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E. Kozuharova, V. Kochmarov, E. Kachaunova, A. Espíndola, B. Aleksandrov & I. Mincheva

Distribution of *Arum* (*Araceae*) in Bulgaria*

Abstract

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The common European *Arum maculatum* L. is an acknowledged medicinal plant. Although the uses of the plant are widely acknowledged, little is known about the actual exploitation potential in natural and cultivated conditions. We aim to address this question. The first step in knowing if a resource is exploitable is checking where the plant is present.
In this study, we first gathered information based on a critical revision of the deposited herbarium samples of genus *Arum* L. in the national Bulgarian herbaria. Secondly, we organized this information in a database, which was used to construct UTM-grid maps of the current known distribution of the taxa in Bulgaria. Thirdly, we compiled the presented information on the UTM-grid maps together with our field study data which we collected during the period April – July 2013 by visiting locations known from the literature and from the herbarium vouchers (see above) and checking for the presence of *Arum*.
When considering the potential exploitation of the plant in natural conditions, our preliminary field survey suggests a more limited potential in Bulgaria, when compared to previous investigations. Also, the fact that the proper identification is difficult even to specialists could lead to a serious hazard, since plant collectors may confuse species, and thus may improperly use them. Based on all the mentioned above, it appears that the most appropriate solution for any pharmaceutical exploitation would be to develop a cultivation program.

Key words: medicinal use, Bulgaria, plant resources.

Introduction

The common European *Arum maculatum* L. is an acknowledged medicinal plant in Bulgaria, even though not among the most popular ones (Medicinal plant act 2000), possibly because it is poisonous. In Bulgarian traditional and folk medicine *Arum maculatum* has been shown to be used in kidney stone disease, colitis, liver disease and hyperacidities. Furthermore, the plant has been reported as a very effective remedy against haemorrhoids - a medical condition that has hardly any other alternative effective cure except surgery

* Extended and enriched version of the poster presented at the XIV Optima meeting in Palermo, 9-15 Sept. 2013.

(Petkov 1982; Pamukov & Ahtardjiev 1989; Pamukov 1995; Dimkov 2001; Ivancheva & Stantcheva 2000; Nikolov 2006). Moreover, the plant substance Ari Tubera has been clinically demonstrated to have an anti-inflammatory activity in the intestinal and respiratory tract (Petkov 1982).

Arum maculatum is among the plants found in the renaissance herbals, namely Zwinger, 1696 to treat malaria (Adams & al. 2011). Ethnopharmacological research studies reveal the application of *Arum maculatum* in Turkey against colitis (Everest & Ozturk 2005) and internal bleeding haemorrhoids (Uzun & al. 2004; Demirci & Özhatay 2012). According to Gürhan & Ezer **(**2004) *Arum balansanum* R. Mill., *Arum detruncatum* C.A. Meyer ex Schott *Arum elongatum* Steven and *Dracunculus vulgaris* Schott are among the plants (84 plant genera belonging to 46 families) that are used for the treatment of haemorrhoids in Turkey. In South Italian traditional and folk medicine, *Arum italicum* Mill. is used against warts (Pieroni & Quave 2005).

The latest general publication dedicated to Bulgarian flora includes genera for which the distribution is only partially known (e.g. *Iris, Euphorbia, Arum* Assyov & Petrova 2006). As a consequence, Raycheva and Stoyanov have recently responded to the need of increasing our knowledge on this when working on genus *Iris*, sect. *Limniris* (*Iridaceae,* Raycheva & Stoyanov 2012). However, the Bulgarian range of *Arum* has not been explicitly evaluated.

In the context of this background information, although the uses of *Arum* are largely acknowledged, little is known about the actual exploitation potential in natural and cultivated conditions, mainly because of the lack of information on its actual range. Therefore, the major goal of this study is to clarify the natural distribution of the genus *Arum* in Bulgaria. Thus, this study would be the first step to further research and data analysis on the evaluation of natural resources and possibilities for exploitation and medicinal application.

Material and methods

We gathered distribution information based on a critical revision of the deposited herbarium samples of genus *Arum* L. in the national Bulgarian herbaria. First, we analyzed 224 herbarium vouchers of Bulgarian *Arum*, deposited in the Herbaria of Agricultural University Plovdiv (SOA – 128 vouchers), the Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences (SOM – 52 vouchers), the Biological Faculty of Sofia University (SO – 34 vouchers), and the Faculty of Pharmacy of Medical University of Sofia (10 vouchers). We organized this information in a database, which we used to construct UTM-grid maps of the current distribution of the taxa in Bulgaria.

