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Systematic treatment of *Veronica* L. Section *Beccabunga* (Hill) Dumort (Plantaginaceae)

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Abstract

***Veronica* species mostly occur in damp fresh water places and in the Mediterranean precipitation regime. Members of this genus grow at different altitudes from sea level to high alpine elevations. They show a high level of polymorphism and phenotypic plasticity in their responses to variations of the enviromental factors, a quality that allows them to occur over a wide range of conditions. A group with particular high levels of polymorphism is the group of aquatic *Veronica* L. species in *V.* sect. *Beccabunga* (Hill) Dumort. Here, we attempt to unravel some confusion in the taxonomic complexity in *V.* section *Beccabunga.* We recognize 20 taxa in *V.* sect. *Beccabunga* and explore the occurrence of *V.* section *Beccabunga,* mainly in the Mediterranean basin; especially in Egypt (Nile delta and Sinai), Turkey and Iran with each country containing 10 taxa, from a total of 20 taxa, and characterized by endemics, or near-endemic as *Veronica anagalloides* ssp. *taeckholmiorum*.The results confirmed that *V.* section *Beccabunga* is divided into three subsections *Beccabunga, Anagallides* and *Peregrinae,* which essentially can be differentiated by the absence or presence of apetiole.**

Keywords: Morphological key, systematic treatment, *Veronica*, *V.* section *Beccabunga*

Introduction

The tribe *Veroniceae*, formerly part of Scrophulariaceae, is now found within an enlarged family Plantaginaceae (Olmstead and Reeves, 1995; APG 1998, 2003). *Veroniceae* is distinguishable from related taxa by its tetramerous corollaand capsule dehiscence (normally loculicidal, only exceptionally septicidal (Hong, 1984). Based on the most recent evidence from phylogenetic analyses of *Veronica* and its related genera , nine monophyletic genera are recognizedin the tribe *Veroniceae* (*Veronica, Scrofella, Veronicastrum, Lagotis, Wulfenia, Kashmiria, Picrorhiza, Wulfeniopsis* and *Paederota;* Albach et al., 2004a).

Veronica is the most species-rich genus of family Plantaginaceae. It comprises about 500 species (Albach et al., 2004a). It is distributed over most of the Northern Hemisphere and in many parts of the Southern Hemisphere, and is ecologically highly diverse with species growing in different habitats and elevations, from aquatic to even dry steppe from sea level to high alpine regions.

Veronica in this wider sense is characterized by several synapomorphies (mostly with several reversals within the genus), such as four calyx and four corolla lobes, short to absent corolla tube, subactinomorphic flowers, two exserted stamens, notched fruit apex, much compressed fruit, and flattened seeds (Albach et al., 2004b). The main progressions (usually parallel) within the genus include: life-form (subshrubby/perennial vs. annual), position of inflorescences (axillary vs. terminal), leaf lamina (large vs. small and linear, undivided vs. pinnatifid), size of corolla (usually related to breeding system), shape of seeds (flat vs. excavate ="cymbiform"), indumentum (glandular vs. eglandular hairs) according to Albach et al. (2004 a, c). Albach et al. (2008) found that most of the subgenera in *Veronica* exhibit only one single basic number, i.e., x = 6, 7, 8, 9, 12, 17, or 20/21. They pointed to the putative ancestral base number in this genus of 9, which has been reduced several times to 8 and 7, respectively (aneuploidy/dysploidy), often associated with transition to annual life history.

Based on the work carried out by Albach et al. (2004 a) and Garnock-Jones et al. (2007), genus *Veronica* is, now grouped into 12 subgenera, each one within in two to 150 species: *V.* subg. *Beccabunga, Veronica, Pseudolysimachium, Synthyris, Cochlidiosperma, Pellidosperma, Stenocarpon, Triangulicapsula, Pocilla, Pentasepalae, Chamaedrys,* and *Pseudoveronica*.

According to (Albach et al., 2004a) , *Veronica* subg. *Beccabunga* includes *V.* sect. *Beccabunga* sensu Stroh (1942) (excluding *V. ciliata* and *V.himalensis*), *V.* subsect. *Serpyllifolia* sensu Stroh (1942) (perennials, incl. *V. serpyllifolia* L. and relatives; excluding *V. aragonensis* and *V. chionantha*) and *V.* subsect.

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Acinifolia sensu Stroh (1942) (annuals, excluding *V. macropoda* and *V. rubrifolia*, the complete subsection sensu Elenevsky), as well as, *V. gentianoides* with its allies and the annual *V. peregrina* of *V.* subsect. *Microspermae* sensu Stroh (1942).

Veronica section *Beccabunga* is composed of semi-aquatic species, hygro- and hydrophytes found in different natural zones and at very different elevations from sea-level to alpine zones (Savinykh, 2003). Section *Beccabunga* includes herbaceous perennials and annuals, which occur primarily in the temperate regions of all continents of the Northern and Southern Hemispheres, except Antarctica. However, the greatest diversity of *Veronica* section *Beccabunga* exists in southwest Asia (Chrtek and Osbornová-Kosinová, 1981). Despite the fact that some species can live in arid habitats, members of *Veronica* sect. *Beccabunga* are not xerophytes.They are flowering and bearing fruit in early spring and are rather mesophytes and ephemeral plants (Savinykh, 2003).

Veronica section *Beccabunga* has been discussed in various floras and monographic studies, such as Krösche (1912), Römpp (1928), Schlenker (1936 a,b), Keller (1942), Stroh (1942), Burnett (1950), Lawalrée (1953), Khoshoo and Khushu (1966), Marchant (1970,1967), Hartl (1968), Walters and Webb (1972), Smejkal and Helanová-Zichová (1974), Jelenevskij (1978), Fischer (1978), Chrtek and Osbornová-Kosinová (1981), Öztürk and Fischer (1982), Sellers (1983), Fischer et al. (1984), Les and Stuckey (1985), Fischer (1989), Klinkova (1993), Tanaka (1996), Tanaka et al. *(*1999), Dzhus and Dmitrieva (1999), Öztürk and Öztürk (2000), Sánchez-Agudo (2004), Sánchez-Agudo et al. (2011), Abd El-Ghani et al. (2010, 2011) and Ellmouni et al. (2017)

Keller (1942) divided section *Beccabunga* into two separate subsections, i.e. *Anagallides* and *Beccabunga* based on absence or presence of a petiole. Subsection *Anagallides* includes species as *V. anagalloides*, *V. anagallis-aquatica*, *V. catenata*, *V. scardica* and *V. kaiseri*, which often form intermediates; it is an extremely confusing complex of several species and subspecies intimately connected. *Veronica beccabunga* and *V. americana* form subsection *Beccabunga,* which distinct from the above mentioned species and form no intermediates with them. Chrtek and Osbornová-Kosinová (1981), Öztürk and Fischer (1982), Saeidi Mehrvarz and Kharabian (2005), and Abd El-Ghani et al. *(*2010, 2011) followed Keller (1942) in his division.

