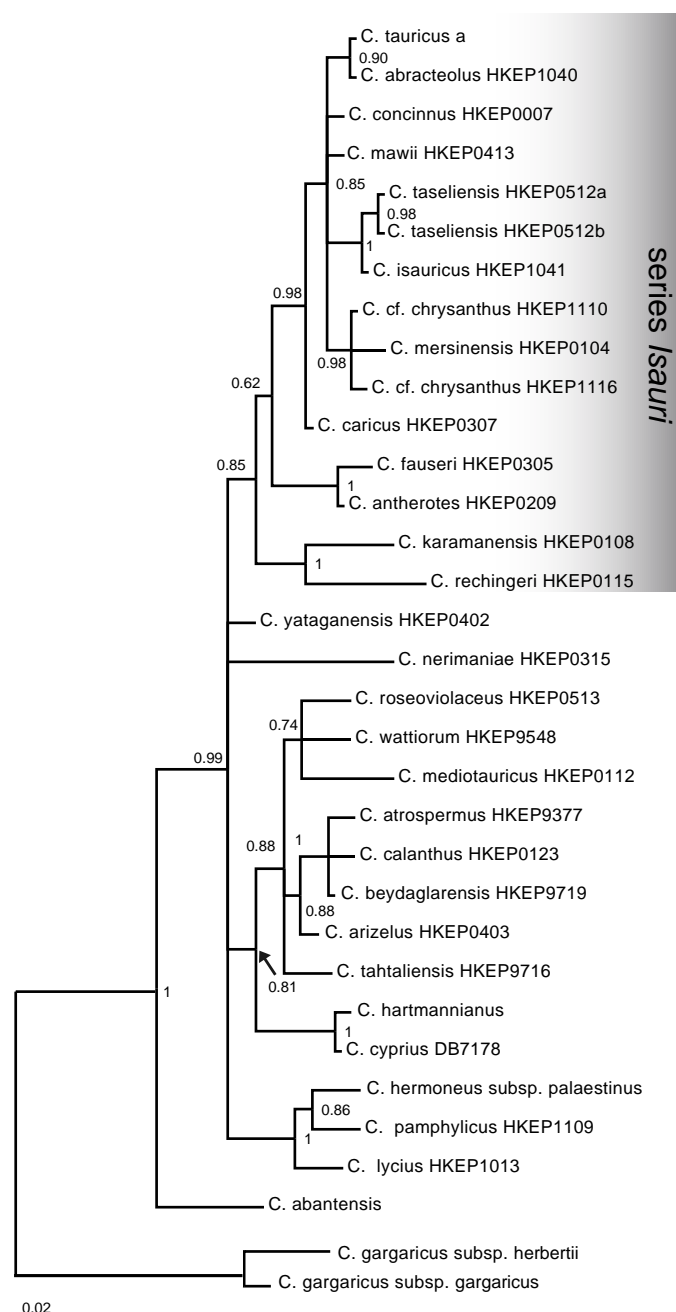
Another crocus, which is very surprising here, is the Crimean *C. tauricus* TRAUTV. erroneously placed by Mathew as a variety of *C. biflorus* subsp. *adamii* (KERNDORFF et al., 2013, 2013a). This one has a close relative, far away from the Crimea in southern central Turkey (Bolkar Dağları), *C. abraceolus*. These two examples of widely separated species clearly show that geographically more distant taxa are genetically not necessarily also more distant.

Furthermore, several allegedly *C. isauricus* populations from Lycia, belong even to a different molecular-systematic group and can be neither this species nor belong to series *Isauri*. Detailed results with regard to this other group will be published elsewhere. All in all because of the rather complicated situation it is not surprising that the ‘real’ *C. isauricus* is frequently misidentified due to the high degree of “overall similarity” to all the nearer and farer relatives of *C. isauricus*. To shed light on these confusing circumstances, we take a closer look to the distinctness and alliance of all these species and their geographical distribution. Consequently, to unite *C. isauricus* and its near relatives, we establish the new series “*Isauri*” of section *Nudiscapus* in the genus *Crocus*.

## Material and methods

## Plant materials

For molecular and morphological analyses we investigated individuals from 15 populations (two to five individuals per population). Voucher specimens of all analyzed individuals were deposited at the herbarium of the IPK Gatersleben (GAT). Additionally, 18 other taxa belonging to section *Nudiscapus* were analyzed by DNA sequencing to function as out-groups.



**Fig. 2:** Phylogenetic tree of series Isauri species derived from a Bayesian analysis of the nrITS region.

## Morphological analysis

The characters of 21 to 35 individuals were measured in the field from fresh but later in some cases also of dried material.

## Molecular methods

For each of the 15 populations and the 18 out-group taxa the spacers of the internal transcribed spacer (ITS) region of the nuclear ribosomal DNA (rDNA) was sequenced. DNA extraction, PCR and sequencing were done according to HARPKE et al. (2013). All sequences newly obtained in this project were depo-

sited in the EMBL nucleotide database under accession numbers LN626327-LN626342 (for all others see HARPKE et al. 2013; HARPKE et al. 2014).

Sequence alignments and phylogenetic analyses

Sequences for all loci were manually aligned. If sequences were identical within the same population, only one sequence per population was included in the phylogenetic analysis. Modeltest 3.7 (POSADA and CRANDALL 1998) was used to test different models of sequence evolution, and the GTR +  $\Gamma$  + I model was chosen by the Akaike information criterion. Bayesian inference (BI) was conducted in MrBayes 3.2 (RONQUIST & al. 2012). In BI two times four chains were run for four million generations each, sampling a tree every 1000 generations. Converging log-likelihoods, potential scale reduction factors for each parameter and inspection of tabulated model parameters in MrBayes suggested that stationarity had been reached in all analyses. The first 25% of trees of each run were discarded as burn-in. Three independent runs of BI analysis were performed to confirm that separate analyses converged on the same result. In each of these analyses, the same topology and similar posterior probabilities (pp) of nodal support were found.

The original description of *Crocus isauricus*

BOWLES (1924) mentioned ‘a rather variable plant collected in 1907 by Walter Siehe in ‘Isauria’ as *C. isauricus*’. He suggests a close affinity of this crocus with *C. chrysanthus*, which was confirmed by our molecular results. Table 1 contains two crocuses from the Isaurian Taurus we refer to *Crocus chrysanthus* sensu lato (HKEP 1110 and HKEP 1116), which also belong to the new series. This surprising result we detail in the discussion.

*Crocus isauricus* was described by Bowles (1924) as follows:

- Gourd-shaped flowers with rounded segments.
- Broad anthers generally show a white, central band before dehiscence, and in most specimens there is a slight shading of grey or even black by the edges of the pollen sacs.
- The leaves are of a remarkably pale grey-green, very similar to those of the strangely blue form of *C. adamii*.
- The flowers have a white ground and a yellow throat and are variously freckled, or finely feathered outside with bluish grey or dull purple.
- The scarlet stigmata give a pleasant touch of colour to an otherwise rather dowdy flower.
- A hard coriaceous tunic has distinct rings at the base, and diphyllos proper spathes.

As can be seen from the description of the species under number 1 Bowles’ plant is congruent to the plant from Sertavul except for the scarlet stigma. As this parameter is known to vary a great deal even within a population Bowles might have had only few plants with rather scarlet stigmas and not orange ones like we found in the majority of individuals analyzed. Also, in dried specimens the stigmas are invariably scarlet.