During the period April – July 2013 we visited locations known from the literature and the herbarium vouchers (see above) and checked for the presence of *Arum*. At each location, we took pictures of all observed plants and we collected vouchers. All collections of tubers and voucher materials are now deposited in the Herbarium of the Faculty of Pharmacy of the Medical University of Sofia. This Herbarium is not yet registered and that is why we do not present voucher numbers at this stage (vouchers can be available upon request).

In the field, we registered the geographic co-ordinates of each location and we further used these to build distribution maps (see below). We registered the number of individuals and their ontogenic stage at each location in order to evaluate natural resource exploitation. We walked throughout the area where the individuals of *Arum* were distributed and waypoints marking the border of distribution were recorded with a GARMIN GPS eTrex Vista HCx, Datum WGS 1984. The waypoint co-ordinates were then placed on topographic maps and the results analyzed.

Identification of the *Arum* species was effected with reference to flora books and monographs (Andreev & al. 1992; Boyce 1993; Delipavlov & Cheshmedzhiev 2003; Bedalov & Kuepfer 2005; eMonocot 2013). Identification in the genus *Arum* has always been a major difficulty. The shape of the leaves does not always show particular specifics among the species and at a section level the morphology of the tuber is an important diagnostic character. Indeed, the most important diagnostics in this group are in the fresh inflorescence, although flowering lasts a few weeks and the chance to find blooming plants is not high. To obtain additional information on the species identities, we observed the sprouting behaviour of the tubers, which in some cases can help differentiate species (*e.g.* in sect. Dioscoridea *A. elongatum* sprouts earlier than *A. cylindraceum*).

Results and discussion

Our herbaria analysis indicate that some vouchers have been misidentified (*A. italicum, A. cylindraceum* and *A. elongatum* identified as *A. maculatum*, and vice-versa). After correction, we can here present the species updated ranges based on herbarium materials of *Arum* species for Bulgaria (Figs. 1, 3, 4, 5, 7).

The information is compiled with our field study data that confirms some of the localities of certain taxa (Figs. 1, 3, 4, 5, 7).

Sect. *Arum* - Species with rhizomatous tuber occurring in Bulgaria

***Arum maculatum* L.**

The populations of this species occur in temperate mixed forests on the lower slopes of the mountains of central and south-western Bulgaria (Fig. 1), in the following floristic regions: **(**according to herbarium vouchers) Predbalkan, Stara planina, Sofia district, Znepole, Strouma valley, Rila, Rhodopes, Trakia lowland. We confirmed several already known localities, as well as spotted some new ones (Table 1, Fig. 1).

We checked several habitats potentially appropriate for *A. maculatum* in the Osogovo Mts. during the flowering period (Fig. 1 FM73). Indeed, according to Mitrev (1995) this mountain hosts one of the biggest populations of this species. However, *A. maculatum* was absent in all the potentially appropriate habitats that we visited, even though we performed strong searches in the area. This would indicate that, contrary to the findings in previous publications, *A. maculatum* has a very restricted distribution in this mountain; thus it was impossible to spot it.

Table 1. Our findings as a result of the field studies carried out in April – July 2013.

Taxon of plants that we located	Locality name, nearest settlement	UTM grid
Sect. Arum - Species with rhizomatous tuber		
confirmed localities in our field study		
Arum maculatum	Urvich	FN91
	Knjazhevo	FN82
	Trunska Bankja	FN34
	Konjavska Mts. Bunovo	FM49
	Bov	FN96
	Blagoevgrad	FM76
	Ljulin	FN72
	Trjavna	LH75
localities known from previous publications that we checked in our field study and did not find *Arum* spp.		
Arum maculatum	Osogiovo	FM37
Arum italicum	Kardzhali region	LG60, LF48, LF58, LF69, LF79
Sect. Dioscoridea - Species with discoid tuber		
confirmed localities in our field study		
Arum elongatum	Dobrogled	NH69
	Strandja mts. – Stoilovo, Dokuzak	NG45
	Strandja mts. – Slivarovo	NG54
	Strandja mts. – Mladezhka river	NG36
Arum cylindraceum	Strandja mts. – Mladezhka river	NG36
	Strandja mts. - Brushljan	NG35
	Kamchia region	NH66, NH76
	Bachkovo	LG24
	Konjavska Mts., Gorna Koznitza	FM58
Arum orientale	Sahrane	LH52
	Kamchia	NH76
	Kamen Brjag	PJ21
	Kaliakra	PJ10
	Strandja mts. – Slivarovo	NG54
	Strandja mts. – Malko Turnovo	NG44
	Zlatograd	LF38
	Bezhanovo	KH88
	Iskar	KJ93
confirmed localities in our field study		
Arum sp.	Rusenski Lom	MJ14
Arum sp.	Panega river	KH78