Borissova (1955) further splitted section *Beccabunga* into three series, i.e. *Anagallides*, *Beccabungae* and *Oxycarpae* based on the petiole and the shape of capsule. Her series *Anagallides* includes species with mostly sessile leaves (*V. anagallis-aquatica, V. anagalloides, V. anagallidiformis, V. scardica, V. poljensis*), the second series *Beccabungae* includes petiolate species (*V. beccabunga* and *V. americana*) ,while the third series *Oxycarpae* include sessile or petiolate species (*V. beccabungoides*, *V. montioides*, *V. bobrovii*,. *V. michauxii*,. *V. lysimachioides* and *V. oxycarpa*).

Although members of *V*. sect. *Beccabunga* were included in molecular phylogenetic analyses since the beginning of phylogenetic analyses of the genus (e.g., Wagstaff and Garnock-Jones 1998), a recent study with fairly complete taxon sampling allowed inferences about the relationships (Ellmouni et al. 2017). However, the complexity of molecular phylogenetic and morphometric analyses did not allow a detailed discussion of systematic implications.

The aim of the present study is to summarize current knowledge of species relationships in *Veronica* section *Beccabunga*, provide a taxonomic basis for discussion and highlight areas of particular need for further research. For that purpose**,** a systematic treatment was conducted to include:

(1) a summary of the species recognized and reported in the earlier workers in different floras.
(2) a key to all species of section *Beccabunga*.
(3) a discussion of its relationships between conspecific species.

Material and methods

Plant material

The present study is based on specimens, both own collections and herbarium specimens from Africa (Egypt, Ethiopia); Europe (Turkey, Germany, Czech, Austria); Asia (Armenia, Azerbaijan, Georgia, Pakistan, Kyrgyzstan, Afghanistan) and North America (USA and Canada). A total of 100 specimens representing 20 taxa of section *Beccabunga* were collected and examined with a MS003A binocular head zoom stereo microscope. (Appendix 1).

Results and Discussion

We here compiled a summary of all species of *Veronica* sect. *Beccabunga* recognized and reported in the earlier studies starting with Pennell (1935) and ending by our treatment (Table 1). In the following, we present an artificial key for all represented taxa.

- Artificial key to species of *Veronica* sect. *Beccabunga* based on morphological characters

1.a) Annuals, without subterranean stem; most leaf-axils flower-bearing; inflorescence "terminal or axillary"; leaves, oblanceolate, or narrowly oblong ……………………………………….….…***V. peregrina* (subsect. *Peregrinae*)**

1.b) Perennials or annuals, with subterranean stems; only the upper leaf-axils flower-bearing; inflorescence terminal; leaves, lanceolate, ovate or orbicular ……………………………………………………………………….. **2**

2.a) Flowering stems procumbent or ascending; upper leaves petiolate, glabrous. ……………..…………………………………………………………….………….... **3 (subsect. *Beccabunga*)**

2.b) Flowering stems erect; upper leaves sessile, glabrous or hairy……………..……………. **6 (subsect. Anagallides)**

3.a) Leaves lanceolate or ovate; leaf blade twice as long as wide, broadest part at base; style 2.5-3.5 mm ..…………………………………………………………………………………..…………***V. americana***

3.b) Leaves obovate or broad elliptic; leaf blade as long as to twice as long as wide, broadest part near middle or above; style 1.8-2.2 mm ………..……………………………………………………………….……..…***V. beccabunga***

4.a) Corolla 6-9 mm in diam.; pedicel not patent, peduncle up to 50 mm long; longer than the subtending leaf; capsule 4-6 mm long, 3-4.5mm wide………..………… ……………….………………. ***V. beccabunga* ssp. *abscondita***

4.b) Corolla 4-7 mm in diam.; pedicel patent, peduncle up to 30 mm long; not longer than the subtending leaf; capsule 2.5-5.5 mm long, 3-5 mm wide ……..…………………….……….………………………….………….. **5**

5.a) Leaves 10-65 mm X 6-33 mm with clear petiole; peduncle up to 30 mm; pedicels subpatent, up to 10 mm; number of flowers up to 22. .……………………………………………………………***V. beccabunga* ssp. *beccabunga***

5.b) Leaves 4-25 X 3-15 mm without clear petiole; peduncle up to 20 mm; pedicel horizontally patent, up to 8 mm; number of flowers up to 15. ….………………………………………………….….***V. beccabunga* ssp. *muscosa***

6.a) Raceme generally glandular or villous **…………………………………………………….………...………… 7**

6.b) Raceme rarely glandular, generally glabrous . **…………………………………………………….……….10**

7.a) Inflorescence axis more or less villous; capsule as long as calyx or longer ……………………….………***V. poljensis***

7.b) Inflorescence axis glandular-pubescent; capsule as long as calyx or shorter ………………………………………. **8**

8.a) Leaves petiolate or sessile ,ovate.………………………………………………***V. anagallis-aquatica* ssp. *michauxii***

8.b) Leaves sessile, orbicular to linear. ……………………………………………………………….……………………**9**

9.a) Capsule elliptic ……………………………………..……………………………. ..***V. anagalloides* ssp. *anagalloides***

9.b) Capsule orbicular..…………………………………………………………………***V. anagalloides* ssp. *heureka***

10.a) Racemes alternate; lower leaves petiolate , upper subsessile or sessile..……………………………..…………**11**

10.b) Racemes opposite; lower leaves shortly petiolate , upper sessile ………………………………..…….………**13**

11.a) Leaves suborbicular to broadly elliptic; capsule with acute apex , and as long as the calyx lobes ……………………..……………..…………..……………………………………..…..…………***V. kaiseri***

11.b) Leaves suborbicular to rhombic; capsule with rounded apex, and slightly shorter than the calyx lobes. ..…………………..…………………………… ……………………..……………………………..….**12**

12.a) Stems erect; length of capsule ≤ 2 mm, width of capsule < 2 mm; style ≥ 1.5 mm long …… …………………………………………………………………………...…… ***V. scardica* ssp. *scardica***

12.b) Stems creeping or erect; length of capsule > 2 mm, width of capsule ≥ 2 mm; style < 1.5 mm long ……………………………………………………………………………….………***V. scardica* ssp. *africana***

13.a) Upper leaves ovate-lanceolate to lanceolate; capsule orbicular ………………………….………..……… **14**

13.b) Upper leaves lanceolate to linear lanceolate or rhombic-lanceolate; capsule elliptical.……………………………**21**

14.a) Flower bract longer than pedicels in 1st and 2nd flower in inflorescence; bract leafy at 1st and 2nd flower and rest lanceolate ………………………………………………………….…………..… ***V. catenata* ssp. *pseudocatenata***

14.b) Flower bract shorter than pedicels, bracts lanceolate allover the inflorescence …………….……………………**15**

15.a) Lower leaves shortly petiolate, leaves broader and longer, pedicel erect ……………………….…………………**16**

15.b) Lower leaves sessile, leaves generally broader and shorter, pedicel patent or suberect ……………………….… **19**

