

# Taxonomic and nomenclatural notes on Pontic-Mediterranean coastal and some Australasian taxa of *Salsola* (*Chenopodiaceae*)

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**Abstract.** Current and historical views on taxonomy and nomenclature of Pontic-Mediterranean coastal and some Australasian taxa of *Salsola* (*Chenopodiaceae*) are analyzed. Taxonomic identity and nomenclature of several names applied and misapplied to members of the species group known in recent publications mainly as *Salsola pontica* (Pall.) Degen sensu lato are discussed. It is demonstrated that *Kali dodecanesicum* C. Brullo & al. is a later synonym of *Salsola squarrosa* Steven ex Moq., which appears to be the earliest species-rank name available for the whole Pontic-Mediterranean group of taxa. This group is represented by Western Mediterranean (*S. controversa* Tod. ex Lojac.), Eastern Mediterranean (*S. squarrosa* s. str.), and mainly Pontic (*S. pontica* s. str.) geographical races. Considering the blurred morphological and geographical limits between these taxa, they are better treated as three subspecies of *S. squarrosa*: subsp. *controversa* (Tod. ex Lojac.) Mosyakin, comb. nov., subsp. *squarrosa*, and subsp. *pontica* (Pall.) Mosyakin, comb. nov., respectively. It is demonstrated that *S. macrophylla* R. Br. (described from Australia) is not conspecific with any of Pontic-Mediterranean coastal taxa but is probably related to the currently recognized species *S. australis* R. Br. The identity of *S. brachypteris* Moq. (described from Java, Indonesia) remains uncertain but, judging from available evidence, it is most probably either related to or conspecific with *S. macrophylla*, or some other insufficiently known Australasian species. The problem of conflicting typifications and application of the name *S. caroliniana* Walter is briefly discussed; it is concluded that the name should be proposed for rejection. The need for further morphological, molecular phylogenetic, and phylogeographic studies of coastal Eurasian and Australasian species of *Salsola* is emphasized.

**Keywords:** *Salsola*, *Chenopodiaceae*, *Salsoloideae*, nomenclature, taxonomy, biogeography



This article is dedicated to Alfred [Christian Horace Bénédict Alfred] Moquin-Tandon (1804–1863), whose excellent publications on *Chenopodiaceae* remain valuable resources for all plant taxonomists studying this fascinating plant family [image in Public Domain: [https://fr.wikipedia.org/wiki/Alfred\\_Moquin-Tandon#/media/File:Alfred\\_Moquin-Tandon.jpg](https://fr.wikipedia.org/wiki/Alfred_Moquin-Tandon#/media/File:Alfred_Moquin-Tandon.jpg)]

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## Introduction

*Salsola* L. sensu lato (*Chenopodiaceae*: *Salsoloideae*: *Salsoleae*) is a notoriously complicated group from the taxonomic and phylogenetic viewpoints; it was recently split into numerous segregate genera supported by molecular phylogenetic and partly morphological and biogeographical evidence (see Akhani et al., 2007; Wen et al., 2010; Wen, Zhang, 2011; Voznesenskaya et al., 2013; Schüssler et al., 2017, and references therein). The process of generic rearrangements in that group is still far from being complete, and further taxonomic and nomenclatural changes are expected. Recent nomenclatural and taxonomic developments resulting from molecular phylogenetic studies and nomenclatural controversies (Akhani et al., 2014; Mosyakin et al., 2014) were summarized in several recent publications (e. g., Hernández-Ledesma et al., 2015; Mosyakin et al., 2017; Mosyakin, 2017, and references therein) and will not be repeated here.

I provide here a brief outline of the state of current knowledge of and remaining taxonomic and nomenclatural problems in just one the group of coastal taxa presumably native to the Mediterranean region and extending to the maritime areas of the Black and Caspian seas and the Sea of Azov. Several names

were applied and misapplied to these coastal plants, and some additional taxa were recently described or recognized. Morphologically similar plants, however, also occur in Australasia (where some might be aliens and some native plants: see Borger et al., 2008; Hrusa, Gaskin, 2008; Chinnock, 2010), North America (all aliens; see Mosyakin, 1996, 2003; Rilke, 1999; Hrusa, Gaskin, 2008; Ayres et al., 2009), and probably some other coastal regions of the world.

In her concise monograph of *Salsola* sect. *Salsola* sensu lato, Rilke (1999) recognized just two western European and Mediterranean coastal taxa of *Salsola*: *S. kali* L. sensu stricto (from the Atlantic and Baltic coasts) and *S. tragus* L. subsp. *pontica* (Pall.) Rilke (from shores of the Mediterranean, Black and Caspian seas, and the Sea of Azov). She also provided extensive lists of synonyms for each recognized taxon, in most cases with information on their types, and relevant nomenclatural references. The species included by Rilke (1999) in her "*Salsola* sect. *Salsola* sensu lato" (in fact, she recognized sect. *Salsola* sensu stricto, sect. *Sogdiana* Rilke, sect. *Androssowia* Rilke, and sect. *Kali* Dumort. with three subsections) are now placed in three genera: *Salsola* sensu stricto, *Soda* (Dumort.) Fourr. (Fourreau, 1869; see Mosyakin et al., 2017), and *Turania* Akhani & Roalson (Akhani et al., 2007). Additionally, one species (*S. rosacea* L.) probably fits in *Noaea* Moq. (see Akhani et al., 2014); as far as I am aware, no relevant combination has been validated yet.

The present article grew from my recent paper published with a modest intention to communicate a new record of the alien species *S. paulsenii* Litv. in Ukraine (Mosyakin, 2017). That article, despite being rather limited in its scope, contained a brief overview of species of *Salsola* sensu lato (now placed in *Salsola* sensu stricto, *Caroxylon* Thunb., *Climacoptera* Botsch., *Pyankovia* Akhani & Roalson, and *Soda*) occurring in Ukraine, and some notes on nomenclature and taxonomy of coastal *Salsola pontica* and related taxa.

