

A SYNOPSIS OF THE GENUS *NOCCAEA* (COLUTEOCARPEAE, BRASSICACEAE)

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Abstract. The controversial limits of *Thlaspi* are discussed, and all of its segregates proposed or revised during the past four decades are critically evaluated. As a result, the majority of specific and infraspecific names previously assigned to *Thlaspi* are currently placed in *Noccaea*, a genus the limits of which are expanded to include almost all of *Thlaspi* segregates. A detailed description of *Noccaea*, a synoptic account of its species, along with full bibliography and typification, and key to all 128 species are presented. The new names *N. germanii*, *N. iranica*, and *N. meyeri* and the following 36 new combinations are proposed: *N. abchasica*, *N. antitaurica*, *N. atlantica*, *N. bornmuelleri*; *N. bovis*, *N. bulbosa*, *N. campylophylla*, *N. cappadocica*, *N. capricornuta*, *N. cilicica*, *N. cornuticarpa*, *N. crassiuscula*, *N. dolichocarpa*, *N. eigii*, *N. elegans*, *N. huber-morathii*, *N. jaubertii*, *N. kurdica*, *N. lilacina*, *N. maassoumii*, *N. natolica*, *N. orbiculata*, *N. oxyceras*, *N. perfoliata*, *N. platycarpa*, *N. pulvinata*, *N. rechingeri*, *N. rostrata*, *N. rosularis*, *N. stenocarpa*, *N. szowitsiana*, *N. triangularis*, *N. umbellata*, *N. vesicaria*, *N. vesicaria* subsp. *boissieri*, and *N. zangezurica*. The genus *Coluteocarpus* is reduced to synonymy of *Noccaea*. *Brossardia papyracea* var. *kotschyi*, *Coluteocarpus reticulatus* var. *boissieri*, *Hutschinsia trinervia*, *Iberidella andersonii*, *Thlaspi affine*, *T. japonicum*, *T. kovatsii*, *T. szowitsianum*, and *Vesicaria reticulata* are lectotypified.

Keywords: Brassicaceae, Coluteocarpeae, Cruciferae, *Noccaea*, *Thlaspi*

The genus *Thlaspi* L. was once considered among the larger genera of Brassicaceae (Cruciferae) and included some 75 species distributed primarily in Eurasia but with fewer taxa in North and South America and northern Africa (Al-Shehbaz, 1986; Appel & Al-Shehbaz, 2003). Over the past two and a half centuries, *Thlaspi* became the dumping site for any Brassicaceae plant with angustiseptate fruits (flattened at a right angle to the septum), two or more seeds per locule, and simple trichomes or no indumentum. Indeed, The International Plant Names Index (IPNI) lists under *Thlaspi* 478 names, of which over 80 are repeated records, though numerous infraspecific names were not listed. Therefore, the above figure provides only a rough estimate of the magnitude of excessive naming of taxa in the complex.

A radical departure from the conventional concept of *Thlaspi* was proposed by Meyer (1973, 1979) who relied heavily on seed-coat anatomy to divide the genus into 12 genera and retained only six species in it. Influenced by tradition, several authors (e.g., Greuter and Raus, 1983; Greuter et al., 1986; Al-Shehbaz, 1986; Artelari, 2002; Appel & Al-Shehbaz, 2003) did not follow Meyer's over splitting of the genus, and *Thlaspi* remained in a state of mess. Although seed-coat anatomy offers a few taxonomically useful features (Meyer, 1991), it is impractical for the practicing taxonomist and, therefore, its wide-scale utilization is limited at best.

In a series of painstaking and detailed studies, Meyer (2001a, b, 2003a–e, 2006a–e, 2010) revised almost all of the *Thlaspi* segregates he established in 1973. His thorough synonymy, complete bibliography, full typification of all taxa, detailed distributions, and excellent illustrations of leaves, floral parts, fruits, and seeds are absolutely valuable for any study on the complex. Unfortunately, he did not deal with several New World and Himalayan taxa, and his keys

to the species are not parallel, difficult to follow, rely a great deal on vegetative characters and seed anatomy, and some of the terminal leads are quite descriptive whereas others are very brief.

Extensive molecular phylogenetic studies (e.g., Mummenhoff & Zunk, 1991; Koch et al., 1993; Mummenhoff & Koch, 1994; Koch, 1995; Zunk et al., 1996; Mummenhoff et al., 1997a, b; Koch et al., 1998a, b; Koch & Mummenhoff, 2001; Koch & Bernhardt, 2004; Koch & Al-Shehbaz, 2004) have amply demonstrated that the generic circumscription of *Thlaspi* prior to Meyer's (1973) work was clearly unnatural. These studies were the foundation for the placement of *Noccaea* Moench in tribe Noccaeeae and the retention of Meyer's (1973, 2001a) six species of *Thlaspi* s.str. in tribe Thlaspideae (Al-Shehbaz et al., 2006). Indeed, recent floristic studies (e.g., Al-Shehbaz, 2010, 2012b; Al-Shehbaz & Watson, 2011) have recognized *Noccaea* as distinct from *Thlaspi*. Subsequent family-wide molecular phylogenetic studies (e.g., Khosravi et al., 2009a; Warwick et al., 2010) showed that *Noccidium* F.K.Mey. belongs in tribe Camelinae, and the remaining ten segregates of Meyer (1973) grouped together with *Noccaea* to form a rather poorly resolved clade suggesting that they form a single genus. Following Al-Shehbaz (2012a), Meyer's ten segregates are referred below to the synonymy of *Noccaea*, the earliest-published generic name in the group.

The tribal name Noccaeeae was reduced by Al-Shehbaz (2012a) to the synonymy of the earlier-published Coluteocarpeae (Dorofeyev, 2004), though a formal transfer of the type species of *Coluteocarpus* Boiss., *C. reticulatus* Boiss. (= *N. vesicaria* (L.) Al-Shehbaz, to *Noccaea* was not done until the present study. *Coluteocarpus* was shown to be nested within *Noccaea* (Warwick et al., 2010, 2011; Firat et al., unpubl.).

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Meyer (2001a) placed *Thlaspi*, all its 11 segregates, and 11 additional genera in tribe Lepidieae subtribe Thlaspidinae as delimited by Schulz (1936). However, such circumscription is totally artificial, as evidenced from several family-wide molecular phylogenetic studies (e.g., German et al., 2009; Khosravi et al., 2009a; Couvreur et al., 2010; Warwick et al., 2010) and the phylogenetic tribal classification of the Brassicaceae (Al-Shehbaz et al., 2006; Al-Shehbaz, 2012a). Meyer's (2001a) circumscription of the Thlaspidinae included 23 genera currently assigned to seven tribes. These are: *Aethionema* W.T.Aiton in tribe Aethionemeae; *Bivonaea* DC. in Bivonaeae; *Brossardia* Boiss., *Eunomia* DC., *Noccaea* (including *Atropatenia* F.K.Mey., *Callothlaspi* F.K.Mey., *Kotschyella* F.K.Mey., *Masmenia* F.K.Mey., *Microthlaspi* F.K.Mey., *Neurotropis* (DC.) F.K.Mey., *Raparia* F.K.Mey., *Thlaspiceras* F.K.Mey., and *Vania* F.K.Mey) in Coluteocarpeae; *Ionopsidium* Rchb. and *Pastorea* Todaro ex Bertol. (= *Cochlearia* L.) in Cochleariae; *Microcardamum* O.E.Schulz and *Hutchinsiella* O.E.Schulz (both synonyms of *Hornungia* Rchb.) in Descurainieae; *Nocccidium* in the Camelinae; *Teesdalia* W.T.Aiton in Iberideae; and *Pachyphragma* (DC.) Rchb., *Physalidium* Fenzl. (= *Graellsia* Boiss.), and *Thlaspi* in Thlaspideae. Meyer (2010) later described *Noccaeopsis* F.K.Mey. based on having very short siliques instead of silicles, but that division is artificial, and the genus was referred by Al-Shehbaz (2012a) to the synonymy of *Noccaea*.

The infrageneric classification of Meyer's (1973) segregates requires substantial re-evaluation of morphological characters in light of comprehensive molecular phylogenetic studies. He placed the six species of *Thlaspi* s.str. in three sections and two series. Such classification can hardly be of any taxonomic value because the genus is rather small. By contrast, for the larger *Noccaea*, Mayer (2006e) recognized 67 species that he placed in four sections and 11 series. Although some of the infrageneric taxa include closely related species, his heavy reliance on vegetative features and the seeds epidermal cells to delimit sections and series, especially in the key, would substantially

limit their usefulness for identification purposes.

Convergence in the *Thlaspi* s.l. complex is widespread in almost every conceivable character, especially those of the fruit (Mummenhoff et al., 1997b). The exception, however, is the sole presence of longitudinally striate and strongly reticulate seed sculpture in *Thlaspi* s.str. (Meyer, 1979, 2001a). Perhaps one of the remarkable examples of convergence is the evolution of horned fruits in species currently assigned to three tribes: *T. ceratocarpum* (Pall.) Murray (Thlaspideae), *Nocccidium hastatum* (DC.) F.K.Mey. (Camelineae), and several species of *Noccaea* (Coluteocarpeae) that Meyer (2003b, 2003d) placed in *Thlaspiceras* and *Kotschyella*, respectively.

The limits of *Apterigia* have recently been expanded by Dorofeyev (2013) to include eight species placed by Meyer (1973, 2006e) and Al-Shehbaz (2012) in *Noccaea*, by Meyer (1973, 2006c) in *Atropatenia*, and by Meyer (1973, 2006d) in *Vania*. The sole character used to unite these species is the lack of apical fruit wing. However, as indicated above, fruit morphology is subject to substantial convergence, and molecular data do not support the recognition of more than one entity in the *Noccaea* complex.

The present synopsis was undertaken with several goals in mind, of which the principal one is providing an updated enumeration of accepted taxa (including major synonymies and typifications) for the World Flora Online currently in progress. All names are being made available online on BrassiBase (<http://brassibase.cos.uni-heidelberg.de>), the major Brassicaceae database housed and continuously undated at Heidelberg University, Germany (see Koch et al., 2012; Kiefer et al., 2013). Furthermore, several segregates of *Thlaspi* were reduced to synonymy by Al-Shehbaz (2012a), but none of their species has formally been transferred to *Noccaea*. These necessary nomenclatural adjustments are presented below for all taxa except one. The formal transfer of *Thlaspi aghricum* P.H.Davis & K.Tan to *Noccaea* is proposed elsewhere and has been accepted for publication. However, the species is included in the following key, though it is not listed in the synopsis below.

TAXONOMY

Noccaea Moench, Suppl. Methodus 89. 1802, non Kuntze, Revis. Gen. Pl. 1: 354. 1891; *Thlaspi* L. sect. *Noccaea* (Moench) Griseb., Spic. Fl. Rumel. 1: 279. 1843. Type species: *N. rotundifolia* (L.) Moench (= *Iberis rotundifolia* L.).

Name derivation: for Domenico Nocca, 1758–1841, Italian clergyman, botanist, and director of the botanic garden at Pavia.

Tribe: Coluteocarpeae V.I.Dorof., Turczaninowia 7(3): 51. 2004. = Tribe Noccaeae Al-Shehbaz, Beilstein & E.A. Kellogg, Pl. Syst. Evol. 259: 112. 2006.

Synonyms: *Apterigia* Galushko, Novosti Sist. Vyssh. Rast. 6: 209. 1970; *Thlaspi* L. sect. *Apterygium* Ledeb., Fl. Ross. 1: 164. 1841, non *Apterygia* Baehni, Arch. Sci. 17: 79. 1964. Type species: *A. pumila* (Steven) Galushko (= *Noccaea pumila* (Steven) Steud.).

Atropatenia F.K.Mey., Feddes Repert. 84: 467. 1973. Type species: *A. rostrata* (N.Busch) F.K.Mey. (= *Noccaea rostrata* (N.Busch) Al-Shehbaz).

Brossardia Boiss., Ann. Sci. Nat., Bot. Sér. 2, 16: 380. 1841. Type species: *B. papyracea* Boiss. (= *Noccaea papyracea* (Boiss.) Khosravi, Mumm. & Mohsenz.).

Callothlaspi F.K.Mey., Feddes Repert. 84: 457. 1973. Type species: *C. lilacinum* (Boiss. & Huet) F.K.Mey. (= *Noccaea lilacina* (Boiss. & Huet) Al-Shehbaz).

Coluteocarpus Boiss., Ann. Sci. Nat., Bot. sér. 2, 17: 172. 1842. Syn. nov. Type species: *C. reticulatus* Boiss. (= *Noccaea vesicaria* (L.) Al-Shehbaz, based on *Alyssum vesicaria* L.).

Cruciundula Raf., Fl. Tellur. 2: 100. 1837. Type species: *C. minima* (Ard.) Raf. (= *Noccaea minima* (Ard.) F.K.Mey.).

Disynoma Raf., Fl. Tell. 3: 81. 1837. Types species: *D. carnea* (Russell) Raf., nom. illeg., based on *Thlaspi carneum* Russell, nom. illeg. (= *Noccaea perfoliata* (L.) Al-Shehbaz).

Iberidella (DC.) Boiss., Ann. Sci. Nat., Bot. Sér. 2, 17: 188. 1842; *Hutchinsia* W.T.Aiton sect. *Iberidella* DC., Syst. Nat. 2: 385. 1821; *Thlaspi* L. sect. *Iberidella* (DC.) Janch., Österr. Bot. Z. 58: 207. 1908. Lectotype species designated by Rollins (in Farr et al.: 865. 1979, as type): *I. trinervia* (DC.) Boiss. (= *Noccaea trinervia* (DC.) Steud.)

Kotschyella F.K.Mey., Feddes Repert. 84: 457. 1973. Type species: *K. stenocarpa* (Boiss.) F.K.Mey. (= *Noccaea stenocarpa* (Boiss.) Al-Shehbaz).

Lagowskia Trautv., Bull. Cl. Phys.-Math. Acad. Imp. Sci. Saint-Petersbourg ser. 2, 16: 321. 1858. Type species: *L. pysocarpa* Trautv. (= *Noccaea vesicaria* (L.) Al-Shehbaz).

Masmenia F.K.Mey., Feddes Repert. 84: 468. 1973. Type species: *M. rosularis* (Boiss. & Balansa) F.K.Mey. (= *Noccaea rosularis* (Boiss. & Balansa) Al-Shehbaz).

Microthlaspi F.K.Mey., Feddes Repert. 84: 452. 1973. Type species: *M. perfoliatum* (L.) F.K.Mey. (= *Noccaea perfoliata* (L.) Al-Shehbaz, based on *Thlaspi perfoliatum* L.).

Neurotropis (DC.) F.K.Mey., Feddes Repert. 84: 467. 1973; *Thlaspi* L. sect. *Neurotropis* DC., Syst. Nat. 2: 377. 1821; *Thlaspi* subgen. *Neurotropis* (DC.) Peterm., Deutschl. Fl. 48. 1849. Lectotype species designated by Meyer (1973: 452): *Neurotropis orbiculata* (Steven ex DC.) F.K.Mey. (= *Noccaea orbiculata* (Steven ex DC.) Al-Shehbaz).

Noccaeopsis F.K.Mey., Haussknechtia 12: 15. 2010. Type species: *N. kamtschatica* (Karav.) F.K.Mey. (= *Noccaea kamtschatica* (Karav.) Czerep.).

Raparia F.K.Mey., Feddes Repert. 84: 467. 1973. Type species: *R. bulbosa* (Spruner) F.K.Mey. (= *Noccaea bulbosa* (Spruner) Al-Shehbaz).

Syrenopsis Jaub. & Spach, Ill. Pl. Orient. 1: 6. 1842. Type species: *S. stylosa* Jaub. & Spach (= *Noccaea jaubertii* (Hedge) Al-Shehbaz).

Thlaspiceras F.K.Mey., Feddes Repert. 84: 467. 1973. Type species: *T. oxyceras* (Boiss.) F.K.Mey. (= *Noccaea oxyceras* (Boiss.) Al-Shehbaz).

Vania F.K.Mey., Feddes Repert. 84: 467. 1973. Type species: *V. campylophylla* F.K.Mey. (= *Noccaea campylophylla* (F.K.Mey.) Al-Shehbaz).