16.a) Capsule ovoid-deltoid, basally wider than apically ovate, apically tapering ..……………..………………………**17**

16.b) Capsule subglobose, basally and apically equal in width (cylindrically), apically rounded or emarginated..…… **18**

17.a) Racemes up to 100 mm long, with ± lax flowers (3-4 flowers / cm); peduncle length up to 20 mm; style up to 1.5 mm long; capsule orbicular or broadly elliptic, with acute apex ……………………..……………………...…………………………..… ***V. anagallis-aquatica* var. *nilotica***

17.b) Racemes 150 mm long, with ± dense flowers (3-7 flowers /cm); peduncle length up to -40 mm; style to 4 mm long; capsule ovoid-deltoid, slightly compressed, with tapering to slightly notched apex ………………………………………………………………..…… ***V. anagallis-aquatica* ssp. *oxycarpa***

18.a) Pedicel curved, at an acute angle with inflorescence axis; racemes less than 1 cm wide, usually glabrous ………...***V. anagallis-aquatica***

18.b) Pedicel straight, at a right angle with inflorescence axis; racemes 1–1.5 cm wide, sparsely - pubescent .... ***V. undulata***

19.a) Raceme up to 150 flowered, glabrous; capsule as long as the calyx or shorter; pedicel suberect .... ***V. anagallis-aquatica* ssp. *lysimachioides***

19.b) Raceme up to 40 flowered, sparsely pubescent or glabrous; capsule as long as the calyx or longer; pedicel patent …………………………………………………………………**20**

20.a) Leaves oblong-ovate to oblong-lanceolate, with entire or subentire margin; raceme with 15 - 25 flowers; style >2 mm ………………………………………………………………………..…***V. catenata* ssp. *catenata***

20.b) Leaves ovate to ovate-lanceolate,with serrulate - subentire margin; raceme with 10-40 flowers; style < 2 mm ……..……………..………………………………………...…………***V. anagalloides* ssp. *heureka* (Egypt)**

21.a) Leaves lanceolate to linear lanceolate; bract longer than the pedicel; style 1-1.3 mm; capsule as long as calyx or slightly longer ………………….***V. anagalloides* ssp. *taeckholmiorum***

21.b) Leaves lanceolate to rhombic-lanceolate; bract shorter than the pedicel or subequal; style 0.6-1.5 mm; capsule as long as or twice calyx …………………………………………..…***V. anagalloides* ssp. *anagalloides* (Egypt)**

Aquatic angiosperms represent a polyphyletic assemblage of diverse evolutionary lineages unified as a 'biological group' by their common invasion of the aquatic environment. Water plants have long been a fascination to naturalists, horticulturists, and aquarists; issues of their complex transition from terrestrial to aquatic life, however, have scarcely been addressed by evolutionary biologists (Les and Philbric, 1993).

The taxonomic history of *Veronica* clearly illustrates the difficulties arising from the recognition of natural (monophyletic) groups within the genus based solely on morphological traits. This is due to the fact that many of the traditionally used taxonomic characters are evolutionary labile and therefore not suitable for taxonomy (Albach et al., 2004**c**). The taxonomic complexity of the genus is due to several polymorphic subsections and groups with closely related taxa (Saeidi and Zarre, 2004).

Veronica subg. *Beccabunga* seems to be an early branching clade in the genus (Albach and Chase 2001; Albach et al. 2004b, c). Within the subgenus, section *Beccabunga* appears to be sister to the rest of the subgenus (Müller and Albach 2010).

According to Keller (1942), Chrtek and Osbornová-Kosinová (1981), Öztürk and Fischer (1982), Saeidi and Kharabian (2005), Abd El-Ghani et al. (2011), *Veronica* section *Beccabunga* comprises two subsections; *Beccabunga*, and *Anagallides*, based on presence or absence of the petiole. In our earlier study (Ellmouni et al. 2017), we confirmed the addition of subsection *Peregrinae* to section *Beccabunga* as a third subsection, congruent with Albach and Chase (2001), Albach and Greilhuber (2004), Taskova et al.(2004), Albach et al. (2004b), Muñoz-Centeno et al. (2006), Albach et al. (2008), Müller and Albach (2010), and Hassan and Abd El-Khalik (2014). Those studies have placed *V. peregrina* in section *Beccabunga* based on DNA data and seed morphology. The annual *Veronica peregrina* L., is the only member of *V.* subsection *Peregrinae* Elenevsky.

The main morphological character shared between *Veronica peregrina* and other taxa in section *Beccabunga* is the shape of leaves, which is oblanceolate in the lower leaves and narrowly oblong in the upper leaves according to Hong and Fisher (1998), whereas the main difference between subsection *Peregrinae* and other members of *V.* section *Beccabunga* is appearing in the inflorescence, which in the first is terminal, with rarely some axillary flowers but in the others the inflorescence is axillary. An additional shared character is the preference for at least seasonally wet habitats. *Veronica peregrina* is hexaploid based on the shared base chromosome number $x = 9$ (Albach et al. 2008).

Subsection *Beccabunga* contains two species, the Eurasian mainly diploid *V. beccabunga* and the Americo-Beringian tetraploid *V. americana* (Öztürk and Fischer, 1982). Sellers (1983) considered *V. beccabunga* and *V. americana* as conspecific, and stated “Although the two taxa are strikingly similar, *V. beccabunga* and *V. americana* are better treated as subspecies of a single species", due, in part, to their geographical distribuation, and slightly difference in both of leaf morphology, and chromosome number (Marchant,1968; Sellers, 1983). We consider, however, these characters to be enough to recognize them as separate species. *Veronica americana* occurs primarily in North America, throughout the Aleutian Islands, and in East Asia along the Pacific coast and neighboring islands; while *V. beccabunga* ranges mainly throughout much of the Old World. However, isolated occurrences of *V. beccabunga* in North America, are presumably introducted. *Veronica beccabunga* has round or obovate leaves with a round apices; *V. americana* has lanceolate or oblong leaves with obtuse apices, whereas *V. beccabunga* is diploid (x=9) while, *V. americana* is a tetraploid species (Marchant, 1968; Sellers,1983; Albach et al., 2008).

V. beccabunga and *V. americana* are not only morphologically similar but, also, form bastard plants that are sterile (Schlenker 1935) despite the fact that they have different ploidy level. Pennell (1921) mentioned that "*V. americana* appears to be only constantly distinguishable from *V. beccabunga* by its leaf-form and more erect habit".

Les and Stuckey (1985) discussed the introduction of *Veronica beccabunga* into eastern North America in the late nineteenth century as a result of ballast disposal. The species spread westwards through the dispersal of seeds and plant fragments. They also mentioned that the slower migration of *V. beccabunga* may be due to its affinity for undisturbed habitats where native species such as *V. americana* area are already established since *V. americana* and *V. beccabunga* are essentially equivalent ecologically (Marie-Victorian, 1935; Les and Stuckey, 1985).

