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Classification and Causes of New Species (*V. edremitense*) which was included in *Veronica beccabunga* L. subsp. *muscosa* [(Korsh.) A.Jelen., 1971] before

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Abstract

In this study, *Veronica beccabunga* subsp. *muscosa* is one of the subspecies of *Veronica beccabunga*, which is understood from more detailed studies that some population (F 1001) samples collected and included to – subsp. *muscosa* in 2000 year; then as a result of more detailed studies came out that it should not be include in -subsp. *muscosa*, it should be classified as a separate and new species called *Veronica edremitense* A.Öztürk & Ö.Kılıç. As a matter of fact, when the population sample (F 1001) was examined more detailed, and when compared with *Veronica beccabunga* subspecies, there are significant morphological and caryological differences. Because of the reasons described in this article we would like to call our population sample as a newspecies called “*V. edremitense* A.Öztürk & Ö.Kılıç” which was collected from Edremit county of Van.

Keywords: *Veronica beccabunga*, *Veronica edremitense*, subsp. *muscosa*, systematic.

1. Introduction

Despite their significance in many habitats, aquatic plants are highly understudied in modern biosystematic studies and they are characterized as morphologically highly variable but taxonomically little differentiated. Generally, a substantial part of the interspecific variation in aquatic plants is cryptic due to reduction and convergence of certain plant parts (Santamaría, 2002). In addition, hybridization, clonal reproduction and phenotypic plasticity contribute to the problem (Ito et al., 2010). Nevertheless, aquatic habitats are important areas for understanding plant evolution and conservation (Steffen, Leuschner, 2014). The Mediterranean is particularly home to a variety of aquatic plants (Cook, 1983). One of those aquatic to semi-aquatic taxa in the Mediterranean area is *Veronica* section *Beccabunga* (Hill) Dumort. The center of diversity of this section lies in the Mediterranean basin particularly in Turkey, Egypt and Iran, which each are home to more than 10 taxa (Abd El-Ghani et al., 2010; Öztürk, Fischer, 1982). *Veronica* taxa are highly diverse ecologically, with species growing in aquatic to dry steppe habitats, from the sea level to the high alpine regions. This diversity and the fact that many taxa have beautiful blue flowers may explain the interest in *Veronica* for a long time (Albach et al., 2005). The taxonomic history of *Veronica* clearly illustrates the difficulties arising in recognition of natural (monophyletic) groups within the genus based only on morphological traits, due to the fact that

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many of the traditionally used taxonomic characters are evolutionary unstable and, therefore, unsuitable for taxonomy (Albach et al., 2004).

Suitable knowledge concerning genetic variation and taxonomic relationship in the Turkish *Veronica* taxa are quite limited. Morphological characters are mostly used to determine phylogenetic relationship. *Veronica* is a good model system to explore this issue since annual life history has been shown to have evolved with convergent morphological characteristics multiple times in the same geographical region (Albach et al., 2004). *Veronica* is the largest genus in the flowering plant family Veronicaceae (Öztürk, Kılıç, 2016). Most species including all annuals are distributed in the Northern Hemisphere but there is also an additional prominent radiation in the Australasian region (but without annuals). Life forms include herbaceous annuals or perennials, and also shrubs or small trees. About 10 % of *Veronica* species are annuals, a life history which has originated at least six times independently in the genus (Albach et al., 2004). Chromosome numbers, phytochemistry and DNA sequence data support the polyphyly of annuals in *Veronica* (Albach, Chase, 2001).