Herbs, perennial with simple or branched caudices or stolons, sometimes biennial, rarely annual, often glaucous. *Trichomes* absent or rarely as short, simple papillae. *Multicellular glands* absent. *Stems* erect to ascending or decumbent, simple or branched basally and/or above, rarely woody at base. *Basal leaves* petiolate, rosulate, simple, entire, denticulate, or dentate; cauline leaves sessile, auriculate, sagittate, or amplexicaul or rarely non-auriculate at base, entire or dentate. *Racemes* many flowered, ebracteate, corymbose, elongated considerably or congested in fruit; rachis straight; fruiting pedicels horizontal to divaricate, rarely ascending or descending, persistent. *Sepals* oblong, ovate, or obovate, free, caduceous or very rarely persistent, erect, glabrous, base of lateral pair not saccate; petals white, pink, lavender, rose, violet, or purple, usually longer than sepals; blade obovate, spatulate, oblanceolate, oblong, or rarely broadly linear, apex obtuse; claw obscurely differentiated from blade, shorter than sepals, glabrous, unappendaged, entire; stamens 6, erect, tetradynamous or subequal; filaments wingless, unappendaged, glabrous, free; anthers ovate or oblong, obtuse or rarely apiculate at apex; nectar glands 2, lateral, subtending bases of lateral stamens, or 4 and 1 on each side of lateral stamen, median glands absent; ovules (1 or) 2–12 per locule; placentation parietal. *Fruit* dehiscent capsular silicles or rarely siliques, obcordate, obovate, obdeltoid, elliptic, ovate, oblong, or rarely linear, flattened and usually strongly angustiseptate, or nearly subquadrangular, uninflated or very rarely inflated, unsegmented; valves papery, obscurely to prominently veined, glabrous, strongly keeled, smooth, winged or wingless apically and sometimes also around margin, unappendaged; gynophore obsolete; replum rounded, visible; septum complete, membranous, not veined; style distinct, included in, subequal, or exerted from and much exceeding apical notch of fruit; stigma capitate, entire, unappendaged. *Seeds* uniseriate, wingless, oblong to ovate, plump or slightly compressed; seed coat minutely reticulate to nearly smooth, not mucilaginous when wetted; cotyledons accumbent. $x = 7$.

A genus of 128 species distributed primarily in Europe and Asia, with one species each in N. Africa, Patagonia (Argentina, Chile), and Mexico and three in the United States.

KEY TO THE SPECIES OF *NOCCAEA*

Mature plants are needed for the reliable identification of species, and fruit characters, seed or ovule number, and petals features are essential. Due to its high variability, vegetative morphology is less reliable and, therefore, used only to a limited degree in the following key.

- 1a. Annuals; non-flowering shoots absent by fruiting time 2
- 1b. Perennials with caudices and remains of basal rosettes, sometimes biennials; non-flowering shoots usually present by fruiting time. 10
- 2a. Fruit 8–17 mm wide; fruit wings prominently reticulate veined, 3–4 mm wide at apex 3
- 2b. Fruit 2–7 mm wide; fruit wings not veined, to 2 mm wide at apex, or absent 5
- 3a. Petals 1.5–2 mm; seeds 1.4–1.8 mm; style obsolete; fruiting raceme dense *N. platycarpa*
- 3b. Petals 2.2–2.8 mm; seeds 2.1–2.3 mm; style 0.1–0.4 mm; fruiting raceme loose 4
- 4a. Ovules/seeds 7–9 per locule; style 0.2–0.5 mm; plants stout, branched *N. orbiculata*
- 4b. Ovules/seeds 4–6 per locule; style 0.1–0.2 mm; plants slender, unbranched *N. szowitsiana*
- 5a. Fruits oblong or elliptic, wingless; style 2.5–3 mm 6
- 5b. Fruits obcordate, winged distally; style absent or 0.1–1(–1.5) mm 7

KEY TO THE SPECIES OF *NOCCA* CONT.

6a. Fruiting racemes lax; fruiting pedicels divaricate, 9–14 mm	<i>N. bornmuelleri</i>
6b. Fruiting raceme dense; fruiting pedicels erect-ascending 5–10 mm	<i>N. jaubertii</i>
7a. Style exerted from apical notch of fruit, rarely equal to it; petals unequal	8
7b. Style well included in apical notch of fruit; petals equal	9
8a. Apical fruit notch absent or to 0.1 mm deep; ovules/seeds 2–4 per locule; large petals 1–1.5 mm wide	<i>N. annua</i>
8b. Apical fruit notch 0.2–1 mm deep; ovules/seeds 3–5 per locule; large petals 1.4–2.2 mm wide	<i>N. natolica</i>
9a. Petals 2–4.7 mm; ovules/seeds 2–4 per locule	<i>N. perfoliata</i>
9b. Petals 2–2.5 mm; ovules/seeds 4–6 per locule	<i>N. umbellata</i>
10a. Leaves ciliate or coarsely to minutely papillate	11
10b. Leaves glabrous	14
11a. Leaves auriculate; style 1.6–2.5(–3.5) mm	<i>N. papillosa</i>
11b. Leaves cuneate at base; style ca. 0.5 mm	12
12a. Petals white; fruit obovate-obcordate; style subequaling the ca. 0.5 mm apical fruit notch	<i>N. iberidea</i>
12b. Petals pink, rose, or lavender; fruit ovate to elliptic; style exerted from the obsolete apical fruit notch	13
13a. Leaves linear, ciliate	<i>N. caespitosa</i>
13b. Leaves orbicular to broadly obovate, minutely papillate	<i>N. oppositifolia</i>
14a. Cauline leaves cuneate at base, neither auriculate nor amplexicaul	15
14b. At least some cauline leaves distinctly auriculate or amplexicaul at base	22
15a. Fruits inflated, bladderly, 16–21 mm wide	<i>N. vesicaria</i>
15b. Fruits flattened, not bladderly, 1–6 mm wide	16
16a. Fruits 1–1.5 mm wide, pyriform-oblong, minutely horned apically; stems woody at base	<i>N. iranica</i>
16b. Fruits 2.2–6 mm wide, ovate, obovate, or oblong, not horned apically; stems herbaceous	17
17a. Fruits 9–20 mm; style 3.2–4.6 mm; ovules/seeds 7–12 per locule	<i>N. rostrata</i>
17b. Fruits 5–8 mm; style 1–2.1 mm; ovules/seeds 1–6(–8) per locule	18
18a. Ovules/seeds 4–8 per locule	19
18b. Ovules/seeds 1 or 2(or 3) per locule	20
19a. Fruits broadly obovate, 5–6 mm wide; style 1.3–2.1 mm; fruiting pedicels 2.3–5 mm; ovules/seeds 4(or 5) per locule	<i>N. abchasica</i>
19b. Fruits ovate-oblong, 3.7–3.9 mm wide; style 1–1.2 mm; fruiting pedicels 2–2.5 mm; ovules/seeds 6–8 per locule	<i>N. zangezurica</i>
20a. Cauline leaves orbicular to obovate-orbicular; fruit apically notched; petals pink; Caucasus	<i>N. germanii</i>
20b. Cauline leaves oblong to oblong-linear; fruits not apically notched; petals white; Iraq, Turkey, Greece	21
21a. Fruits 2.2–3.5 mm wide; petals equal, 1.5–2.3 mm wide; Greece	<i>N. epirota</i>
21b. Fruits 3–5 mm wide; petals unequal, 1–1.4 mm wide; Iraq, Turkey	<i>N. kurdica</i>
22a. Fruit apex horned	23
22b. Fruit apex not horned	33
23a. Perennials, usually with woody base and leaf remains of previous seasons	24
23b. Biennials, without woody base	26
24a. Style exerted from apical notch, 1.8–3 mm; petals 6–7.7 mm	<i>N. cilicica</i>
24b. Style included or equaling apical notch, 0.8–1.2 mm; petals 2.5–4 mm	25
25a. Ovules/seeds 2–4 per locule; petals 2.5–3 mm; Pakistan	<i>N. cornuticarpa</i>
25b. Ovules/seeds 6–8 per locule; petals 3.5–4 mm; Iran, Turkmenistan	<i>N. stenocarpa</i>
26a. Fruits narrowly oblong	27
26b. Fruits ovoid- to obovoid-obdeltoid or obdeltoid	29
27a. Fruits 5–6 mm, horn 0.4–1 mm; petals 4–4.8 × 1.2–1.7 mm	<i>N. cappadocica</i>
27b. Fruits 7.3–10 mm, horn 1.4–2.5 mm; petals 2.5–3.5 × 0.8–1.1 mm	28
28a. Seeds 1.7–1.8 mm; fruit horn 1.5–2.5 mm; petals 2.5–2.8 mm	<i>N. bovis</i>
28b. Seeds 2.7–2.8 mm; fruit horn 1.2–1.5 mm; petals 3–3.7 mm	<i>N. meyeri</i>
29a. Style exerted; fruit apex truncate, minutely horned, without apical notch	30
29b. Style included; fruit apex with distinct horns 1.1–3.7 mm, apical notch 1.1–2 mm	31
30a. Petals 2.8–3.5 × 0.8–1 mm; style 1–1.3 mm; fruits obovoid-obdeltoid	<i>N. rechingeri</i>
30b. Petals 3.5–5 × 1.4–1.8 mm; style 1.3–1.8 mm; fruits obdeltoid	<i>N. triangularis</i>
31a. Fruits narrowly obdeltoid, horn 3.3–3.7 mm	<i>N. capricornuta</i>
31b. Fruits obovate- or ovate-obdeltoid, horn 1.1–2.3 mm	32
32a. Seeds tuberculate; style 1.2–2 mm	<i>N. huber-morathii</i>
32b. Seeds smooth; style 0.9–1.2 mm	<i>N. oxyceras</i>
33a. Petals purple, violet, mauve, pink, red, or lavender, rarely color-tinged	34
33b. Petals white or creamy white (color unknown in <i>N. antitaurica</i> , <i>N. dolichcarpa</i> , <i>N. edinensium</i> , and <i>N. zaffranii</i>)	58
34a. Fruits (16–)30–35 × (13–)30–40 mm	<i>N. papyracea</i>
34b. Fruits 2.5–12 (–16) × 1.5–9(–12) mm	35
35a. Style included in apical fruit notch or subequaling it	36
35b. Style exerted from apical fruit notch, or fruit not notched	41

KEY TO THE SPECIES OF *NOCCAEA* CONT.

36a. Perennials with a bulbous base	37
36b. Biennials or perennials without bulbous base	38
37a. Fruits 10–12 mm wide; Algeria	<i>N. atlantica</i>
37b. Fruits 4.5–8.5 mm wide; Greece	<i>N. bulbosa</i>
38a. Petals unequal, 7–9 mm; style 1.5–1.8 mm; ovules/seeds 1 or 2 per locule	<i>N. aghrica</i>
38b. Petals equal, 2.3–4.2 mm; style 0.3–1.2 mm; ovules/seeds (2 or)3–6 per locule	39
39a. Basal leaves dentate; fruits 7.5–13 mm; Turkey	<i>N. violascens</i>
39b. Basal leaves entire or repand; fruits 5–9(–10) mm; Europe	40
40a. Anthers bluish purple; style (0.5–)0.8–1.2 mm; ovules/seeds 4–6 per locule; C, W, N Europe	<i>N. caerulescens</i>
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152a. Seeds yellow- to orange-brown; ovules/seeds 4 per locule; anthers 0.5–0.8 mm	<i>N. aptera</i>
152b. Seeds dark or red- brown; ovules/seeds 4–6 per locule; anthers (0.7–)0.8–9 mm	153
153a. Sepals 1.7–2.2 mm; petals 3–4.5 mm; fruit 3.2–4 mm wide; style 1.2–1.9 mm; Turkey	<i>N. angustifolia</i>
153b. Sepals 2–3 mm; petals 4.2–6.4 mm; fruits 2.5–3.5 mm wide; style 1.5–3 mm; Balkan Peninsula, Bulgaria	<i>N. viridisepala</i>

SYNOPSIS OF *NOCCAEA*

Unless otherwise indicated, Meyer accounts (1973, 2001b, 2003a–e, 2006a–e, 2010) were used as the primary source for typification of the majority of taxa. However, the citation of type collections in various herbaria was also enriched by checking JSTOR (<http://plants.jstor.org/>) and all major herbaria that have the images of their types online. The presence in a given herbarium of more than one isotype or isolectotype is shown by a number (two and up) preceding the herbarium acronym.

Noccaea abchasica (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Callothlaspi abchasicum* F.K.Mey., Feddes Repert. 84: 458. 1973. TYPE: GEORGIA. Abchazia, Gora Achaguvash, ca. 6,700 m, 29 Jul 1905, *J. N. Woronow 249* (Holotype: LE).

Homotypic synonym: *Thlaspi abchasicum* (F.K.Mey.) V.I.Dorof., *Konspekt. Fl. Kavkaza* 3(2): 457. 2012.

Distribution: Georgia.

Noccaea albanica F.K.Mey., Feddes Repert. 84: 461. 1973. TYPE: ALBANIA. Mali I Brasit, ca. 800 m, 7 May 1956, *X. Qosia & M. Demiri s.n.* (Holotype: JE).

Homotypic synonym: *Thlaspi albanicum* (F.K.Mey.) Greuter & Burdet, *Willdenowia* 13: 95. 1983.

Distribution: Albania.

Noccaea alpestris (Jacq.) Kerguelen, *Coll. Patrim. Nat.* 8: 14. 1993.

Basionym: *Thlaspi alpestre* Jacq., *Enum. Stirp. Vindob.* 116, 260. 1762, non L., *Sp. Pl.*, ed. 2: 2: 903. 1763. TYPE: not located.

Heterotypic synonym: *Thlaspi alpinum* Crantz, *Stirp. Austr.*, 1: 23. 1762; *Thlaspi montanum* L. var. *alpinum* (Crantz) DC., *Syst. Nat.* 2: 380. 1821; *Noccaea crantzii* F.K.Mey., Feddes Repert. 84: 461. 1973, non *N. alpina* (L.) Rchb., *Fl. Germ. Excurs.* 663. 1832; TYPE: Illustration (T. 3, fig. 1) in Crantz (1762) above.

Distribution: Austria.

Both *Thlaspi alpestre* and *T. alpinum* are generally accepted as conspecific (Jalas et al., 1994). Meyer (1973, 2006e) overlooked the fact that Jacquin's *Thlaspi alpestre* was published prior to Crantz's *T. alpinum* (Stafleu & Cowan, 1979). Therefore, the older epithet *alpestre* should have been taken instead of proposing a new name in *Noccaea*.

Noccaea amani (Post) F.K.Mey., Feddes Repert. 84: 465. 1973.

Basionym: *Carpoceras amani* Post, *Bull. Herb. Boissier* 1: 16. 1893. TYPE: TURKEY. Amanus, Jul 1891, *G. Post s.n.* (Lectotype designated by Meyer (2006e: 182): JE).

Homotypic synonym: *Thlaspi amani* (Post) Bornm., *Mitt. Thüring. Bot. Vereins* 38: 58. 1929; *T. amani* (Post) Greuter & Burdet, *Willdenowia* 13: 95. 1983, *comb. superfl.*

Distribution: Turkey.

Hedge (1965) reduced the species to synonymy of *Noccaea microstyla* (both as *Thlaspi*). However, *N. amani* differs from the latter by having reddish violet (vs. yellow) anthers, longer (1–1.8 vs. 0.3–0.5 mm) styles, 4 or 5 (vs. 2 or 3) ovules/seeds per locule, and larger (3.8–4 × 1–1.5 vs. 2.8–2.9 × 0.7–0.8 mm) petals. In my opinion, the differences are substantial to justify their recognition as independent species.

Noccaea andersonii (Hook.f. & Thomson) Al-Shehbaz, *Adansonia sér.* 3, 24(1): 91. 2002.

Basionym: *Iberidella andersonii* Hook.f. & Thomson, *J. Linn. Soc., Bot.* 5: 177. 1861. TYPE: INDIA. Garhwal [Uttarakhand], Chor hoti pass [Uttaranchal], 16,000 ft [4,877 m], *R. Strachey & J. E. Winterbottom 12* (Lectotype here designated: K-000484215; Isolectotype: GH).

Homotypic synonym: *Thlaspi andersonii* (Hook.f. & Thomson) O.E.Schulz, *Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl.* 43: 98. 1926.

Heterotypic synonym: *Iberidella tibetica* C. Marquand & Airy Shaw, *J. Linn. Soc., Bot.* 48: 163. 1929. TYPE: CHINA. Tibet, Nymia La, 14,000–15,000 ft [4,267–4,572 m], 21 Jun 1924, *F. K. Ward 5827* (Holotype: K-000484217).

Distribution: Bhutan, China (Xizang), India (Sikkim), Nepal, Pakistan.

Although Jafri (1973: 90), followed by Al-Shehbaz (2002), designated *Strachey & Winterbottom II* (K) as the lectotype of *N. andersonii*, this collection number was not cited among the four syntypes listed by Hooker & Thomson (1861). Therefore, a new lectotypification, proposed above, was needed.

Noccaea angustifolia F.K.Mey., Feddes Repert. 84: 465. 1973. TYPE: TURKEY. Karagoellidagh, above Artabir, 6 Aug 1894, *P. Sintenis 7319* (Holotype: JE; Isotypes: E, G, W, Z). Homotypic synonym: *Thlaspi angustifolium* (F.K.Mey.) Greuter & Burdet, *Willdenowia* 13(1): 95. 1983.

Distribution: Turkey.

Noccaea annua (K.Koch) F.K.Mey., Feddes Repert. 84: 465. 1973.

Basionym: *Thlaspi annuum* K.Koch, *Linnaea* 15: 258. 1841. TYPE: ARMENIA. Dschelaloglu, 24 Apr 1837, *K. Koch s.n.* (Lectotype designated by Meyer (2006e: 164): B-10077011; Isolectotype: B).