Veronica subsect. *Anagallides* is a taxonomically extremely difficult group in desperate need of a DNA based analysis to disentangle taxonomically useful characters from those having evolved in parallel or phenotypically plastic. Both ITS and plastid *rps*16-*trn*K-sequences did not help much in resolving relationships (Ellmouni et al. 2017). Species in Europe have been studied intensively (including crossing experiments) by Schlenker (1935) and Marchant (1970) and seem to be distinct species. Hybrids between the species of the subsection appear to be common (e.g., between *V. angallis-aquatica* and *V. catenata*), sometimes resulting in sterile plants (*V.* × *lackschewitzii*) but probably also leading to fertile backcross plants. A further difficulty is the wide distribution and weedy nature with plants often found along the smallest ephemeral puddles. Due to these difficulties species delimitation is complicatedand often based on single characters as capsule shape (e.g., *V. oxycarpa*) or indumentum (e.g., *V. michauxii*). As mentioned by Fischer (1981), when collecting plants from the group many individuals in different parts of the population should be checked for variability of the characters, and information on sterile and injured plants should be recorded. Flower color may be an important character as it is often not discernible in herbarium specimens. One character, which deserves some attention, is the position of the inflorescence. For Egyptian flora, some emphasis is put on this character.

The current work supports that *Veronica anagalloides*, is represented by three subspecies ; *V. anagalloides* ssp. *anagalloides, V. anagalloides* ssp. *taeckholmiorum* and *V. anagalloides* ssp. *heureka*.These possess lanceolate to linear-lanceolate leaves,and small elliptic capsule. However, these are differentiated by the length of the pedicel in relation to the bract. *Veronica anagalloides* ssp. *anagalloides* and ssp. *taeckholmiorum* share lanceolate to linear lanceolate upper leaves, and small , elliptic capsule;but differ in the length of pedicel and bract, density of flowers , and the size of capsule. In *V. Anagalloides* ssp. *taeckholmiorum*,bracts longer than pedicel (up to 1 cm), inflorescence dense (up to 9 flowers/ cm), and small size of capsule; ssp. *anagalloides* has bracts as long as or shorter, density of inflorescence less than in other subspecies (up to 7 flowers / cm) and relatively large size of capsule (Abd El-Ghan et al*.*, 2010). The extreme polyphyly of *V. anagalloides* in molecular and morphometric analyses by Ellmouni et al. (2017) is noteworthy and suggests that species boundaries are either very young, hybridization occurs frequently and/or phenotypic plasticity blurs species boundaries.

Natural hybrids are also reported to involve *Veronica anagallis-aquatica* and *Veronica anagalloides* (Fischer, 1981). A natural hybrid involving *Veronica poljensis* and *Veronica anagalloides* has been reported by Öztürk and Fischer (1982), on the basis of morphological intermediacy.

With regards to *Veronica poljensis*, we do not agree neither with Marchant (1970) who considered *V. poljensis as a* part of *V. anagalloides* nor with Jelenevskij (1978) who included *V. poljensis* in *V. anagallis-aquatica* subsp. *anagalloides*) but agree with Schlenker (1936) and Borisova (1955) who treated *V. poljensis* as a separate species. Schlenker (1936) had explained the relation between *V. poljensis*, *V. anagallis* and *V. anagalloides,* stating that *V. poljensis* resembles *V . anagalloides* in the narrow and linear-lanceolate leaves and the small flowers; but differs with broader capsule; while it shares *V . anagallis-aquatica* in the suborbicular capsule but differs in its narrow leaves. However, more detailed studies remain to test the coherence of plants with villous capsules.

Veronica anagallis-aquatica is a polymorphic species, a homophyllous amphibious macrophyte (Sculthorpe, 1967). The polymorphic nature is extended to the molecular results in Ellmouni et al. (2017), which make it look probable that the species forms kind of source from which other taxa originated.This species has serrulate to subentire, narrowly ovate to lanceolate, and sessile leaves. In some streams, *V. anagallis-aquatica* occurs both as emerged and submerged forms at low water velocities, where the substrate is a mixture of sand and silt,while in high water velocity, *V. anagallis-aquatica* occurs, only, as the submerged form growing on gravel substrate (Boeger and Poulson, 2003)**.** The *V. anagallis-aquatica* group has a nearly world-wide distribution (Chrtek &Osbornová-Kosinová, 1981).

Chrtek and Osbornová-Kosinová (1981) and El-Hadidi et al. (1999) mentioned the absence of *V. anagallis-aquatica* var. *anagallis-aquatica* in Egypt, but pointed out the presence of *V. anagallis-aquatica* var. *nilotica* in Egypt, particularly Aswan area. In the meantime, Abd El-Ghani et al. (2010), partially agreed with previous authors,who confirmed the occurrence of both taxa, *V. anagallis-aquatica* subsp. *anagallis-aquatica* and *V. anagallis-aquatica* var. *nilotica* in Egypt. The main differences between the two taxa are that subsp. *anagallis-aquatica* has broader leaves, a dense inflorescence; and capsules with rounded apex, equal to or shorter than calyx, whereas *V. anagallis-aquatica* var. *nilotica* has smaller leaves, lax inflorescence with fewer flowers and capsules with acute apex, equal to or slightly longer than calyx.

There are three more taxa commonly separated from *V. anagallis-aquatica* as either species or subspecies, which are *V. anagallis-aquatica* subsp. *michauxii*, subsp.*oxycarpa*, and subsp. *lysimachioides* (Fischer, 1978). The first one is characterized by a glandular-villous indumentum on stem and leaves. Specimens from this taxon consistently clustered close in molecular and morphometric analyses by Ellmouni et al. (2017). *V. anagallis-aquatica* subsp. *oxycarpa* is considered transitional between subsp. *anagallis-aquatica* and subsp. *lysimachioides* and this is also highlighted in the morphometric analysis (Ellmouni et al. 2017), which grouped individuals of this taxon either with subsp. michauxii or subsp. *lysimachioides.* According to Fischer (1981), it is characterized by ovate to elliptic leaves and apically tapering capsules.

Veronica anagallis-aquatica subsp. *lysimachioides* is characterized by glabrous surface, uniformly sessile leaves, dense inflorescence, and capsules with roundish-obtuse apex. Öztürk and Fischer (1982) mentioned that this taxon presents considerable problems in its delimitation from its closest relatives, especially from subsp. *oxycarpa*, which is insufficiently understood. Though quite well characterized by Schlenker (1936 a), *V. lysimachioides* has been neglected by many authors (e.g., by Marchant, 1970; Elenevskij,1969 & 1978). Fischer (1978, 1981) has given a full description of the taxon. It is differentiated by the very dense raceme; all leaves sessile; the complete absence of glandular hairs; pedicels up to 3.5 mm; and capsules shorter than 3.5 mm, with obutse apex. These characters are not especially characteristic and consequently specimens formed a polyphyletic group in the morphometric analysis of Ellmouni et al. (2017).