***Arum italicum* Mill.**

This is the only wintergreen *Arum* with rhizomatous tuber in Bulgaria. The populations of this species occur in temperate mixed forests in low mountainous habitats. According to the herbarium vouchers, its distribution in Bulgaria is comparatively wide (Fig. 3), which also agrees with previous general surveys (Boyce 1993; Bedalov and Küpfer, 2005). However, we could not confirm identifications of many herbarium vouchers due to the bad condition of the material. Also, it was hard to confirm the species occurrences in the field due to the phenological stage of the plant (inflorescences not fully developed) at the time of visits. *A. italicum* occurs in the following floristic regions **(**according to herbarium vouchers): Rhodopes (Central, Eastern)

We checked several potentially appropriate habitats in the area of Kardzhali (Table 1, Fig. 3 - LG60, LF48, LF58, LF69, LF79), because, according to Delipavlov & Cesmedziev (2003), the only locality of this species occurs in that area. These researchers have carried

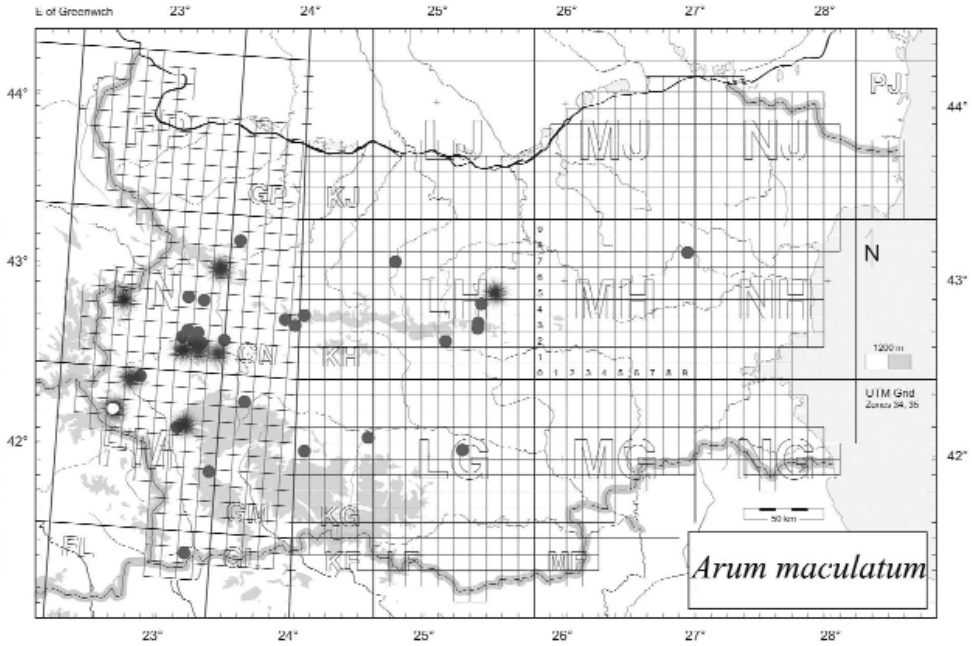

Fig. 1. Current distribution of *Arum maculatum* in Bulgaria. Legend: dots - herbaria data; splash - populations of *A. maculatum* found during our field study; blue splash with white dot in the centre - potentially appropriate habitats in area reported in previous publications as locality of *A. maculatum* where we could not confirm its occurrence during our field study.

Fig. 2. *Arum maculatum* from Konjavska Mts. Bunovo FM49.