Heterotypic synonyms: *Thlaspi stenopterum* Conrath & Freyn, *Bull. Herb. Boissier* 3: 38. 1895, non Boiss. & Reut., *Diagn. Pl. Orient. ser. 1*, 8: 40. 1849; *T. freynii* N.Busch in Kuznecov et al., *Fl. Caucas. Crit.* 3(4): 171. 1908; *Noccaea freynii* (N.Busch) Czerep., *Sosud. Rast. SSR* 140. 1981. TYPE: ARMENIA. Ljalwar and Lok, 2,200–2,600 m, 1888 and 1891, *P. Conrath s.n.* (Lectotype designated by Meyer (2006e: 166): BRNM; Isolectotype: GZU).

Distribution: Armenia, Georgia.

Several additional synonyms given by Meyer (2006e) are not repeated here.

Noccaea antitaurica (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Callothlaspi antitauricum* F.K.Mey., Feddes Repert. 84: 457. 1973. TYPE: TURKEY. [Kayseri], Région montagneuse supérieure du Dédé-Dagh (l'undes pics de l'anti-Tauris), à 12 lieues à l'ESE du Mont-Argée, 8 Aug 1856, *B. Balansa 439* (Holotype: G-BOIS).

Homotypic synonym: *Thlaspi antitauricum* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 95. 1983.

Distribution: Turkey.

Noccaea aptera (Velen.) F.K.Mey., Feddes Repert. 84: 462. 1973.

Basionym: *Thlaspi apterum* Velen., Allg. Bot. Z. Syst. 33. 1904. TYPE: BULGARIA. Sliven, 1887, *Skorph s.n.* (Holotype: PRC).

Distribution: Albania, Bosnia and Herzegovina, Bulgaria, Macedonia, Montenegro, Serbia, Turkey.

Noccaea apterocarpa (Rech.f. & Aellen) Al-Shehbaz & Menke, Taxon 61: 949. 2012.

Basionym: *Aethionema apterocarpum* Rech.f. & Aellen, Phytion (Horn) 3: 49. 1951. TYPE: IRAN. Khorasan, Kuh-e Hazar Masjed, 2,000–2,500 m, 8–9 Jun 1948, *K. H. Rechinger 5063* (Holotype: W; Isotypes: C, E, KD, M, MO, UC, US, WU, ZT).

Homotypic synonyms: *Aethionema trinervium* (DC.) Boiss. var. *apterocarpum* (Rech.f. & Aellen) Hedge in Rech.f., Fl. Iran. 57: 107. 1968; *Thlaspi apterocarpum* (Rech.f. & Aellen) Mozaff., Iranian J. Bot. 7: 139. 1996.

Distribution: Iran.

Noccaea apterocarpa was treated by Hedge (1968) as a variety of *Aethionema trinervium* (= *N. trinervia*). However, it differs from the latter by having smaller (3–3.5 × 2–2.5 vs. 5–9 × 3–4 mm) fruits without (vs. with) apical notch and persistent (vs. caducous) sepals. Persistent sepals are not known elsewhere in *Noccaea*.

Noccaea arctica (A.E.Porsild) Holub, Preslia 70: 107. 1998; *Thlaspi arcticum* A.E.Porsild, Sargentia 4: 40. 1943. TYPE: CANADA. Yukon Territories, Arctic coast of Mackenzie River delta, Kay Point, 69°12'N, 138°30'W, 23–25 Jul 1934, *A. E. Porsild 7144* (Holotype: CAN; Isotypes: GH, S).

Distribution: Canada (Yukon), U.S.A. (Alaska).

I have not examined the material on which *Noccaea arctica* is reported for Russia in the Panarctic Flora (<http://nhm2.uio.no/paf/results?biogeographic=&bioclimatic=®ion=&name=noccaea+arctica>). However, if the fruit apex in that material is obtuse, then the Panarctic record is correctly based on *N. arctica*. However, if the apex is distinctly notched, then that record is based on *N. borealis*.

Noccaea arenaria (Duby) F.K.Mey., Feddes Repert. 84: 463. 1973.

Basionym: *Thlaspi alpestre* L. var. *arenarium* Duby, Bot. Gall. 1: 38. 1828. TYPE: FRANCE. Landes, Mont-de-Marsan, *Perris* (Neotype designated by Meyer (2006e: 127): LY; Isoneotypes: JE, S, W).

Homotypic synonym: *Thlaspi arenarium* (Duby) Jord. ex F.W.Schultz, Arch. Fl. France Allemagne 1: 162. 1850.

Distribution: France.

Noccaea atlantica (Batt.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi atlanticum* Batt. in Batt. & Trab., Fl. de l'Alger. 1(Append. 2): 2. 1890. TYPE: ALGERIA. Djebel-Tamesguida, 13 Jun 1890, *J. A. Battandier s.n.* (Holotype: MPU-007905; Isotype: MPU).

Homotypic synonym: *Raparia atlantica* (Batt.) F.K.Mey., Feddes Repert. 84: 458. 1973.

Distribution: Algeria.

Noccaea banatica (R.Uechtr.) F.K.Mey., Feddes Repert. 84: 464. 1973.

Basionym: *Thlaspi banaticum* R.Uechtr., Oesterr. Bot. Z. 25: 186. 1875. TYPE: ROMANIA. Banat, Dumugled, *Simkovicz s.n.* (Lectotype designated by Meyer (2006e: 159): JE; Isolectotypes: LI, W).

Distribution: Romania.

Noccaea bellidifolia (Griseb.) F.K.Mey., Feddes Repert. 84: 460. 1973.

Basionym: *Thlaspi bellidifolium* Griseb., Spic. Fl. Rumel. 2: 505. 1846. TYPE: MACEDONIA. Ljubatrin, A. *Grisebach s.n.* (Holotype: GOET).

Distribution: Albania, Bulgaria, Macedonia.

Noccaea boeotica F.K.Mey., Feddes Repert. 84: 462. 1973. TYPE: GREECE. Mt. Helicone Boeotica, 19 May 187?, *T. G. Orphanides 1053* (Holotype: JE-00000206; Isotypes: G, S, W).

Distribution: Greece.

Noccaea borealis F.K.Mey., Haussknechtia 12: 11. 2010. TYPE: RUSSIA. Poljarnyj Ural, Bass. R. Syni, Verchovja r. Lopta, 19 Jul 1926, *B. N. Gorodkov s.n.* (Holotype: LE).

Distribution: Russia.

Noccaea bornmuelleri (Rech.f.) Al-Shehbaz, *comb. nov.*

Basionym: *Syrenopsis bornmuelleri* Rech.f., Ann. Naturhist. Mus. Wien 4: 49. 264. 1939. TYPE: TURKEY. Kurdistan, Siirt, Parklansschaft auf dem Daharaköl Dağ, 1,700 m, 15 Jun 1936, *J. Frödin 264* (Holotype: W; Isotype: JE).

Homotypic synonym: *Thlaspi bornmuelleri* (Rech.f.) Hedge, Notes Roy. Bot. Gard. Edinburgh 26: 184. 1965.

Distribution: Turkey.

Noccaea bovis (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspiceras bovis* F.K.Mey., Feddes Repert. 84: 454. 1973. TYPE: TURKEY. Amanus Mts., between Achagi Zarkoun and Bagajak, 1,800 m, 1 Jul 1932, A. *Eig & M. Zoharay s.n.* (Holotype: HUJ).

Homotypic synonym: *Thlaspi bovis* (F.K.Mey.) Greuter & Burdet, Willdenowia 13(1): 95. 1983.

Distribution: Turkey.

Noccaea brachypetala (Jord.) F.K.Mey., Feddes Repert. 84: 464. 1973.

Basionym: *Thlaspi brachypetalum* Jord., Observ. Pl. Nouv. 3: 5. 1846. TYPE: FRANCE. Grenoble et de Gap, A. Jordan (Lectotype designated by Meyer (2006e: 14): LY).

Heterotypic synonyms: *Thlaspi alpestre* L., Sp. Pl., ed. 2. 2: 903. 1763, nom. illeg., non Jacq, Enum. Stirp. Vindob. 116, 260. 1762. TYPE: "Habitat in Austria. Stamina flore longiora," (Lectotype designated by Marhold & Mátonfi in Cafferty & Jarvis (2002: 536): Herb Linn. No. 825.14 (LINN)).

Thlaspi tatrense Zapař., Bull. Acad. Cracovie, Cl. Sci. Math 1913: 431. 1913; *Noccaea brachypetala* subsp. *tatrensis* (Zapař.) F.K.Mey., Feddes Repert. 84: 464. 1973. TYPE: SLOVAKIA. Tatry, 1,585 m, 30 Jul 1879, E. Janota s.n. (Lectotype designated by Meyer (2006e: 148): KRAM).

Thlaspi huteri Kerner, Sched. Fl. Austro-Hung. 7: 39. 1896; *Noccaea brachycarpa* subsp. *huteri* (Kerner) F.K.Mey., Feddes Repert. 84: 464. 1973. TYPE: AUSTRIA. Tirol, 1,300–1,500 m, R. Huter 2523 (Holotype: WU; Isotypes: GOET, 2GZU, K, W, Z).

Distribution: Austria, Czech Republic, Finland, France, Italy, Slovakia, Spain, Sweden, Switzerland.

This highly variable species was divided by Meyer (1973; 2006e) into three subspecies under which he listed over two dozen synonyms. Nonetheless, the distinguishing characters used, especially the size measurements of leaves, are part of a continuum over a large geographical range.

Noccaea brevistyla (DC.) Steud., Nomencl. Bot., ed. 2. 2: 196. 1841.

Basionym: *Hutchinsia brevistyla* DC., Syst. Nat. 2: 387. 1821. TYPE: FRANCE. Corsica, Labillardière s.n. (Holotype: G-DC).

Homotypic synonym: *Thlaspi brevistylum* (DC.) Jord., Observ. Pl. Nouv. 3: 27. 1846.

Heterotypic synonyms: *Thlaspi rivale* C.Presl, Delic. Prag. 1: 12. 1822; *Noccaea brevistyla* subsp. *rivalis* (C.Presl) F.K.Mey., Haussknechtia 12: 195. 2006. TYPE: ITALY. Sicily, Curma grandi Nebrodum, 1817, C. B. Presl s.n. (Holotype: PRC).

Thlaspi pseudorivulare Hausskn. ex Bornm., Mitth. Thüring. Bot. Vereins 38: 56. 1929; *Noccaea pseudorivularis* (Hausskn. ex Bornm.) F.K.Mey., Feddes Repert. 84: 466. 1973; *N. brevistyla* subsp. *pseudorivularis* (C.Presl) F.K.Mey., Haussknechtia 12: 196. 2006. TYPE: GREECE. Pinus Tymphaeus, Chaliki, Mt. Plaka, 4 Jul 1896, P. Sintenis 802 (Lectotype designated by Meyer (2006e: 196): JE-00010170; Isolectotypes: B, S, W).

Distribution: Albania, France, Greece, Italy.

This variable species complex is in need of further studies, and it seems that the variation is somewhat continuous in every character except for distribution. It remains to be seen whether or not the species merits the division into subspecies, as done by Meyer (2006e), or

treated as a polymorphic entity as done here.

Noccaea bulbosa (Spruner) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi bulbosum* Spruner in Boiss., Diagn. Pl. Orient. ser. 1, 1: 74. 1843. TYPE: GREECE. "Hab. in umbrosis regionis montanae, mons Parnes Atticae," 4,000 ft [1,219 m], 1840, W. von Spruner s.n. (Lectotype designated by Meyer (2006b: 197): G-BOIS; Isolectotypes: JE, W).

Homotypic synonym: *Raparia bulbosa* (Spruner) F.K.Mey., Feddes Repert. 84: 458. 1973.

Heterotypic synonym: *Raparia bulbosa* (Spruner) F.K.Mey. subsp. *aegaea* F.K.Mey., Haussknechtia 11: 199. 2006. TYPE: GREECE. Ikaria (Nikaria), Hagios Kirykos, ca. 900 m, 18 Apr 1934, K. H. & F. Rechinger 4443 (Holotype: W).

Distribution: Greece.

Meyer (2006b) distinguished subsp. *aegaea* from subsp. *bulbosa* solely on the slight differences in floral size and style length. In my opinion, these are insignificant to support the recognition of infraspecific taxa.

Noccaea caerulescens (J.Presl & C.Presl) F.K.Mey., Feddes Repert. 84: 463. 1973.

Basionym: *Thlaspi caerulescens* J.Presl & C.Presl, Fl. Čech. 133. 1819. TYPE: CZECH REPUBLIC. Prague, W. Mann (Neotype designated by Meyer (2006e: 134): PR).

Heterotypic synonyms: *Thlaspi sylvestre* Jord., Observ. Pl. Nouv. 3: 9. 1846; *T. caerulescens* J.Presl & C.Presl subsp. *sylvestre* (Jord.) M.Laínz, Bol. Soc. Brot. sér. 2, 53: 38. 1979; *Noccaea caerulescens* subsp. *sylvestris* (Jord.) F.K.Mey., Feddes Repert. 84: 463. 1973. TYPE: FRANCE. Lyon, Soucieux, A. Jordan s.n. (Lectotype designated by Meyer (2006e: 138): LY; Isolectotype: JE).

Thlaspi sylvestre var. *oligospermum* Merino, Fl. Galicia 3: 510. 1909; *T. oligospermum* (Merino) Greuter & Burdet, Willdenowia 13(1): 96. 1983; *Noccaea oligosperma* (Merino) Holub, Preslia 70: 108. 1998. TYPE: FRANCE. Coruna, R. P. B. Merino s.n. (Holotype: not seen).

Distribution: Austria, Belgium, Czech Republic, England, Finland, Germany, Netherlands, Norway, Poland, Russia, Scotland, Sweden, Switzerland, Wales.

An extremely variable species that was divided into numerous entities recognized at the specific, subspecific, and varietal ranks. The complex is in much need of thorough systematic and molecular studies to resolve its taxonomy. It is beyond this study to deal with such complexity, and most of the three dozen synonyms listed by Meyer (2006e) are not repeated herein.

Noccaea caespitosa (Boiss.) Al-Shehbaz & Menke, Taxon 61: 949. 2012.

Basionym: *Iberidella caespitosa* Boiss., Ann. Sci. Nat., Bot., ser. 2 17: 190. 1842. TYPE: TURKEY. Alpius Armeniae, P. M. R. Aucher-Eloy 155 (Holotype: G-BOIS; Isolectotypes: BM, K).

Homotypic synonyms: *Aethionema caespitosum* (Boiss.) Boiss., Fl. Orient. 1: 343. 1867; *Eunomia caespitosa* (Boiss.) O.E.Schulz, Bot. Jahrb. Syst. 66: 95. 1933; *Apterigia caespitosa* (Boiss.) V.I.Dorof., Konspekt. Fl. Kavkaza 3(2): 459. 2012.

Distribution: Turkey.

Noccaea camlikensis Aytaç, Nordt & Parolly, Bot. J. Linn. Soc. 150: 410. 2006. TYPE: TURKEY. Konya, Derebucak, Çamlık village, Kizıldag, 1,400–1,600 m, 4 Jun 2000, H. Duman 7306 (Holotype: GAZI; Isotype: ANK).

Homotypic synonym: *Callothlaspi camlikense* (Aytaç, Nordt & Parolly) F.K.Mey., Haussknechtia 11: 185. 2006.

Distribution: Turkey.

Noccaea campylophylla (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Vania campylophylla* F.K.Mey., Feddes Repert. 84: 467. 1973. TYPE: TURKEY. Prov. Van, Distr. Satak, Kavuşşahap Dag, 3,100 m, 23 Jul 1954, P. H. Davis & O. Polunin 23132 (Holotype: JE; Isotype: E).

Distribution: Iran, Turkey.

Noccaea cappadocica (Boiss. & Balansa) Al-Shehbaz, *comb. nov.*

Basionym: *Carpoceras cappadocicum* Boiss., Diagn. Pl. Orient. ser. 2, 6: 19. 1859. TYPE: TURKEY. Region montagneuse speriure du Dédé-Dagh (l'un des pics de l'anti-Taurus), à 12 lieues à l'ESE du Mont Argée, 6 Aug 1856, B. Balansa 438 (Holotype: G-BOIS).

Homotypic synonyms: *Thlaspiceras cappadocicum* (Boiss. & Balansa) F.K.Mey., Feddes Repert. 84: 455. 1973; *Thlaspi cappadocicum* (Boiss. & Balansa) Bornm., Repert. Spec. Nov. Regni Veg. Beih. 89: 70. 1936.

Heterotypic synonyms: *Thlaspiceras cappadocicum* (Boiss. & Balansa) F.K.Mey. subsp. *microspermum* F.K.Mey., Feddes Repert. 84: 455. 1973; *Thlaspi cappadocicum* (Boiss. & Balansa) Bornm. subsp. *microspermum* (F.K.Mey.) Greuter & Burdet, Willdenowia 13(1): 95. 1983. TYPE: TURKEY. Amanus Mts., Achagi Zarkoun, ca. 1,800 m, 1 Aug 1932, A. Eig & M. Zohary s.n. (Holotype: HUJ).

