Critical revision of the vascular flora of Albania

(Albánia edényes flórájának kritikai revíziója)

1. Introduction

Harbouring a wide range of natural habitats from maritime sands and cliffs to mountain pastures, screes and summit areas, Albania is treated to be a floristically extremely rich country. Even so, our knowledge on the Albanian flora was very imperfect and full of questions even at the beginning of the 21st century. Summarising works on the Albanian flora were appeared more times in local monographs (ASCHERSON & KANITZ 1877, DEMIRI 1983, PAPARISTO *et al.* 1988, QOSJA *et al.* 1992, QOSJA *et al.* 1996, VANGJELI *et al.* 2000) in Prodromus Peninsulae Balcanicae (HAYEK 1927, 1928, 1929a, b, 1930, 1931a, b, c, 1933), in Flora Europaea (TUTIN *et al.* 1964, 1968, 1972, 1976, 1980), in Med-Checklist (GREUTER *et al.* 1984, 1986, 1989) and in Atlas Florae Europaeae (JALAS & SUOMINEN 1972, 1973, 1976, 1979, 1980, 1983, 1986, 1989, 1991, 1994; JALAS *et al.* 1996, 1999; KURTTO *et al.* 2004, 2007, 2010). The information about the Albanian vascular flora is very contradictory in these works considering the number of taxa of the Albanian flora (from 448 to 3633 taxa), the status of taxa in Albania (native, introduced or cultivated), and even in the included taxa itself, with a very slight overlap among the different works.

Our project aimed to critically revise the existing botanical information on the Albanian flora and provide a wide range of new information for the complete re-evaluation of the flora. Because of the lack of critical guides, we aimed to revise and synthesize the knowledge on the Albanian flora to serve as basis for any subsequent botanical works in Albania and surrounding areas.

2. Applied Methods

Our work was achieved by four basic methods: 1) intensive field studies aimed to explore all parts of the country providing wide range of chorological data, 2) herbarium and literature studies aimed to track down vouchers to re-evaluate the occurrence of vouchered taxa in the study area after revision, 3) nomenclatural studies for identifying taxonomical units and defining the names of them 4) molecular studies aimed to recognise different lineages and solve the relations of taxon groups, to give a proper taxonomic treatment of the studied groups.

3. Results

3.1. Taxonomic and nomenclatural results

The nomenclatural works were focused on Balkan endemic taxa, occurring also in Albania, to clear up their taxonomic relations and proper positions. Typifications and nomenclatural corrections were achieved in 11 genera (*Acer*, *Carex*, *Centaurea*, *Chamaecytisus*, *Mulgedium*, *Pancicia*, *Ranunculus*, *Reichardia*, *Sesleria*, *Tanacetum*, and *Viola*) (CLEMENTI *et al.* 2014, CONTI *et al.* 2015, KUZMANOVIĆ *et al.* 2013, 2015, TOMOVIĆ *et al.* 2013).

Revision of the herbarium of Friedrich Karl Meyer, allowed us to re-evaluate a number of taxa described by him from Albania, without molecular studies. We concluded, that *Achillea lurensis*, *Campanula latifolioides*, *Genista albanica*, *Medicago coerulescens* and *Seseli angustum* all are later heterotypic synonyms of long known species (BARINA 2016a<[1]).

[1] „<" refers for materials under publication, expected publishing date is 2016 or 2017

When more details were required for the clear treatment of the studied groups, the complex assessment of their taxonomy was achieved, involving the members of five genera (*Carex*, *Chamaeyctisus*, *Gymnospermium*, *Scilla*, *Tanacetum*).

In genus *Scilla*, we confirmed that the completely ignored *Scilla albanica*, which had only a single specimen known, is a distinct endemic of serpentine areas in North Central Albania above 1200 m with large populations in three adjoining mountain areas. The species belongs to *Scilla litardierei* group, together with *S. litardierei*, *S. lakusicii* and *S. messeniaca*, all restricted endemics of various habitats in the Balkan Peninsula (BARINA et al. 2015b).

During the revision of the genus *Chamaecytisus* in Albania and the surrounding areas (PIFKÓ 2015) we recognised that the variously identified populations in Thate Mts (SE Albania), apparently being intermediate between *Ch. austriacus* agg. and *Ch. eriocarpus* agg., are belonging to a new, undescribed taxon, named *Ch. pseudojankae* (PIFKÓ & BARINA 2016). A more widely distributed *Chamaecytisus* taxon from the East Central evaporite and limestone areas was also recognised and described as *Ch. korabensis* (PIFKÓ & BARINA 2016). We also found, that the North Albanian endemic *Ch. mitrushii* and *Ch. purpureus* are conspecific and constitutes a well outlined group in genus *Chamaecytisus*, together with *Ch. granaticus* (PIFKÓ et al. 2016<).

In relation with our work, another new species, *Reichardia albanica* was recognised and described from South Albania and its taxonomic relations has been specified (CONTI *et al.* 2015).

The insufficiently known *Carex markgrafii* was usually treated as a likely valueless form of *C. montana*; our studies evinced, that these taxa are far from each other and *C. markgrafii* is a well outlined endemic of Central Albanian limestone mountains (MESTERHÁZY et al. 2016<).