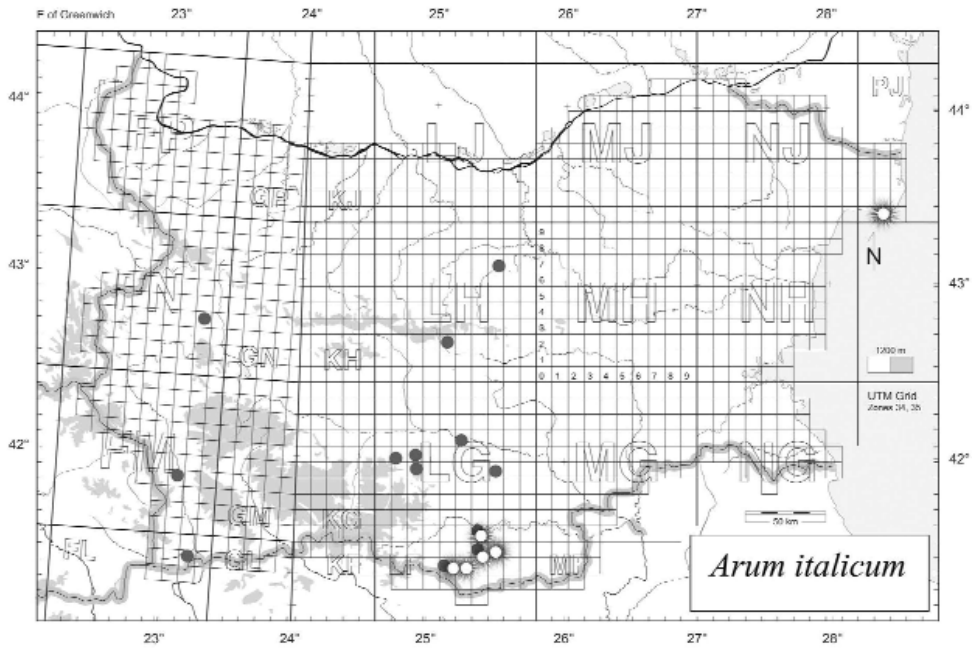

Fig. 3. Current distribution of *Arum italicum* in Bulgaria. Legend: dots – herbaria data; splash with white dot in the centre – potentially appropriate habitats in area reported in previous publications as locality of *A. italicum* where we could not confirm its occurrence during our field study.

out the most detailed investigation on *Arum* in Bulgaria so far and thus their opinion matters (Delipavlov & Cesmedziev 1983). Our field research in the area of Kardzhali did not bring a positive result, which suggests a restricted distribution. Also we could not confirm the occurrence of *A. italicum* in the area of north-east Bulgaria, cape Kaliakra (PJ10), and the herbarium material from this site was revised and not confirmed (misidentified instead of *Arum* sp*., sect. Dioscoridea*). All the plants we found in the area of cape Kaliakra (PJ10) had discoid tubers (Table 1).

Sect. *Dioscoridea* - Species with discoid tuber occurring in Bulgaria

***Arum cylindraceum* Gasp. (Syn. *A. alpinum* Scott & Kotchy)**

The populations of this species occur in temperate mixed forests on the lower slopes of the mountains, extending down to the sea level, in the following floristic regions **(**according to herbarium vouchers): Stara planina, Znepole, Strandja. The plants that we identified as *A. cylindraceum* were found as members of the deciduous forest understorey in the area of Stranja Mts. (NG36, NG35) and under deciduous shrubs in the vicinity of Gorna Koznitza (FM58). The habitats where we found the plants in the area of river Kamchia estuary (NH66, NH76 - deciduous forest ground layer or under shrubs) were similar. At the time of voucher collecting from the populations in the area of Gorna Koznitza and