Veronica catenata was known earlier in Egypt and elsewhere as *V. aquatica* Bernh. (Muschler,1912; Täckholm, 1956) or as *V. anagallis-aquatica* var. *aquatica* (Bernh.) Nyman (Täckholm, 1974). However, the correct name for the plant, *V. catenata* Pennell, was clarified by Burnett (1950). Chrtek and Osbornová-Kosinová (1981) concluded that the Egyptian material should be included in *V. catenata*, not *V. anagallis-aquatica*, and gave the Egyptian material subspecific rank as *V. catenata* subsp. *pseudocatenata*, which goes in line with El-Hadidi et al. (1999), Boulos (1995, 2002), and Abd El-Ghani et al. (2010, 2011). The results of our work agree with all prevoius authors in the occurrence of *V. catenata* subsp. *pseudocatenata* in Egypt. However, a close relationship with *V. catenata* subsp. *catenata* is not supported by Ellmouni et al. (2017). Abd El-Ghani et al. (2010) suggested the occurrence of *V. catenata* subsp. *catenata* in Egypt, based on some collected specimens showing the characters of *V. catenata* subsp. *catenata*and differing from *V. catenata* subsp. *pseudocatenata* in bracts that are shorter than the pedicels. Furthermore bracts in *V. catenata* subsp. *catenata* become less lanceolate from the first pedicel to the last one, with the reverse case in *V. catenata* subsp. *pseudocatenata* , where the first and second flower pedicels have large and leafy bracts and then become more lanceolate.

Veronica catenata subsp. *catenata* resembles *V. catenata* subsp. *pseudocatenata* in the shape of upper leaves (ovate-lanceolate to lanceolate), inflorescence lax (with 3-7 per cm pedicel), ± straight and spreading, and orbicular and larger capsule . On the other hand, *V. catenata* subsp. *catenata* resembles *V. anagallis-aquatica* in having lanceolate bracts shorter than flowersand fruiting pedicels,. The two taxa differ mainly in lower leaves sessile, leaves that are generally broader and shorter, pedicels patent, inflorescence less dense, capsule normally as long as the calyx or even slightly longer in *V. catenata* subsp. *catenata*, while *V. anagallis-aquatica* has shortly petiolate lower leaves, leaves that are generally broader and longer, pedicel ± erect, inflorescence dense, capsule often shorter than calyx.

For *Veronica scardica*, Chrtek and Osbornová-Kosinová (1981) reported another subspecies in the Egyptian flora named subspecies *africana*, which is stated to have "sessile leaves in upper part of stem [which] often caused misidentification with *V. anagallis-aquatica*, which sometimes has its lowermost leaves shortly petiolate. Racemes of *V. anagallis-aquatica* are always opposite; while alternate" in *V. scardica* subsp. *africana*..

V. scardica subsp. *scardica* and *V. scardica* subsp. *africana* possess rhombic to suborbiculate leaves; ; capsule 2-3.5 mm long~~,~~ slightly shorter than the calyx lobes wide, and with rounded apex, possibly vary from each other in the size of flowers and fruits. A close association between both taxa is not suggested by results from Ellmouni *et al.* (2017) and remains to be tested more rigorously. Separate origins are likely, especially since European plants are restricted to heavy-metal soils (Fischer et al. 1984) other than Egyptian plants.

Marchant (1970) reported successful artificial crosses between *Veronica scardica* and *V. beccabunga*, although seeds were inviable. Supposed naturally occurring hybrids of this cross are believed to represent instead hybrids of *V. scardica* and *V. anagallis-aquatica* (Fischer et al., 1985).

Veronica kaiseri was described by Täckholm (1942) based on plants from the Sinai Peninsula. Based on more detailed comparisons of Sinai plants (Täckholm 1956, 1974),*V. kaiseri* is closely related to *V. scardica*, differing in the apex of capsules, which are acute in *V. kaiseri* ,while rounded as in *V. scardica*. In herbarium specimens, *V. kaiseri* is sometimes misidentified as *V. beccabunga,* which resembles *V. kaiseri* in its habit. The differences are seen in capsules and inflorescences. *Veronica beccabunga* has opposite inflorescences, while *V. kaiseri* has alternate inflorescences. There are also differences in leaves: *V. kaiseri* has upper leaves sessile or very shortly petiolate, but *V. beccabunga* has all petiolate leaves. *Veronica kaiseri* differs from *V. anagallis-aquatica* in leaves (being suborbicular to broadly elliptic), color of the corolla (bright blue) and (ellipsoid capsule, with acute apex) while in *V. anagallis-aquatica* leaves are ovate to lanceolate, corolla violet and the capsule is orbicular with rounded apex. It, thus, resembles mostly *V. anagalloides*, especially subsp. *heureka,* from which it is differentiated by the acute capsule apex, alternate inflorescence and leaves suborbicular to broadly elliptic with short petiole below rather than ovate leaves that are all sessile.

Chrtek and Osbornová-Kosinová (1981) stated that *V. kaiseri* was only known from the Sinai Peninsula, especially its southern granite mountain region. Several studies (Boulos, 1995; El-Hadidi and Fayed, 1995; El-Hadidi et al*.*, 1999; Boulos, 2002) agree with Chrtek and Osbornová-Kosinová(1981) and Täckholm (1974) in the occurrence of *Veronica kaiseri* only in Sinai. However, Abd El-Ghani et al. *(*2010) collected some specimens from Nile Delta (Fayoum area), which resemble *V. kaiseri* in having alternate and lax inflorescence with few flowers and capsules with acute apex. The specimens differ from the holotype kept in *Agriculture Museum* Herbarium in leaf morphology (being elliptic-ovate in Fayoum specimens *vs*. ovate and petiole length of the lower leaves (1mm long *vs.* 2-3 mm). More recently ,the species was discovered in Jordan by Gregor & Albach in von Raab-Straube & Raus (2016).

Veronica undulata is similar to *V. anagallis aquatica* in their subglobose capsules, (basally and apically equal in width), with rounded or emarginated apex. In *V. anagallis-aquatica,* pedicel curved, at an acute angle with inflorescence axis; inflorescence less than 1 cm wide, glabrous , while pedicel straight, at a right angle with inflorescence axis; inflorescence1–1.5 cm wide, and sparsely glandular pubescent in *V. undulata.* It was not included in the analyses by Ellmouni et al. (2017) but its distinction is supported by the specific distribution area in Eastern Asia and the hexaploid level not reported in any other taxon of the subsection (Albach et al. 2008).

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Table 1: Species recognized and reported in earlier studies. "+"in different columns 1-13 refers to presence of species in studies of the respective author, "**-**" refers to absence and "X" to presence as synonym in respective study. **Author name:** 1- Ellmouni *et al*. (this publication) 2- Podlech (2012). 3- Abd El-Ghani et al. (2010). 4- Martínez Ortega *et al*. (2009) 5- Hong and Fisher (1998) 6- Sellers (1983). 7- Öztürk and Fischer (1982). 8- Fischer (1981). 9- Fischer (1978). 10- Walters and Webb (1972). 11-Borissova (1955). 12- Schlenker (1936a) 13- Pennell (1935).