#### **Taxa placed by Rilke (1999) in *Salsola tragus* subsp. *pontica*: a brief overview**

I already commented that "[s]ynonymization of the Australian taxon *S. macrophylla* with the Pontic (and eastern Mediterranean?) *S. pontica* (Pall.) Degen (= *Kali ponticum* (Pall.) Sukhor., *S. tragus* subsp. *pontica* (Pall.) Rilke) cursorily done by Rilke (1999) and later accepted by Galasso and Bartolucci (2014), who coined the combination *Kali macrophyllum* (R. Br.) Galasso & Bartolucci, seems to be at least questionable. Their identity has not been proven yet beyond doubt, and until such a proof is available, I prefer to use the name *S. pontica* for our plants" (Mosyakin, 2017: 410). I also

concluded that for establishing the priority name (or names) for the Pontic-Mediterranean coastal species (or a group of species) "the identity of two earlier species-rank names (*S. macrophylla* described from Australia and *S. brachypteris* Moq. described from Java, Indonesia) mentioned by Rilke (1999) in synonymy of her *S. tragus* subsp. *pontica* should be critically assessed as well" (Mosyakin, 2017: 410).

Following these preliminary conclusions, in this article I provide further results of my critical assessment of available evidence on the possible identity and application of the names *S. macrophylla* and *S. brachypteris* and on forgotten (and almost never taxonomically recognized until now) Mediterranean taxa *S. squarrosa* Steven ex Moq. and *S. controversa* Tod. ex Lojac. Additionally, it was necessary to re-evaluate available data on the name *S. caroliniana* Walter, a very obscure taxon described from North America in 1788. Two new nomenclatural combinations are proposed for Pontic-Mediterranean coastal taxa.

Herbarium acronyms are given following Thiers (2017—onward). Digital images of many herbarium specimens cited in the article are available online.

#### **What is *Salsola macrophylla* R. Br.?**

The type specimen of *Salsola macrophylla* (BM000016766, available at <https://plants.jstor.org/stable/10.5555/al.ap.specimen.bm000016766>) has the printed label on blue paper ("R. Brown, Iter Australiense, 1802–5. [Presented by direction of J.J. Bennett, 1876], No. 3082" [handwritten number added – S.M.] and the handwritten label ("2. *Salsola macrophylla*. prodr. 411. East Coast") attached to it. There is also a handwritten pencil text in the lower right corner of the sheet: "Brown's manuscript description of *Salsola macrophylla* was based on material collected on inner entrance [of] Thirsty Sound, Queensland [illegible text follows, scan cut – S.M.]". A recent map with a cross indicating the *locus classicus* and Rilke's identification label ("*Salsola tragus* L. subsp. *pontica*. Det./rev. S. Rilke. Kassel, 30.1.1999") are also attached. In my opinion, the specimen does not belong to *S. pontica* (sensu stricto or sensu lato).

The type specimen contains four plant fragments: two larger terminal branches (mounted on the left and right sides of the sheet), a middle portion of a branch (central lower part of the sheet), and a small terminal part of a branch (center of the sheet). All fragments are morphologically similar and thus there is no reason to suspect that they represent a mixed collection of different taxa. Larger branch fragments are rather thick; they belonged to a robust or probably even somewhat lignescent plant with erect or somewhat ascending

branches. Stem leaves are indeed rather long; fruits are mainly immature, but it looks like the fruits in nodes and lower parts of branches have short-winged or almost wingless tepals. However, a few fruits in the terminal part of the central branch fragment are better developed, and those fruits evidently have tepals with quite well-developed and broad wings. One fruit is especially well visible; as far as it can be seen in the high-resolution digital image, its two minor wings are rather large also, similar to those in *S. australis*. Judging from that evidence, in combination with morphological data provided by Borger et al. (2008) and Chinnock (2010), we can conclude that *S. macrophylla* most probably represents a rather tall-growing tropical and subtropical Australasian race, probably a lignescent short-lived perennial, which is related to *S. australis*. Its taxonomic status remains obscure, but data of Borger et al. (2008) and Chinnock (2010) indicate that some taxonomic recognition of that plant is to be expected (a separate species, or a subspecies of *S. australis*?), following further research. Consequently, the name *S. macrophylla* should not be applied to any native Pontic-Mediterranean coastal taxa of *Salsola*.

#### What is *Salsola brachypteris* Moq.?

Rilke (1999: 133) listed the names *Salsola brachypteris* Moq. and *S. kali* var. *brachypteris* (Moq.) Benth. (Bentham, 1870) in synonymy of her *S. tragus* subsp. *pontica* (Pall.) Rilke. If it is indeed so, the name *S. brachypteris* could be of priority for the whole Pontic-Mediterranean complex, or for some of its segregate species (if recognized). Because of that I studied in more detail the protologue, other relevant literature, and high-resolution images of original and some other specimens available online.

The name *S. brachypteris* appeared for the first time in the article by Moquin-Tandon (1835: 214) as *nomen nudum* because no description or diagnosis of the species was provided. The name was mentioned in the key to groups of species of *Salsola* and was included in the third group, with the following diagnosis: "Alæ crassiusculæ, brevissimæ (unguiformes). Ex.: *S. Soda* L., *S. collina* Pall. Ill., *S. brachypteris* Moq. in Belang." It is evident that this brief diagnostic statement was applied to several species, of which only three taxa were mentioned as examples. No diagnostic characters distinguishing *S. brachypteris* from other taxa have been provided. Consequently, the name remained invalid until 1840, when Moquin-Tandon (1840: 147) published the following description:

"28. *S. BRACHYPTERIS* (Moq. in Belang. fl. Pers.) herbacea suberecta glauca ramosa, ramis alternis

suberectis, foliis alternis elongatis semiteretibus spinoso-muricatis crassis carnosis rigidibus, floralibus vix dilatatis, bracteis folio florali multò brevioribus perigonio fructifero longioribus, floribus solitariis, alis minutissimis squamæformibus vix distinctis cartilagineis.