Table 1: Species of series Isauri and their geographical distribution.

| species                            | investigated population | geographical distribution <sup>2</sup> |
|------------------------------------|-------------------------|--|
| <i>C. tauricus</i> <sup>1</sup>    | cultivated specimens    | Crimea                                 |
| <i>C. abracteolus</i>              | HKEP 1040               | Bolkar Dağları                         |
| <i>C. mawii</i>                    | HKEP 0413               | Kuyucak Dağları                        |
| <i>C. concinnus</i>                | HKEP 0007               |  |
| <i>C. isauricus</i> <b>epitype</b> | HKEP 1041               | Isaurian Taurus                        |
| <i>C. taseliensis</i>              | HKEP 0512a              |  |
| <i>C. taseliensis</i>              | HKEP 0512b              |  |
| <i>C. mersinensis</i>              | HKEP 0104               | Isaurian/Cilician Taurus               |
| <i>C. cf. chrysanthus</i>          | HKEP 1110               |  |
| <i>C. cf. chrysanthus</i>          | HKEP 1116               |  |
| <i>C. caricus</i>                  | HKEP 0307               | Caria                                  |
| <i>C. fauseri</i>                  | HKEP 0305               |  |
| <i>C. antherotes</i>               | HKEP 0209               |  |
| <i>C. karamanensis</i>             | HKEP 0108               | Isaurian Taurus                        |
| <i>C. rechingeri</i>               | HKEP 0115               | Babadağ                                |

<sup>1</sup>(TRAUTV.) PUR., Trudy Bot. Sada Imp. Yur’evsk. Univ. 1: 194 (1900)

<sup>2</sup>the colours of the geographical groups are congruent to those in Fig. 3

Results & Discussion

The phylogeny of crocus, which was obtained by molecular-systematic analyses, revealed several surprising results, like, e.g., the occurrence of *C. baytopiorum* in series *Crocus* or the alliance of *C. pestalozzae* between species of series *Aleppici* (PETERSEN et al., 2008; HARPKE et al., 2013). Most interesting is the finding that the presumed close relationship of *C. chrysanthus* with *C. biflorus* could be shown in many examples. That there is a close link between them can be seen already by the number of their hybrids, which is unique in the genus and many garden crocuses originated from this species group. For HERBERT (1847) the relationship of *C. chrysanthus* and *C. biflorus* was so close that he placed them as varieties of one species. This was not accepted by MAW (1886) for several reasons and cannot be accepted by us due to the genetic results, which clearly support a differentiation of these taxa at species level. Up to date there was only one clear distinguishing parameter for both, the basic colour of segments, yellow in *C. chrysanthus* and bluish or white in variants of *C. biflorus*. The results of the genetic analyses of most known and all new species of section *Nudiscapus* show that blue and yellow flowering species are combined in several clusters/series, e.g. *C. ancyrensis* and *C. angustifolius* with *C. reticulatus* and its closer relatives in the newly defined series *Reticulati* (HARPKE et al., 2014) or *C. adamii* and *C. almehensis* in the new series *Adami* (KERNENDORFF et al., in preparation). This means that not only the relationship between *C. chrysanthus* sensu lato and *C. biflorus* sensu lato is even closer than thought before but also between several new and not yet determined species of both lineages. One major conclusion of this finding is that species with blue, white or yellow basic segment colours can, on a genetic ground, occur together in a series. The results of the molecular analyses also show that behind *C. chrysanthus* sensu lato or other yellow-flowering species like *C. ancyrensis* (HARPKE et al., 2014) probably some more unknown species are hidden similar to all the associated species found in case of *C. biflorus* sensu lato and its relatives.

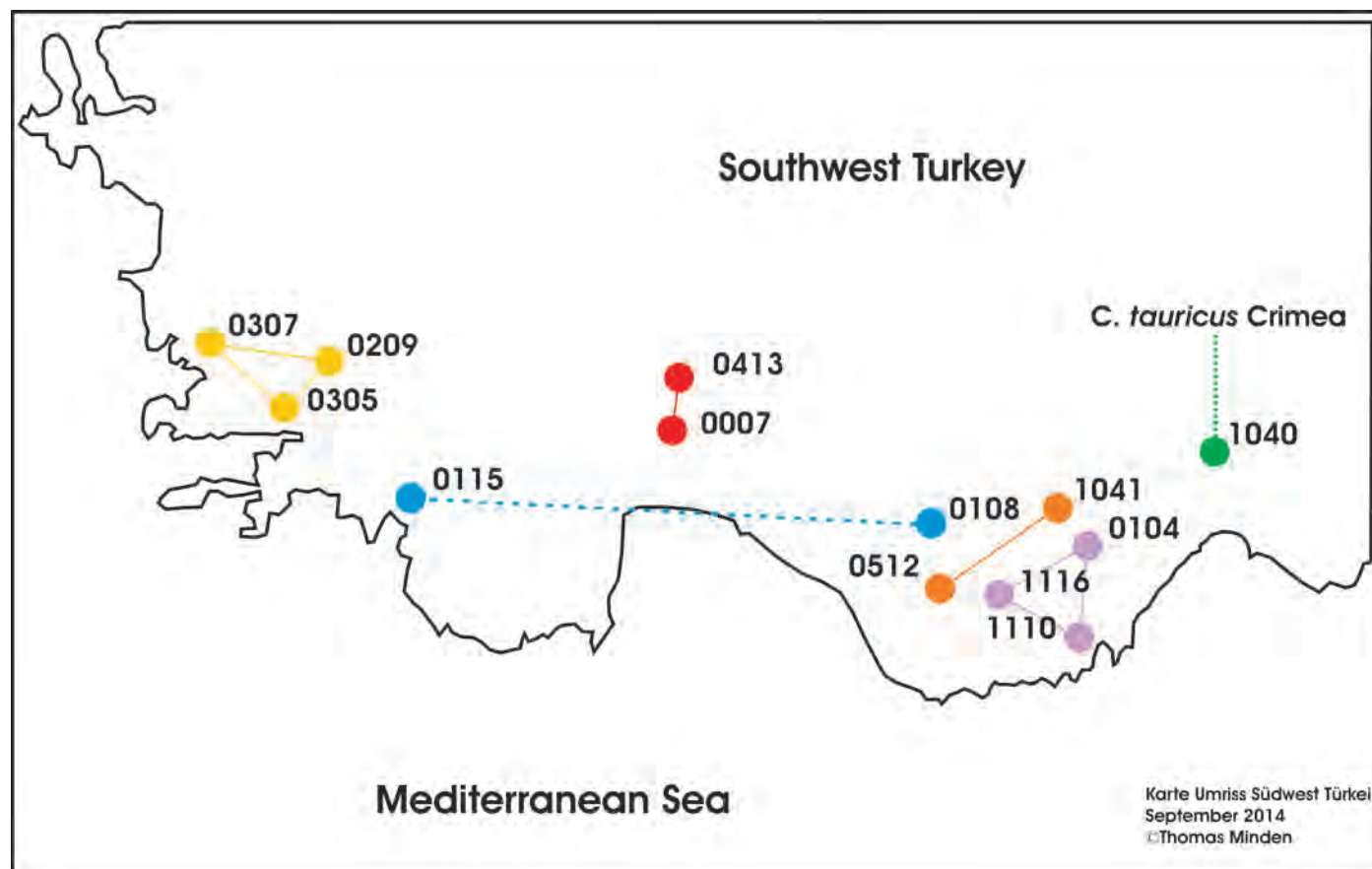


Fig. 3: Map of geographical distribution of species of series Isauri.