Three Series: Borissova (1955)	Two Subsections: Keller (1942)	Three Subsections	Species	Subspecies or variates	1	2	3	4	5	6	7	8	9	10	11	12	13
		Subsection : *Peregrinae*	***V. peregrina***	***V. peregrina***	+	+	-	+	+	-	-	-	-	+	-	-	+
Series: *Anagallides*	**Subsection: *Anagallides***	**Subsection: *Anagallides***	***V. anagallis-aquatica***	***V. anagallis-aquatica***	+	+	+	+	+	+	+	+	+	+	+	+	+
				V. anagallis-aquatica* var. *nilotica	+	-	+	-	-	-	-	-	-	-	-	+	-
				V. anagallis-aquatic* subsp. *lysimachioides	+	-	-	-	-	-	+	+	+	-	X	X	-
				V. anagallis-aquatic* subsp. *michauxii	+	+	-	-	-	-	+	+	+	-	X	X	-
				V. anagallis-aquatic* subsp. *oxycarpa	+	+	-	-	X	-	+	+	+	-	X	X	-
			V. anagalloides	***V. anagalloides***	-	-	-	-	+	+	-	-	+	+	+	+	-
				V. anagalloides* subsp. *anagalloides,	+	+	+	+	-	-	+	+	-	-	-	-	-
				V. anagalloides* subsp. *heureka	+	+	+	-	-	-	+	+	-	-	-	-	-
				V. anagalloides* subsp. *taeckholmiourm,	+	-	+	-	-	-	-	-	-	-	-	-	-

				V. anagalloides* X *V. anagallis-aquatica	+	-	-	+	-	-	+	-	-	-	-	-	-
			V. anagallidiformis	***V. anagallidiformis***	-	-	-	-	-	-	-	-	-	-	+	-	-
			V. catenata	***V. catenata,***	-	-	-	+	-	+	-	-	-	+	-	-	*
				V. catenata* var. *catenata,	+	-	+	-	-	-	-	-	-	-	-	-	-
			V. kaiseri	***V. kaiseri***	+	-	+	-	-	-	-	-	-	-	-	-	-
			V.* X *lackschewitzii	***V.* X *lackschewitzii***	+	-	-	+	-	-	-	-	-	-	-	-	-
			V. scardica	***V. scardica,***	+	-	-	-	-	+	+	+	+	+	+	+	-
				V. scardica* subsp. *africana	+	-	+	-	-	-	-	-	-	-		-	-
			V. poljensis	***V. poljensis***	+	-	-	-	-	-	+	-	-	-	+	+	-
			V.undulata	***V.undulata***	+	+	-	-	+	-	-	+	-	-		-	-
			V. beccabungoides	***V. beccabungoides***	-	-	-	-	-	-	-	+	X	-	+	-	-
Series: *Oxycarpae*			***V. michauxii***	***V. michauxii***	-	X	-	-	-	-	X	X	X	-	+	+	-
			V. lysimachioides	***V. lysimachioides***	-	-	-	-	-	-	X	X	X	-	+	+	-
			V. oxycarpa	***V. oxycarpa***	-	X	-	-	+	-	X	X	X	-	+	+	-
Series: *Beccabungae*	**Subsection: *Beccabungae***	**Subsection: *Beccabungae***	***V. americana***	***V. americana***	+	-	-	-	-	*	-	-	-	-	+	+	+
			V. beccabunga	***V. beccabunga***	-	-	-	-	-	+	X	+	+	+	+	+	+
				V. beccabunga* var. *beccabunga.,	+	-	+	+	-	-	+	-	-	-	-	-	-
				V. beccabunga* subsp. *abscondita,	+	-	-	-	-	-	+	+	-	-	-	-	-
				V. beccabunga* subsp. *muscosa.	+	+	-	-	+	-	-	+	-	-	-	-	-
		Number of taxa			**20**	**7**	**10**	**6**	**5**	**6**	**11**	**12**	**7**	**5**	**11**	**10**	**3**

* as *V. beccabunga* subsp. *americana*** partly as *anagallidiformis* (*)

Appendix 1 : Voucher information for taxa used in the systematic revision. A total of 100 specimens representing 20 taxa of section Beccabunga, was used in the systematic revision

	Latin Name	Voucher	Locality	Latitude	Longitude
1	*Veronica sp.*	Jaroslav 613771, BRNU 620815	Brehy, Czech Republic	50° 4' N	15° 34' E.
2	*Veronica sp.*	Jaroslav 747670, BRNU 620816	Sezemic, Czech Republic	50° 4' N	15° 51' E.
3	*Veronica sp.*	Jaroslav 797430, BRNU 620817	Hradišťko II, Czech Republic	50° 7' N	15° 24' E.
4	*V. americana*	Don Mansfield 12-431, CIC 43770	Idaho, Owyhee County,U.S.A.	42° 60' N	116° 76' W
5	*V. americana*	R. R. Halse 8268, SRP 38705	Oregon, Benton County, U.S.A.	44° 29 N	123° 61' W
6	*V. americana*	Hans Hallman 1151, USFS0049862	Montana, Carter County,U.S.A.	45° 90' N	104° 45' W
7	*V. americana*	Ashley Van Hoose 19, HPSU008353	Washington, Clark County,U.S.A.	45° 44' N	121° 37' W
8	*V. americana*	L. Price 37, SRP 5589	Alaska, Susitna County,U.S.A.	62°15' N	150°10' W
9	*V. americana*	Gerald B. Straley 4303, UBC V193722	British Columbia, Canada	48° 51' N	123° 18' W
10	*V. americana* (*V.beccabunga* subsp. *americana*)	V. Wagner 14308, ID119478	Boundary County,Idaho, U.S.A.	48° 35' N	116° 46' W
11	*V. anagallis-aquatica*	F. Yousef 5, Herbarium Fayoum university 18	Al Gharaq, ATSA, El- Fayoum, Egypt	29° 7' N	30° 41'E
12	*V. anagallis-aquatica*	Jaroslav 613771, BRNU 620814	Brehy, Czech Republic	50° 4' N	15° 34' E.
13	*V. anagallis-aquatica*	Danihelka 07/034, BRNU 597098	Moravia, Czech Republic	48° 47' N	16° 40' E
14	*V. anagallis-aquatica*	Danihelka, BRUN 617636	Moravia, Czech Republic	48° 51' N	16° 36' E
15	*V. anagallis-aquatica*	Scalone 27.06 0.08, OLD	Tsagveri, Georgia	41° 47' N	43° 28' E
16	*V. anagallis-aquatica* subsp. *anagallis-aquatica*	O. Karabacak 1018, VANF	B9, Van: Muradiye, Turkey	38°59' N	43° 46' E