Distribution: Turkey.

Five specimens of *Noccaea cappadocica* (at GOET, JE, 3P) differ from the holotype only in the collection number (*Balansa 1004* instead of *Balansa 438*), and they carry the exact collection data.

Noccaea capricornuta (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspiceras capricornutum* F.K.Mey., Feddes Repert. 84: 454. 1973. TYPE: TURKEY. Cassius, Ain el Aramie, 700 m, 17 May 1933, E. Wall s.n. (Holotype: S).

Homotypic synonym: *Thlaspi capricornutum* (F.K.Mey.) Greuter & Burdet, Willdenowia 13(1): 95. 1983.

Distribution: Syria, Turkey.

Noccaea cariensis (Carlström) Parolly, Nordt & Aytaç, Bot. J. Linn. Soc. 150: 413. 2006.

Basionym: *Thlaspi cariensis* Carlström, Willdenowia 16: 73. 1986. TYPE: TURKEY. Mugla, 1 km E of Marmaris, 19 Apr 1983, A. Carlström 9293 (Holotype: LD).

Homotypic synonym: *Callothlaspi carienne* (Carlström) F.K.Mey., Haussknechtia 11: 183. 2006.

Distribution: Turkey.

Noccaea cepaeifolia (Wulfen) Rchb., Fl. Germ. Excurs. 663. 1832.

Basionym: *Iberis caepaifolia* Wulfen in Jacqin, Misc. Austriac. 2: 28. 1781. TYPE: ITALY. "In valle Rabl," F. X. Wulfen s.n. (Lectotype designated by Meyer (2006e: 40): W).

Homotypic synonym: *Thlaspi cepaeifolium* (Wulfen) W.D.J.Koch, Deutschl. Fl., ed. 3. 4: 534. 1833.

Distribution: Austria, Italy.

Noccaea cikaea F.K.Mey., Feddes Repert. 84: 461. 1973. TYPE: ALBANIA. Çika, Mali e Qorres, ca. 1,220 m, F. K. Meyer 5206 (Holotype: JE).

Homotypic synonym: *Thlaspi cikaeum* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 95. 1983.

Distribution: Albania.

Noccaea cilicica (Schott & Kotschy ex Boiss.) Al-Shehbaz, *comb. nov.*

Basionym: *Carpoceras cilicicum* Schott & Kotschy ex Boiss., Fl. Orient. 1: 332. 1867. TYPE: TURKEY. Taurus, Bulghar Dagg, above Gülek, 7,000 ft [2,130 m], 8 Jul 1853, C. G. T. Kotschy 70 (Holotype: G-BOIS; Isotypes: B, K, 2P, S, W, WAG).

Homotypic synonym: *Kotschyella cilicica* (Schott & Kotschy ex Boiss.) F.K.Mey., Feddes Repert. 84: 457. 1973; *Thlaspi cilicicum* (Boiss.) Hayek, Ann. Nat. Hofm. Wien 28: 155. 1914.

Distribution: Turkey.

Noccaea cochlearioides (Hook.f. & Thomson) Al-Shehbaz, Adansonia sér. 3, 24: 91. 2002.

Basionym: *Thlaspi cochlearioides* Hook.f. & Thomson, J. Linn. Soc., Bot. 5: 177. 1861. TYPE: [INDIA], Sikkim, 14,000–16,000 ft, J. D. Hooker s.n. (Holotype: K-00077284).

Distribution: Bhutan, India, Nepal, Pakistan.

Noccaea cornuticarpa (Naqshi) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi cornuticarpum* Naqshi, J. Econ. Tax. Bot. 5: 717. 1984. TYPE: PAKISTAN. Apharwat top, A. R. Naqshi 3462 (Holotype: KASH; Isotype: KASH).

Distribution: Pakistan.

Noccaea corymbosa (J.Gay) F.K.Mey., Feddes Repert. 84: 460. 1973.

Basionym: *Hutschinsia corymbosa* J.Gay, Syll. Pl. Nov. 1: 169. 1824. TYPE: SWITZERLAND. Wallis, near Zermatten, J. Gay s.n. (Holotype: K; Isotypes: JE, W).

Homotypic synonym: *Thlaspi corymbosum* (J.Gay) Rechb., Ic. Fl. Germ. Helv. 2: 3. 1837, non Molina, Sag. Stor. Nat. Chili, ed. 2. 292. 1810.

Distribution: France, Italy, Switzerland.

Noccaea crassiuscula (F.K.Mey.) Al-Shehbaz, *comb. nov.*
Basionym: *Masmenia crassiuscula* F.K.Mey., Feddes Repert. 84: 468. 1973. TYPE: TURKEY. Osmaniye, Koyun meleten dag Amanos daglari, ca. 1960 m, 9 Jun 1968, Y. Akman 203 (Holotype: BASB).

Homotypic synonym: *Thlaspi crassiusculum* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 95. 1983.

Distribution: Turkey.

Noccaea cretica (Degen & Jáv.) F.K.Mey., Feddes Repert. 84: 466. 1973.

Basionym: *Thlaspi microphyllum* Boiss. & Orph. subsp. *creticum* Degen & Jáv., Magyar Bot. Lapok 21: 25. 1923. TYPE: GREECE. Crete, Dist. Mylopotamos, above Jovis, *Baldacci 53* (Lectotype designated by Meyer (2006e: 191): BP; Isolectotypes: BPU, G, W, WU).

Homotypic synonym: *Thlaspi graecum* Jord. subsp. *creticum* (Degen & Javorka) Greuter, Flor. Rep. Cretan Area 44. 1972; *Thlaspi creticum* (Degen & Jáv.) Greuter & Burdet, Willdenowia 13(1): 95. 1983.

Distribution: Greece.

Noccaea cypria (Bornm.) F.K.Mey., Feddes Repert. 84: 466. 1973.

Basionym: *Thlaspi cyprium* Bornm., Mitth. Thüring. Bot. Vereins 38: 54. 1929. TYPE: CYPRUS. Summit of Mt. Troodos and at Riv. Maschinari, 6,000 ft [1,829 m], 20 May 1862, C. G. T. Kotschy s.n. (Holotype: JE; Isotypes: G-BOIS, W).

Distribution: Cyprus.

Noccaea dacica (Heuff.) F.K.Mey., Feddes Repert. 84: 464. 1973.

Basionym: *Thlaspi dacicum* Heuff., Oesterr. Bot. Z. 8: 26. 1858. TYPE: ROMANIA. Retjeszath, 6 Aug 1836, *Rochel & Heuffel s.n.* (Neotype designated by Meyer (2996e: 157): DR).

Heterotypic synonyms: *Noccaea dacica* subsp. *montenegrina* F.K.Mey., Feddes Repert. 84: 464. 1973; *Thlaspi dacicum* Heuff. subsp. *montenegrinum* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 95. 1983. TYPE: MONTENEGRO. Biele Carini, 7 Jul 1872, J. Pantocsek s.n. (Holotype: W).

Distribution: Montenegro, Romania.

The morphologically overlapping quantitative characters used by Meyer (2006e) do not justify the division of the species into infraspecific taxa.

Noccaea densiflora (Boiss. & Kotschy) F.K.Mey., Feddes Repert. 84: 465. 1973.

Basionym: *Thlaspi densiflorum* Boiss. & Kotschy in Unger & Kotschy, Ins. Cyp. 328. 1865. TYPE: TURKEY.

Kassan Oghlu, Gorumse, 5,600 ft [1,707 m], 13 May 1859, C. G. T. Kotschy 62 (Holotype: W; Isotypes: 2B, 2BM, G, JE, 3P, S, W, ZT).

Distribution: Turkey.

Noccaea dolichocarpa (Zohary) Al-Shehbaz, *comb. nov.*

Basionym: *Carpoceras dolichocarpum* Zohary, Palestine J. Bot., Jerusalem Ser. 2: 159. 1941. TYPE: TURKEY. Hatay, Amanus, E slopes between Karagouz and Bagajak, 800–1,600 m, A. Eig & M. Zohary s.n. (Holotype: HUI).

Homotypic synonyms: *Thlaspiceras dolichocarpum* (Zohary) F.K.Mey., Feddes Repert. 84: 454. 1973; *Thlaspi dolichocarpum* (Zohary) Greuter & Burdet, Willdenowia 13(1): 95. 1983.

Distribution: Turkey.

Noccaea eburneosa F.K.Mey., Feddes Repert. 84: 464. 1973. TYPE: SWITZERLAND. Avers, below Juppa, 2,010 m, 17 Jul 1941, W. Koch s.n. (Holotype: ZT; Isotype: JE).

Distribution: Switzerland.

Noccaea edinensium F.K.Mey., Feddes Repert. 84: 460. 1973. TYPE: TURKEY. Prov. Kütahya, Murat Dag, above Gediz, above Kesik Sögüt, 1,900 m, 5 Jul 1962, P. H. Davis & M. J. E. Coode 36781 (Holotype: E).

Homotypic synonym: *Thlaspi edinensium* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 95. 1983.

Distribution: Turkey.

Noccaea eigii (Zohary) Al-Shehbaz, *comb. nov.*

Basionym: *Carpoceras eigii* Zohary, Palestine J. Bot., Jerusalem Ser. 2: 158. 1941. TYPE: SYRIA. Amanus Mts., between Achagi Zarkoun and Bagajak, ca. 1,800 m, 1 Jul 1932, A. Eig & M. Zohary s.n. (Holotype: HUI).

Homotypic synonyms: *Thlaspiceras eigii* (Zohary) F.K.Mey., Feddes Repert. 84: 454. 1973; *Thlaspi eigii* (Zohary) Greuter & Burdet, Willdenowia 13(1): 95. 1983.

Heterotypic synonyms: *Thlaspiceras eigii* subsp. *samuelssonii* F.K.Mey., Feddes Repert. 84: 454. 1973; *Thlaspi eigii* subsp. *samuelssonii* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 95. 1983. TYPE: TURKEY. Cassius, prope transitum ad Ain el Aramie, ca. 750 m, 26 Apr 1933, G. Samuelsson 4087 (Holotype: S S-G-8723).

Distribution: Syria, Turkey.

The slight differences in flower size between subspp. *samuelssonii* and *eigii* are quantitative in nature and represent extremes of an otherwise morphological continuum.

Noccaea elegans (Boiss.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi elegans* Boiss., Diagn. Pl. Orient. ser. 1, 5: 82. 1844. TYPE: TURKEY. Caria, 1842, C. Pinard s.n. (Holotype: G-BOIS; Isotypes: B, G, GOET, JE, 2K, W).

Homotypic synonym: *Thlaspiceras elegans* (Boiss.) F.K.Mey., Feddes Repert. 84: 456. 1973.

Distribution: Turkey.

Noccaea epirota (Halácsy) F.K.Mey., Feddes Repert. 84: 459. 1973.

Basionym: *Thlaspi epirotum* Halácsy, Consp. Fl. Graec. 1: 109. 1900. TYPE: GREECE. [N Pindos], "in lapidosis mobil. Alp. M. Smolika dist. Konitsa," 18 Jul 1896, A. Baldacci 208 (Lectotype designated by Franzén in Strid (1986: 324) and, apparently unaware of that, by Meyer (2006e: 42): WU; Isolectotypes: WU, Z).

Distribution: Greece.

Noccaea fendleri (A.Gray) Holub, Preslia 70: 108. 1998.

Basionym: *Thlaspi fendleri* A.Gray, Smithsonian Contr. Knowl. 5(6): 14. 1853. TYPE: U.S.A. New Mexico, [on the Organ Mts., NE of El Paso, 1852, C. Wright 1322 (Lectotype partially designated by Wootton & Standley (1915: 273) and completed by Holmgren (1971: 88): GH; Isolectotypes: GH, K, MO, PH, UC). Homotypic synonym: *T. montanum* L. var. *fendleri* (A.Gray) P.K.Holmgren, Mem. New York Bot. Gard. 21(2): 87. 1971.

Distribution: U.S.A.

Meyer (2006e) did not treat the New World *Noccaea* in his account and, therefore, full synonymies and typifications are provided herein. North American authors (e.g., Holmgren, 1971; Rollins, 1993) treated this species as conspecific with the European *Thlaspi montanum*, whereas Payson (1926) correctly recognized the North American taxa (five subspecies are cited below) as native to the continent. Molecular phylogenetic studies by Koch & Al-Shehbaz (2004) amply supported Payson's view of the independent status of the North American representatives. In addition to the substantial disjunction between the central European *Noccaea montana* and the western North American *N. fendleri*, the former differs by having fruits shorter than wide to rarely as long as wide, whereas the latter has fruits 1.5–2 times longer than wide. Both Payson and Rollins (1993) recognized four species in this complex, but I accept their treatment by Holmgren as infraspecific taxa at the subspecific instead of varietal rank. For keys distinguishing the five subspecies of *Noccaea fendleri*, see Al-Shehbaz (2010) and (as *Thlaspi*) Holmgren (1971).

Noccaea fendleri (A.Gray) Holub subsp. **californica** (S.Watson) Al-Shehbaz & M.Koch, Syst. Bot. 29: 382. 2004.

Basionym: *Thlaspi californicum* S.Watson, Proc. Amer. Acad. Arts 17: 365. 1882. TYPE: U.S.A. California, Humboldt Co., Kneeland Prairie, 2,500 ft [762 m], Jun 1882, B. Rattan s.n. (Holotype: GH; Isotypes: DS, NDG, NY, P, 2US).

Homotypic synonyms: *Thlaspi alpestre* L. var. *californicum* (S.Watson) Jepson, Man. Fl. Pl. Calif. [Jepson] 436. 1925; *T. glaucum* (A.Nelson) A.Nelson subsp. *californicum* (S.Watson) Munz, Aliso 4: 91. 1958; *T. montanum* L. var. *californicum* (S.Watson) P.K.Holmgren, Mem. New York Bot. Gard. 21(2): 80. 1971.

Distribution: U.S.A. (California).

Noccaea fendleri (A.Gray) Holub subsp. **fendleri**

Heterotypic synonyms: *Thlaspi prolixum* A.Nelson, Amer. J. Bot. 32: 287. 1945. TYPE: U.S.A. Arizona, San Carlos Indian Reservation, about 20 miles W of Rice, 9 May 1935, A. & R. Nelson 1832 (Holotype: RM; Isotype: MO).

Thlaspi stipitatum A.Nelson, Amer. J. Bot. 32: 288. 1945. TYPE: U.S.A. Arizona, Arizona Mts., between Ruby and Tucson-Nogales Hwy, Pena Banca Mts, S of Tucson, not far from Ruby, 15 Mar 1935, A. & R. Nelson 1196 (Holotype: RM; Isotypes: GH, MO, NY, S, UC, US, UTC, WTU).

Distribution: U.S.A. (Arizona, New Mexico, Texas).

Noccaea fendleri (A.Gray) Holub subsp. **glauca** (A.Nelson) Al-Shehbaz & M.Koch, Syst. Bot. 29: 382. 2004.

Basionym: *Thlaspi alpestre* L. var. *glaucum* A.Nelson, First Rep. Fl. Wyoming, 84. 1896. TYPE: U.S.A. Wyoming, Albany Co., La Plata Mines, 21 Aug 1895, A. Nelson 1777 (Holotype: RM; Isotypes: GH, ILL, ISC, NY, UC, US).

Homotypic synonyms: *Noccaea glauca* (A.Nelson) Holub, Preslia 70: 108. 1998; *Thlaspi fendleri* var. *glaucum* (A.Nelson) C.L.Hitchc., Vasc. Pl. Pacif. N. W. 2: 554. 1964; *T. glaucum* (A.Nelson) A.Nelson, Bull. Torrey Bot. Club 25: 275. 1898.

Heterotypic synonyms: *Thlaspi coloradense* Rydb., Bull. Torrey Bot. Club 28: 280. 1901; *T. fendleri* A.Gray var. *coloradense* (Rydb.) Maguire, Amer. Midl. Naturalist 27: 469. 1942; *Noccaea coloradensis* (Rydb.) Holub, Preslia 70: 107. 1998. TYPE: U.S.A. Colorado, El Paso Co., Bald Mt., near Pikes Peak, 11,500 ft [3,505 m], 1 Aug 1896, E. A. Bessy s.n. (Holotype: NY).

Thlaspi purpurascens Rydb., Bull. Torrey Bot. Club 28: 281. 1901; *T. alpestre* var. *purpurascens* (Rydb.) Ostenf., Skr. Vidensk.-Selsk. Christiania, Math.-Naturvidensk. Kl. 1909(8): 47. 1910. TYPE: U.S.A. Arizona, near Prescott, 1876, E. Palmer 571 (Holotype: NY-00185801; Isotypes: MO, 2NY, YU).

Thlaspi australe A.Nelson, Amer. J. Bot. 32: 287. 1945. TYPE: U.S.A. Arizona, W side of Baboquivari Peak, 16 Apr 1935, A. & R. Nelson 1545 (Holotype: RM; Isotypes: GH, MO, NY, S, UC, US, WIS).