To series *Isauri* belong at the present state of knowledge two different “*C. chrysanthus* sensu lato” closely associated to *C. mersinensis* (Fig. 2 and Tab. 1), which we cannot describe as new species at present due to lack of material. Furthermore, we presume the existence of more species belonging to series *Isauri*. Therefore, in case of a newly discovered crocus presumed to belong to this series, adequate molecular analyses should be made to clarify its position in the phylogeny of the genus/series. An association to series *Isauri* solely on morphological or even geographical parameters should be avoided, as relationships in this series are unexpected close even between the yellow and blue-violet/white coloured species and those separated by wide geographical distances.

The situation gets even more complicated by the existence of another group of somewhat farer allied species, which can be recognized as a “sister-series” to series *Isauri* with several species erroneously thought to be or belong to *C. isauricus* and its relatives. This will be dealt with elsewhere. For the time being we have to accept this taxonomically complex and not completely satisfying situation until more information is available.

## Description of species

### 1. *Crocus isauricus* SIEHE ex BOWLES

**H o l o t y p u s:** Not known. Authentic herbarium material at the British Museum from south of the city of Karaman (near the border of the Turkish provinces of Karaman and Mersin) is presumed by Brian Mathew as the possible type specimen.

But, the above mentioned herbarium specimen is unfortunately not suitable for an identification of this crocus. The flowers were not opened before preparation to see details of filaments, anthers, and styles. Furthermore, due to decayed colours, the present “tobacco-like” condition of the pressed specimens, do not allow identification.

### 1. *Crocus isauricus* KERNDORFF & PASCHE (ex BOWLES)

**E p i t y p u s:** A known locality for *C. isauricus* sensu BOWLES exists in an area north of the city of Sertavul (1500-1600 m) where it was studied by us.

Tab. 2: Compilation of continuous parameters and their mean values and of phenotypic characteristics of species of the new series Isauri

| taxon                        | corn tunic |       |             |                   |                  |                            | color of sheathing leaves |                   | segm prop. | true leaves   |            |                           |                 |                            |                  | stamen and styles |                         |          |                |          |                 |                  |
|------------------------------|------------|-------|-------------|-------------------|------------------|----------------------------|---------------------------|-------------------|------------|---------------|------------|---------------------------|-----------------|----------------------------|------------------|-------------------|-------------------------|----------|----------------|----------|-----------------|------------------|
|                              | outer      | inner | splits (mm) | sub-length splits | neck-length (mm) | teeth on rings (length,mm) | cataphylls                | bract/ bracteoles |            | leaf-no. mean | col leaves | white stripe <sup>2</sup> | leaf-diam. (mm) | leaf-ribs no. <sup>3</sup> | length fila (mm) | length anth (mm)  | length style-bran. (mm) | col fila | col anth       | col conn | col style       | style acc. stam. |
| <i>Crocus</i>                |            |       |             |                   |                  |                            |                           |                   |            |               |            |                           |                 |                            |                  |                   |                         |          |                |          |                 |                  |
| <i>tauricus</i> <sup>1</sup> | c          | so    | >5          | ab                | 3-5(8)           | m<1, f>5                   | silv                      | silv (if pr)      | -          | -             | -          | -                         | 2               | -                          | -                | -                 | -                       | -        | or             | -        | or              | -                |
| <i>abtractolus</i>           | c          | c     | 2-5         | ab                | 3-7              | m<0.5                      | silv t br                 | ab                | 2.8        | 4.1           | gr         | <1/3-1/3                  | 1-2             | 2(3)                       | 5                | 8.7               | 6                       | y        | y              | c/ly     | dy/or           | 88le             |
| <i>mauii</i>                 | c          | so    | >5          | rare              | 5                | m<0.5 dist                 | silv t br                 | silv t br         | 3.5        | 5.6           | d gr       | 1/3->1/3                  | 1-1.5           | (0)1-2                     | 5.8              | 11.3              | 5.3                     | ly/y     | y              | c/ly     | or/r            | 73le             |
| <i>concinus</i>              | c          | so    | >5          | rare              | 2-5              | m<0.5                      | silv                      | silv              | 3.4        | 4.6           | d/g gr     | 1/3                       | 1-1.5           | 2                          | 5.3              | 10.8              | 5.2                     | dy/or    | 68y/32b        | lanth    | orr/r           | 80s              |
| <i>tasclensis</i>            | c          | so    | >5          | ab                | 3-5              | ab                         | silv                      | silv              | 3.3        | 5.7           | d/y gr     | 1/3                       | 1-2.5           | 2(3)                       | 4.5              | 9.8               | 6.3                     | dy       | 79y/21b        | c/b/b/g  | or              | 97se             |
| <i>isauricus</i>             | c          | so    | >5          | ab                | 3-5              | m<1                        | silv                      | silv              | 2.2        | 5.6           | l/g gr     | 1/3->1/3                  | 1-1.5           | (0)1-2                     | 5.7              | 11.4              | 5.2                     | y        | y <sup>3</sup> | c        | or <sup>4</sup> | 86se             |
| <i>mersinensis</i>           | c          | so    | >5          | ab                | 5-10             | up m<0.5                   | silv-y                    | silv incon.       | 2.7        | 4.2           | 1 gr       | <1/3-1/3                  | 1.5-2           | (1)2                       | 4.7              | 9.9               | 5.5                     | y/or     | y/g            | c/ly     | or              | 72le             |
| <i>caricus</i>               | c          | so    | >5          | ab                | 5-7              | m<0.5                      | silv-y-br                 | silv con.         | 3.1        | 4.5           | d gr       | 1/3                       | 1-1.5           | (0)1-2                     | 8.9              | 9                 | 5                       | br/vi    | b              | b        | or              | 96s              |
| <i>fauveri</i>               | c          | c     | >5          | ab                | 4-6              | m0.5-1(2)                  | silv-br                   | silv-br           | 2.8        | 4.9           | d gr       | 1/3                       | 1-1.5           | 1-2                        | 5.8              | 9.3               | 4.9                     | dy/or    | b              | b        | or              | 96se             |
| <i>antherotes</i>            | c          | c     | 2-5         | rare              | 8-12             | up ml-2(4)                 | silv br-ap                | silv con.         | 2.6        | 4.7           | g gr       | <1/3->1/3                 | 1.5             | (1)2                       | 5.3              | 10.5              | 6.5                     | y        | b              | b/g      | or              | 82se             |
| <i>karamanensis</i>          | c          | so    | 2-5         | rare              | 3-10             | f<0.5                      | silv                      | silv              | 3.4        | 4.9           | g gr       | 1/4-1/3                   | 1.5             | 1(2)                       | 5.3              | 10                | 7                       | dy       | 59b/18y/       | b/g t    | y/or            | 70se             |
| <i>rechingeri</i>            | c          | c     | >5          | ab                | 2-3              | ab                         | silv                      | silv              | 3.1        | 6.3           | 1 gr       | >1/3                      | 1.5-2           | 1(2)                       | 6.1              | 8.4               | 5.3                     | or       | y              | c/ly     | dor/r           | 85se             |