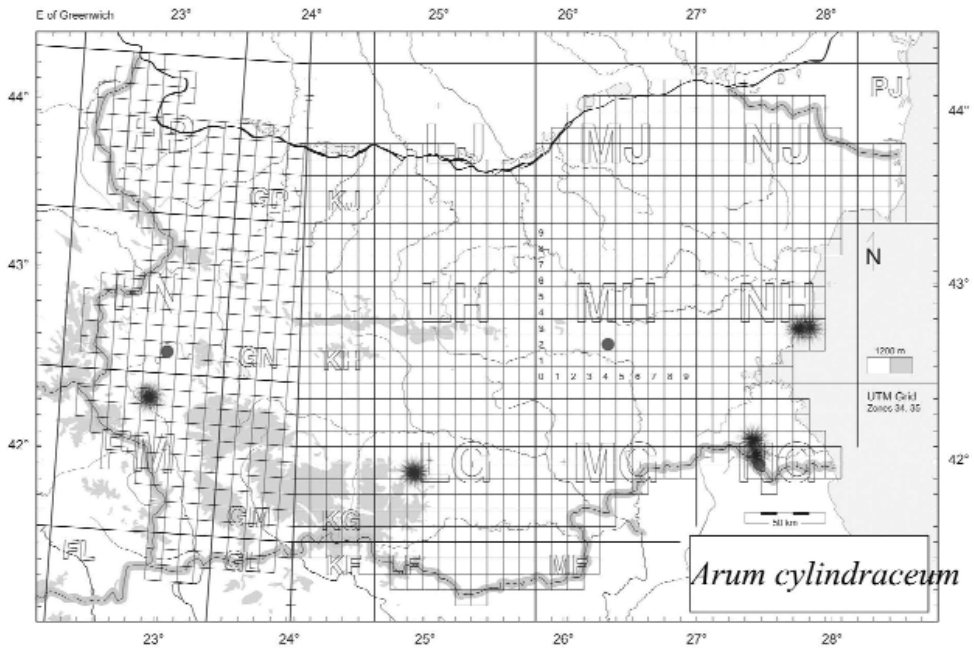

Fig. 4. Current distribution of *Arum cylindraceum* in Bulgaria. Legend: dots – herbaria data; splash – populations of *A. cylindraceum* found during our field study.

Fig. 5. *Arum cylindraceum* from Stranja Mts. NG36.

Kamchia estuary we did not have enough data for identification due to the phenological stage – lack of inflorescences. However in the autumn we were certain about the fact that these plants were *A. cylindraceum* due to the careful analysis of morphology of leaves, morphology of tubers and the lack of sprouting in late autumn. The careful analysis of the available characters of the individuals found in the vicinity of Bachkovo monastery (LG24) (morphology of leaves and infructescence, morphology of tubers and the lack of sprouting in late autumn) suggests that the specimens could belong to *A. cylindraceum*, or be hybrids of *A. cylindraceum* with *A. orientale,* or *A. elongatum*.

The results of our field study indicate that *Arum cylindraceum* seems to have a wider distribution in Bulgaria than it was believed before. Therefore implications for further research are additional field trips during flowering period for reliable identification of the dubious findings.

***Arum orientale* M. Bieb.**

The taxonomic status of this species is largely unclear and still under revision and discussion (Boyce 1993; Bedalov & Kuepfer 2005). The Bulgarian populations classically assigned to this species occur in temperate mixed forests on the lower slopes of the mountains in the following floristic regions: (according to herbarium vouchers) Black sea coast, Predbalkan, Stouma valley, Rhodopes, Trakia lowland, Stara planina, Danube plane, Znepole, Strandja.

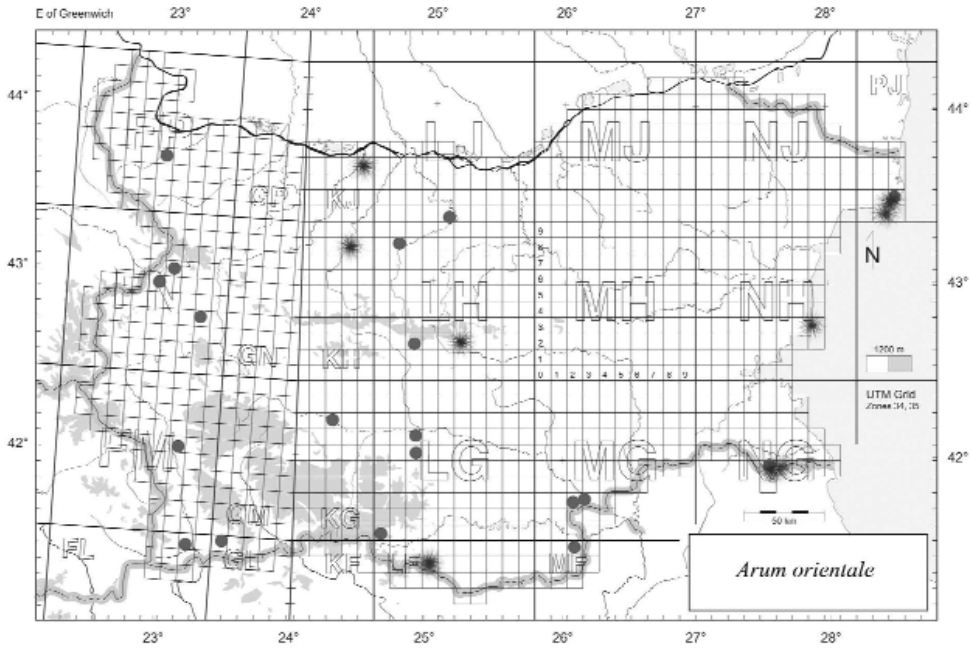

Fig. 6. Current distribution of *Arum orientale* in Bulgaria. dots: herbaria data; splash – populations of *A. orientale* found during our field study.

