One hundred and fifty years of wavering: a concise review of the plant endemism studies in the Crimea (Ukraine)

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Abstract. Estimates of the number of narrow Crimean endemics have been revised over 30 times since 1856 and have varied strongly, ranging from 10 to 300 species. According to the author's recent revision, endemics in the Crimea number approximately 130 species and subspecies. Comparisons with similar in size regions indicate that the estimate of the Crimean vascular plant endemism presented here is plausible.

Key words: The Crimea, narrow regional endemism

Introduction

The Crimean Peninsula serves as an illustrative and instructive example of the substantial taxonomic and geographic difficulties involved in recognizing the regional endemics. It occupies a unique position, located between the Circumboreal and Mediterranean phytogeographical regions (Takhtajan 1986), at the remote northeastern enclave of the Mediterranean and yet at the very south of the Ukraine and of Eastern Europe. Well isolated by the Black Sea and the Sea of Azov, it is surrounded by such floristically rich and diverse regions as the East-European Plain (to the North), the Balkan Peninsula (to the West), the Caucasus (to the East) and Asia Minor (to the South). The Crimea is therefore regarded as both a crossroads for plant migration and a phytogeographically constrained area. No wonder, it has long been one of the most attractive areas for many generations of Russian and Ukrainian botanists, many of whom had focused their attention on the Crimean plant endemism.

Notes concerning the concept of endemism

Unfortunately, endemism is often poorly defined by biogeographers. The generally accepted definition terms an endemic as: "…simply a species confined to a particular geographical area" (Whittaker & al. 2001: 455). Such a broad concept creates difficulties when one wishes to compare data sets developed by different authors. That is why, there have been ongoing discussions concerning endemism among biogeographers, with special emphasis on its spatial scale dependence (Peterson & Watson 1998; Tan & Strid 2001; Laffan & Crisp 2003).

Some authors prefer to work in relation to national endemics without reference to the geographical extent of the species within each country (Kutluk & Aytuğ 2000). This approach is viewed as one emphasizing the conservation responsibility of the State (Ekim & al. 2000).

Many florists think that an endemic should completely fit a phytochore (Yurtsev 1983; Takhtajan 1986). In such a case we should use the term "en-

demic" when we have a taxon of a certain rank distributed within one phytochore of a certain rank. The remaining cases with combined areas should be treated as phytogeographical (or chorological) elements (Yena 2004). However, one often wishes to forgo the cumbersome phase of defining the phytochores from which the endemics are defined. Comparison of endemism between different geographical areas requires a "simple, universal system by which taxa are classified into objective distributional categories" (Tan & Strid 2001: 71). Tan and Strid have proposed a convenient scheme of such categories based on the linear distance between the remotest endemics localities. In relation to the Crimea and similarly sized regions, taxa termed by them as *narrow regional endemics*, i.e. when the distance between the remotest localities is between 51–167 km, seem applicable.

Assessment of the Crimean endemism

The term "endemic" was first applied to the flora of the Crimea by Christian Steven (Steven 1856), 36 years after it was introduced by De Candolle (De Candolle 1820). The actual number of narrow regional endemics has been furiously debated in the subsequent years (Yena 2001a). Some emotional descriptions of the Crimean endemism have included: "lower as expected" (Steven 1856), "dethroned" (Aggeenko 1897), "overestimated" (Kotov 1965), "slightly pronounced" (Rubtzov & Privalova 1970), "infinitessimal" (Grosset 1979), "quite high" (Fedorov 1979) and "significant" (Golubev 1996). The assessment of the exact number of endemic species has been correspondingly variable, with estimates ranging from 10 to 300 species.

What causes underlie these wildly differing estimates? Certainly, the taxonomic and phytogeographic experience of each scientist, the social and historical conditions of their work, and the prevailing scientific paradigm under which each one worked, were the leading factors. The Russian and Ukrainian botanists, who practice European taxonomic standards, judge regional endemism differently from those who have conformed to the spirit of *The Flora of the USSR*. Taxonomists who practice polytypic standards draw somewhat broader species limits (the so-called "lumpers"), while those who work under monotypic standards draw narrower species boundaries (the so-called "splitters"), recognizing more species. Table 1 documents all earlier estimates of the total species diversity and endemism in the Crimea, and the estimates formed under various systems are highlighted.

As one can see, the prevailing concepts on the species have been alternating during the period examined here. Unfortunately, the extreme monotypicians in the USSR have distorted the patterns of endemism considerably and closing one's eyes on this fact would lead to grave misinterpretations. That is why in our work we have tried to turn the taxonomical standards towards the polytypic species concept as the one widest accepted among the botanists in the world (Hamilton & Reichard 1992).