In insulâ Java.

Planta sicca fragilis. Folia caduca. Facies *S. Sodæ*. Fructus vix inflati. (v. s. ex itin. Belang.)".

Later Moquin-Tandon (1849: 189) provided an updated description and additional information on his species, including references to additional herbarium specimens seen ("v. s. in h. Belang. Mus. paris. DC. et Hook.").

The plant was collected in Java (now Indonesia) by Charles Paulus Bélanger (1805–1881) during his travels in Europe, the Caucasus, Persia, India, Indonesia, and some other regions in 1825–1829, described in his *Voyages aux Indes orientales par le nord de l'Europe, les provinces du Caucase, la Géorgie, l'Arménie et la Perse, suivi de détails topographiques et autres sur le Pégou, les îles de Java, de Maurice et de Bourbon, sur le Cap de Bonne-Espérance et Sainte-Hélène, pendant les années 1825, 1826, 1827, 1828 et 1829*; see Ross (1964) for complicated bibliographic details. In 1828 Bélanger visited Java, mainly areas of Batavia (now Jakarta) and Buitenzorg (now Bogor), and some adjacent islands (Hooker, 1836).

In subsequent publications *Salsola brachypteris* was usually mentioned as a synonym of *S. kali* sensu latissimo (e. g., Boerlage 1900: 38; Backer, 1949: 106), and only rarely it was recognized as a species (e. g., Miquel, 1855: 1022; Hooker, 1859: xlvi).

I traced online the original specimen from Java that was certainly studied in detail by Moquin-Tandon and should be considered the type (P00799151; available online from <https://science.mnhn.fr/institution/mnhn/collection/p/item/p00799151>). The sheet contains two plant fragments (one mounted in the center of the sheet, another much smaller fragment in the envelope in the upper right corner), the labels, and additional annotation slips on which Moquin-Tandon wrote a description (which was evidently used for preparing the published descriptions) and analytical drawings illustrating diagnostic characters of the species. The yellow-paper label in the lower left corner of the sheet contains the following text: "*Salsola brachypteris* Moq. Java N<sup>o</sup>. 4. M. Bèlangé [Bélanger – S.M.]".

There are several other available specimens in P identified as *S. brachypteris* (e.g., P05196083, image available from <https://science.mnhn.fr/institution/mnhn/collection/p/item/p05196083>; P00256012, <https://>

science.mnhn.fr/institution/mnhn/collection/p/item/p00256012; P00256013, <https://science.mnhn.fr/institution/mnhn/collection/p/item/p00256013>), but the two last cited specimens were collected in Timor, and they are morphologically different from the type specimen. The sheet P05196083 contains two gatherings, one from Timor [four fragments, left side of the sheet: "Herb. Mus. Paris. *Salsola brachyptera* Moq. (an differt ab *australi* Br.?) I-le Timor"] and one from Java (one broken branch, most probably a fragment of the type P00799151: "Herbarium Moquinianum. *Salsola brachypterus* Moq. Java (Belangé, no. 4) A. Moq.-Tand.", with a characteristic signature of Moquin-Tandon). Both specimens have small slips "Herb. Al. de Bunge" attached at larger labels. Most probably these plant fragments were provided to Bunge by Moquin-Tandon or some other colleague, and later returned to the P herbarium through the herbarium of E. Cosson (see the small label in the upper right corner of the sheet). All mentioned specimens from Timor evidently are members of *Salsola* sect. *Salsola* ("*S. kali* – *S. tragus* – *S. pontica* – *S. australis* etc. aggregate" in the widest possible sense) and are morphologically different from the type from Java (P00799151, formally designated here as the lectotype of *Salsola brachypterus* Moq., because of the existence of the second specimen of Moquin-Tandon in P: P05196083, right-hand plant, possibly a fragment of the type).

After studying the high-resolution image of the type of *S. brachypterus*, I am certain that there is not even a slight possibility that this name is applicable to any native Pontic-Mediterranean taxon of the *Salsola pontica* group. First, judging from the available larger fragment of P00799151, the plant itself was probably either a robust annual or a short-lived perennial, somewhat lignescent at base. Leaves were probably easily detached at base, falling off (caducous) at maturity/senescence or under unfavorable environmental conditions (changes of draught and rainy seasons?), which was properly noted by Moquin-Tandon (1840, 1849) in the original and updated descriptions. Most importantly, the branches and bases of lower leaves in that fragment are condensed, positioned very close to each other, with leaves subopposite or even opposite (!). That leaf arrangement is very peculiar, almost never occurring in most species of *Salsola* sect. *Salsola*, and it explains why Moquin-Tandon (1835, 1840, 1849) so consistently compared his plant to *Salsola soda* L. (now *Soda inermis* Fourr.).

Thus, the characters observed in the plant fragments of the type specimen and data of the protologue and later publications indicate that *S. brachypterus* is definitely not conspecific with any native Pontic-

Mediterranean taxon (either sensu lato or sensu stricto). It might be related to *S. macrophylla* (see above), a predominantly tropical Australasian (or exclusively Australian?) race of the *S. australis* aggregate, which is in need of further research. It should be noted that some Australian specimens of *Salsola* also have that very peculiar branching habit, with subopposite or opposite arrangement of lower branches and leaves (see, for example, a specimen of "*S. kali* var. *strobilifera* Benth."; K000899590, image available from: <https://plants.jstor.org/stable/viewer/10.5555/al.ap.specimen.k000899590>). Many intriguing questions about that taxon remain, but, in any case, we can safely exclude the name *S. brachypterus* from our further considerations on appropriate names to be applied to Pontic-Mediterranean taxa.