Veronica taxa have a very polymorphic structure. There are many taxonomic problems. There are some literatures about *Veronica* taxa (Öztürk, 1977; Öztürk, 1978a; Öztürk, 1978b; Chrtek, 1981; Öztürk, Fischer, 1982; Fischer, 1982; Öztürk, 1982; Öztürk, 1983; Öztürk, 1986; Öztürk, Fischer, 1989; Öztürk, Fischer, 1991; Elçi, 1994; Öztürk, 2000; Öztürk, Öztürk, 2000a; Öztürk, Öztürk, 2000 b; Öztürk, 2001; Öztürk, 2004a; Öztürk, 2004b; Öztürk, 2005; Öztürk, 2006; Öztürk, 2008; Öztürk, 2010; Öztürk, Kılıç, 2016). *Veronica beccabunga* L. is a very prolific, succulent, leafy green plant. It is found in damp freshwaters, streams, and rivers. This plant prefers cold, moving, and oxygen-rich water, and it can adapt to acidic or alkaline water (Anonymous, 2010). In Turkish flora *V. beccabunga* is perennial with creeping rhizome, blackening when dry. Stem always completely glabrous, decumbent to ascending; all leaves shortly but clearly petiolate, fleshy, dark green, shining, completely glabrous; calyx 2-2.5 mm in flower; corolla deep or bright blue; seed broadly elliptic; flowering between May-October; generally widespread streams, marshes, ditches, wet meadows, preferably in running water, an altitude of 20-3200 m (Davis, 1978). The taxonomic problems of the distinctions taxa of *Beccabunga* section is continuing to daylight. The extent of discontinuity in the *Beccabunga* section taxa can not be determined precisely (Fischer, 1985). This study was carried out to solve these problems on the subspecies of *Veronica beccabunga*.

In this study, population (F 1001) samples collected and included to *Veronica beccabunga* -subsp. *muscosa* subsp in 2000 year (Öztürk, Öztürk, 2000a); than understood from more detailed studies that it should not be include to -subsp. *muscosa*, it should be classified as a separate and new species called *Veronica edremitense*. We believe that this work will contribute to the Turkish flora. As a matter of fact, in a congress declaration the results of the examinations of the specimens were submitted by A.Öztürk, the classification of the examined plant should be assessed as subspecies or species level as a separate and new taxon (Öztürk, 2008).

2. Relevance

In this study, our population (F 1001) samples should be classified as a separate and new species called *Veronica edremitense*. We believe that this work will contribute to the Turkish flora and *Veronica* taxa.

3. Material and Methods

To reach the aim of this article we used figure, datas and literature sources about *Veronica* genus and plant materials of *Veronica* taxa are deposited herbarium of Van Yüzüncü Yıl University (VANF). Because of discriminant properties of *Beccabunga* section; length of stylus, indumentum, fruit shape, plant life time, petiolate or not, corolla diameter, pedicelled or not and pedicel angle to stem were detected on fresh materials. All of the studied plant samples were freshly identified (Fischer in P.H. Davis, 1978) and the results were observed and examined on fresh plant samples. Distinctive morphologic characters of *Veronica beccabunga* subspecies and species nova (*V. edremitense*) is seen in Table 1.

The identification key of the *Veronica beccabunga* subspecies as follows (Öztürk & Öztürk, 2000a);

1. Stem basal leaves and median leaves petiole long than 8 mm

* *Veronica beccabunga* subsp. *muscosa*

1. Stem basal leaves and median leaves petiole 8 mm or short than 8 mm

3. Diameter of corolla 6–9 mm; the angle of peduncle to main axis narrow than 30°

* *Veronica beccabunga* subsp. *abscondita*

4. Diameter of corolla 5–6 mm; the angle of peduncle to main axis wide than 35°

* *Veronica beccabunga* subsp. *beccabunga*

4. Discussion

Veronica beccabunga subsp. *muscosa* is one of the subspecies of *Veronica beccabunga*, which is understood from more detailed studies that population samples (F1001) which were included in -subsp. *muscosa* (Öztürk & Öztürk, 2000a) should not be included in in -subsp. *muscosa*, it should be classified as a separate and new species (*Veronica edremitense*) because of the reasons described in this article and in Table 1.

Although seed lengths of -subsp. *beccabunga* is 0.4 mm and subsp. *abscondita* is 0.6 mm; the seed length of our predicted new species (*V. edremitense*) is 1.8 mm (Table 1). So seed length of *V. edremitense* is 4.5 times longer than -subsp. *beccabunga* and 3 times longer than than -subsp. *abscondita*. Also total chromosome number of our population samples (F 1001) are significant shorter than subspecies; -*abscondita*, -*beccabunga* and -*muscosa* (Table 1). In addition, average chromosome length of -subsp. *beccabunga* is 2.666 micron and average chromosome length of -subsp. *abscondita* is 2.036 micron. Whereas average chromosome length of our population samples (F 1001) is 1.711 micron (Table 1).