Table 1. Assessments of diversity and endemism in the Crimea (1856–2005). Gray shading indicates the use of the monotypic concept, no shading indicates use of the polytypic concept. Correspondingly, average assessment of endemism level is obviously alternating.

№	Year of publication	Author	Crimean flora, in total (spp. and sspp.)	Endemics, spp. and sspp.			Endemism (%) (excl. "doubtful")
				"true"	incl. relicts	"doubtful" (excl. "true")	
1.	1856-1857	Steven	1654	135			8,2
2.	1897	Aggeenko	1769	15			0.8
3.	1900	Taliev		~10			
4.	1914	Yanata		17			
5.	1923	Wulf	2000	12			0.6
6.	1926	Wulf	2000	13	13		0.7
7.	1930	Maleev			14		
8.	1944	Wulf		41	16		
9.	1948	Lukina	2052		21		
10.	1957	Kotov		135	27		
11.	1959	Rubtzov	2200	198	22	5	9.0
12.	1962	Rubtzov	2295	197			8.6
13.	1964	Rubtzov & Privalova	2295	200	23		8.7
14.	1965	Kotov	1711	224	25		13.1
15.	1970	Rubtzov & Privalova	2269	187	20		8.2
16.	1972	Rubtzov	2421	199		36	8.2
17.	1973	Rubtzov		~190			
18.	1975	Rubtzov & Privalova	2433	240			9.9
19.	1978	Golubev & Molchanov		140	23		
20	1979	Rubtzov & al.	2356	191		42	8.1
21.	1979	Grosset	2380	107	7	3	4.5
22.	1979	Fedorov		79		57	
23.	1980	Golubev & Kossykh	2421	95		151	3.9
24.	1984	Golubev	2601	232		29	8.9
25.	1985	Zaverukha	2400	~300			12.5
26.	1991	Dubovik		234			
27.	1992	Didukh.		116			
28.	1996	Golubev	2775	251		29	9.0
29.	1998	Yena	2709	156			5.8
30.	1999	Yena	2709	154	15	64	5.7
31.	1999	Yena.	2709	146	14		5.4
32.	2001a	Yena	2697	142			5.2
33.	2003	Yena	2700	127			4.7
34.	2005	Geltman & Zheznyakovsky		157			
35	2005	Yena	2680	129			4.8

Difficulties of wavering assessments are combined with the dramatic fate of some key sources. The author of the first *Flora of the Crimea* (3 volumes, 11 issues, 1927-1969), E. V. Wulf, was killed at the beginning of World War 2, and several other researchers took up his interpretation. *The Flora of the Ukrainian SSR* (12 volumes, 1936-1965) allocated the flora of the Crimea to volume 8, after the Crimean Administrative Region was transferred to the Ukraine from the Russian Federation in 1954. *The Manual of Higher Plants of the Ukraine* (Prokhudin 1987) did not identify properly any regional endemics. Both editions of a recent monograph on the Crimean flora prepared in the last decades of the 20th century (Golubev 1984;1996) have sadly failed to print typographically at all.

There are five key figures in the history of studies into the Crimean endemism: C. C. Steven, V. N. Aggeenko, E. V. Wulf, N. I. Rubtzov, and V. N. Golubev (Figs on the right). Their well-commented on and widely recognized assessments of the Crimean endemism have laid the standard for certain periods. The first three authors undertook critical revisions of the taxa, while two others provided preliminary synoptic data. V. N. Golubev has put forward a "critical mass" of taxonomic and phytogeographical questions which are yet to be solved.

Only ten years ago, the endemic flora of the Crimea was estimated at 279 species (Golubev 1996), an estimate that put the Crimean Peninsula on par with such areas of high endemism as Sardinia and Sicily. Our recent investigations (Yena 2001a, 2003), based on the polytypic standard and the latest floristic data, have led to the conclusion that the flora of the Crimea comprises 129 endemic species and subspecies.

Of the 150 former endemics, one-third was found to occur outside the Crimea, while two-thirds were "dethroned" for taxonomic reasons. Among these, many taxa referred to as endemics did not deserve taxonomic acknowledgment. There were many undistinguished "races" in such genera as *Cirsium* Mill., *Cruciata* Mill., *Euphrasia* L., *Thymus* L., *Scutellaria* L., *Sideritis* L., *Stipa* L., and *Vincetoxicum* Wolf, and we were able to confirm the taxonomic status only of a few species. For example, in genus *Thymus* we have only one Crimean endemic now (*Thymus dzevanovskyi* Klokov & Des.-Shost.), whereas nine other previously recognized endemics are simply glabrous or downy-leaved forms of other widespread species (Gogina 1990). Some "doubtful" according to their consideration taxa [e. g. *Lepidium turczaninowii* Lipsky, *Trachomitum venetum* (L.) Woodson subsp. *tauricum* (Pobed.) Greuter & Burdet] have turned out as good species or subspecies, and the problem was simply in the absence of specimens in nearly all herbaria (Yena 2001b). The two above-mentioned taxa were presumed extinct, until rediscovered by the author in 1996.