In my opinion, the amazing morphological diversity of Australian *Salsola* does not fit just one native species now recognized as *S. australis*. Judging from specimens and images I have seen, and from other available evidence (Mueller, 1891; Wilson, 1984; Rilke, 1999; Borger et al., 2008; Chinnock, 2010, etc.), there are at least five native Australian species of *Salsola* (plus probably one or two introduced ones?). An article is under preparation (Mosyakin et al., in progress), in collaboration with Australian colleagues.

#### **The problem of *Salsola caroliniana* Walter**

It is now evident that the names *S. macrophylla* and *S. brachypterus* should not be applied to native Pontic-Mediterranean taxa. However, before proposing taxonomic and nomenclatural solutions for the coastal Pontic-Mediterranean species complex of *Salsola*, we should consider in more detail another earlier name, *S. caroliniana* Walter, which may compete in terms of priority with the names of Pontic-Mediterranean taxa.

*Salsola caroliniana* was described by Thomas Walter in *Flora Caroliniana* (Walter, 1788: 111), one of the earliest North American floristic and taxonomic publications consistently applying binomial nomenclature and Linnaean taxonomy. The real identity of that species name remains uncertain (see Botschantzev, 1974; Tzvelev, 1993, 1996; Mosyakin, 1996, 2003; Rilke, 1999, and references therein). The standing type of *S. caroliniana* (Botschantzev, 1974: 614; Rilke, 1999) is a small fragment of a *Salsola* branch mounted on page 93 (specimen 93-F) of the *Walter Herbarium* folio volume kept at BM (image available from *Botanica Caroliniana – Texts, Data, and Images* at [http://folio.furman.edu/botcarweb/indices?urn=urn:cite:fufolioimg:BotCarWalter.walter\\_v\\_93\\_01135](http://folio.furman.edu/botcarweb/indices?urn=urn:cite:fufolioimg:BotCarWalter.walter_v_93_01135)). It definitely belongs to the *S. kali* – *S. tragus* – *S. pontica* aggregate, but is hardly identifiable precisely as a concrete species or subspecies of that group.

It was commonly assumed that specimens mounted in the *Walter Herbarium* folio are types and other original specimens used by Walter for descriptions of new taxa in his *Flora Caroliniana*, but that view was challenged by Ward (2006, 2007), who claimed that most specimens from the *Walter Herbarium* cannot be regarded holotypes and in most cases are not suitable for designation of lectotypes. He later proposed the "neotype" for *S. caroliniana* (Ward, 2008: 483), the specimen collected in South Carolina in 1939 (GH00247988, image available from <https://plants.jstor.org/stable/10.5555/al.ap.specimen.gh00247988>). That "neotypification" is, however, ineffective because the earlier typification has been disregarded (Art. 9.19 of ICN: McNeill et al., 2012); it is also evidently in conflict with the protologue (Art. 9.19(b) of ICN: McNeill et al., 2012). The name *S. caroliniana* is not in current use, and was used rather inconsistently in the past. Considering these and some other arguments, especially the history of misapplication of the name, its uncertain taxonomic identity, and conflicting typifications, I believe that the best solution is to reject the name *S. caroliniana*. The relevant nomenclatural proposal has been prepared (Mosyakin, manuscript submitted to *Taxon*); it contains more arguments and detailed information on the nomenclatural problem of *S. caroliniana*.

#### What is *Kali dodecanesicum* C. Brullo & al.?

Brullo et al. (2015b) described from the Dodecanese archipelago (Greece; holotype from Rhodes) a new species, *Kali dodecanesicum*, and proposed to distinguish their new taxon and *Kali ponticum* (*Salsola pontica*) using the following characters mentioned in the key (Brullo et al., l.c.: 67):

*Kali dodecanesicum*: Plant yellowish-green, prostrate, with branches prostrate–ascending, perianth 2.5–3.0 mm long, anthers 2 mm long, fruiting perianth 4.0–4.5 in diameter with wings 0.5–1.0 mm wide.

*Kali ponticum*: Plant green to green-glaucous (often tinged with reddish), erect with branches ascending, perianth 2.0–2.2 mm long, anthers 0.8–1.4 mm long, fruiting perianth 3.0–3.5 in diameter with wings 0.2–0.4 mm wide or with tubercles only (at least in Israel).

However, judging from my experience with living plants observed in southern Ukraine (shores of the Black Sea from Odessa Region to Crimea) and herbarium specimens consulted mainly in KW, LE, and in several other herbaria, plants of *S. pontica* from Ukraine are normally (or at least quite often) yellowish-green or light green; dark green individuals sometimes also occur, but they seem to be less common. Wings are usually short

or barely developed, but this character is very variable and fruits with winged tepals (with wings up to 1 mm wide) sometimes occur in middle and upper parts of branches. Both erect and prostrate-ascending plants were observed in *S. pontica*, but the growth habit in this taxon greatly depends on environmental conditions. Besides, Pallas (1803: 37) mentioned in the protologue that his *S. kali* var. *pontica* is a prostrate plant (at least when young): "*Planta* annua patentissima, diffusa, ab imo ramosissima, junior prostrata..."

Brullo et al. (2015b: 67) also indicated that, in their understanding, *K. ponticum* has "stems and leaves green, glabrous or subglabrous..."; but Pallas (1803: 37) reported that the whole plant is slightly hispid-pilose ("...tota planta subpiloso-aspera..."). Both glabrous (common) and somewhat hispid plants of *S. pontica* occur in the Black Sea area, quite often in the same populations. Because of that Tzvelev (1993: 82) reserved the name *S. pontica* var. *pontica* for hispid plants and proposed var. *glabra* Tzvelev for glabrous forms of that species, which are more common, at least along northern shores of the Black Sea.