Thlaspi glaucum var. *hesperium* Payson, Univ. Wyoming Publ. Sci., Bot. 1: 154. 1926; *T. hesperium* (Payson) G.N.Jones, Univ. Wash. Publ. Biol. 5: 161. 1936; *T. fendleri* var. *hesperium* (Payson) C.L.Hitchc., Univ. Wash. Publ. Biol. 17(2): 554. 1964. TYPE: U.S.A. California, Trinity Co., Doreleska, Salmon Mts., 2,000 m, 18 Jul 1909, H. M. Hall 8570 (Holotype: RM; Isotypes: 2C, DS, GH, MO, 2NY, S, UC, US).

Thlaspi fendleri var. *tenuipes* Maguire, Amer. Midl. Naturalist 27: 469. 1942. TYPE: U.S.A. Utah, Sanpete Co., Mayfield Canyon, 0.5 mile above Ranger Station, 10,928 ft [3,331 m], 8 Aug 1940, B. Maguire 19998 (Holotype: UTC).

Thlaspi glaucum A.Nelson var. *pedunculatum* Payson, Univ. Wyoming Publ. Sci., Bot. 1: 152. 1926. TYPE: U.S.A., Idaho, [Nez Perce Co. or Latah Co.], near Kendrick, 21 Apr 1894, *L. F. Henderson* 2893 (Holotype: RM).

Distribution: Mexico, U.S.A. (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Texas, Utah, Washington, Wyoming).

Noccaea fendleri (A.Gray) Holub subsp. **idahoense** (Payson) Al-Shehbaz & M.Koch, Syst. Bot. 29: 383. 2004. Basionym: *Thlaspi idahoense* Payson, Univ. Wyoming Publ. Sci., Bot. 1: 159. 1926. TYPE: U.S.A. Idaho, Custer Co., Bonanza, alt. 7,000 ft [2,134 m], 25 Jul 1916, *J. F. Macbride* & *E. B. Payson* 3436 (Holotype: RM; Isotypes: CAS, CM, GH, MO, NY, P, UC, US). Homotypic synonyms: *Thlaspi fendleri* var. *idahoense* (Payson) C.L.Hitchc., Vasc. Pl. Pacif. N. W. 2: 554. 1964; *T. montanum* L. var. *idahoense* (Payson) P.K. Holmgren, Mem. New York Bot. Gard. 21(2): 81. 1971. Heterotypic synonyms: *Thlaspi aileeniae* Rollins, Contr. Gray Herb. 214: 16. 1984; *Thlaspi idahoense* Payson var. *aileeniae* (Rollins) Rollins, Crucifer. Continental N. Amer. 904. 1993. TYPE: U.S.A. Idaho, Custer Co., off road to Cape Horn, between Knopp Creek and Valley Creek, ca. 16 miles NW of Stanley, 15 Jul 1983, *R. C. & K. W. Rollins* & *A. G. Roads* 83287 (Holotype: GH; Isotypes: CAS, E, GH, ID, NY, RSA, US).

Distribution: U.S.A. (Idaho).

Noccaea fendleri (A.Gray) Holub subsp. **siskiyouense** (P.K.Holmgren) Al-Shehbaz & M.Koch, Syst. Bot. 29: 383. 2004.

Basionym: *Thlaspi montanum* L. var. *siskiyouense* P.K.Holmgren, Mem. New York Bot. Gard. 21(2): 84. 1971. TYPE: U.S.A. Oregon, Kerby Flat at base of Eight Dollar Mt., above Illinois River, 2 miles W of Selma, 18 May 1942, *L. Constance* & *R. C. Rollins* 2972 (Holotype: WTU; Isotypes: GH, MO, NY, RM, UC, US, UTC).

Distribution: U.S.A. (Oregon).

Noccaea ferganensis (N.Busch) Czerep., Sosud. Rast. SSSR 140. 1981.

Basionym: *Thlaspi ferganense* N.Busch, Bot. Zhurn. S.S.S.R. 21: 551. 1936. TYPE: "Fergana, jugum Alaicum, prope Ak-basoga. In decliv. Angustiarum inter *Juniperus*, 9,500 ft [2,896 m]. 30 Jun 1901. Leg. *Alexeenko* (Flora Turkestanica Ex. 1983" (Lectotype designated by German (2008: 9): LE; Isolectotypes: LE).

Distribution: W China, Kazakhstan, Kyrgyzstan, Mongolia, Tajikistan, Uzbekistan.

Meyer (2006e) listed as a holotype another specimen collected on 31 June 1901, but due to the presence at LE of more than one collection by Alexeenko, the above lectotypification by German is adopted herein. The species has recently been first recorded for Mongolia (German, 2009) and Uzbekistan (Tojibaev, 2011).

Noccaea firmiensis F.K.Mey., Feddes Repert. 84: 463. 1973. TYPE: FRANCE. Aveyron, Firmy, 12 Apr–20 May 1882, *L. Giraudias s.n.* (Holotype: JE-00010185; Isotype: JE).

Homotypic synonym: *Thlaspi firmiense* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 96. 1983.

Distribution: France.

Noccaea flagellifera (O.E.Schulz) Al-Shehbaz, Adansonia sér. 3, 24: 91. 2002.

Basionym: *Thlaspi flagelliferum* O.E.Schulz, Anz. Akad. Wiss. Wien, Math.-Naturwiss. Kl. 43: 98. 1926. TYPE: CHINA. Sichuan. Wa-schan, Yadschou, May 1915, *H. Weigold s.n.* (Holotype: W; Isotype: B).

Distribution: China (Sichuan).

Noccae gardeziana F.K.Mey., Haussknechtia 12: 172. 2006. TYPE: AFGHANISTAN. Prov. Gardez, Paktia, in jugo Sata Kandao, between Gardez and Khost, 2,900 m, 8 Jul 1965, *K. H. Rechinger* 32117 (Holotype: W).

Distribution: Afghanistan.

Noccaea germanii Al-Shehbaz, *nom. nov.*

Replaced name: *Eunomia rotundifolia* C.A.Mey., Verz. Pfl. Casp. Meer. 194. 1831, non *Noccaea rotundifolia* (L.) Moench, Suppl. Meth. 89. 1802. TYPE: "In alpinis Elborus Caucasi occidentalis, inter fragmina lapidum (alt. 1500 hexap.)." Additional data on syntypes: "locis lapidosis (alt. 9,000 p.), 10 July 1829, Enum. Cauc. Casp. N. 1678, *D. Meyer*" (Lectotype designated by Dorofeyev (2012: 460): LE; Isolectotypes: 2LE).

Distribution: Armenia, Azerbaijan, Georgia.

The species is named in honor of Dr. Dmitry A. German (12 August 1976–), an outstanding student of the Brassicaceae.

Noccaea goesingensis (Halácsy) F.K.Mey., Feddes Repert. 84: 462. 1973.

Basionym: *Thlaspi goesingense* Halácsy, Oesterr. Bot. Z. 30: 173. 1880. TYPE: AUSTRIA. Mt. Goesing, ad pagum Ternits, 4 May 1880, *E. von Halácsy s.n.* (Holotype: WU; Isotypes: 3B, F, 2FR, GOET, GT, 2GZU, 2HBG, JE, 2K, MA, US, Z).

Heterotypic synonym: *Thlaspi umbrosum* Waisbecker, Oesterr. Bot. Z. 43: 318; 44: 74. 1893. TYPE: AUSTRIA. Bernstein, 700 m, 8 May 1892, *A. Waisbecker s.n.* (Holotype: BP; Isotypes: B, JE, K).

Distribution: Austria, Bosnia and Herzegovina, Bulgaria, Serbia.

Noccaea graeca (Jord.) F.K.Mey., Feddes Repert. 84: 463. 1973.

Basionym: *Thlaspi graecum* Jord., Observ. Pl. Nouv. 3: 30. 1846. TYPE: GREECE. [Peloponnes], Taygeto, Jul 1844, *T. H. H. von Heldreich s.n.* (Holotype: LY; Isotypes: G, JE, W).

Heterotypic synonym: *Thlaspi taygeteum* Boiss., Diagn. Pl. Orient. ser. 1, 8: 40. 1849. TYPE: GREECE. [Peloponnes], Laconia, Taygetos, above Mistra, Apr 1842, *E. Boissier s.n.* (Holotype: G; Isotypes: JE, W).

Distribution: Greece.

Noccaea griffithiana (Boiss.) F.K.Mey., *Haussknechtia* 12: 170. 2006.

Basionym: *Carpoceras griffithianum* Boiss., *Diagn. Pl. Orient.*, ser. 2, 1: 40. 1854. TYPE: AFGHANISTAN. Bharowul, *W. Griffith 1473* (Holotype: G; Isotype: K).
Homotypic synonym: *Thlaspi griffithianum* (Boiss.) Boiss., *Fl. Orient.* 1: 329. 1867.

Distribution: Afghanistan, Pakistan.

Noccaea haussknechtii (Boiss.) F.K.Mey., *Feddes Repert.* 84: 460. 1973.

Basionym: *Thlaspi haussknechtii* Boiss., *Fl. Orient.* 1: 330. 1867. TYPE: TURKEY. Taurus Cataonicus, Beryt Dagh, 9,000–10,000 ft [2,740–3,050 m], 10 Aug. 1865, *C. Haussknecht 1102* (Holotype: JE; Isotype: G-BOIS).

Distribution: Turkey.

Noccaea huber-morathii (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspiceras huber-morathii* F.K.Mey., *Feddes Repert.* 84: 455. 1973. TYPE: TURKEY. Prov. Erzincan, Dist. Refahiye, 1 km N Refahiye, 1,540–1,560 m, 2 Jul 1953, *A. Huber-Morath 12974* (Holotype: G).

Homotypic synonym: *Thlaspi huber-morathii* (F.K.Mey.) Greuter & Burdet, *Willdenowia* 13(1): 96. 1983.

Heterotypic synonyms: *Thlaspiceras huber-morathii* F.K.Mey. subsp. *divergens* F.K.Mey., *Feddes Repert.* 84: 455. 1973; *Thlaspi huber-morathii* subsp. *divergens* (F.K.Mey.) Greuter & Burdet, *Willdenowia* 13(1): 96. 1983. TYPE: TURKEY. Erzincan, Kara Dag, Refahiye-Erzincan, 27 km E Refahiye, 1,940–1,960 m, 2 Jul 1953, *A. Huber-Morath 12973* (Holotype: G).

Distribution: Turkey.

The differences between subsp. *huber-morathii* and subsp. *divergens* are only quantitative in nature, and the latter is somewhat bigger than the former. Both were collected from nearby localities, which make their independent status rather doubtful.

Noccaea iberidea (Boiss.) Al-Shehbaz & Menke, *Taxon* 61: 949. 2012.

Basionym: *Eunomia iberidea* Boiss., *Ann. Sci. Nat., Bot.*, ser. 2, 17: 191. 1842; *Aethionema iberideum* (Boiss.) Boiss., *Fl. Orient.* 1: 351. 1867. TYPE: TURKEY. Olympus Bithynus, *P. M. R. Aucher-Eloy 345* (Holotype: G-BOIS; Isotypes: E, K, P).

Distribution: Turkey.

Noccaea iranica Al-Shehbaz, *nom. nov.*

Replaced name: *Thlaspi pulvinatum* Mozaff., *Iranian J. Bot.* 7: 138. 1996, non *T. pulvinatum* (F.K.Mey.) Greuter & Burdet, *Willdenowia* 13: 96. 1983. TYPE: IRAN. Azarbaijan, between Shhindege and Takab, kuh-e Gharadash (Aghdash), from Ghezghapan and Auchdare, 2,500–2,800 m, 4 Jul 1991, *V. Mozaffarian 69874* (Holotype: TARI, n.v.)

Distribution: Iran.

Noccaea iranica, described and illustrated by Mozaffarian (1996) as the later homonym *Thlaspi pulvinatum*, is somewhat anomalous in *Noccaea* for being woody at base and for having non-auriculate cauline leaves and pyriform-oblong fruits with truncate, minutely horned apex.

Noccaea jankae (Kerner) F.K.Mey., *Feddes Repert.* 84: 462. 1973.

Basionym: *Thlaspi jankae* Kern., *Oesterr. Bot. Z.* 17: 35. 1867. TYPE: SLOVAKIA. Nitra, zobor, 587 m, 28 May 1975, *F. K. & J. Meyer 11461* (Neotype designated by Meyer (2006e: 110): JE).

Heterotypic synonyms: *Thlaspi finitimum* Dvořáková, *Folia Geobot. Phytotax.* 8: 150. 1973. TYPE: SLOVAKIA. Nitra, Mt. Žibrica, ca. 500 m, 1 May 1936, *V. Krist s.n.* (Holotype: BRNU-276631).

Thlaspi hungaricum M.Dvorakova, *Preslia* 50: 15. 1978; *Noccaea hungarica* (Dvořáková) Holub, *Folia Geobot. Phytotax.* 18: 204. 1983. TYPE: HUNGARY. Budapest, 6 May 1911, *S. Jávroka s.n.* (Holotype: BP-68164).

Distribution: Hungary, Slovakia.

Noccaea japonica (H.Boissieu) F.K.Mey., *Haussknechtia* 12: 14. 2010.

Basionym: *Thlaspi japonicum* H.Boissieu, *Bull. Herb. Boissier* 7: 797. 1899. TYPE: JAPAN. Shakotan, 9 Jun 1893, *U. J. Faurie 9908* (Lectotype here designated: P-01817547).

Distribution: Japan.

Although cited the two syntypes of *Thlaspi japonicum*, Meyer (2010) did not designate a lectotype. I have examined the lectotype above, and it is also available on the JSTOR website (<http://plants.jstor.org/>).

Noccaea jaubertii (Hedge) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi jaubertii* Hedge, *Notes Roy. Bot. Gard. Edinburgh* 26: 185. 1965; based on *Syrenopsis stylosa* Jaub. & Spach, *Ill. Pl. Orient.* 1: 6. t. 3. 1842; non *T. stylosum* Rchb., *Ic. Fl. Germ.* 2, 3: t. 6. 1837–1838; nec *T. stilosum* (Ten.) Mutel, *Fl. Franç.* 1: 99. 1834 (as *stylosum*), nec *Noccaea stilosa* (Ten.) Rchb., *Fl. Germ. Excurs.* 663. 1832 (as *stylosa*). TYPE: TURKEY: Bursa, in *Olympo bithyno*, Jul 1839, *Jaubert s.n.* (Holotype: P?).

Distribution: Turkey.

Noccaea kamtschatica (Karav.) Czerep., *Sosud. Rast. SSSR* 140. 1981.

Basionym: *Thlaspi kamtschaticum* Karav., *Sist. Zametki Mater. Gerb. Krylova Tomsk. Gosud. Univ. Kuybysheva* 83: 4. 1965. TYPE: RUSSIA. Kamtschatka, ad litem superiorem fluvium Pankara, 17 Aug 1930, *P. Novograbenov 2533* (Lectotype designated by Meyer (2010: 16): MW; Isolectotypes: LE, MW).

Homotypic synonym: *Noccaeopsis kamtschatica* (Karav.) F.K.Mey., *Haussknechtia* 12: 16. 2010.

Distribution: Russia.

Meyer (2010) placed the species in his monospecific *Noccaopsis* because it has silique fruits with length: width ratio more than 3:1 instead of silicles with a ratio < 3:1, a feature characteristic of the vast majority of *Noccaea* species. Similar fruit types occur in numerous genera of the Brassicaceae and sometimes within a given species. Therefore, such a difference in the fruit type is usually unreliable when used alone in the recognition of genera in the family.

Noccaea kovatsii (Heuff.) F.K.Mey., Feddes Repert. 84: 461. 1973.

Basionym: *Thlaspi kovatsii* Heuff., Flora 36: 624. 1853. TYPE: ROMANIA. Mt. Bagys ad Lunkány, May 1832, *Heuffel s.n.* (Holotype: BP).

Heterotypic synonyms: *Thlaspi affine* Schott & Kotschy ex Boiss., Fl. Orient. 1: 327. 1867; *T. alpinum* Crantz var. *affine* (Schott & Kotschy ex Boiss.) Stoj. & Stef., Fl. Balg. 1: 491. 1924; *T. kovatsii* var. *affine* (Schott & Kotschy ex Boiss.) Nyár. In Savulescu, Fl. Rep. Pop. Romine 3: 403. 1955. TYPE: ROMANIA. Krajuluj, 6,000 ft [1,828 m], 24 Jun 1850, *C. G. T. Kotschy 375* (Lectotype here designated: B).

Thlaspi longiracemosum Schur, Oesterr. Bot. Z. 8: 22. 1858. TYPE: ROMANIA. Near Corona, *Schur s.n.* (Lectotype designated by Meyer (2006e: 85): WU).

Thlaspi pawlowskii Dvořáková, Preslia 45: 315. 1973; *Noccaea pawlowskii* (Dvořáková) Holub, Preslia 70: 108. 1998. TYPE: ROMANIA. Suliguț, 2 Jun 1936, *B. Pawlowski s.n.* (Holotype: KRA).

Distribution: Hungary, Romania.