Explanatory notes:

corn tunic: c = coriaceous, so = softer, ab = absent, m = many, f = few, dist = distant, up = on upper rings;

color of sheathing leaves: silv = silvery (skinny), pr = present, t = tips, y = yellowish, br = brownish/brown;

segmprop.: segment proportion (= average length of outer segments/average width of outer segments) as a rule: 2-2.5 bowl-shaped flowers, 2.5-3.5 "normal" flowers, 3.5-5 rather starry star-like flowers;

true leaves: segm = colour, gr = green, g = grey, d = dark, l = light, y = yellow;

stamen and styles: fila = filaments, anth = anthers, conn = connectives, col = colour; colours of filaments: y = yellow, or = orange, ory = orange-yellow, br/vi = brownish-violet, d = dark, l = light; colour of

anthers: b = black, g = grey, 68y/32b = 68% of the anthers of the investigated population is yellow, 32% is black; in case of *C. karamanensis* the proportion is 59% black, 18% yellow and 23% yellow with black

tips; colours of connectives: c = colourless, bl = blue, lanth = like anthers; colours of styles: or = orange, orr = orange-red, r = red; style acc. stam = length of style according to stamen

(numbers are % of investigated specimens of a population, le = longer to equal, se = shorter to equal, s = shorter.

<sup>1</sup>data for *C. tauricus* of corn tunic parameter and colour of sheathing leaves are from cultivated specimens, all others are from the Flora of the U.S.S.R.

<sup>2</sup>in dimension of the leaf-diameter

<sup>3</sup>on both sides of the grooves

<sup>4</sup>in dried specimens invariably scarlet

<sup>5</sup>in dried specimens invariably grey



To clarify its position in the phylogenetic tree of this and its allied species it was necessary to analyse and define an epitype from material of HKEP 1041, which agrees morphologically with the original description by E.A. Bowles (HKEP 1041, Gatersleben, GAT 7162). Additionally, some more details about the species as in the original description are added from 21 randomly selected and measured specimens of population HKEP 1041. A flowering herbarium specimen of this epitype is deposited in Gatersleben, GAT 7162.

Cormus subglobosus, 14–19 mm diameter. Tunicae exteriores coriaceae, interiores leviter molles, generaliter dissectae modice in segmenta lata (>5 mm), subfissurae absunt. Annuli ad basem satis lati dentibus multis parvis, plerumque <<1 mm longis. Collum durum formatum triangulis aliquid latis, 3–5 mm longis. Cataphyllae plerumque 3, argenteae-albae, recutitae, non infuscae aetate provecta. Folia 5–5.6–7 (n=21), attingentia vel superantia flores sub anthesi, dilute virida usque ad grisea-virida, 1–1.5 mm diameter, glabra, (0)1–2 costis in omni sulco in folio inferiore. Latitudo virgae albae 1/3 diameter folii vel magis. Faux saturate lutea, saepe aurantiaca in centro, glabra, perinthii tubus albus, infra leviter caerulea vel violacea ad apicem. Segmenta externa 22–33 mm, plerumque 26 mm longa, 9–14 mm, plerumque 12 mm lata. Segmenta interna 21–32 mm, plerumque 27 mm longa, 8–13 mm, plus minusve 11 mm lata. Segmenti relatio segmentorum exteriorum valde humilis (2.2), significans florem crateri aequalem. Segmenta externa et interna intus clare alba sine maculis. Latera externa segmentorum exteriorum dilute maculata caerulea-violacea, plerumque non indicans strias aut partes pinnatinerves sine maculis subnigris ad tubum perianthii versus. Color externus segmentorum interiorum albus, raro macula tenui. Prophyllum abest. Bractea et bracteola adsunt, argentea-alba, plerumque conspicua. Filamenta 4.5–7 mm plus minusve 5.7 mm longa (n = 21), lutea, glabra; antherae 9–13.5 mm, plus minusve 11.4 mm longae (n = 21), luteae raro cum marginibus griseis, connectivum sine colore usque ad dilute luteum. Pollen flavum. Stilus saturate luteus usque ad aurantiacum, in statu sicco semper scarlatinus. Stilus divisus in partes tres, expansus et clare buccinatus in apicem; rami 3.5–7.5 mm, plus minusve 5.2 mm longi. Stigma antheris brevior usque ad aequalem 86%, longior 14% (n=21). Capsula et semina non visa. Chromosomatorum somaticorum numerus 10.

Corm sub-globose, 14–19 mm in diameter. Outer tunics coriaceous the inner ones slightly softer, splits generally into rather broad segments (>5 mm) without sub-splits (Fig. 5c). Rings at base fairly broad with many tiny teeth of predominantly <<1 mm length. The hard neck is built of rather broad-based triangles, 3–5 mm long. Cataphylls mainly 3, silvery-white, skinny, not becoming brown with age. Leaves 5–5.6–7 (n = 21) reaching or overtopping the flowers at anthesis, light green to greyish-green, 1–1.5 mm in diameter, glabrous, (0)1–2 ribs underneath. Width of the white stripe 1/3 of leaf diameter or more. Throat deep yellow in the centre often orange, glabrous, perianth tube white below soft blue or violet near apex. Outer segments between 22 and 33 mm but usually 26 mm long, between 9 and 14 mm mostly 12 mm wide. Inner segments between 21 and 32 mm but usually 27 mm long and between 8 and 13 mm on average 11 mm wide. Segment-proportion of outer segments very low (2.2) which signals a very bowl-shaped flower. Inside all segments are invariably clear white without markings (Fig. 4c). Outside of outer segments is predominantly very finely speckled light bluish-violet mostly without indications of striping or feathering. No

dark spots near the perianth tube are present. Outside colouring of the inner segments is uniformly white, rarely with very fine speckles. Prophyll absent. Bract and bracteole present, silvery-white, mostly conspicuous. Filaments 4.5–7 mm on average 5.7 mm (n = 21) long, yellow (Fig. 4c), glabrous; anthers 9–13.5 mm on average 11.4 mm (n = 21) long, yellow rarely with greyish edges, connective colourless to light yellow. Pollen yellow. The styles are deep yellow to orange, in dried specimens invariably scarlet. They are divided into 3 branches which are broadened at apex or significantly trumpet-shaped towards the end; branches short 3.5–7.5 mm on average 5.2 mm long. The styles are 86% shorter to equal, 14 % longer as stamens (n = 21). Capsule and seeds not seen. Chromosome number 2n = 10.

*Crocus isauricus* is characterised by a coriaceous corm tunic like all its relatives, a very bowl-shaped flower (segment proportion is 2.2) which is in most cases pure white with only faint spots or markings on the outside of the outer segments. The anthers are predominantly yellow rarely with greyish edges and the styles are mostly shorter than stamen.

**Distribution and habitat:** Contrary to the present knowledge *Crocus isauricus* is not at all widely distributed. Instead, it is most probably more or less confined to the ancient area of “Isauria” (Fig. 1) and bears its name more precisely now. It grows in open mountain steppes on basic brown calcareous soils together with *Colchicum sanguicolle*, *Colchicum triphyllum*, *Astragalus*, *Verbascum*, *Geranium tuberosum*, *Alkanna orientalis*, *Chionodoxa forbesii*, *Euphorbia*, *Crataegus monogyna*, *Juniperus* etc.

All the other crocuses meant to be *C. isauricus* are new species and were already described in some cases (KERNDORFF et al., 2012 & 2013).