Thus, the diagnostic characters given for *K. dodecanesicum* by Brullo et al. (2015b) seem to be rather elusive and/or variable. However, the rather short, inflated and prominently succulent bracts/bracteoles abruptly contracted into thin and quite long spines reported for *K. dodecanesicum* and illustrated in Brullo et al. (2015b: 62, Fig. 1; 64, Fig. 3) are normally not peculiar to specimens of *S. pontica* from northern shores of the Black Sea. The reported morphological differences between the mainly Pontic (also occurring in some localities in the Eastern Mediterranean area) and the eastern Mediterranean races are better suited for subspecies rather than two separate species.

But is *Kali dodecanesicum* really a new species?

At the end of his treatment of *Salsola* in De Candolle's *Prodromus*, Moquin-Tandon (1849: 190) provided a list (with descriptions and other data) of some insufficiently known species ("Species non satis notae"), which he, although, accepted. One of such species was *Salsola squarrosa* Steven ex Moq., for which the following information was given:

"40. *S. SQUARROSA* (Stev. obs. ined. in herb. Willd. 1840), foliis teretiusculis oblongis mucronatis... — In ins. Naxo. Folia carnosa, reflexa. Flores axillares. — An *S. Kali* varietas?"

As we see, the species was known to Moquin-Tandon by only one collection in the Willdenow herbarium in Berlin (B), which was annotated by Ch. Steven. A short diagnostic description has been published as well, so

there is no doubt that the name *S. squarrosa* is valid. The plant was collected in the island of Naxos (Greece).

There is just one specimen in B (B-Willd, Willdenow Herbarium) matching the protologue of *S. squarrosa* (B-W-05383010, digital images available from <http://herbarium.bgbm.org/object/BW05383010> [image ID: 325010] and <http://plants.jstor.org/stable/10.5555/al.ap.specimen.b%20-w%2005383%20-01%200>). The text on the Willdenow Herbarium folder follows: "Pentandria Digynia / *Salsola squarrosa* / foliis teretiusculis oblongis / carnosis mucronatis reflexis / floribus axillaribus / Habitat in insula Naxos". As we see, that text closely matches the published description (Moquin-Tandon, 1849: 190). The herbarium sheet bears two labels: [Label 1] "*Salsola Kali* L. var. (v. Pounge)" and [Label 2] "In insula Naxia (Schwartz)". There are also the following texts written directly on the sheet: "*S. squarrosa*. S." (top right corner) and "Schwartz Centuria. W." (bottom right corner). The plant fragment is ca. 17 cm long; the plant is yellowish-green, slightly hispid or papillose; flowers/fruits condensed; bracts and bracteoles short (probably prominently succulent and inflated when fresh), abruptly contracted into long subulate spines.

Judging from the high-resolution digital image of the type (holotype) specimen, the brief original description (Moquin-Tandon, 1849: 190), and other available evidence (including the obvious geographic proximity of *loci classici*), there should be no doubt that *Salsola squarrosa* is the priority name for the taxon described later as *Kali dodecanesicum* (Brullo et al., 2015b).

Moreover, *S. squarrosa* seems to be the earliest available binomial applicable for the whole Mediterranean coastal complex of races known earlier as *S. pontica*, *S. controversa*, and under the misapplied names *S. tragus* auct. and *Kali macrophylla* sensu Galasso & Bartolucci (2014: 83; non *S. macrophylla* R. Br.). Consequently, if just one native coastal species of *Salsola* is recognized in the Pontic-Mediterranean area, it should be called *S. squarrosa* (sensu lato). However, before proposing a nomenclatural and taxonomic solution, it is necessary to consider another name applicable to Mediterranean plants, *S. controversa*.

#### **What is *Salsola controversa* Tod. ex Lojac.?**

In my recent article (Mosyakin, 2017: 410) I commented that the coastal species of *Salsola* from the Black Sea area (which I accepted as *S. pontica*) "belongs to a problematic group of Pontic-Mediterranean coastal taxa currently known as *S. pontica* (either sensu lato or sensu stricto) and *Kali dodecanesicum* C. Brullo, Brullo, Giusso & Ilardi (see Brullo et al. 2015b). No nomenclatural combination in *Salsola* is currently

available for the latter taxon; however, it is quite possible that it is in fact conspecific with *S. controversa* Tod. ex Lojac. described from Sicily (Lojacono Pojero, 1904: 271–272), which in that case will be the correct name for this Mediterranean species (if it is indeed specifically distinct from *S. pontica*), or for the whole Pontic-Mediterranean coastal group (if treated as one species, incl. *S. pontica*"). I also indicated that *S. controversa* was validated by Lojacono Pojero (1904: 271–272), not by Nyman (see also Rilke, 1999; Domina et al., 2014). This species was firmly forgotten even by Italian authors (probably because its name was considered invalid), and only occasionally *S. controversa* was mentioned in literature, mainly as a synonym of *S. kali* or *S. tragus* (see, e.g., Casu, 1910). It has not been mentioned at all in recent Italian publication on *Salsola* sensu lato (Brullo et al., 2013, 2015a, b) and in the inventory of plant species described from Italy and their *loci classici* (Peruzzi et al., 2015).

Formally, all herbarium specimens distributed by Todaro under No. 1088 (now present in many herbaria) are syntypes of *S. controversa*. However, my analysis of high-resolution images of various specimens available online (in particular, K000899539, K000899540, P05157673, P05344327, etc., most of them available from JSTOR Global Plants: <https://plants.jstor.org>; and especially specimens from PAL, see below) indicate that Todaro's plants deposited in various collections are rather diverse morphologically. They in fact represent either a mixed collection or several gatherings, and belong to three entities: (1) the coastal taxon (*S. controversa* sensu stricto), (2) *S. tragus*, and (3) forms morphologically intermediate between these taxa. Because of that, proper typification of *S. controversa* becomes a crucial issue, especially if we intend to preserve the original application of the name established by its validating author, Lojacono Pojero (1904).