Fig. 7. *Arum orientale* from village of Sahrane LH52 and village of Iskar KJ 93.

Based on the available characters (leaves and inflorescence, the morphology of the tuber and the sprouting in late autumn) we detected its presence at a locality in the vicinity of village of Sahrane and village of Iskar (LH52, KJ 93, Table 1, Figs. 6 and 7). The plants that we located in the area of cape Kaliakra (PJ10) and village of Kamen brjag (PJ21) were at fruiting stage, when we found them under groups of deciduous trees or at the base of shrubs as well as completely exposed as a part of the steppe vegetation (Table 1, Fig. 6). The same fruiting stage was found with regard to the plants collected from the Strandja Mts. (NG44, deciduous forest ground layer, Table 1, Fig. 6). Individuals of this species at a stage before flowering were found in the area of the River Kamchia estuary (NH76, deciduous forest ground layer or under shrubs, Table 1, Fig. 6), Strandja Mts. (NG54, deciduous forest ground layer, Table 1, Fig. 6), the village of Bezhanovo (KH88, deciduous forest ground layer, Table 1, Fig. 6), and the in the vicinity of Zlatograd (LF38, deciduous forest ground layer, Table 1, Fig. 6). The plants of all these populations found before or after flowering could not be identified with certaintly as *A. orientale* until their sprouting behaviour could be observed in the autumn and in addition a careful examination of their tuber morphology could be carried out.

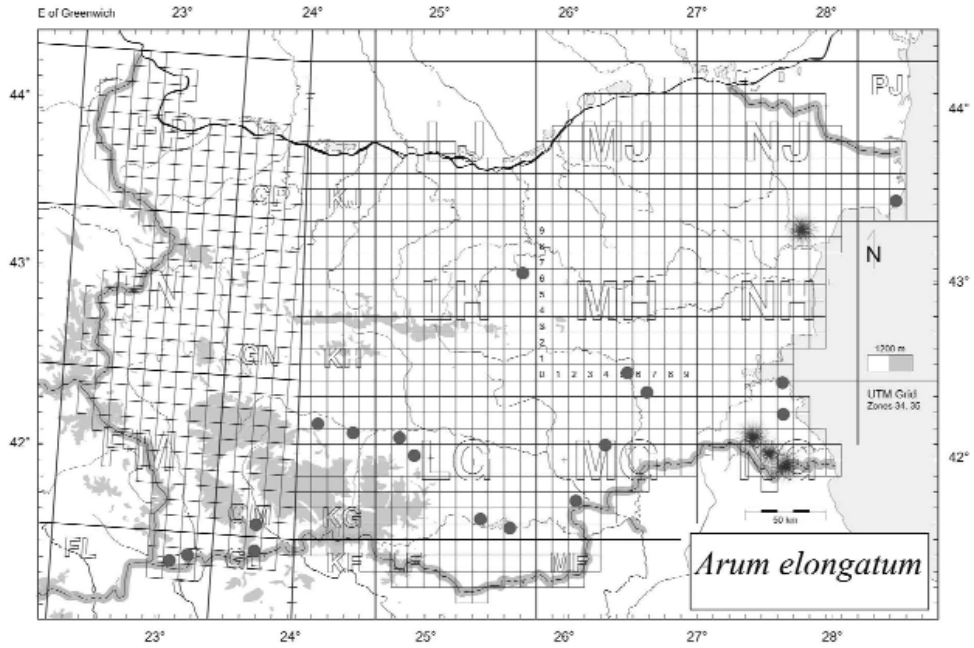

Fig. 8. Current distribution of *Arum elongatum* in Bulgaria. Legend: dots – herbaria data; splash – populations of *A. elongatum* found during our field study.