## 2. *Crocus rechingeri* KERNDORFF & PASCHE spec. nova

**H o l o t y p u s:** Turkey, Lycian Taurus, Antalya province, Babadağ, 1200–1400 m, 15.3.2001, HKEP 0115 (Gatersleben, GAT 7246)

Cormus subglobosus, 13–15 mm diameter; tunica externa et interna coriacea; tunicae dissectae in segmenta ex >5 mm, subfissurae absunt; collum brevissimum (2–3 mm), constans ex triangulis latis basalibus, orta ex incisionibus profundis deorsum ad propinquum medium tunicae; annuli duri sine dentibus, praecipue margine integra; Cataphyllae argenteae-albae; folia multa (4–8), plus minusve 6.3, plerumque folia superantia flores ad anthesin, dilute virida, glabra, plus minusve 1.5–2 mm diameter, 1(2) costis in omni sulco in folio inferiore; latitudo virgae albae >1/3 diameter foliorum. Faux saturate aurantiaca, cincta corona lutea, glabra; perianthii tubus sine colore usque ad luteolum, striatus griseus-violaceus ad apicem versus. Segmenta externa 18–32 mm, plerumque 25 mm longa; 6–8 mm, plerumque 10 mm lata. Segmenta interna 17–30 mm, plerumque 24 mm longa, 6–11 mm plus minusve 8 mm lata. Segmentorum relatio longitudine latitudineque 3. Segmenta externa et interna intus leniter pelucida-caerulea vel subcaerulea-lilacina, segmenta externa intus graviter caerulea venosa vel pinnatinervia. Latera externa segmentorum exteriorum albida, bubalina vel subcaerulea tribus striis prominentibus violaceis ad lineam, comitatae striis gracilibus. Segmenta interiora extus plerumque uniformiter et leniter subcaerulea-lilacea sine maculis. Prophyllum abest. Bractea

et bracteola adsunt, argentea-alba, recutita, bracteola angustior quam bractea. Filamenta plus minusve 6.1 mm, saturate lutea usque ad aurantiacum; antherae plus minusve 8.4 mm, luteae; connectivum sine colore usque ad flavum. Stilus plerumque saturate aurantiacus-rubrus, divisus in partes tres, expansus vel buccinatus in apicem; rami breves, plus minusve 5.3 mm longi sine vel cum papillis paucis. Stigma antheris plerumque aequalis vel longior (85%). Capsula et semina non visa. Chromosomatorum somaticorum numerus 12.

Corm sub-globose, about 13–15 mm in diameter; outer and inner tunics coriaceous; tunic splits into segments of >5 mm, sub-splits absent; neck very short (2–3 mm), consistent of broadly based triangles originated by deep cuts downwards to near the middle of the tunic; rings hard without teeth, mainly whole-edged (Fig. 5f); cataphylls silvery-white; leaves many (4–8), in average 6.3, mostly overtopping flowers at anthesis, light green, glabrous, 1.5–2 mm in diameter, 1(2) ribs underneath; white stripe >1/3 of leaf-diameter. Throat deep orange surrounded by a yellow corona, glabrous (Fig. 4f); perianth tube colourless to yellowish, striped greyish-violet towards the apex. Outer segments are between 18 and 32 mm but usually 25 mm long, between 6 and 8 mm mostly 10 mm wide. Inner segments are between 17 and 30 mm but usually 24 mm long and between 6 and 11 mm in average 8 mm wide. Segment proportion of length/width is 3. Inside of all segments is a soft clear blue or bluish-lilac, the insides of outer ones frequently are with intense blue veins or featherings (Fig. 4f). Outside of outer segments whitish, buff-coloured or bluish-violet with three prominent vertical violet stripes accompanied by thin ones orientated often to the segment side-edges. Outside colouring of the inner segments is mostly uniformly soft bluish-lilac without markings. Prophyll absent. Bract and bracteole present, silvery-white, skinny; bracteole much narrower than bract. Filaments on average 6.1 mm, deep yellow to orange (Fig. 4f); anthers on average 8.4 mm, yellow, connective colourless to yellow. Pollen yellow. The styles are mostly deep orange-red, divided into 3 branches which are significantly expanded or trumpet-shaped towards the end; branches short, 5.3 mm long on average, without or with few papillae. The styles are mostly equal to or longer as the stamens (85 %). Capsule and seeds not seen. Chromosome number  $2n = 12$ .

**Distribution and habitat:** *Crocus rechingeri* is most probably confined to the Babadağ in the Lycian Taurus. It grows in clearings of open pine forests in rather stony grounds filled with brown calcareous soils together with *Pinus halepensis*, *Quercus*, *Cistus*, *Amygdalus*, *Ranunculus*, *Ornithogalum*, *Muscari* etc.

### 3. *Crocus concinnus* KERNDORFF & PASCHE spec. nova

**H o l o t y p u s:** Turkey, central Taurus (Kuyucak Dağları), Antalya province, 1000–1800 m, 26.2.2000, HKEP 0007 (Gatersleben, GAT 23069)

Cormus subglobosus, 15–17 mm diameter; tunica externa coriacea, interiora mollis; tunicae dissectae in segmenta lata >5 mm, subfissurae vel raro incisurae; collum 2.5 mm, constans ex triangulis brevibus; annuli ad basem cormi saepe sine dentibus, superiores generaliter dentibus minutis <<0.5 mm; cataphyllae argenteae-albae. Folia 3–4.6–7, saturata usque ad grisea-virida, 1–1.5 mm diameter, glabra; latitudo virgae albae 1/3 diameter foliorum, duobus costis in omni sulco in folio inferiore; folia

attingentia flores ad anthesin; bractea et bracteola argentea-alba, recutita. Faux saturate aurantiaca, glabra; perianthii tubus sine colore usque ad dilute luteum, stria violacea apud apicem prolongata in segmenta. Segmenta externa 20–31 mm, plerumque 24 mm longa, 5–11, plerumque 7 mm lata. Segmenta interna 18–29 mm, plerumque 23 mm longa, 5–13 mm, plerumque 8 mm lata. Segmenti relatio segmentorum exteriorum 3.4, indicans comparate segmenta lorata. Segmenta externa et interna intus saturate violacea-caerulea, alteruter sine maculis vel venulis subnigris. Lateralia externa segmentorum exteriorum bubalina vel violacea caerulea, saepe striis ad lineam comitatae, striis parvis vel pinnatinervis. Color segmentorum interiorum extus plerumque uniformis caeruleus-violaceus sine maculis, saepe cum maculis fuscis ad perianthii tubum. Prophyllum abest. Bractea et bracteola adsunt, argentea-alba, inconspicua. Filamenta plus minusve 5.3 mm longa, saturate aurantiaca, dense papillata; antherae plus minusve 10.8 mm longae, 68% luteae, 32% nigrae ( $n = 35$ ). Connectivum antherarum colore eodem. Pollen flavum. Stilus saturate aurantiacus-rubrus usque ad rubrum, divisus in partes tres, expansus vel buccinatus ad apicem versus; rami breves, plus minusve 5.3 mm. Stigma antheris brevior (80%). Capsula et semina non visa. Chromosomatorum somaticorum numerus 12.