Noccaea kurdica (Hedge) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi kurdicum* Hedge, Notes Roy. Bot. Gard. Edinburgh 23: 547. 1961. TYPE: TURKEY. Prov. Van, Distr. Gevaş, Artas Dag, 11,500 ft [3,500 m], 16 Jul 1954, *P. H. Davis & O. Polunin 22806* (Holotype: E; Isotypes: BM, JE, K).

Homotypic synonym: *Vania kurdica* (Hedge) F.K.Mey., Feddes Repert. 84: 467. 1973; *Apterigia kurdica* (Hedge) V.I.Dorof., Novosti Sist. Vyssh. Rast. 44: 94. 2013.

Distribution: Iraq, Turkey.

Noccaea libanotica F.K.Mey., Feddes Repert. 84: 466. 1973. TYPE: LEBANON. Sanin, 1,800 m, 17 Jun 1897, *J. Bornmüller 92* (Holotype: JE-00004194).

Homotypic synonym: *Thlaspi libanoticum* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 96. 1983.

Distribution: Lebanon, Syria.

Noccaea lilacina (Boiss. & A. Huet) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi lilacinum* Boiss. & A.Huet, Diagn. Pl. Orient. ser. 2, 5: 41. 1856. TYPE: TURKEY [as Armenia]. Inter Gumuchchané et Zazalarchane, May 1843, *A. Huet du Pavillion s.n.* (Holotype: G-BOIS).

Homotypic synonym: *Callothlaspi lilacinum* (Boiss. & A.Huet) F.K.Mey., Feddes Repert. 84: 457. 1973.

Distribution: Turkey.

Noccaea limosellifolia (Reut. ex Burnat) F.K.Mey., Feddes Repert. 84: 460. 1973.

Basionym: *Thlaspi rotundifolium* (L.) Gaudin var. *limosellifolium* Reut. ex Burnat, Fl. Alp. Marit. 1: 142. 1892. TYPE: France. Col de la Madone delle Fenestre, 13 Aug 1852, *G. Reuter* (Holotype: G).

Distribution: France, Italy.

Noccaea lutescens (Velen.) F.K.Mey., Feddes Repert. 84: 462. 1973.

Basionym: *Thlaspi lutescens* Velen., Sitzungsber. Königl. Böhm. Ges. Wiss. 1903(28): 2. 1903. TYPE: GREECE. Thessaloniki, Panórama, 350 m, *F. K. & J. Meyer 21887* (Neotype designated by Meyer (2006e: 118): JE).

Heterotypic synonym: *Thlaspi lutescens* subsp. *drenorskii* F.K.Mey., Feddes Repert. 84: 462. 1973. TYPE: BULGARIA. Alibotush, 1,600 m, 6 Jun 1933, *A. K. Drenovski s.n.* (Holotype: SOM).

Distribution: Bulgaria, Greece, Macedonia.

Noccaea maassoumii (Mozaff.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi maassoumii* Mozaff., Iranian J. Bot. 7: 135. 1996. TYPE: IRAN. Mazandaran, S. of Ramsar, Siemam Mt., 3,600 m, *Runemark & Maassoumi 21825* (Holotype: TARI, n.v.).

Distribution: Iran.

Although the type collection of the species was not examined, the illustration and description given by Mozaffarian (1996) clearly place it in *Noccaea*, though in somewhat isolated position due to having woody lower stems.

Noccaea macrantha (Lipsky) F.K.Mey., Feddes Repert. 84: 464. 1973.

Basionym: *Thlaspi praecox* Wulfen var. *macranthum* Lipsky, Zap. Kievsk. Obsc. Estestvoip. 13: 271. 1894. TYPE: RUSSIA. Tshernomor okr., Novorossiysk, 20 Apr 1889, *V. Lipsky s.n.* (Lectotype designated by Dorofeyev (2003: 121): LE).

Homotypic synonym: *Thlaspi macranthum* (Lipsky) N.Busch, Trudy Bot. Sada Imp. Yur'evsk. Univ. 7: 142. 1906.

Distribution: Russia, Ukraine.

Noccaea magellanica (Comm. ex Poir.) Holub, Preslia 70: 108. 1998.

Basionym: *Thlaspi magellanicum* Comm. ex Poir., Encycl. 7: 541. 1806. TYPE: [Chile or Argentina] Magellan, 1767, *P. Commerson s.n.* (Holotype: P-JUSS; Isotype: BAA!).

Distribution: Patagonian Argentina and Chile.

For a complete synonymy and typification, see Al-Shehbaz (2012b)

Noccaea mexicana (Standl.) Holub, Preslia 70: 108. 1998.

Basionym: *Thlaspi mexicanum* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 22: 76. 1940. TYPE: MEXICO. Peak of Cerro Potosi, Municipio de Galeana, 21 Jul 1935, *C. H. Müller 2244* (Holotype: F; Isotypes: GH, MICH, MO).

Distribution: Mexico.

Noccaea meyeri Al-Shehbaz, *nom. nov.*

Replaced name: *Thlaspiceras crassifolium* Hub.-Mor. & F.K.Mey., Feddes Repert. 84: 454. 1973, non *Noccaea crassifolia* Rouy & Foucaud, Fl. France 2: 91 et 92. 1895. TYPE: TURKEY. Prov. Seyhan, Distr. Osmaniye, Yaglipinar S of Yarpus, 1,350–1,400 m, 2 Jul 1959, A. Huber-Morath 16241 (Holotype: G).

Homotypic synonym: *Thlaspi crassifolium* (Hub.-Mor. & F.K.Mey.) Greuter & Burdet, Willdenowia 13: 95. 1983.

Distribution: Turkey.

The transfer of *Thlaspiceras crassifolium* to *Noccaea* would have created a later homonym. Therefore, the new name *N. meyeri* is proposed in honor of Dr. Friedrich Karl Meyer (1926–2013) who worked extensively on *Thlaspi* s.l. and its dozen segregates, including *Noccaea*.

Noccaea microphylla (Boiss. & Orph.) F.K.Mey., Feddes Repert. 84: 460. 1973.

Basionym: *Thlaspi microphyllum* Boiss. & Orph., Diagn. Pl. Orient. ser. 2, 6: 19. 1859. TYPE: GREECE. Mt. Parnass, Carcaria, *T. G. Orphanides s.n.* (Lectotype designated by Meyer (2006e: 65); G-BOIS; Isolectotype: JE).

Distribution: Albania, Greece, Macedonia.

Noccaea microstyla (Boiss.) F.K.Mey., Feddes Repert. 84: 466. 1973.

Basionym: *Thlaspi microstylum* Boiss., Diagn. Pl. Orient. ser. 1, 8: 38. 1849. TYPE: TURKEY. Cassius, May–Jul 1846, E. Boissier *s.n.* (Holotype: G-BOIS).

Distribution: Syria, Turkey.

Noccaea minima (Ard.) F.K.Mey., Feddes Repert. 84: 459. 1973.

Basionym: *Thlaspi minimum* Ard., Animadv. Bot. Spec. Alt. 33. 1764. TYPE: ITALY. [Belluno], Mt. del Vette, *Arduino s.n.* (Lectotype designated by Meyer (2006e: 44); LINN 827.5).

Heterotypic synonym: *Thlaspi kernerii* Huter, Oesterr. Bot. Z. 24: 82. 1874. TYPE: ITALY. Mt. Raut, *Huter 587* (Lectotype designated by Meyer (2006e: 46); WU; Isolectotypes: HBG, JE, LI, W).

Distribution: Austria, Italy.

Noccaea montana (L.) F.K.Mey., Feddes Repert. 84: 461. 1973.

Basionym: *Thlaspi montanum* L., Sp. Pl. 2: 747. 1753. TYPE: “Habitat in Helvetiae, Austriae, Italiae, Monspelii petrosis.” (Lectotype desinganted by Marhold & Mártonfi (2001: 189), Herb. Linn. No. 825: 10, LINN).

Distribution: Austria, Belgium, Czech Republic, France, Germany, Hungary, Slovakia, Switzerland,

Mayer (2006e) listed some two dozen synonyms under the species and gave full citation and typification. These are not repeated here, and the interested reader should consult that reference.

Contrary to the North American literature (e.g., Holmgren, 1971; Rollins, 1993; Holmgren, 2005), Koch and Al-Shehbaz (2004) and Meyer (2006e, 2010) amply demonstrated (as *Thlaspi* or *Noccaea*) that the native American *N. fendleri* is unrelated molecularly, morphologically, and geographically to the central European *N. montana*. The taxonomy of the North American plants has recently been corrected by Al-Shehbaz (2010) and above (see under *N. fendleri*).

Noccaea natolica (Boiss.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi natolicum* Boiss., Ann. Sci. Nat., Bot. sér. 2, 17: 180. 1842. TYPE: TURKEY, *P. M. R. Aucher-Eloy 4151* (Lectotype designated by Meyer (2003a: 7); G-BOIS; Isolectotypes: G, P, W).

Homotypic synonyms: *Thlaspi perfoliatum* L. var. *natolicum* (Boiss.) Post, Fl. Syr. Pal. Sin. 94. 1896; *Microthlaspi natolicum* (Boiss.) F.K.Mey., Feddes Repert. 84: 452. 1973.

Heterotypic synonyms: *Microthlaspi natolicum* (Boiss.) F.K.Mey. var. *drabiflorum* (Fenzl) F.K.Mey., Feddes Repert. 84: 453. 1973; *Thlaspi drabiflorum* Fenzl, Pug. Pl. Nov. Syr. 14. 1842. TYPE: SYRIA. Prope Suedia, *C. G. T. Kotschy s.n.* (Holotype: W).

Microthlaspi natolicum (Boiss.) F.K.Mey. subsp. *gaillardotii* F.K.Mey., Feddes Repert. 84: 452. 1973; *Thlaspi perfoliatum* L. subsp. *gaillardotii* (F.K.Mey.) Greuter & Burdet, Willdenowia 13(1): 96. 1983. TYPE: LEBANON, “Champs calcaires au pied du Liban près Saïda,” *C. Gaillardot s.n.* (Holotype: JE).

Thlaspi perfoliatum L. var. *longistylum* Post, Fl. Syr. Pal. Sin. 94. 1896; *Microthlaspi natolicum* (Boiss.) F.K.Mey. subsp. *longistylum* (Post) F.K.Mey., Feddes Repert. 84: 453. 1973; *T. annuum* K.Koch var. *longistylum* (Post) Dinsmore in Post, Fl. Syr. Pal. Sin., ed. 2, 1: 99. 1932. TYPE: SYRIA. Shuway in Jab. Nusayriyyah, *G. E. Post s.n.* (Lectotype designated by Meyer (2003a: 12); BEI).

Microthlaspi natolicum (Boiss.) F.K.Mey. var. *pentadactylonis* F.K.Mey., Feddes Repert. 84: 453. 1973. TYPE: CYPRUS, Petacactylo, *C. G. T. Kotschy 367* (Holotype: W).

Microthlaspi natolicum (Boiss.) F.K.Mey. subsp. *sporadium* F.K.Mey., Feddes Repert. 84: 453. 1973. TYPE: GREECE, “in umbrosis Rhodi,” Mar 1845, *T.T.H. Von Heldreich s.n.* (Holotype: JE; Isotypes: E, W).

Distribution: Cyprus, Greece, Lebanon, Syria, Turkey.

Several authors (e.g., Greuter & Burdet in Greuter & Raus, 1983; Greuter et al., 1986; Artelari, 2002) have confused the limits of this species and *Noccaea perfoliata* (both as *Thlaspi*) and recognized some of the infraspecific taxa above as part of the latter species. The flowers of *N. natolica* have larger and unequal petals, whereas those of *N. perfoliata* have smaller and equal petals. Meyer (1973, 2003a) over divided *N. natolica* (as *Microthlaspi*) into four subspecies and two additional varieties based almost solely on microscopic differences in seed size, style length, and petal size. This excessive division of the species into

infraspecific taxa is impractical and not useful. Therefore, the five infraspecific taxa above are considered herein as only minor variants of the species.

Noccaea nepalensis Al-Shehbaz, *Adansonia* sér. 3, 24: 89. 2002. TYPE: NEPAL. Dozam Khola, near Simikot, 10,500 ft. [3,200 m], 29 May 1952, *O. V. Polunin, W. R. Sykes & L. H. J. Williams 4199* (Holotype: BM; Isotypes: A, E).

Distribution: Nepal.

Noccaea nevadensis (Boiss. & Reut.) F.K.Mey., *Feddes Repert.* 84: 460. 1973.

Basionym: *Thlaspi nevadense* Boiss. & Reut., *Pugill. Pl. Afr. Bor. Hispan.* 11. 1852. TYPE: SPAIN. Sierra Nevada, below Cueva de Panderon, Jul 1849, *Reuter s.n.* (Holotype: G).

Distribution: Spain.

Noccaea occitanica (Jord.) F.K.Mey., *Feddes Repert.* 84: 463. 1973.

Basionym: *Thlaspi occitanicum* Jord., *Observ. Pl. Nouv.* 3: 12. 1846. TYPE: FRANCE. La Séranne près Ganges, *A. Jordan s.n.* (Holotype: LY).

Homotypic synonyms: *Thlaspi sylvestre* Jord. subsp. *occitanicum* (Jord.) Rouy & Foucaud, *Fl. France* 2: 151. 1895; *T. alpestre* L. subsp. *occitanicum* (Jord.) O.Bolòs & Vigo, *Butl. Inst. Catalana Hist. Nat., Secc. Bot.* 38(1): 77. 1974; *T. caeruleascens* J.Presl & C.Presl subsp. *occitanicum* (Jord.) M.Laínz, *Bol. Soc. Brot. sér. 2*, 53: 38. 1979; *Noccaea caeruleascens* (J.Presl & C.Presl) F.K.Mey. subsp. *occitanicum* (Jord.) Kerguelen, *Collect. Patrim. Nat.* 8: 14. 1993.

Heterotypic synonym: *Thlaspi tallonis* Sennen, *Plantes d'Espagne* nr. 6039. 1927; *Thlaspi alpestre* L. var. *tallonis* (Senn.) O.Bolòs & Vigo, *Butl. Inst. Catalana Hist. Nat., Secc. Bot.* 38: 77. 1974; *Noccaea occitanica* subsp. *tallonis* (Sennen) F.K.Mey., *Feddes Repert.* 84: 463. 1973. TYPE: SPAIN. Gerona, Llivia, Néguila, 1,270 m, 24 Jun 1927, *F. Sennen 6039* (Holotype: BC; Isotype: W).

Distribution: France, Spain.

Noccaea ochroleuca (Boiss. & Heldr.) F.K.Mey., *Feddes Repert.* 84: 461. 1973.

Basionym: *Thlaspi ochroleucum* Boiss. & Heldr., *Diagn. Pl. Orient. ser. 1*, 8: 39. 1849. TYPE: TURKEY. Prov. Isparta, Mons Davros Dag Pisidiae, May 1845, *T. H. H. von Heldreich s.n.* (Lectotype designated initially as type by Hedge (1965: 335) and finalized by Meyer (2006e: 95): G-BOIS; Isolectotypes: BM, G, GOET, JE, K, P, W).

Homotypic synonyms: *Thlaspi alpinum* Crantz var. *ochroleucum* (Boiss. & Heldr.) Stoj. & Stef., *Fl. Balg.* 1: 491. 1924; *T. praecox* Wulfen var. *ochroleucum* (Boiss. & Heldr.) Stoj. & Stef., *Fl. Balg.*, ed. 2, 1: 448. 1933.

Distribution: Turkey.

Noccaea oppositifolia (Pers.) Al-Shehbaz & Menke, *Taxon* 61: 949. 2012.

Basionym: *Iberis oppositifolia* Pers., *Syn. Pl.* 2: 186. 1806. TYPE: LEBANON. *J.J. H. Labillardière s.n.* (Holotype: G).

Homotypic synonyms: *Lepidium oppositifolium* (Pers.) Labill., *Icon. Pl. Syr.* 5: 14. 1812; *Thlaspi oppositifolium* (Pers.) Poir. in Lamarck, *Encycl. Suppl.* 5: 277. 1817; *Eunomia oppositifolia* (Pers.) DC., *Syst. Nat.* 2: 556. 1821; *Aethionema oppositifolium* (Pers.) Boiss., *Fl. Orient.* 1: 344. 1867.

Distribution: Lebanon, Turkey.

Noccaea orbiculata (Steven ex DC.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi orbiculatum* Steven ex DC., *Syst. Nat.* 2: 377. 1821. TYPE: GEORGIA. Iberia, 1820, *C. Steven s.n.* (Holotype: G-DC; Isotype: LE).

Homotypic synonym: *Neurotropis orbiculata* (Steven ex DC.) F.K.Mey., *Feddes Repert.* 84: 452. 1973.

Distribution: Georgia, Turkey.

Noccaea oxyceras (Boiss.) Al-Shehbaz, *comb. nov.*

Basionym: *Carpoceras oxyceras* Boiss., *Diagn. Pl. Orient. ser. 1*, 8: 37. 1849. TYPE: TURKEY. Cassius, Jun 1846, *E. Boissier 51* (Holotype: G-BOIS).