Sukhorukov (2014: 332) listed in synonymy of *Kali pontica* the name "*Salsola controversa* Todaro ex Nym., Consp. Fl. Eur. 3: 631 (1881)" and designated its lectotype, with the following citation: "Lectotypus (Sukhorukov, designated here): Palermo, in arenosis maritimis, IX. [sensu anno], Todaro 1088 (K-000899539 !, iso — K-000899540 !)" (here "sensu anno" is evidently an error, probably meaning "sine anno", "no year indicated"). In my opinion, this lectotype designation was a premature decision, because of the considerations that follow. First, Sukhorukov probably has not seen the real protologue and original description of *S. controversa*, because *Flora Sicula* (Lojacono Pojero, 1904) is not cited anywhere in his book (Sukhorukov, 2014), while no description of the species was provided by Nyman, who simply cited the name *S. controversa*

in synonymy. Second, the sheet K000899539 (image available from: <https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000899539>) evidently contains two morphologically different plant fragments: the left-hand plant is pale green to yellowish green (probably the living plant was light green to yellowish green) while the right-hand fragment is dark green. The left-hand plant has better developed (more mature) fruits than the right-hand one, which is only flowering. Both plant fragments have rather lax inflorescences, with flowers/fruits not much condensed on branches.

Lojacono Pojero (1904: 272) in his detailed original description reported that his species is glaucous-green ("...glaucescens..."), with flowers arranged in very dense and large panicle-like inflorescences ("...floribus densissimis secus ramulos alternos paniculatos crebris magnis fere contiguis..."), and with strongly angular branches ("...ramis <...> omnibus valide angulatis..."). Thus, morphological characters of the pale green fragment (left-hand plant, K000899539) are evidently in conflict with the protologue. The taxonomic identity of the right-hand (immature) fragment is problematic, especially if we take into consideration that the specimens distributed by Todaro under No. 1088 represent a mixed collection or several gatherings of rather diverse plants belonging to two or three entities (see above). However, the right-hand fragment is morphologically very similar to plant fragments mounted on the sheet K000899540 (reported as an isolectotype by Sukhorukov, 2014). Plant fragments on K000899540 (image available from <https://plants.jstor.org/stable/10.5555/al.ap.specimen.k000899540>) have tepals with rather well developed wings and, in my opinion, definitely belong to *S. tragus* (as well as P05157673: <https://science.mnhn.fr/institution/mnhn/collection/p/item/p05157673>; and some other specimens of Todaro No. 1088). Characters of the right-hand fragment of K000899539 also contradict the protologue; in particular, in the shape of inflorescences (terminal branches with flowers/fruits are not particularly dense and not "paniculate"); the plant seems to be very sparsely short-papillose, while Lojacono Pojero reported his species as glabrous.

The specimen K000899539 has an additional label (in the lower right corner of the sheet) "Herbarium Kewense. Herbarium Churchillianum Proprium. Bequeathed, 1906" indicating that it was added to the Kew herbarium in 1906, after the death of G.C. Churchill. He was donating parts of his private collection to K starting from 1884, and in 1892 "in connection with a will he thought of making, he announced the intention he had formed of bequeathing to Kew his European herbarium" (Hemsley, 1906: 386). The main European part of his private herbarium

was accumulated for many years, but already in 1899 Churchill was unable to add specimens to his collection because of his failing health (see relevant details in Hemsley, 1906). Thus, it is evident that Lojacono Pojero has never seen the specimen K000899539 (the lectotype designated by Sukhorukov, 2014) and did not use it when he was preparing the validating description of *S. controversa* in *Flora Sicula*. In contrast, Lojacono Pojero evidently used the collections of the *Herbarium Siculum* in Palermo (now *Herbarium Mediterraneum Panormitanum*, PAL) until 1913, when he left Palermo (Domina et al., 2014).

In view of the new information about patterns of diversity of coastal Mediterranean taxa and the need for precise application of the name *S. controversa*, there are two possible ways of coping with the uncertain situation caused by Sukhorukov's lectotypification. The first option is to accept his lectotypification, despite its conflict with the protologue; in that case, a second-step lectotypification (right-hand immature fragment?) with simultaneous epitypification is needed. However, in my opinion, **both plants** on the sheet K000899539 do not match the protologue in many of their morphological characters: the plant fragments are not glaucous, their flowers/fruits are not condensed on the branches and not arranged in very dense and large panicle-like inflorescences, and branches are not strongly angular. At least one (right-side) plant fragment most probably belongs to *S. tragus*. Thus, the only reasonable option under Art. 9.19 of ICN (McNeill et al., 2012) is to have that lectotypification (Sukhorukov, 2014) superseded because of its evident and serious enough conflict with the protologue (Art. 9.19(b) of ICN: McNeill et al., 2012) and to select another lectotype among several specimens from PAL, which perfectly match the original detailed description provided by Lojacono Pojero (1904).

There are four Todaro's specimens in PAL available online and identified as *S. controversa*, all with printed labels (No. 1088). A PAL specimen on sheet with ID No. 58916 (image available from: [http://147.163.105.223/herbarium\\_vdetails\\_en2.asp?idmode=simple&id=71449](http://147.163.105.223/herbarium_vdetails_en2.asp?idmode=simple&id=71449)) is immature; the plant has narrow, almost filiform leaves and most probably belongs to *S. tragus sensu stricto*. Morphological characters of plant fragments of three specimens correspond to the characters given in the protologue. The specimen with PAL ID No. 58918 ([http://147.163.105.223/herbarium\\_vdetails\\_en2.asp?idmode=simple&id=71451](http://147.163.105.223/herbarium_vdetails_en2.asp?idmode=simple&id=71451)) is designated here as the lectotype of *S. controversa* (see below). Two other specimens (PAL ID Nos. 58915 and 58917; see links to images below) are considered isolectotypes.