Although average chromosome length of -subsp. *beccabunga* and -subsp. *abscondita* near to each other (0.230 micron difference), included -subsp. *muscosa* and our population (F 1001) samples that we claim to be separate a new species (*V. edremitense*) has differences from -subsp. *beccabunga* and -subsp. *abscondita* (0.649 micron difference). Similar differences exist as total chromosome lengths and this measure shows correlation (Table 1).

Besides, there are some differences between population samples (F 1001) and other two subspecies (-subsp. *beccabunga*, -subsp. *abscondita*); capsule shape and dimensions, petiole, leaf margin, stylus length, there are angle differences between mature pedicels inflorescence with main axis. For example, in -subsp. *beccabunga* capsula is slightly emarginate, in -subsp. *abscondita* capsula is elliptic ovate; in *V. edremitense* which was supposed as -subsp. *muscosa* is roundish tapered (Drip). There is also a weak tap-root system in (F1001) population, whereas there are fibrous root in three subspecies (Table 1). F 1001 population growing in Van (Turkey) as a geographical distribution area but the main distribution area of -subsp. *muscosa* is in Afghanistan, Pakistan and partly in Turkmenistan and Iran.

5. Conclusion

In Table 1, if we can compare not found features of -subsp. *muscosa* with new species, also there will be some differences. So geographical distribution areas of -subsp. *muscosa* and *V. edremitense* is leaving from each other. More detail differences between -subsp. *muscosa* and new species *Veronica edremitense* is seen in Table 1.

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Appendix

Distinctive Charachers	subsp. <i>beccabunga</i>	subsp. <i>abscondita</i>	subsp. <i>muscosa</i>	<i>V. edremitense</i> (species nova, F1001 population)
Root Type	Adventive, fibrous	Adventive, fibrous	Adventive, fibrous	Thin, taproot
Stem Position	Procumbens and vertical	Procumbens and vertical	Procumbens and stolon	Vertical
Leaves	Fleshy and stout	Fleshy and stout	Tenuifolius	Tenuifolius
Growing Altitudes	1-2400 m	2200-2900 m	1700-1900 m	1700-1900 m
Anthesis	5-9. months	5-9. months	4-10. months	5-11. months (two time)
Geographical spreading	Europe - Turkey	East Turkey	Iran-Turkmenistan-Afghanistan	Turkey (Van, Erzurum)
Locality	Mountain stream	Clean Mountain stream	Uzbekistan, Pakistan, Kazakistan	Organic matter rich soil, Watery sandy places, swamp
Lenght of pedicel	(2-) 3-7 (8-12) mm	(1-) 2-6 mm	1-5 mm	15-30 mm
Status of peduncul and leaf	Peduncul not over the leaf or equal	Peduncul over the leaf	-	Peduncul over the leaf
Fruit bracte shape and lenght	Broad, elliptic lanceolate (2 mm)	Narrow, lineare acicular (4 mm)	-	Narrow, lineare acicular (2 mm)
Mature pedicel angle	Broad: 80°-90°	Narrow: 10°-30°	-	Narrow: 30°-60°
Capsula shape	Orbiculate-marginate	Elliptic-ovale	-	Constricted at apex, suborbicular
Capsul length	3.5-4.5 x 3-4 mm	3-4.5 x 2.5-4 (-5) mm	3-4.5 (-5) mm	2.5-4 x 3-4.5 (-5) mm
Stylus length	1.4-1.9 mm	(-2) 2.2-3 (3.5) mm	1.2-1.7 mm	1-2.2 mm
Seed length	0.4 mm	0.6 mm	-	1.8 mm
Chromosome number	2n=18, 36	2n=18	2n=?	2n=18
Avarage Chromosome length	2.266	2.036	-	1.711
Total chromosome lenght	40.796	36.646	-	30.798
Chromosome type	median	median	median	median
Leaf margin	-	-	Serrulate (5-9 piece) crenulate	Entire thin undulate
Leaf lamina length	-	-	4-25 x 2.5-15 mm	15x40-15-30 mm
Peduncul length	-	-	3-15 (-20) mm	50 mm
Corolla length	-	-	4-6 mm	4-7 mm