17	*V. anagallis-aquatica*	Ö. Eyübophe 1990, GAZI 1723	A4, Ankara, Kizilcahamam, Turkey	40°28'N	32° 38' E
18	*V. anagallis-aquatica*	M. Kucuk 12,5,GAZI	Kürtün, Gümüşhane, Turkey	40° 42'N	39° 05'E
19	*V. anagallis-aquatica* spp. *anagallis-aquatica*	E.Akcicek2162, GAZI	B3, Afyon: Kumalar Dağı, Haydarlı, Turkey	38°45'N	30°33'E
20	*V. anagallis-aquatica*	H.Duman 1988, GAZI 2350	C6, Kahramanmaras,Turkey	37° 34' N	36° 56' E
21	*V. anagallis aquatica*	Uzunhisarcikli 1446, GAZI	B5 Kayseri: Korumaz Dagi,Turkey	38°45' N	35°26' E
22	*V. anagallis-aquatica* spp. *anagallis-aquatica*	A. Güner 6535, HUB	Rize camlihemsin yaylas, Turkey	40° 57' N	41° 1' E
23	*V. anagallis-aquatica*	M. Vural 1985,GAZI 2484	Kars,Arpaçay, Bardaklı,Turkey	40° 49' N	43° 28' E
24	*V. anagallis-aquatica* spp. *anagallis-aquatica*	A. Duran 1992, GAZI 1453	Çankırı, Atkaracalar Demirli,Turkey	40° 50' N	33° 03' E
25	*V. anagallis-aquatica*	C. Birden 1409 , GAZI	kırıkkale delice büyükavşar,Turkey	39° 53' N	32° 54' E
26	*V. anagallis-aquatica*	H. Pesmen 4527, HUB 25015	Kemer Kumluca yolu Ulupınar Antalya, Turkey	36°27'N	30° 25'E
27	*V. anagallis-aquatica*	H. Pesmen 442,3, HUB 25011	Adrasan Kumluca Antalya, Turkey	36°27'N	30° 25'E
28	*V. anagallis-aquatica* spp. *anagallis-aquatica*	ADK 22.05.2003, HUB 1282	Duzce, Akçakoca, Karatavuk Köyü, Turkey	36°27'N	30° 25'E
29	*V. anagallis-aquatica*	B. Mutlu 1391, HUB 24985	Isparta şarkikaraağaç kızıldağ Milli parkı, Turkey	38°02'N	31° 21'E
30	*V. anagallis-aquatica*	E.Vitek 07-1096 W	Armenia (I Didn't have photo to know the main locality)	?	?
31	*V. anagallis-aquatica*	Albach D3-1, OLD	Belek, Turkey	36°54' N	30°59' E
32	*V. anagallis-aquatica*	E. George 332, CIC 44236	Oregon, Malheur County,U.S.A.	42° 54° N	117° 16' W
33	*V. anagallis-aquatica*	D. Giblin 3912, SRP 47299	Idaho, Adams County, U.S.A.	45° 11 N,	116° 75' W
34	*V. anagallis-aquatica*	Joy Mastrogiuseppe 6350, ID119442	Washington, Kittitas County, U.S.A.	47°10' N	120°55' W
35	*V. anagallis-aquatica*	Susan Bernatas 172, ID 100006, ID119451	Colorado, Teller County,U.S.A.	38° 51' N	105° 10' W
36	*V. anagallis-aquatica*	Terry Taylor 108, UBC V224883	British Columbia,Canada	53° 43' N	127° 20' W
37	*V. anagallis-aquatica*	Neuffer, Hurka, Friesen 30.07.2004, OSBU 15652	Kirgisische Republik, Tien-shan, Schlucht kurpsi, enrlang des Flusses, Atoinoksky Gebirgskette, Kyrgyzstan	41° 30' N	72° 19' E
38	*V. anagallis-aquatica* var. *nilotica*	F. Yousef 6, Herbarium Fayoum university 19	Al Gharaq, ATSA, El- Fayoum, Egypt	29° 7'56 N	30°41'E

39	*V. anagalloides*	Danihelka 10/124 BRUN 617635	Moravia,Czech Republic	48° 51' N	16° 36' E
40	*V. anagalloides*	Danihelka 07/037 BRUN 597103	Moravia,Czech Republic	48° 51' N	16° 36' E
41	*V. anagalloides*	Danihelka 07/042 BRNU 59112	Moravia,Czech Republic	48° 45' N	16° 44' E
42	*V. anagalloides*	R. Scalone 29.06.08, OLD	S5, Tsodniskari, Georgia	41° 47' N	46° 10' E
43	*V. anagalloides*	R. Scalone 01.07.08, OLD	Telavi, Georgia	41°54' N	45° 22' E
44	*V. anagalloides*	R. Scalone 30.06.08, OLD	S5, Tsodniskari, Georgia	41° 47' N	46° 10' E
45	*V. anagalloides*	R. Scalone 01.07.08, OLD	Georgia	° ' N	° ' E
46	*V. anagalloides*	Ali A. Dönmēz 1559, HUB 25028	Turkey	° ' N	° ' E
47	*V. anagalloides*	Ekim 7793 GAZI	Bingöl - Elazig, Turkey	38 ° 68' N	39° 22' E
48	*V. anagalloides*	H.Duman 16.3.1992, GAZI	Mugla, Turkey	36 ° 58 ' N	28 ° 41' E
49	*V. anagalloides*	F. Özgökce 8424, VANF	Özalp, Van Province Turkey	38° 39' N	43° 59' E
50	*V. anagalloides* subsp. *anagalloides*	F. Yousef 9, Herbarium Fayoum university 20	Rasheed El-Mahmoudeya, Beheira,Egypt	31°19' N	30°26' E
51	*V. anagalloides* subsp. *heureka*	F. Yousef 11, Herbarium Fayoum university 21	El- Fayoum, Egypt	29°18'N	30° 50'E
52	*V. anagalloides* subsp. *heureka*	O. Karabacak 7537, VANF 12967	Van, Ercis, Turkey	38°14'N	43°23' E
53	*V. anagalloides* subsp. *taeckholmiorum*	F. Yousef 12, Herbarium Fayoum university 22	El- Fayoum, Egypt	29°20'N	30°48'E
54	*V. beccabunga* subsp. *beccabunga.*	F. Yousef 15, Herbarium Fayoum university23	Al Siauf, Alexandria Governorate,Egypt	31°13' N	30° 0'1E
55	*V. beccbunga* subsp. *beccabunga*	R. Scalone 27.06.08, OLD	Borjomi-Bakuriani-Akhalkalaki, Georgia	41° 47' N	43°28' E
56	*V. beccabunga* subsp. *abscondita*	F. Özgökce 7252, VANF	Özalp, Van Province, Turkey	38° 39' N	43° 59' E
57	*V. beccabunga* subsp. *beccabunga*	Murat 5807, VANF 5559	Gürpınar, Turkey	38°32' N,	43°41' E
58	*V. beccabunga* subsp. *abscondita*	Murat 7343, VANF 5557	Gürpınar, Turkey	38°32' N,	43°41' E
59	*V. beccabunga* subsp. *abscondita*	Murat 1686,VANF 2932	Van muradiye, Turkey. (Elevation 2600)	38° 59' N	43° 46' E
60	*V. beccabunga* subsp. *abscondita*	Murat 1686,VANF 2932	Van muradiye, Turkey. (Elevation 2660,)	38° 59' N	43° 46' E
61	*V. beccabunga* subsp. *abscondita*	Murat 4158, VANF 2928	Van muradiye, Turkey	38° 59' N	43° 46' E