A new taxon of Berberidaceae family, *Gymnospermium maloi*, was recently separated from *G. scipetarum* (TAN *et al.* 2011). Our studies evinced complete morphological (BARINA *et al.* 2015c) and genetic identity (BARINA *et al.* 2016b<) of the two taxa, and detected two lineages in the European populations.

The enigmatic *Chrysanthemum albanicum* was known only from the type collection, which however had been destroyed during World War II in Berlin. Following the original description, the population were re-discovered and we concluded, that this endemic plant belongs neither to genus *Chrysanthemum*, *Achillea* nor *Tanacetum* (BARINA *et al.* 2016c<).

3.2. Chorological results

For the evaluation and revision of the Albanian flora, 3 data sets were established and developed during the project: 1) recently collected distributional records, 2) published chorological records, 3) herbarium specimens' records, together with their recent revisions.

The field studies resulted near 50 000 distributional records with hundreds of species never reported from Albania previously (BARINA *et al.* 2013a, 2015a).

The assembling of 899 literature sources resulted more than 65 000 records. The review of herbaria (more than 45 000 herbarium specimens in 20 herbaria) resulted *ca* 35 000 herbarium vouchers from the recent territory of Albania (BARINA *et al.* 2016, BARINA 2016<). Both literature and herbarium records were georeferred (if possible) for GIS use (see below). When it was possible, a relation between the literature item and the herbarium data were searched. Thereby it was concluded that single records were frequently published under different names, resulting erroneous reports of taxa from Albania (BARINA *et al.* 2013a, 2015a, 2016).

Herbarium revisions highlighted, that dozens of unpublished records were incorporated in Flora Europaea, without ascertaining their correct identification (BARINA *et al.* 2016). Based on herbarium revisions more than 4% of the taxa, published previously from Albania, proved to be mistakenly reported (BARINA *et al.* 2013a, 2015a).

Based on targeted field studies mainly in man-made and disturbed habitats, the first evaluation of the Albanian alien flora was compiled (BARINA *et al.* 2013b). Beyond giving a complete list of introduced plants in the country, this work concluded that owing to the long lasting seclusion of the area and the extended land use, Albania is the least infected country in Europe (with 196 introduced species, of which 81 naturalised and no invasives are known). With the opening of the country from the 2000's, and especially recently, the number of introduced plants increase rapidly and our work will be the reference for any subsequent studies of alien plants in Albania and surrounding areas. The rapid changes in the floristic composition of the Albanian landscape can be traced by the emergence of dangerous invasives as *Ambrosia artemisiifolia* (BARINA *et al.* 2015a) or *Cenchrus incertus* (RAKAJ & BARINA ined.) in the last years.

The orchid flora of Albanian graveyards was studied thematically. Altogether 28 orchid species were found in 166 cemeteries with a maximum of 10 species per cemetery. It was concluded, that Albanian graveyards can be important places for plant conservation and our work revealed the regional differences within country (MOLNÁR *et al.* 2016<).

3.3. Synthetic results

All works on nomenclature, taxonomy, chorology and herbarium research were steps towards the synthesis of our knowledge on the composition and specificities of the Albanian flora and the peculiarities of the biogeography of the country.

As a preliminary synthesys, a catalogue of newly reported and confirmed vascular plant taxa in Albania was compiled (RAKAJ *et al.* 2014). The catalogue includes all taxa reported from the recent territory of Albania between 1990 and 2012, but omitted from overview works as e.g. Flora Europaea, disregarding erroneous reports.

For summarising our nomenclatural, taxonomical and chorological results, a critical checklist of the Albanian flora was compiled (BARINA *et al.* 2016d<). According to the list, altogether 5415 taxa (4259 species and 1156 subspecies) were reported from the recent territory of Albania (49% more, than reported previously in most). 4.08% (221) of these were reported and included previous summarising works erroneously (cf. BARINA *et al.* 2013a, 2015a). Further 4.43% (240) of these taxa are known in Albania only in cultivation, but reported frequently as native or alien taxa. There is a remarkable number (15.44%, 836) of taxa which are included in most of basic works, as Albanian Floras, Flora Europaea or Med-Checklist; however, their occurrences cannot be proven, as no localities can be assigned to the records. It means, that the works listed these taxa from Albania without being found there indeed. Finally, only about 2960 vascular plant species can be native in Albania, but the occurrence of a number of them was not confirmed recently (extinct or disappeared taxa).

As most of the works dealing with the Albanian flora include no chorological data, we had no previous information on the distribution of the taxa in the country, whether they are common, sporadic or rare, or whether they occur even recently in the country. To fill this huge gap in the knowledge, primarily based on our recently collected chorological data, amended with literature and herbarium data, we compiled a chorological atlas of the Albanian flora (BARINA *et al.* 2016e<). The editing of distributional maps for the first time for the vascular plant taxa in Albania enabled to reveal the regional biogeographical characteristics within the country, the local substrate preferences of taxa, and to draw the attention to taxa whose distribution is insufficiently known.

From the floristically least known country in Europe up to the 21st century, for the end of the project, Albania became a well-known area of the continent. Having a revised alien flora, a critical checklist for the whole flora and an up-to-date chorological atlas, this territory can be a reference area in the Balkans for the neighbouring countries of which similar works are completely or partly missing. The results of the project will be widely used in the botanical research, nature conservation and related fields (as e.g. invasion biology, tourism or economy) not only in Albania, but in any nearby countries and general conclusions Europe- and worldwide.

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