A revision, of course, includes both delendae and addenda. However, there have been found only two new "good" endemic taxa – *Thesium krymense* Romo, Didukh & Boratyński and *Allium nathaliae* Seregin (Romo & al. 2004; Seregin 2004) – added by the author, while several other newly described "Crimean endemics" proved to be false.

Acad. C. C. Steven
(1781–1863)

Prof. E. V. Wulf
(1885–1941)

Prof. N. I. Rubtsov
(1907–1988)

Prof. V. N. Golubev
(b. 1926)

Comparing the endemism of similar-size regions

In order to investigate the validity of our estimate in comparison with those of earlier authors, we have employed a comparative approach, comparing our estimate of endemism with those of eight similar-size regions, where the number of *narrow regional endemics* is known precisely (Table 2).

It has been demonstrated that floristic comparisons between areas of similar size are most appropriate (Shmidt 1984; Peterson & Watson 1998; Whittaker & al. 2001). Furthermore, comparisons between island-like areas hold greater promise for examining endemism (Whittaker & al. 2001). It should be noted that only four out of the eight areas are isolated naturally (the Crimea, Sardinia, Sicily, and Peloponnesus), whereas the remaining four are artificially curbed by political/administrative borders which lower their comparative value.

Unfortunately, we had to ignore many sources where certain types of endemics have not been separated distinctly. For example, some coastal Davis' squares in Turkey that can be compared to the Crimea in land area, ranging from 0.53–1.27 spp./100 km2 in Northern Anatolia to 1.81–2.15 spp./100 km2 in Southern Anatolia (Kutluk & Aytuğ 2000), could not be used. In each grid, all *national* Turkish endemics were counted, not only the *narrow regional* ones.

Table 2. Comparative data on narrow regional endemism in selected areas of 20–30.000 km2.

References	Region	Area (km2)	Vascular flora, species & subspecies	Endemics, species & subspecies	Endemism. %	Density of endemics. spp./100 km2
1	Ukrainian Carpathians	24.000	1997	16	0.8	0.07
2	Crimea (Ukraine)	26.860	2680	129	4.8	0.48
3	Turkish Thrace	23.500	2350	56	2.4	0.24
4	Albania	28.750	3300	100	3.0	0.35
5	Sardinia (Italy)	23.800	2050	200	9.8	0.84
6	Sicily (Italy)	25.430	2631	238	9.7	0.94
7	Peloponnesus (Greece)	21.500	2060	247	12.0	1.15
8	Israel	20.807	2225	165	7.4	0.79

References: **1**, Tasyenkevicz (2003); **2**, Yena (this study); **3**, Özhatay (2000); **4**, Tan & Mullaj (2001); **5**, Médail & Quézel (1997); **6**, Yena & Raimondo (2003); **7**, Tan with Iatrou (2001); **8**, Boulos & al. (1994).

We should also take into account some extra biogeographical effects, such as the relationship between latitude and diversity. Rules concerning geographical gradients and floristic indexes have been clearly indicated by many florists (Schmidt 1984; Whittaker & al. 2001; Tan & Strid 2001). Irrespective of the lack of precise data, there is still reason to assume that a *latitudinal gradient* of narrow regional endemism exists (Yena 2003). At least, "the degree of endemism follows the same latitudinal trend as species richness" (Major 1988: 128), albeit sometimes over the limited latitudinal spans (Gaston 2003).

Biogeographically, the eight considered regions are divided into two groups: the "northern" group (predominantly sub-Mediterranean) displaying levels of endemism ranging from 0.8 to 4.8 % (with endemic density ranging from 0.07 to 0.48 spp./100 km2), and the "southern" group (true Mediterranean) displaying levels of endemism ranging from 7.4 to 12 % (0.79 to 1.15 spp./100 km2). Table 2 illustrates that the Crimea, being on the Mediterranean margin, possesses levels of endemism similar to those of other sub-Mediterranean areas rather than to true Mediterranean ones, which suggests that the estimate of plant endemism in this study appears to be reasonable.

Work with Crimean endemics will continue, but it would be surprising if the total number of species greatly departs from 130 – mysteriously close to Steven's 1856 assessment.

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