### A taxonomic and nomenclatural solution for Pontic-Mediterranean coastal taxa of *Salsola*

Unfortunately, Brullo et al. (2013, 2015a, b) and almost all other authors who recently commented on taxonomy of Pontic-Mediterranean taxa of *Salsola* (e. g., Sukhorukov, 2014) did not mention an interesting article on phylogeography of some European coastal plants (Kadereit et al., 2005), partly based on results from the dissertation by Arafeh (2005). That article provided noteworthy data and conclusions on the genetic and geographical differentiation of five coastal species, including the taxon listed under the name *Salsola kali*. Their molecular phylogeography results based on AFLP evidence clearly indicate that three rather distinct but closely related lineages of coastal *Salsola* exist in the Pontic-Mediterranean area. Unfortunately, Kadereit et al. (2005) refrained from discussing taxonomy of the taxa involved and made no attempt to match the revealed lineages with any existing names in *Salsola*.

The studied taxon (in fact, taxa) was accepted as *S. kali* sensu latissimo, including at least five entities corresponding, in my opinion, to *S. kali* sensu stricto (Atlantic and Baltic race), *S. tragus* (inland weedy race), *S. controversa* (western Mediterranean), *S. squarrosa* (= *Kali dodecanesicum*; eastern Mediterranean), and *S. pontica* sensu stricto (mainly Pontic, with extensions to the eastern Mediterranean area). Following these molecular results and the taxonomic discussion provided above, one may prefer to accept *S. controversa*, *S. squarrosa*, and *S. pontica* as separate species. However, considering the evident genetic similarity (Kadereit et al., 2005) and blurred morphological and geographical borders of these three coastal taxa, I prefer to treat them as three subspecies of *S. squarrosa* (see new combinations below).

Further detailed morphological, molecular phylogenetic, and phylogeographic studies of coastal Eurasian and all Australasian species of *Salsola* are needed, preferably in comparison with data on morphologically diverse *S. tragus* and some other Eurasian inland taxa. Reliable morphological characters of the discussed taxa should be further specified using a wider geographical coverage and the population-based approach. It should be also taken into consideration that plants of *S. tragus* quite often co-occur with *S. squarrosa* sensu lato in maritime coastal habitats (at least in the Black Sea area, but probably also in the Mediterranean region: see comments above, under *S. controversa*), where they often develop rather thick and fleshy leaves, and can be thus confused with the coastal taxa.

### Nomenclature and new combinations

I recognize here three subspecies of coastal Pontic-Mediterranean taxa known in recent publications under many properly applied and misapplied names, such as *Salsola pontica*, *S. kali* subsp. *pontica*, *S. tragus* subsp. *pontica*, *Kali ponticum*, *K. dodecanesicum*, *S. tragus* auct., p.p., excl. pl. etc. (see Iljin, 1936, 1952; Tzvelev, 1993, 1996; Mosyakin, 1996, 2003; Rilke, 1999; Sukhorukov, Akopian, 2013; Sukhorukov, 2014; Brullo et al., 2013, 2015a, b, and references therein).

*Salsola squarrosa* Steven ex Moq. in DC., Prodr. 13(2): 190. 1849. (Moquin-Tandon, 1849: 190).

**Type** (holotype, the only specimen cited in the protologue): [Greece, Naxos] "in ins. Naxo"; Herb. Willd. 5383 (B-W-05383010, images available from <http://herbarium.bgbm.org/object/BW05383010> [image ID: 325010] and <http://plants.jstor.org/stable/10.5555/al.ap.specimen.b%20-w%2005383%20-01%200>).

#### *Salsola squarrosa* subsp. *squarrosa*

**Type**: see above.

= *Kali dodecanesicum* C. Brullo, Brullo, Giusso & Iardi, Phytotaxa 218(1): 63. 2015. (Brullo et al., 2015b: 63).

**Type** (holotype): "GREECE. Dodecanese: Rhodes, sandy coast near Kattavia, 35° 58' 35" N, 27° 44' 25" E, 22 August 2013, *S. Brullo & V. Iardi s.n.*" (CAT).

*Salsola squarrosa* subsp. *controversa* (Tod. ex Lojac.) Mosyakin, **comb. nov.**

**Basionym**: *Salsola controversa* Tod. ex Lojac., *Fl. Sicula* 2(2): 271. 1904. (Lojacono Pojero, 1904: 271, description on page 272).

**Type** (lectotype, designated here): "Todaro. Flora Sicula Exsiccata. *Salsola controversa* Tod. *enum. fl. sic. ined.* In arenosis maritimis—Palermo. Septembri. n. 1088. Legit Todaro" (PAL ID No. 58918, image available from [http://147.163.105.223/herbarium\\_vdetails\\_en2.asp?idmode=simple&id=71451](http://147.163.105.223/herbarium_vdetails_en2.asp?idmode=simple&id=71451)). **Isolectotypes**: PAL ID No. 58915 ([http://147.163.105.223/herbarium\\_vdetails\\_en2.asp?idmode=simple&id=71448](http://147.163.105.223/herbarium_vdetails_en2.asp?idmode=simple&id=71448)); PAL ID No. 58917 ([http://147.163.105.223/herbarium\\_vdetails\\_en2.asp?idmode=simple&id=71450](http://147.163.105.223/herbarium_vdetails_en2.asp?idmode=simple&id=71450)); P05344327 (<https://science.mnhn.fr/institution/mnhn/collection/p/item/p05344327>).

The earlier lectotypification (Sukhorukov, 2014: 332) is superseded following Art. 9.19(b) of ICN (McNeill et al., 2012).

*Salsola squarrosa* subsp. *pontica* (Pall.) Mosyakin, **comb. nov.**

**Basionym**: *Salsola kali* L. var. *pontica* Pall., Ill. Pl.: 37. 1803. (Pallas, 1803: 37).



**Type** (lectotype, designated by Rilke, 1999: 133): [Ukraine, Crimea, Sudak] "Sudagh. Herb. Pallas" (BM000016635, image available from: <https://plants.jstor.org/stable/10.5555/al.ap.specimen.bm000016635>).