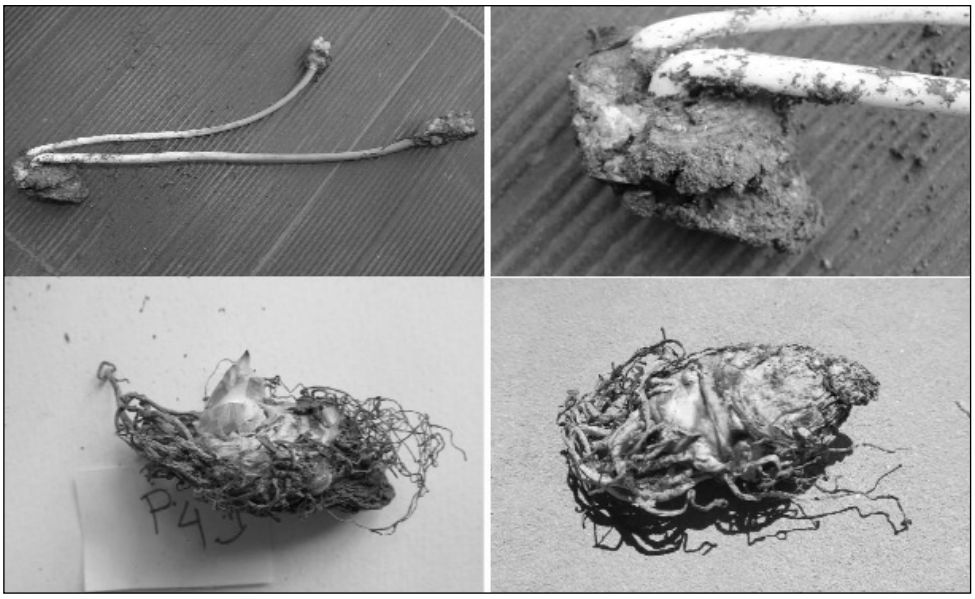

Fig. 9. *Arum elongatum* from Strandja Mts. NG 36, NG 45, and village of Dobrogled NH69.

***Arum elongatum* Steven**

This species was known to occur in temperate mixed forests on the lower slopes of the mountains in the following floristic regions (according to herbarium vouchers): Black sea coast, Predbalkan, Stouma valley, Slavjanka, Belasitza, Rhodopes, Trakia lowland, Tundja hilly region. In our field study, plants identified as *Arum elongatum* were found in the area of Stranja Mts. (NG45, NG54, NG36, NG35, deciduous forest ground layer, Table 1, Figs. 8 and 9) and the village of Dobrogled (NH69, deciduous forest ground layer, Table 1, Figs. 8 and 9).

Conclusions

Our revision provides an updated view of the range of genus *Arum* in Bulgaria. For example we found that *A. cylindraceum* is more widely distributed than initially considered (Andreev & al. 1992; Ancev 1996; Delipavlov & Cheshmedzhiev 2003; Assyov & Petrova, 2006). Also we confirmed the opinion of Delipavlov & Cheshmedzhiev (2003) that *A. maculatum* is less widely distributed than initially considered (Andreev & al. 1992, Assyov & Petrova 2006). In other words *A. maculatum* occurs only in the floristic regions: Predbalkan, Stara planina, Sofia district, Znepole, Strouma valley, Rila, Rhodopes, Trakia lowland. This suggests a more limited potential of natural resources exploitation compared to previous investigations. Mitrev (1995) evaluated the potential resource of the plant substance (Ari Tubera) as 51 tonnes per year. We consider this quite impossible. Mitrev (1995) extrapolated the exploitation potential based on the presumption of a wider distribution of *A. maculatum* on the territory of Bulgaria than it obviously occupies in reality. Also we did not confirm the occurrence of *Arum* species in many places where they were supposed to exist. In addition the populations that we found often consisted of a restricted number of individuals.

The fact that the proper identification is difficult even to specialists could lead to a hazard, since plant collectors may confuse species, and thus, may improperly use them.

Based on all the information mentioned above with regard to the potential pharmaceutical exploitation of the plant substance of *Arum maculatum*, our results suggest that the most appropriate solution would be developing an indoors cultivation program rather then exploiting natural populations.

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References

Adams, M., Alther, W., Kessler, M., Kluge, M. & Hamburger, M. 2011: Malaria in the Renaissance: remedies from European herbals from the 16th and 17th century. – J Ethnopharmacol. **133(2):** 278-288.

Ancev, M.E. 1996. Phytotaxonomic and phytogeographical studies in Bulgaria during the last decade (1983-1993). – Bocconea **5:** 33-44.

Andreev, N., Anchev, M., Kozuharov, S., Markova, M., Peev, D. & Petrova. A. 1992. Identification guide to the higher plants of Bulgaria. — Nauka i izkustvo. – Sofia (in Bulgarian).

Assyov, B. & Petrova, A. 2006: Conspectus of the Bulgarian vascular flora, 3° ed.– Sofia.