Homotypic synonyms: *Thlaspi oxyceras* (Boiss.) Hedge, *Fl. Turkey* 1: 339. 1965; *Thlaspiceras oxyceras* (Boiss.) F.K.Mey., *Feddes Repert.* 84: 454. 1973.

Distribution: Turkey.

Noccaea papillosa (Boiss.) F.K.Mey., *Feddes Repert.* 84: 460. 1973.

Basionym: *Thlaspi papillosum* Boiss., *Fl. Orient.* 1: 330. 1867. TYPE: TURKEY. [Prov. Denizli], Cadmus, Dewileh, Jun 1942, *E. Boissier s.n.* (Holotype: G-BOIS).

Homotypic synonym: *Apterigia papillosa* (Boiss.) V.I.Dorof., *Novosti Sist. Vyssh. Rast.* 44: 94. 2013.

Distribution: Turkey.

Noccaea papyracea (Boiss.) Khosravi, *Mumm. & Mohsenz.*, *Feddes Repert.* 119: 21. 2008.

Basionym: *Brossardia papyracea* Boiss., *Ann. Sci. Nat., Bot. sér. 1*, 16: 380. 1841. TYPE: IRAN. Ispahan, *P. M. R. Aucher-Eloy 4127* (Holotype: G-BOIS; Isotypes: K, 2P).

Heterotypic synonyms: *Brossardia papyracea* Boiss. var. *kotschy* Boiss., *Diagn. Pl. sér. 1*, 8: 41. 1849; *Brossardia retusa* Boiss., *Fl. Orient.* 1: 336. 1867. TYPE: IRAN. Kuhdelu, 3 May 1842, *C. G. T. Kotschy 327* (Lectotype here designated: G-BOIS; Isolectotypes: B, E, K, US).

Distribution: Iran, Iraq, Turkey.

Both *Brossardia retusa* and *B. papyracea* var. *kotschy* are based on the same mixed collection. The species has only recently been recorded for Turkey (Adigüzel & Koyuncu, 1999) and placed in *Noccaea* by Khosravi et al. (2007).

Noccaea parviflora (A.Nelson) Holub, *Preslia* 70: 108. 1998.

Basionym: *Thlaspi parviflorum* A.Nelson, *Bull. Torrey Bot. Club* 27: 265. 1900. TYPE: U.S.A. Wyoming, Yellowstone National Park, Golden Gate, 28 Jun 1899, A. & E. Nelson 5554 (Holotype: RM; Isotypes: CM, DS, GH, 2ISC, MO, 2NY, P, US).

Distribution: U.S.A. (Idaho, Montana, Wyoming).

Noccaea perfoliata (L.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi perfoliatum* L., *Sp. Pl.* 2: 646. 1753. TYPE: "Habitat in Germaniae, Helvetiae, Galliae apricis, agris" (Lectotype designated by Jafri (1973: 85) as type: Herb. Linn. No. 825.9 (LINN); same lectotypification was proposed thirty years later by Meyer (2003a: 17) who overlooked the earlier one).

Homotypic synonym: *Microthlaspi perfoliatum* (L.) F.K.Mey., *Feddes Repert.* 84: 453. 1973.

Heterotypic synonyms: *Thlaspi granatense* Boiss. & Reut., *Diagn. Pl. Orient. ser. 2, 1:* 40. 1854; *Microthlaspi granatense* (Boiss. & Reut.) F.K.Mey., *Feddes Repert.* 84: 453. 1973. TYPE: SPAIN. In regione alpina superiori montis Sierra de Baza, 21 May 1851, E. Bourgeau 1025 (Holotype: G-BOIS; Isotype: WAG).

Distribution: Native to S and C Europe, NW Africa, and SW Asia eastward into W China; naturalized in NC Europe and North America.

This is an extremely widespread and morphologically variable species that includes several chromosomal races (Koch, 1995; Koch et al., 1998a, b; Koch & Bernhardt, 2004). Several dozens of species and infraspecific taxa were described in this complex, but I follow Meyer (2003a), who listed and typified all of them, in treating them as minor variants of the species. The variation does not seem to fall into geographically and morphologically defined groups, and the division of the species into infraspecific or specific segregates would not be practical at this point. Therefore, a broad species concept is adopted herein. The synonymy at the specific and infraspecific levels are extensive and need not be repeated here, and only those at the specific rank are listed.

Noccaea phrygia (Bornm.) F.K.Mey., *Feddes Repert.* 84: 465. 1973.

Basionym: *Thlaspi phrygium* Bornm., *Mitth. Thüring. Bot. Vereins* 38: 57. 1929. TYPE: TURKEY. Phrygia, Mt. Sultandagh, 1,850 m, 16 Jun 1899, J. Bornmüller 4093 (Holotype: B).

Distribution: Turkey.

Noccaea platycarpa (Fisch. & C.A.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi platycarpum* Fisch. & C.A.Mey., *Index Seminum Hort. Petrop.* 7: 57. 1840. TYPE: TURKEY. Grown at LE from seeds collected by Wiedemann s.n. (Lectotype designated by Dorofeyev (2012: 456); LE; Isolectotype: K).

Homotypic synonym: *Neurotropis platycarpa* (Fisch. & C.A.Mey.) F.K.Mey., *Feddes Repert.* 84: 452. 1973.

Heterotypic synonyms: *Thlaspi kotschyianum* Boiss. & Hohen., *Diagn. Pl. Orient. ser. 1, 8:* 39. 1849; *Neurotropis kotschyana* (Boiss. & Hohen.) Czerep., *Sosud. Rast. SSSR* 140. 1981. TYPE: IRAN. Elburs, Passgala, 6 May 1843, C. G. T. Kotschy 102 (Holotype: G-BOIS; Isotypes: B, BM, GOET, H, JE, K, 3P, W, WAG).

Thlaspi brevicaulis Boiss. ex Kotschy, *Diagn. Pl. Orient. ser. 2, 5:* 40. 1856. TYPE: SYRIA. "Hab. in subalpinis Bludan suprà Zebdani Antilibani," near Damascus, 6,000 ft [1,829 m], 6 Jun 1855, C. G. T. Kotschy 47 (Holotype: G-BOIS; Isotypes: B, GZU, JE, K, 3P, S, W).

Thlaspi cardiocarpum Hook.f. & Thomson, *J. Proc. Linn. Soc., Bot.* 5: 176. 1861. TYPE: AFGHANISTAN. 1838–1840, Griffith 1402 (Lectotype designated by Meyer (2001b: 49): K; isolectotype: W).

Thlaspi armenum N.Busch, *Trudy Bot. Sada Imp. Yur'evsk. Univ.* 7: 142. 1906; *Neurotropis armena* (N.Busch) Czerep., *Sosud. Rast. SSSR* 140. 1981. TYPE: AZERBAIJAN. Prop Nachiczewan, *Szovits s.n.* (Holotype: LE).

Distribution: Afghanistan, Azerbaijan, China, Greece, Iran, Iraq, Kazakhstan Lebanon, Pakistan, Syria, Tajikistan, Turkey, Turkmenistan, Uzbekistan.

The species has recently been recorded for China by German and Chen (2009).

Noccaea praecox (Wulfen) F.K.Mey., *Feddes Repert.* 84: 462. 1973.

Basionym: *Thlaspi praecox* Wulfen in Jacqin, *Coll.* 2: 124. 1789. TYPE: "*Thlaspi montanum praecox*," (Lectotype designated by Meyer (2006e: W))

Heterotypic synonyms: *Thlaspi cuneifolium* Griseb., *Oesterr. Bot. Z.* 23: 268. 1873; *Noccaea cuneifolia* (Griseb.) Holub, *Preslia* 70: 108. 1998. TYPE: MONTENEGRO. Bjela Gora, Jastrelica, 27 Apr 1872, J. Pantocsek s.n. (Lectotype designated by Meyer (2006e: 102): GOET-002665; Isolectotypes: B, DR, G, JE, W).

Distribution: Albania, Austria, Bosnia and Herzegovina, Croatia, Italy, Montenegro, Serbia, Slovenia.

Meyer (2006e) listed a dozen additional synonyms (all in *Thlaspi*) that are not repeated herein.

Noccaea pulvinata (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Vania pulvinata* F.K.Mey., *Feddes Repert.* 84: 467. 1973. TYPE: TURKEY. Prov. Hakkari, Cilo Dag, 10 km W of Cilo Tepe, 12,000 ft [3,660 m], 9 Aug. 1954, P. H. Davis & O. V. Polunin 24207 (Holotype: E; Isotype: JE).

Homotypic synonym: *Thlaspi pulvinatum* (F.K.Mey.) Greuter & Burdet, *Willdenowia* 13: 96. 1983, non *T. pulvinatum* Mozaff., *Iranian J. Bot.* 7: 138. 1996.

Distribution: Turkey.

Noccaea pumila (Steven) Steud., *Nomencl. Bot.*, ed. 2: 2: 197. 1841.

Basionym: *Iberis pumila* Steven, Mém. Soc. Imp. Naturalistes Moscou 3: 269. 1812. TYPE: AZERBAIJAN. Schahdagh, Jun 1810, *Steven s.n.* (Lectotype designated by Dorofeyev (2012: 459): H).
 Homotypic synonyms: *Thlaspi pumilum* (Steven) Ledeb., Fl. Ross. 1(1): 164. 1841; *Apterigia pumila* (Steven) Galushko, Novosti Sist. Vyssh. Rast. 6: 209. 1970.
Distribution: Azerbaijan, Georgia.

Noccaea rechingeri (F.K.Mey) Al-Shehbaz, *comb. nov.*
 Basionym: *Thlaspiceras rechingeri* F.K.Mey., Feddes Repert. 84: 456. 1973. TYPE: TURKEY. Prov. Hatay, Akma Dag, 3,600 ft [1,097m], Jun 1862, (Pl. Syriae bor. Ex Aano occidental supra Arsus), *C. G. T. Kotschy 181* (Holotype: W; Isotypes: G, JE).
 Homotypic synonym: *Thlaspi rechingeri* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 96. 1983.
Distribution: Turkey.

Noccaea rhodopensis F.K.Mey., Feddes Repert. 84: 462. 1973. TYPE: BULGARIA. Between Bačkovovo and Kurudere, 2 May 1967, *F. K. & J. Meyer 8718* (Holotype: JE; Isotype: JE).
Distribution: Bulgaria.

Noccaea rostrata (N.Busch) Al-Shehbaz, *comb. nov.*
 Basionym: *Thlaspi rostratum* N.Busch, Monit. Jard. Bot. Tiflis, n.s. 1926–27(3–4): 10. 1927. TYPE: AZERBAIJAN. Nachitshevan, Ordubad, 26 May 1923, *A. A. Grossheim s.n.* (Holotype: LE).
 Homotypic synonym: *Apterigia rostrata* (N.Busch) Galushko, Novosti Sist. Vyssh. Rast. 6: 209. 1970; *Atropatenia rostrata* (N.Busch) F.K.Mey., Feddes Repert. 84: 467. 1973.
Distribution: Azerbaijan.

Noccaea rosularis (Boiss. & Balansa) Al-Shehbaz, *comb. nov.*
 Basionym: *Thlaspi rosulare* Boiss. & Balansa, Diagn. Pl. Orient. ser. 2, 5: 39. 1856. TYPE: TURKEY. [Niğde], “in regione montana superiore jugi montis Masmeneudagh,” 8 Aug 1855, *B. Balansa s.n.* (Holotype: G-BOIS; Isotypes: GH, K, 2P, US).
 Homotypic synonyms: *Masmenia rosularis* (Boiss. & Balansa) F.K.Mey., Feddes Repert. 84: 468. 1973.
Distribution: Turkey.

Noccaea rotundifolia (L.) Moench, Suppl. Meth. 89. 1802.
 Basionym: *Iberis rotundifolia* L., Sp. Pl. 2: 649. 1753. TYPE: “Habitat in Helvetica,” not yet designated (Jarvis, 2007). It is likely that Herb. Linn. No. 827.7 (LINN) can serve as the lectotype, but without examining that collection, a formal lectotypification will have to wait.
 Heterotypic synonyms: *Noccaea rotundifolia* subsp. *grignensis* F.K.Mey., Feddes Repert. 84: 459. 1973; *Thlaspi rotundifolium* (L.) Gaudin subsp. *grignense* (F.K.Mey) Greuter & Burdet, Willdenowia 13: 96.

1983; *T. cepaeifolium* (Wulfen) W.D.J.Koch subsp. *grignense* (F.K.Mey.) Greuter & Burdet, Willdenowia 15: 70. 1985; *T. grignense* (F.K.Mey.) Landolt, Fl. Indicativa 270. 2010. TYPE: ITALY. Grigna-Gruppe am Comer See, ca. 2,000 m, 12 Jul 1904, *G. Geilinger s.n.* (Holotype: Z).
Noccaea rotundifolia subsp. *intermedia* F.K.Mey., Feddes Repert. 84: 459. 1973. TYPE: FRANCE. Beuil au Mont Monnier, 20 Jun and 4 Aug 1894, *G. P. Vidal s.n.* (Holotype: JE).

Distribution: Austria, France, Germany, Italy, Slovenia, Switzerland
 Mayer (2006e) gave an extensive list of 16 synonyms that are not repeated herein, and only the above additional synonyms are given. The two subspecies of *Noccaea rotundifolia* described by Meyer (1973) differ only slightly in floral measurements and style length.

Noccaea rubescens (Schott & Kotschy ex Boiss.) F.K.Mey., Feddes Repert. 84: 459. 1973.
 Basionym: *Aethionema rubescens* Schott & Kotschy ex Boiss., Fl. Orient. 1: 343. 1867. TYPE: TURKEY. Iter cilicicum in Tauri alpes, Bulgar Dag, summit of Metdesis, 11,800 ft [3,597 m], 3 Jul 1853, *C. G. T. Kotschy 160* (Holotype: G-BOIS).
 Homotypic synonym: *Thlaspi rubescens* (Boiss.) Greuter & Burdet, Willdenowia 13: 96. 1983.
 Heterotypic synonyms: *Thlaspi crassum* P.H.Davis, Fl. Turkey 10: 41. 1988; *T. sintenisii* Hausskn. ex Bornm. subsp. *crassum* (P.H.Davis) Parolly, Willdenowia 25: 248. 1995. TYPE: TURKEY. Niğde, Ala Dağları, 29 Aug 1965, *G. W. Findlay 163* (Holotype: E).
Distribution: Turkey.

Noccaea salisii (Brügger) F.K.Mey., Feddes Repert. 84: 464. 1973.
 Basionym: *Thlaspi salisii* Brügger, Z. Ferdinandeums Tirol, ser. 3, 9: 45. 1860. TYPE: SWITZERLAND. Silvaplana, *Brügger s.n.* (Lectotype designated by Meyer (2006e: 155): CHUR).
Distribution: Austria, Italy, Switzerland.

Noccaea sarmatica F.K.Mey., Feddes Repert. 84: 464. 1973. TYPE: MOLDOVA. Dshamano, Bulbokskogo rajonna, 25 Apr 1950, *V. N. Andrejev & L. I. Posharinkaja s.n.* (Holotype: LE).
 Homotypic synonym: *Thlaspi sarmaticum* (F.K.Mey.) V.I.Dorof., Turczaninowia 5(3): 113. 2002.
Distribution: Moldova, Ukraine.

Noccaea sintenisii (Hausskn. ex Bornm.) F.K.Mey., Feddes Repert. 84: 458. 1973.
 Basionym: *Thlaspi sintenisii* Hausskn. ex Bornm., Mitth. Thüring. Bot. Vereins 38: 52. 1929. TYPE: TURKEY. Prov. Pontus, Karagoellidag, Mt. Manator, 3 Aug 1894, *P. E. E. Sintenis 7316* (Holotype: JE-00004211; Isotypes: B, BM, DS, FR, JE, 2K, 3LD, S, 2TBI, W, Z).

Homotypic synonym: *Apterigia sintenisii* (Hausskn. ex Bornm.) V.I.Dorof., *Novosti Sist. Vyssh. Rast.* 44: 94-95. 2013.

Distribution: Turkey.

Noccaea stenocarpa (Boiss.) Al-Shehbaz, *comb. nov.*

Basionym: *Carpoceras stenocarpum* Boiss., *Diagn. Pl. Orient. ser. 1, 8: 37.* 1849. TYPE: IRAN, near Tehran, Mt. Totschal, 17 May 1843, *C. G. T. Kotschy 165* (Holotype: G-BOIS; Isotypes: B, GOET, JE, K, 4P, W).

Homotypic synonyms: *Kotschyella stenocarpa* (Boiss.) F.K.Mey., *Feddes Repert.* 84: 457. 1973; *Thlaspi stenocarpum* (Boiss.) Hedge, *Fl. Iranica* 57: 116. 1968.

Distribution: Iran, Turkmenistan.

Noccaea stenoptera (Boiss. & Reut.) F.K.Mey., *Feddes Repert.* 84: 461. 1973.