Corm sub-globose, 15–17 mm in diameter; outer tunics coriaceous, the inner ones softer; tunic splits into broad segments >5 mm, sub-splits or notches very rare; neck of 2–5 mm short triangles; rings near corm-base often without teeth, upper ones generally with very many but tiny teeth <<0.5 mm (Fig. 5b); cataphylls silvery-white; true leaves 3–4.6–7, dark to greyish green, 1–1.5 mm in diameter, glabrous, white stripe 1/3 of leaf-diameter, 2 ribs underneath; leaves reaching the flower at anthesis; bract/bracteole silvery-white, skinny. Throat deep orange, glabrous; perianth tube colourless to light yellow, violet stripes near the apex are prolonged into the segments. Outer segments between 20 and 31 mm but usually 24 mm long, between 5 and 11 mm mostly 7 mm wide. Inner segments between 18 and 29 mm but usually 23 mm long and between 5 and 13 mm frequently 8 mm wide. The segment proportion of outer segments is 3.4 signalling comparatively strap-like segments. Inside all segments are deep violet-blue either without markings or darker veins (Fig. 4b). Outside of outer segments can be buff-coloured or violet-blue frequently with 3 vertical violet stripes accompanied by smaller stripes or featherings. Outside colouring of the inner segments is mostly uniformly bluish-violet without markings but often with a darker spot near the perianth-tube. Prophyll absent. Bract and bracteole present, silvery-white, inconspicuous. Filaments on average 5.3 mm long, deep orange (Fig. 4b), densely papillous; anthers 10.8 mm long on average, 68% yellow, 32% black of the investigated population ( $n = 35$ ); connective colour of similar colour proportions as anthers. Pollen yellow. The styles are deep orange-red to red, divided into 3 branches which are expanded or trumpet-shaped towards the end; branches short, 5.3 mm long on average. The styles are mostly shorter compared to stamen (80%). Capsule and seeds not seen. Chromosome number  $2n = 12$ .

**Distribution and habitat:** *Crocus concinnus* is until today only known from the type locality in the Kuyucak Dağları in Antalya province. It has a remarkable vertical distribution from over 1800 m down to around 1000 m. In the higher levels the locality is predominated by *Cedrus libani* in the lower parts by *Pinus* and *Quercus*. It occurs in rocky grounds with deeper patches of “terra rossa”, solely on limestone.



## Determination key for species of series *Isauri*

The species of series *Isauri* have the following characteristics in common: All the outer corm tunics are annulate and coriaceous. The splits of the tunic generate predominantly segments >5mm, less frequently only of 2-5 mm width. Sub-splits or notches are absent or very rare. Teeth on corm tunic rings are mostly present though very different in size and numbers. Exceptions are *C. tase-liensis* and *C. rechingeri* which have no teeth on rings. However, all the other considered morphological and phenotypic parameters mostly show significant differences to distinguish the species fairly easy (Tab. 2 and Figs. 4 & 5). In the determination key below average values are presented for several continuous parameters, which resulted by measuring between 20 and 35 specimens of the taxa. As a consequence, one needs to measure a fairly large amount of randomly selected individuals of a population in the field to receive reliable results.

|     |  |                            |
|-----|--|----------------------------|
| 1   | bracteole absent or occasionally present   | 2                          |
| 1*  | bracteole always present   | 3                          |
| 2   | bracteole occasionally present, crocus of the Crimean peninsula  | <i>Crocus tauricus</i>     |
| 2*  | bracteole absent, crocus of the Cilician Taurus (Bolkar Dağları)   | <i>Crocus abracteolus</i>  |
| 3   | anthers black  | 4                          |
| 3*  | anthers partly black/greyish and partly yellow   | 5                          |
| 3** | anthers yellow   | 6                          |
| 4   | segment proportion low (2.6), corm large (18-23 mm), neck conspicuous (8-12 mm)  | <i>Crocus antherotes</i>   |
| 4*  | segment proportion >2.8-3.1, corm small (10-13 mm), neck short (4-7 mm)  | 7                          |
| 5   | basic color of flowers deep lilac or bluish-violet   | <i>Crocus concinnus</i>    |
| 5*  | basic color of flowers pure white or creamy white  | 8                          |
| 6   | basic color of flowers deep lilac or bluish-violet   | <i>Crocus mawii</i>        |
| 6*  | basic color of flowers white to soft clear blue or lilac-blue, never deeply colored  | 9                          |
| 7   | filaments dark brownish-violet, around 9 mm on average   | <i>Crocus caricus</i>      |
| 7*  | filaments dark yellow to orange, below 6 mm on average   | <i>Crocus fauseri</i>      |
| 8   | leaves about 5 on average, greyish-green, 1.5 mm in diameter, leaf-ribs 2(3), white stripe narrow (1/4 to 1/3 of leaf-diameter)      | <i>Crocus karamanensis</i> |
| 8*  | leaves about 6 on average, dark to yellowish green, 1-2.5 mm in diameter, leaf-ribs 1(2), white stripe normal (1/3 of leaf-diameter) | <i>Crocus taseiensis</i>   |
| 9   | length of filaments between 4.7-5 mm on average, no. of leaves 4.2-5.6, throat deep yellow without corona                            | 10                         |
| 9*  | length of filaments above 6 mm on average, no. of leaves 6.3 on average, throat deep orange with a yellow corona                     | <i>Crocus rechingeri</i>   |
| 10  | neck of tunic short (3-5 mm), leaves on average 5.6, light greyish-green, white stripe 1/3 to >1/3 of leaf-diameter                  | <i>Crocus isauricus</i>    |
| 10* | neck of tunic long (5-10 mm), leaves on average 4.2, light green, white stripe <1/3 to 1/3 of leaf-diameter                          | <i>Crocus mersinensis</i>  |

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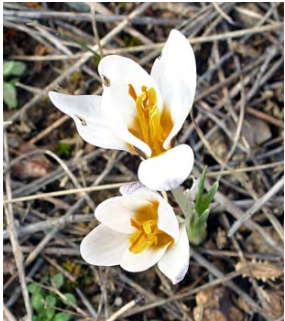

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## Appendix - Major morphological features of *Crocus* spp.

Fig. 4a: Species of the Crimea (Tschatir-dag) and the Cilician Taurus (Bolkar Dağları) belonging to series Isauri.

|  |  | characteristics of flowers and stamen   | characteristics of styles   |
|--|--|---|---|
|   |   | <i>Crocus tauricus</i> <sup>1</sup><br>segment ratio unknown<br>filaments not mentioned<br>anthers orange<br>connectives not mentioned                                      | styles deeply cleft;<br>stigmas entire, orange <sup>1</sup> ;<br>length of branches not mentioned;<br>length according to stamen<br>not mentioned |
|  |  | <i>Crocus abacteolus</i><br>segment ratio 2.8<br>filaments yellow, 5 mm long o.a. <sup>2</sup> , anthers yellow, 8.7 mm long o.a.<br>connectives colourless to light yellow | styles trifid,<br>dark yellow to orange,<br>style-branches 6 mm o.a.,<br>styles 88% longer to equal,<br>12% shorter than stamen                   |

<sup>1</sup> data from Flora of the USSR; <sup>2</sup>on average

Fig. 4b: Species of the central Taurus (Kuyucak Dağları) belonging to series Isauri.





|   |   |  |  |
|---|---|--|--|
|  |  | <i>Crocus mawii</i><br>segment ratio 3.5<br>filaments l. yellow to yellow, 5.8 mm o.a.;<br>anthers yellow, 11.3 mm o.a.;<br>connectives broad, colourless to l. yellow, upper part rarely blackish | styles trifid,<br>orange to red,<br>style-branches 5.3 mm o.a.,<br>styles<br>73% longer to equal,<br>27% shorter than stamen |
|  |  | <i>Crocus concinnus</i><br>segment ratio 3.4<br>filaments dark yellow to orange, 5.3 mm o.a.,<br>anthers 68% yellow, 32% black, 10.8 mm o.a. connectives with similar colour proportion            | styles trifid,<br>orange-red to red,<br>style-branches 5.2 mm o.a.,<br>styles<br>80% shorter, 20 % longer than stamen        |



Fig. 4c: Species of the Isaurian Taurus belonging to series Isauri.