≡ *Salsola ruthenica* Pjin subsp. *pontica* (Pall.) Pjin, Sorn. rast. SSSR [Сорные растения СССР] 2: 140. 1934. ≡ *S. pontica* (Pall.) Pjin, Fl. URSS [Флора СССР] 6: 212. 1936, *nom. inval.* ≡ *S. pontica* (Pall.) Degen, Fl. Velebit. 2: 47. 1937. ≡ *S. kali* L. subsp. *pontica* (Pall.) Mosyakin, Ann. Missouri Bot. Gard. 83: 389. 1996. ≡ *S. tragus* L. subsp. *pontica* (Pall.) Rilke, Biblioth. Bot. 149: 133. 1999. ≡ *Kali ponticum* (Pall.) Sukhor., Novosti Sist. Vyssh. Rast. [Новости систематики высших растений] 42: 106. 2011, as "*pontica*". ≡ *Kali tragus* (L.) Scop. subsp. *ponticum* (Pall.) Mosyakin, Ukrayins'k. Bot. Zhurn. [Український ботанічний журнал] 69(3): 395. 2012, as "*pontica*".

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Мосякін С.Л. Таксономічні та номенклатурні нотатки про понтично-середземноморські та деякі австралазійські таксоны *Salsola* (*Chenopodiaceae*). Укр. бот. журн., 2017, 74(6): 521–531.

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Проаналізовано сучасні та історичні погляди щодо систематики та номенклатури понтично-середземноморських та деяких австралазійських таксонів *Salsola* (*Chenopodiaceae*). Обговорюється таксономія та номенклатура декількох назв, які раніше застосовувалися до представників видової групи, що здебільшого була визнана у недавніх публікаціях під назвою *Salsola pontica* (Pall.) Degen s. l. Показано, що *Kali dodecanesicum* C. Brullo & al. є синонімом раніше описаного виду *Salsola squarrosa* Steven ex Moq.; остання назва є пріоритетною у ранзі виду для усієї понтично-середземноморської групи таксонів. Ця група представлена західносередземноморською (*S. controversa* Tod. ex Lojac.), східносередземноморською (*S. squarrosa* s. str.) та переважно чорноморсько-каспійською (*S. pontica* s. str.) географічними расами. Враховуючи нечіткі морфологічні та географічні межі між цими таксонами, їх доцільно розглядати як три підвиди виду *S. squarrosa*: subsp. *controversa* (Tod. ex Lojac.) Mosyakin, comb. nov., subsp. *squarrosa*, та subsp. *pontica* (Pall.) Mosyakin, comb. nov., відповідно. Показано, що вид *S. macrophylla* R. Br. (описаний з Австралії) є відмінним від усіх понтично-середземноморських прибережних таксонів; натомість він, очевидно, споріднений з нині визнаним

видом *S. australis* R. Br. Ідентичність *S. brachypteris* Moq. (описаний з о. Ява, Індонезія) лишається невизначеною; судячи з наявних даних, цей таксон, ймовірно, споріднений з *S. macrophylla* або з деякими іншими недостатньо відомими австралазійськими видами. Стисло розглянута проблема типіфікації та застосування назви *S. caroliniana* Walter; зроблено висновок, що цю назву слід запропонувати до відхилення. Наголошено на потребі проведення подальших морфологічних, молекулярно-філогенетичних та філогеографічних досліджень приморських євразійських та австралазійських видів *Salsola*.

**Ключові слова:** *Salsola*, *Chenopodiaceae*, *Salsoloideae*, номенклатура, систематика, біогеографія

Мосякин С.Л. Таксономические и номенклатурные заметки о понтично-средиземноморских и некоторых австралазийских таксонах *Salsola* (*Chenopodiaceae*). Укр. бот. журн., 2017, 74(6): 521–531.

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Проанализированы современные и исторические взгляды на систематику и номенклатуру понтично-средиземноморских и некоторых австралазийских таксонов рода *Salsola* (*Chenopodiaceae*). Обсуждены систематика и номенклатура нескольких названий, которые ранее применялись к представителям видовой группы, которая признавалась в недавних публикациях преимущественно под названием *Salsola pontica* (Pall.) Degen s. l. Показано, что *Kali dodecanesicum* C. Brullo & al. является синонимом ранее описанного вида *Salsola squarrosa* Steven ex Moq.; последнее название является приоритетным в ранге вида для всей понтично-средиземноморской группы таксонов. Эта группа представлена западносредиземноморской (*S. controversa* Tod. ex Lojac.), восточносредиземноморской (*S. squarrosa* s. str.) и преимущественно черноморско-каспийской (*S. pontica* s. str.) географическими расами. Учитывая нечеткие морфологические и географические границы между этими таксонами, их целесообразно рассматривать как три подвида вида *S. squarrosa*: subsp. *controversa* (Tod. ex Lojac.) Mosyakin, comb. nov., subsp. *squarrosa*, и subsp. *pontica* (Pall.) Mosyakin, comb. nov., соответственно. Показано, что вид *S. macrophylla* R. Br. (описан из Австралии) отличается от всех понтично-средиземноморских прибрежных таксонов; он, очевидно, является родственным признанному сейчас виду *S. australis* R. Br. Идентичность *S. brachypteris* Moq. (описан с о. Ява, Индонезия) остается неопределенной; судя по имеющимся данным, этот таксон, вероятно, родственен *S. macrophylla* или некоторым другим недостаточно изученным австралазийским видам. Кратко рассмотрена проблема типификации и применения названия *S. caroliniana* Walter; сделан вывод о том, что это название следует предложить номенклатурно отвергнуть. Отмечена необходимость проведения дальнейших морфологических, молекулярно-филогенетических и филогеографических исследований приморских евразийских и австралазийских видов *Salsola*.

**Ключевые слова:** *Salsola*, *Chenopodiaceae*, *Salsoloideae*, номенклатура, систематика, биogeография