62	*V. beccbunga* subsp. *beccabunga*	ü. Güler 1986, GAZI	Kirikkale, Keskin, Turkey	39° 40' N	33 ° 36 ' E
63	*V. beccabunga* subsp. *beccabunga*	A. Güner 2545, HUB 25056	Rize: Camlihemsin, Ayder, Turkey	41 ° 02 ' N	41° 01 ' E
64	*V. beccbunga* subsp. *beccabunga*	A. Güner 3686, HUB 25053	Rize: Camlihemsin, Ayder, Turkey	41 ° 02 ' N	41° 01 ' E
65	*V. beccabunga* subsp. *muscosa*	Neuffer, Hurka, Friesen 27.07.2004, OSBU 15560	Kirgisische Republik, Pamiro-Alai, Alaisky Gebirgskette,FlussnKok-Su/ Kyrgyzstan	39° 39' ' N	72° 08' E
66	*V. americana*	V. Wagner 14308, ID119478	Boundary County, Idaho, U.S.A.	48° 35' N	116° 46' W
67	*V. beccabunga* subsp. *beccabunga*	E.R. Manton 1608, UBC V238612	British Columbia, Canada	49° 93' N,	123° 36' W
68	*V. catenata*	Jaroslav 613771, BRNU 620813	Brehy, Czech Republic	50° 4' N	15° 34' E.
69	*V. catenata*	J. Danihelka 07/032, BRNU 597095	Moravia, Czech Republic	48° 45' N	16° 44' E
70	*V. catenata*	J. Danihelka 07/170, BRNU 596968	Kostelec, Czech Republic	49° 41' N	13° 00' E
71	*V. catenata*	David Giblin 2390, ID 161075, ID119504	Washington, Adams County, U.S.A.,	46° 89' N	119.19' W
72	*V. catenata*	John Corman s.n., MONT 79674	Montana, Beaverhead County, U.S.A.,	45° 21' N	112.63' W
73	*V. catenata*	W. Owen 85023, SRP 10066	Idaho, Owyhee County, U.S.A.	42° 60' N	116° 76' W
74	*V. catenata*	R. Dale Thomas 9721, WWB019512	Missouri, Shannon County, U.S.A.	37°12' N	91°26' W
75	*V. catenata* var. *catenata*	F. Yousef 1, Herbarium Fayoum university 24	El- Fayoum,Egypt	29°18'N	30°50' E
76	*V. catenata* subsp. *pseudocatenata*	F. Yousef 4, Herbarium Fayoum university 25	El- Fayoum, Egypt	29°18' N	30°50' E
77	*V. kaiseri*	F. Yousef 17, Herbarium Fayoum university 26	El- Fayoum, Egypt	29°18' N	30°50' E
78	*Veronica x lackschewitzii*	J. Danihelka 07/036, BRNU 597100	Moravia, Czech Republic	48° 47' N	16° 40' E
79	*Veronica x lackschewitzii*	J. Danihelka 07/036, BRNU 597101	Moravia,Czech Republic	48° 47' N	16° 40' E
80	*Veronica x lackschewitzii*	J. Danihelka 07/036, BRNU 597102	Moravia, Czech Republic	48° 47' N	16° 40' E
81	*V. anagallis-aquatica* spp. *lysimachioides*	O. Karabacak. 7538, VANF 12965	Van, Ercis, Turkey	38° 14' N	43° 23' E

82	*V. anagallis-aquatica* spp. *lysimachioides*	Murat 8926 VANF, 5562	Gürpınar, Turkey	38°32' N,	43°41' E
83	*V. anagallis-aquatica* spp. *lysimachioides*	S. Yildirimli 2359, HUB 24992	Ovacık, Tunceli, Turkey	39° 21 ' N	39° 12' E
84	*V. anagallis-aquatica* spp. *lysimachioides*	E.Akcicek 0638,HUB 25206	Erkenek, Turkey	37° 55 ' N	37° 56' E
85	*V. anagallis-aquatica* subsp.*michauxii*	O. Karabacak 5487, VANF 12966	Van, Ercis, Turkey	39°09' N	43° 22' E
86	*V. anagallis-aquatica* spp. *michauxii*	Demirkus 2152, HUB 24994	Erzurum: Oltu, Azort, Turkey	40° 32' N	41° 58' E
87	*V. anagallis-aquatica* spp. *michuaxii*	Demirkus 2740, HUB 24995	Kars: Göle, Turkey	40° 36' N	43° 03' E
88	*V. anagallis-aquatica* spp. *michauxii*	Demirkus 2955, HUB 24999	Kars: Posof, Turkey	41° 30' N	42°43' E
89	*V. anagallis-aquatica* spp. *michuaxii*	A. Güner 5186, HUB 24989	Erzurum: Ispir, Ikizdere arasi Turkey	40° 28' N	40° 59' E
90	*V. anagallis-aquatica* spp. *oxycarpa*	Murat 1786, VANF 2918	Muradiye İBesparmak, Turkey	38°52' N	43°46' E
91	*V. anagallis-aquatica* subsp.*oxycarpa*	F. Özgökce 4851,VANF	Özalp, Van Province, Turkey	38° 39' N	43° 59' E
92	*V. anagallis-aquatica* subsp.*oxycarpa*	M. Armagan 1973,VANF 5832	Guzeldere, Turkey	39° 61' N	41°4' E
93	*V. anagallis-aquatica* subsp.*oxycarpa*	H. Sumbül 2529, HUB 25305	Kazancı Köyü, Turkey	41°09' N	36° 07' E
94	*V. anagallis-aquatica* subsp.*oxycarpa*	A. Güner 4078, HUB 25000	Rize: Camlihemsin, Hisarcik-Siraköy arasi, Turkey	41 ° 02 ' N	41° 01 ' E
95	*V. anagallis-aquatica* subsp.*oxycarpa*	S. Yildirimli 3491, HUB 25001	Tunceli ovacık, karagöl, Turkey	39 ° 21' N	39 °12 ' E
96	*V. scardica*	B Motto 880, HUP 25361	Isparta, Turkey	37° 47'N	30° 30' E
97	*V. scardica* subsp. *africana*	F. Yousef 13, Herbarium Fayoum university 27	El- Fayoum, Egypt	29° 18' N	30° 50' E
98	*V. poljensis*	F. Öztürk 1081, VANF	Van Edremit, Turkey	38° 25' N	43° 15' E
99	*V. peregrina*	J. F. Smith 9734, SRP 39910	Idaho, Adams County,U.S.A.	44° 42' N	116° 32' W
100	*V. peregrina*	B. Ertter 19952, SRP 46473	Idaho, Ada County,U.S.A.	43° 638' N	116° 197' W