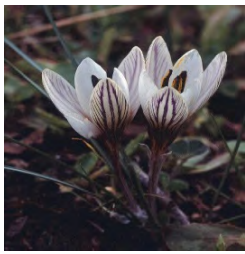




|   |   | characteristics of stamen  | characteristics of styles  |
|---|---|--|--|
|  |  | <p><i>Crocus isauricus</i> epitype<br/>segment ratio 2.2; filaments yellow, 5 mm long o.a., anthers yellow, 11.4 mm long o.a., rarely grey-edged; connectives colourless to light yellow</p>                     | <p>styles trifid, yellow to orange (dried scarlet), broadened at apex or trumpet-shaped; branches 5.2 mm o.a., styles 86% shorter to equal, 14 % longer than stamens</p> |
|  |  | <p><i>Crocus taseliensis</i><br/>segment ratio 3.3; filaments deep yellow, 4.5 mm long o.a.; anthers 79% yellow, 21% black, 9.8 mm long o.a.; connectives colourless rarely blue, black or grey towards apex</p> | <p>styles trifid, orange, irregular edged, not trumpet shaped; branches 6.3 mm o.a., styles 97% shorter to equal, 3% longer than stamen</p>                              |





Fig. 4d: Species of the Cilician Taurus belonging to series Isauri.

|   |   |   |   |
|---|---|---|---|
|  |  | <p><i>Crocus mersinensis</i><br/>segment ratio 2.7; filaments yellow to orange-yellow, 4.7 mm long o.a.; anthers yellow, rarely greyish, 9.9 mm long o.a.; connectives colourless to light yellow</p> | <p>styles trifid, orange, trumpet-shaped; branches 5.5 mm o.a.; styles 72% longer to equal, 28% shorter than stamen</p> |
|---|---|---|---|

**Fig. 4e:** Species of *Caria* belonging to series *Isauri*.



|  |  | characteristics of stamen  | characteristics of styles   |
|--|--|--|---|
|   |   | <b><i>Crocus caricus</i></b><br>segment ratio 3.1<br>filaments dark brownish- violet,<br>8.9 mm long o.a.,<br>anthers black, 9 mm long o.a.<br>connectives black   | styles trifid, orange,<br>style-branches 5 mm o.a.,<br>styles 97% shorter,<br>3% longer than stamen             |
|   |   | <b><i>Crocus fauseri</i></b><br>segment ratio 2.8<br>filaments dark yellow to orange,<br>5.8 mm long o.a.,<br>anthers black, 9.3 mm long<br>o.a. connectives black | styles trifid, orange,<br>style-branches 4.9 mm o.a.,<br>styles 96% shorter to equal,<br>4% longer than stamen  |
|  |  | <b><i>Crocus antherotes</i></b><br>segment ratio 2.6<br>filaments yellow, 5.3 mm long<br>o.a.,<br>anthers black, 10.5 mm long o.a.<br>connectives black/grey       | styles trifid, orange,<br>style-branches 6.5 mm o.a.,<br>styles 82% shorter to equal,<br>18% longer than stamen |

**Fig. 4f:** Species from the Isaurian Taurus and its relative in the Lycian Taurus (Babadağ) belonging to series *Isauri*.

|   |   |   |  |
|---|---|---|--|
|  |  | <b><i>Crocus karamanensis</i></b><br>segment ratio 3.4<br>filaments d. yellow, 5.3 mm long<br>o.a.,<br>anthers 10 mm long o.a., 59%<br>black, 18% yellow, 23% yellow<br>+ black tips;<br>connectives black/grey | styles trifid,<br>yellow to orange,<br>style-branches 7 mm o.a.,<br>styles<br>70% shorter to equal,<br>30% longer than stamen  |
|  |  | <b><i>Crocus rechingeri</i></b><br>segment ratio 3.1<br>filaments orange, 6.1 mm long<br>o.a.,<br>anthers yellow, 8.4 mm long o.a.<br>connectives colourless to l. yel-<br>low                                  | styles trifid,<br>deep orange-red,<br>style-branches 5.3 mm o.a.,<br>styles<br>85% longer to equal,<br>15% shorter than stamen |



**Fig. 5a:** Species of the Crimea (Tschatir-dag) and the Cilician Taurus (Bolkar Dağları) belonging to series Isauri.

|   | characteristics of corm tunics  | characteristics of leaves  |
|---|---|--|
|  | <p><b><i>Crocus tauricus</i></b><br/>Corm globose, 12-17 mm in diameter; outer tunics coriaceous, inner ones softer; splits into &gt;5 mm broad segments, no sub-splits; neck 3-5(8) mm long, consistent of broadly based triangles; rings pronged or toothed; teeth many of varying length, mainly very small (&lt;1mm) but up to 5 mm or longer.</p>  | <p>cataphylls not mentioned; no. of leaves not mentioned; leaves glabrous, appearing with flowers, ca. 2 mm broad<sup>1</sup>; ribs underneath and white stripe not mentioned; bract present, mostly tubular and one-pointed (see left crocus of left photograph of fig. 1a); bracteole absent or occasionally present.</p>                |
|  | <p><b><i>Crocus abacteolus</i></b><br/>Corm globose, 12-15 mm in diameter; outer and inner tunics coriaceous; tunic splits into 2-5 mm broad segments, no sub-splits; neck short (3-7 mm), narrow-based triangles abruptly prolonged into very thin fibres, acute at the top (bristly); rings pronged at the edge or minutely toothed with many but very short teeth of mostly &lt; 0,5 mm.</p> | <p>cataphylls silvery-white, brownish at tips. True leaves 4-4.1-6, green, 1-2 mm in diameter, glabrous, white stripe &lt;1/3 to 1/3 of leaf-diameter, 2(3) ribs underneath. Leaves at anthesis smaller than or reaching the flowers. Bract present and conspicuous, silvery, skinny, tubular and two-pointed (fig); bracteole absent.</p> |

<sup>1</sup> data from the Flora of the USSR;**Fig. 5b:** Species of the central Taurus (Kuyucak Dağları) belonging to series Isauri.