Bedalov, M. & Kupfer, F. 2005: Studies on the genus *Arum* (*Araceae*). – Bull. Soc. Neuchâteloise Sci. Nat. **128:** 43-70.

Boyce, P. 1993. The genus *Arum*. – London.

Delipavlov, D. & Cesmedziev, I. 1983: *Arum* L. in Balgaria. – Pp 151-157 in: Velchev, V. 1081 (ed.), Third Nat. Conf. Bot., Sofia 26-30.10.1981. – Sofia (in Bulgarian).

—, — 2003: Key to the Plants in Bulgaria. – Plovdiv (in Bulgarian).

Demirci, S. & Özhatay, N. 2012: An ethnobotanical study in Kahramanmaraş (Turkey); wild plants used for medicinal purpose in Andirin, Kahramanmaraş. – Turk J. Pharm. Sci. **9(1):** 75-92

Dimkov, P. 2001: Natural healing methods and living with nature; Bulgarian traditional medicine, **1-3.** – Astrala (in Bulgarian).

eMonocot 2013 *http://e-monocot.org/key/4* 12.11.2013

Everest, A. & Ozturk, E. 2005: Focusing on the ethnobotanical uses of plants in Mersin and Adana provinces (Turkey). – J. Ethnobiol. Ethnomed. **1:** 1-6.

Gürhan, G, Ezer, N. 2004: Halk Arasında Hemoroit Tedavisinde Kullanılan Bitkiler-I. Hacettepe Üniversitesi Eczacılık Fakültesi Dergisi 24 1: 37-55 (in Turkish).

Ivancheva, S. & Stantcheva, B. 2000: Ethnobotanical inventory of medicinal plants in Bulgaria. – J. Ethnopharmacol. **69(2):** 165-172.

Medicinal Pl. Act. State Gaz. 29, 07.04.2000. http://lex.bg/laws/ldoc/2134916096 12.11.2013

Mitrev, A. 1995: *Arum maculatem* L. – Pp. 36-37 in: Bondev I. (ed.) Horological atlas of medicinal plants in Bulgaria Хорологичен атлас на лечебните растения в България. – Sofia (in Bulgarian).

Nikolov, S. (ed.) 2006: Specialized Encyclopedia of medicinal plants in Bulgaria. "Bulgarian encyclopedia" – Sofia.

Pamukov, D. 1995: Home pharmacy. – Sofia (in Bulgarian).

—, *Ahtardjiev, H. 1989:* Pharmacy from the nature. – *Sofia* (in Bulgarian).

Petkov, V. 1982: Contemporary phytotherapy. Medicine and physculture. – Sofia (in Bulgarian).

Pieroni, A. & Quave, C.L. 2005: Traditional pharmacopoeias and medicines among Albanians and Italians in southern Italy: A comparison. – J. Ethnopharmacol. **101:** 258-270.

Raycheva, Ts. & Stoyanov, K. 2012: Status of the collections of sect. *Limniris* (*Iris*, *Iridaceae*) in the Bulgarian herbaria. – Pp. 359-366 in: Petrova, A. (ed.), Proc. VII Nat. Conf. Bot., 29–30.09.2011. – Sofia.

Uzun, E., Sariyar, G., Adsersen, A., Karakoc. B., Ötük, G., Oktayoglu, E., Pirildar, S. 2004: Traditional medicine in Sakarya province (Turkey) and antimicrobial activities of selected species. – J. Ethnopharmacol. **95(2-3):** 287-296.

Addresses of the authors:

Ekaterina Kozuharova[1], Vladimir Kochmarov[1,5], Eli Kachaunova[2], Anahí Espíndola[3], Borislav Aleksandrov[4]& Irena Mincheva[1],

[1]Department of Pharmacognosy, Faculty of Pharmacy, Dunav 2, Sofia 1000, Bulgaria. E-mail: ina_kozuharova@yahoo.co.uk

[2]Department of Ecosystem Research, Environmental Risk Assessment and Conservation Biology, Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences, 2 Gagarin Street, Sofia 1113, Bulgaria.

[3]Department of Biological Sciences, Life Sciences South 252, University of Idaho, Moscow, ID, U.S.A.

[4]University of Architecture, Civil Engineering and Geodesy, Hristo Smirnenski 1, Sofia 1046, Bulgaria.

[5]Panacea 2001 LTD, Galabez 2 Sofia 1505, Bulgaria.