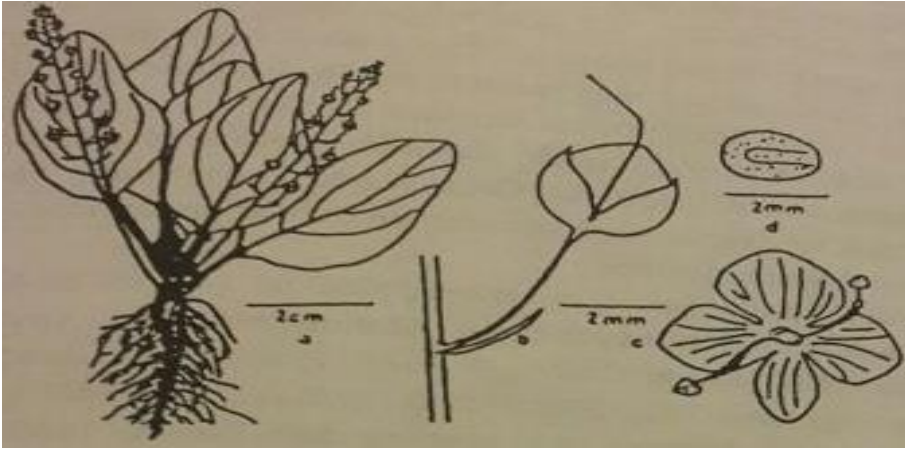


Fig. 1. Basionim of *V. edremitense* A.Öztürk & Ö.Kılıç

a. Stem, racemes and petiolate leaves, **b.** Fruiting pedicel, peduncul, capsula and stylus, **c.** Corolla and stamens, **d.** Seed

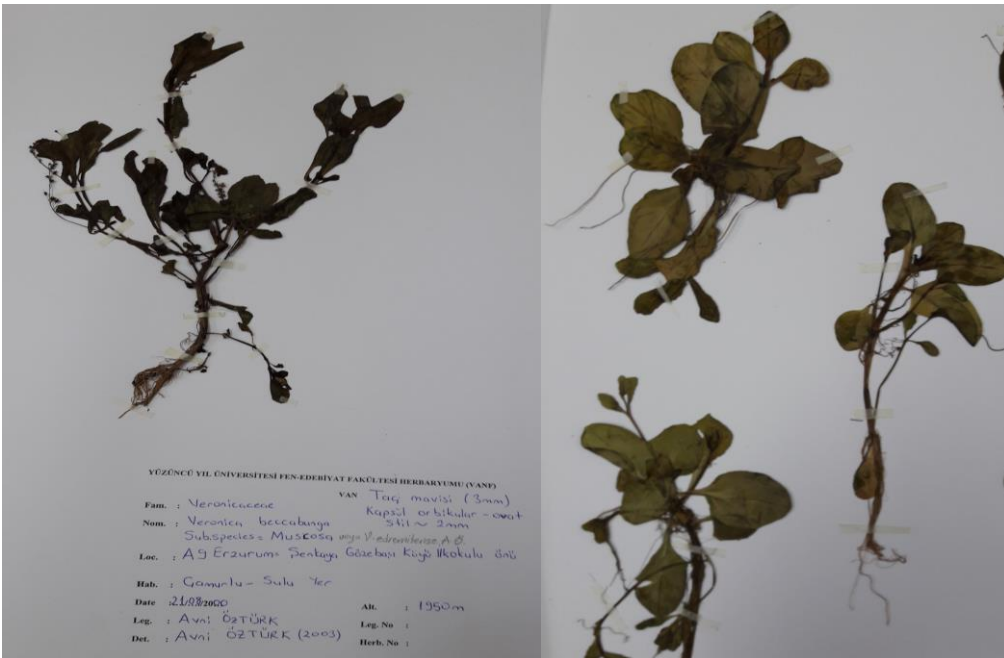




Fig. 2. Holotypes of *V. edremittense* A.Öztürk & Ö.Kılıç