|   |   |   |
|---|---|---|
|  | <p><b><i>Crocus mawii</i></b><br/>Corm flattened globose, 15-17 mm in diameter; outer tunics coriaceous, the inner ones softer; splits of tunic into broad segments &gt;5mm, sub-splits occasionally present; neck bristly, 5 mm long, consistent of medium sized triangles; rings significantly saw-edged or with distant short teeth &lt;1 mm.</p>      | <p>cataphylls silvery-white with light brown tips; true leaves 4-5.6-7, dark green, 1-1.5 mm in diameter, glabrous, white stripe 1/3 to &gt; 1/3 of leaf-diameter, (0)1-2 ribs underneath; leaves very differently developed at anthesis, from not visible to overtopping the flower; bract/bracteole silvery, rarely with brownish tips.</p> |
|  | <p><b><i>Crocus concinnus</i></b><br/>Corm globose, 15-17 mm in diameter; outer tunics coriaceous, the inner ones softer; splits of tunic into broad segments &gt;5 mm, sub-splits or notches very rare; neck of 2-5 mm short triangles; rings near corm-base often without teeth, upper ones generally with very many but tiny teeth &lt;&lt;0.5 mm.</p> | <p>cataphylls silvery-white; true leaves 3-4.6-7, dark to greyish green, 1-1.5 mm in diameter, glabrous, white stripe 1/3 of leaf-diameter, 2 ribs underneath; leaves reaching the flower at anthesis; bract/bracteole silvery-white, skinny.</p>   |



Fig. 5c: Species of the Isaurian Taurus belonging to series Isauri.



|   | characteristics of tunics   | characteristics of leaves  |
|---|---|--|
|  | <p><b><i>Crocus isauricus</i> epitype</b><br/>Corm globose, 10-12 mm in diameter; outer tunics coriaceous, inner ones softer; splits into &gt;5 mm broad segments, no sub-splits; neck 3-5 mm long, consistent of broadly based triangles; rings mostly toothed; teeth many, rather small (&lt;1mm).</p>        | <p>cataphylls silvery-white; true leaves 4-5.6-7, light greyish-green, 1-1.5 mm in diameter, glabrous, white stripe 1/3 to &gt; 1/3 of leaf-diameter, (0)1-2 ribs underneath; leaves very differently developed at anthesis, from not visible to overtopping the flower; bract/bracteole silvery, rarely with brownish tips.</p> |
|  | <p><b><i>Crocus taseliensis</i></b><br/>Corm globose, 10-15 mm in diameter; outer tunics coriaceous, the inner ones softer, splits into &gt;5 mm broad segments, no sub-splits; neck 3-5 mm long, consistent of broadly based triangles; rings predominantly whole-edged or slightly pronged, teeth absent.</p> | <p>cataphylls 3-4, silvery-white; true leaves 3-5.7-8, linear, dark green to yellowish-green, glabrous, 1-2.5 mm in diameter, white stripe 1/3 of leaf-diameter, 2(3) ribs underneath; leaves very differently developed at anthesis, from tips visible to overtopping the flower; bract and bracteole silvery-white.</p>        |

Fig. 5d: Species of the Cilician Taurus belonging to series Isauri.


|   |   |  |
|---|---|--|
|  | <p><b><i>Crocus mersinensis</i></b><br/>Corm globose, 10-15 mm in diameter; outer tunics coriaceous, the inner ones softer; splits into &gt;5 mm broad segments, no sub-splits; neck 5-10 mm long, consistent of narrow-based triangles abruptly prolonged into very thin fibres, acute at the top (bristly); basic rings pronged, upper ones with many but very tiny teeth (&lt;&lt;0.5 mm).</p> | <p>cataphylls 3-4, white to yellowish; true leaves 2-4.2-6, frequently light green, 1.5-2 mm in diameter, glabrous, white stripe &lt;1/3 to max. 1/3 of leaf-diameter, (1)2 ribs underneath of each side of the blade. Leaves well developed at anthesis but mostly shorter than flowers; bract and bracteole silvery, mostly inconspicuous.</p> |
|---|---|--|

Fig. 5e: Species of *Caria* belonging to series *Isauri*.



|  | characteristics of tunics   | characteristics of leaves  |
|--|---|--|
|  | <p><b><i>Crocus caricus</i></b><br/>Corm globose, small, 10-13 mm in diameter; outer tunics coriaceous, inner ones softer; splits into segments &gt;5 mm, no sub-splits; neck bristly, 5-7 mm long, formed by narrow-based, acute fibres; rings soft with many very tiny teeth &lt;&lt;0.5 mm, rarely up to 1 mm.</p>   | cataphylls 3-4, silvery, yellowish or light brown; true leaves 2-7 but mostly 4 or 5, dark green, 1-1.5 mm in diameter, glabrous with (0) 1-2 ribs underneath; white stripe 1/3 of leaf-diameter; leaves longer than flowers at anthesis; bract and bracteole silvery white, conspicuous.  |
|  | <p><b><i>Crocus fauseri</i></b><br/>Corm globose, small, 10-12 mm in diameter; outer and inner tunics coriaceous; splits into segments &gt;5 mm, sub-splits rare; neck bristly, formed of broadly based triangles, extended up to 4-6 mm; rings with many small teeth, mainly 0.5-1 mm, rarely up to 2 mm.</p>  | cataphylls 3, silvery-white to brownish or brown, sometimes persistent; leaves 3-4.9-7, dark green, 1-1.5 mm in diameter, glabrous, very rarely ciliate, 1 or 2 ribs underneath on each side of the groove; white stripe 1/3 of leaf diameter; mostly much longer as flowers at anthesis; bract and bracteole silvery-white or brownish. |
|  | <p><b><i>Crocus antherotes</i></b><br/>Corm globose, big, 18-22 mm in diameter; outer and inner tunics coriaceous; tunic splits into segments of 2-5 mm, sub-splits rare, instead many notches &lt;1 mm; neck conspicuous, 8-12 mm long, consistent of broadly-based triangles abruptly prolonged into acute, long narrow fibres; rings conspicuous with many teeth, on lower rings &lt;1 mm on upper rings 1-2 (4) mm.</p> | cataphylls silvery-white, brownish at apex; leaves 3-4.7-8, greyish-green, 1.5 mm in diameter, glabrous, white stripe <1/3 to > 1/3 of leaf-diameter, (1)2 ribs underneath; leaves at anthesis well developed, from shorter to longer as flowers; bract and bracteole silvery, skinny, conspicuous.                                      |

Fig. 5f: Species of the Lycian Taurus (Babadağ) and its relative in the Isaurian Taurus belong to series *Isauri*.

|   |   |  |
|---|---|--|
|  | <p><b><i>Crocus karamanensis</i></b><br/>Corm globose, 13-17 mm in diameter; outer tunics coriaceous, the inner ones little softer, splits of tunics mainly 2-5 mm, sub-splits very rare (&lt;0.5 mm); neck variable in size and form, between 3-10 mm long, consistent of short to medium-sized triangles prolonged into a bristly neck; rings frequently pronged, teeth sparse, never longer than 0.5 mm.</p> | cataphylls silvery-white; true leaves 3-4.9-7, greyish-green, 1.5 mm in diameter, glabrous, white stripe 1/4 - 1/3 of leaf-diameter, 1(2) ribs underneath; leaves rarely reaching the flowers at anthesis, never overtopping them; bract and bracteole silvery, skinny.              |
|   | <p><b><i>Crocus rechingeri</i></b><br/>Corm globose, 13-15 mm in diameter; outer and inner tunics coriaceous; tunic splits into segments of &gt;5 mm, sub-splits absent; neck very short (2-3 mm), consistent of broadly based triangles originated by deep cuts downwards to near the middle of the tunic. Rings hard without teeth, mainly whole-edged.</p>   | cataphylls silvery-white; leaves many, 4-6.3-8, light green, glabrous, 1.5-2 mm in diameter, 1(2) ribs underneath; white stripe >1/3 of leaf-diameter; leaves mostly overtopping flowers at anthesis; bract and bracteole silvery-white, skinny; bracteole much narrower than bract. |

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