Basionym: *Thlaspi stenopterum* Boiss. & Reut., *Diagn. Pl. Orient. ser. 1, 8: 40.* 1849, non Conrath & Freyn, *Bull. Herb. Boissier* 3(1): 38. 1895. TYPE: SPAIN. Sierra de Guadarrama Castellae, above El Paular, 1841, *G. F. Reuter s.n.* (Holotype: G).

Heterotypic synonyms: *Thlaspi suffruticosum* Asso ex Loscos & J.Pardo, *Ser. Inconf. Pl. Aragon. ed. 2,* 38. 1867; *Noccaea suffruticosa* (Asso ex Loscos & J.Pardo) Holub, *Preslia* 70: 108. 1998. TYPE: Not located.

Distribution: Spain.

Noccaea stilosa (Ten.) Rchb., *Fl. Germ. Excurs.* 663. 1832.

Basionym: *Iberis stilosa* Ten., *Fl. Napol.* 1: 37. 1812. TYPE: ITALY. La Majella, Mt. Amaro, *Tenore s.n.* (Holotype: NAP).

Homotypic synonym: *Thlaspi stilosum* (Ten.) Mutel, *Fl. Franç.* 1: 99. 1834 (as *stylosum*).

Distribution: Italy.

Noccaea swatensis F.K.Mey., *Hausknechtia* 12: 178. 2006. TYPE: PAKISTAN. Swat, E Kalam, 3,000 m, 6 Jun 1965, *J. Lamond & K. H. Rechinger 30855* (Holotype: W).

Distribution: Pakistan.

Meyer (2006e) described *Noccaea swatensis* solely on flowering material. More complete material of the species was erroneously interpreted by Jafri (1955, 1973) as *Thlaspi septigerum* (Bunge) Jafri. The latter name is based on disjunct Altai plants known as *Eutrema septigera* Bunge which was reduced by Busch (1939) to synonymy of *E. edwardsii* R.Br.

Noccaea sylvia (Gaudin) F.K.Mey., *Feddes Repert.* 84: 461. 1973.

Basionym: *Thlaspi sylvium* Gaudin, *Fl. Helv.* 4: 221. 1829. TYPE: SWITZERLAND. Zermatt, *Murith s.n.* (Lectotype designated by Meyer (2006e: 91): LAU).

Homotypic synonyms: *Thlaspi minimum* Ard. subsp. *sylvium* (Gaudin) H.P.Fuchs, *Feddes Repert.* 90:

553. 1979; *T. alpestre* Jacq. subsp. *sylvium* (Gaudin) Kerguélen, *Lejeunia* 120: 175. 1987; *Noccaea alpestris* (Jacq.) Kerguélen subsp. *sylvium* (Gaudin) Kerguélen, *Collect. Patrim. Nat.* 8: 14. 1993.

Distribution: France, Italy, Switzerland.

Noccaea szowitsiana (Boiss.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi szowitsianum* Boiss., *Fl. Orient.* 1: 324. 1867. TYPE: ARMENIA. "Hab. in humidis montis Karagiol prov. Karabagh," 1 Jun 1829, *Szovits 295* (Lectotype here designated: G-BOIS; Isotypes: 2LE).

Homotypic synonym: *Neurotropis szowitsiana* (Boiss.) F.K.Mey., *Feddes Repert.* 84: 452. 1973.

Distribution: Armenia, Azerbaijan.

Meyer (2001b) indicated that the type is at G-BOIS, whereas Dorofeyev (2003: 123) designated one of the two sheets at LE as the lectotype. Both authors did not meet the requirements of lectotypification in Article 7.10 of ICN in McNeill et al. (2012) and, therefore, a lectotypification of the species is needed.

Noccaea tatianae (Bordz.) F.K.Mey., *Feddes Repert.* 84: 465. 1973.

Basionym: *Thlaspi tatianae* Bordz., *Izv. Kievsk. Bot. Sada* 12-13: 114. 1931. ARMENIA. Two syntypes were cited by Meyer (2006e), none of which was examined by him or the present author. Lectotypification of the species is needed.

Distribution: Armenia, Azerbaijan, Iran, Turkey.

Noccaea tenuis (Boiss. & Buhse) F.K.Mey., *Feddes Repert.* 84: 459. 1973.

Basionym: *Iberidella tenuis* Boiss. & Buhse, *Nouv. Mém. So. Imp. Naturalistes Moscou* 12: 25. 1860. TYPE: IRAN. Kuh-e Sahand, Damirdagh, 10,000 ft [ca. 3050 m], *F. A. Buhse 589/2* (lectotype designated by Hedge 1968: 117 as type: G-BOIS; Isolectotype: LE).

Homotypic synonyms: *Aethionema tenue* (Boiss. & Buhse) Boiss., *Fl. Orient.* 1: 343. 1867; *Thlaspi tenue* (Boiss. & Buhse) Hedge, *Fl. Iranica* 57: 117. 1968.

Distribution: Iran.

Noccaea thlaspidioides (Pall.) F.K.Mey., *Hausknechtia* 12: 5. 2010.

Basionym: *Lepidium thlaspidioides* Pall., *Reise Russ. Reich.* 3: 161. 1776. LECTOTYPE designated by Meyer (2010: 5): Plate 56, Fig. 1 in Gmelin, *Fl. Sibir.* 3. 1768.

Homotypic synonym: *Thlaspi thlaspidioides* (Pall.) Kitag., *Rep. Inst. Sci. Res. Manchoukuo* 2: 293. 1938.

Heterotypic synonyms: *Thlaspi cochleariforme* DC., *Syst. Nat.* 2: 381. 1821; *Noccaea cochleariformis* (DC.) Á. & D. Löve, *Bot. Not.* 128(4): 513. 1976. TYPE: RUSSIA. Sibiria et Dahuria ad jugum Yablonski-Chrebet, *Patrin s.n.* (Holotype: G-DC).

Thlaspi exauriculatum Kom., *Repert. Spec. Nov. Regni Veg.* 9: 392. 1911; *Noccaea exauriculata* (Kom.) Czerep., *Sosud. Rast. SSSR* 140. 1981.

TYPE: RUSSIA. Insula Sachalin, 18 Jun 1909, *M. E. Semjagin s.n.* (Holotype: LE).

Distribution: N China, Kazakhstan, Mongolia, Russia.

Holmgren (1971) listed *Thlaspi cochleariforme* as a synonym of *T. montanum*, but as shown by Meyer (2010) the former is a synonym of *Noccaea thlaspidioides*, a species clearly unrelated to *N. montana*. Records of *N. thlaspidioides* (as *T. cochleariforme*) from Tibet (Xizang) in Zhou et al. (2001) are likely based on plants of *N. yunnanensis*.

Noccaea triangularis (F.K.Mey.) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspiceras triangulare* F.K.Mey., Feddes Repert. 84: 455. 1973. TYPE: TURKEY. Prov. Seyhan, Osmaniye, near Zortum, Amanus, 1,500 m, 17 Jun 1967, *Y. Akman 220* (Holotype: G).

Homotypic synonym: *Thlaspi triangulare* (F.K.Mey.) Greuter & Burdet, Willdenowia 13: 96. 1983.

Distribution: Turkey.

Noccaea trinervia (DC.) Steud., Nomencl. Bot., ed. 2. 2: 197. 1841.

Basionym: *Hutchinsia trinervia* DC., Syst. Nat. 2: 387. 1821. TYPE: IRAN. Mt. Elwind, *A. Michaux s.n.* (Lectotype here designated: G-DC-00131230; Isolectotype: P).

Homotypic synonyms: *Aethionema trinervium* (DC.) Boiss., Fl. Orient. 1: 342. 1867; *Iberidella trinervia* (DC.) Boiss., Ann. Sci. Nat., Bot. Sér. 2, 17: 188. 1842; *Vania trinervia* (DC.) Khosravi et al., Ann. Missouri Bot. Gard. 96: 570. 2009; *Thlaspi trinervium* (DC.) Mozaff., Iranian J. Bot. 7: 139. 1996.

Distribution: Afghanistan, Armenia, Azerbaijan, Iran, Iraq, Kazakhstan, Turkey, Turkmenistan, Uzbekistan.

Khosravi et al. (2009b) placed the species in genus *Vania*, which is reduced herein to synonymy of *Noccaea*. They designated Oliver's collection at G-DC as the lectotype, but that collection was made in 1822, a year after the original publication of the species. Therefore, a new lectotypification is proposed above.

Noccaea tymphaea (Hausskn.) F.K.Mey., Feddes Repert. 84: 462. 1973.

Basionym: *Thlaspi tymphaeum* Hausskn., Mitth. Thüring. Bot. Vereins N. Folge 3-4: 115. 1893. TYPE: GREECE. Pindus Tymphaeus, Mt Zygus, above Metzovo, 4,500–5,000 ft [1,371–1,524 m], Jul 1885, *C. Haussknecht s.n.* (Holotype: JE-00004213; Isotypes: B, JE, W).

Heterotypic synonyms: *Thlaspi pindicum* Hausskn., Mitth. Thur. Bot. Ver. N. Folge 3-4: 115. 1893; *Noccaea pindica* (Hausskn.) Holub, Preslia 70: 108. 1998. TYPE: GREECE. Pindus Tympaeus, Zygus, 4,500–5,000 ft [1,371–1,524 m], July 1885, *C. Haussknecht s.n.* (Holotype: JE-00004235; Isotypes: JE, K).

Distribution: Albania, Bosnia and Herzegovina, Greece, Macedonia.

Noccaea umbellata (Steven ex DC.) Al-Shehbaz, *comb. nov.*
Basionym: *Thlaspi umbellatum* Steven ex DC., Syst. Nat. 2: 377. 1821. TYPE: IRAN. Gilan, *S. G. Gmelin s.n.?* (Holotype: H; isotypes, LE, MW).

Homotypic synonym: *Microthlaspi umbellatum* (Steven ex DC.) F.K.Mey., Feddes Repert. 84: 453. 1973.

Distribution: Armenia, Azerbaijan, Iran.

The present author has not seen the type collection of the species to justify if the lectotypification of the species, as done by Dorofeyev (2012: 457), is needed or not.

Noccaea valerianoides (Rech.f.) F.K.Mey., Feddes Repert. 84: 460. 1973.

Basionym: *Thlaspi valerianoides* Rech.f., Phytion (Horn) 3: 50. 1951. TYPE: TURKEY. Kurdistan, Passet Aghzi Gedik, 13 km N of Mukus, 2,900 m, 24 Jun 1939, *J. Frödin* (Holotype: W; Isotypes: JE, UPS).

Homotypic synonym: *Apterigia valerianoides* (Rech.f.) V.I.Dorof., Novosti Sist. Vyssh. Rast. 44: 94. 2013.

Heterotypic synonym: *Noccaea valerianoides* subsp. *rechingeri* F.K.Mey., Haussknechtia 12: 69. 2006. TYPE: IRAN, Prov. Mazanderan, Distr. Kudjur, Mt. Ulodj, 3,200–3,400 m, 9 Aug 1948, *K. H. & F. Rechinger 6522* (Holotype: W).

Distribution: Iran, Turkey.

The species is poorly collected in both Iran and Turkey, and the disjunct population in Iran is hardly distinct morphologically to merit its recognition as an independent subspecies.

Noccaea versicolor (Stoj. & Kitan.) F.K.Mey., Haussknechtia 12: 116. 2006.

Basionym: *Thlaspi lutescens* Velen. f. *versicolor* Stoj. & Kitan., Izv. Bulg. Bot. Druzh. 9: 97. 1943. TYPE: GREECE. Tasos, Ilija, 1,100 m, 8 Apr 1942, *N. Stojanov & B. Kitanov s.n.* (Holotype: SOM).

Distribution: Greece, Turkey.

Noccaea vesicaria (L.) Al-Shehbaz, *comb. nov.*

Basionym: *Alyssum vesicaria* L., Sp. Pl. 2: 910. 1753. TYPE: “*Vesicaria Orientalis foliis dentatis Coroll.*” In Tournefort, Rel. Voy. Levant 2: [“t. 14”]. 1717 (Lectotype designated by Al-Shehbaz & Turland in Cafferty & Jarvis (2002: 531)).

Homotypic synonyms: *Coluteocarpus vesicaria* (L.) Holmboe, Bergens Mus. Årbok 13: 6. 1907.

Heterotypic synonym: *Coluteocarpus reticulatus* (Lam.) Boiss., Ann. Sci. Nat., Bot. sér. 2, 17: 162. 1842; *Vesicaria reticulata* Lam. ex Poir., Encycl. (Lamarck) 8: 572. 1808. TYPE: TURKEY. *J. P. de Tournefort s.n.* (Lectotype here designated: MPU).

Distribution: Armenia, Azerbaijan, Georgia, Turkey.

Noccaea vesicaria subsp. **boissieri** (Bornm.) Al-Shehbaz, *comb. nov.*

Basionym: *Coluteocarpus reticulatus* var. *boissieri* Bornm., Beih. Bot. Centralbl. 19(2): 207. 1906. TYPE: IRAN. Mt. Schuturun Kuh, May 1897, *T. Strauss s.n.* (Lectotype here designated: JE-00006910).

Homotypic synonyms: *Coluteocarpus vesicaria* subsp. *boissieri* (Bornm.) Hedge, Notes Roy. Bot. Gard. Edinburgh 26: 181. 1965; *C. boissieri* (Bornm.) O.E.Schulz in Engler & Prantl, Nat. Pflanzenfam., ed. 2, 17B: 428. 1936.

Distribution: Iran, Iraq, Lebanon, Turkey.

Subspecies *boissieri* differs from subsp. *vesicaria* by having (1 or)2-seeded fruits with a complete septum and ovate to spatulate or rhomboid rosette leaves (vs. 4–10(–12)-seeded fruits with the septum reduced to a narrow rim and linear to narrowly oblanceolate rosette leaves).

Noccaea violascens (Schott & Kotschy) F.K.Mey., Feddes Repert. 84: 465. 1973.

Basionym: *Thlaspi violascens* Schott & Kotschy in Unger & Kotschy, Ins. Cyp. 328. 1862. TYPE: TURKEY. Taurus, Bulgar Dagh, 7,000 ft [2,134 m], 8 Jul 1853, *C. G. T. Kotschy 70a* (Holotype: W; Isotypes: B, G, WAG).

Distribution: Turkey.

Noccaea virens (Jord.) F.K.Mey., Feddes Repert. 84: 463. 1973.

Basionym: *Thlaspi virens* Jord., Observ. Pl. Nouv. 3: 17. 1846. TYPE: FRANCE. A lectotype should be selected from the four syntypes collected by A. Jordan and presumably housed at LY: Mont Lozère près Villefort, Mont Mèzin, Mont Pilat près Lyon, and Pierre-sur Haute. None of these were examined by the present author.

Homotypic synonyms: *Pterotropis virens* (Jord.) Four., Ann. Soc. Linn. Lyon, sér. 2, 16: 337. 1868; *Noccaea caerulescens* (J.Presl & C.Presl) F.K.Mey. subsp. *virens* (Jord.) Kerguelen, Collect. Patrim. Nat. 8: 15. 1993.

Distribution: France, Italy, Switzerland.

Noccaea viridisepala (Podp.) F.K.Mey., Feddes Repert. 84: 461. 1973.

Basionym: *Thlaspi praecox* Wulfen var. *viridisepalum* Podp., Verh. K. K. Zool.-Bot. Ges. Wien 52: 632. 1902. TYPE: BULGARIA. Vitosha, ca. 1500 m, 7 May 1967, *F. K. & J. Meyer 8863* (Neotype designated by Meyer (2006e: 88): JE).

Homotypic synonyms: *Thlaspi viridisepalum* (Podp.) Greuter & Burdet, Willdenowia 13: 96. 1983.

Distribution: Albania, Bosnia and Herzegovina, Bulgaria, Greece, Macedonia, Montenegro.

Noccaea wendelboi (Rech.f.) F.K.Mey., Haussknechtia 12: 179. 2006

Basionym: *Thlaspi wendelboi* Rech.f., Biol. Skr. 10(3): 26. 1959. TYPE: PAKISTAN. Chitral, Barum Gol, Soth Barum Glacier, ca. 4,500 m, 27 Jul 1950, *P. Wendelbo s.n.* (Holotype: W).

Distribution: Afghanistan, Pakistan.

Both Hedge (1968) and Jafri (1973) reduced this species to synonymy of *Noccaea griffithiana* (as *Thlaspi*). However, *N. wendelboi* is a diminutive plant that grows at much higher altitudes, and it has smaller flowers and smaller and narrower fruits than those of *N. griffithiana*. Furthermore, the style in *N. wendelboi* subequals (vs. much shorter) than the apical notch of the very narrowly (vs. rather broadly) winged fruits. Without thorough studies on these narrow endemics, I prefer to maintain both of them as distinct species.

Noccaea yunnanensis (Franch.) Al-Shehbaz, Adansonia sér. 3, 24(1): 91. 2002.

Basionym: *Thlaspi yunnanense* Franch., Bull. Soc. Bot. France 33: 407. 1886. TYPE: CHINA. Yunnan. Yentze-hay, Lankong, 3,200 m, 1 June 1886, *J. M. Delavay 2077* [as 4077 in the original description] (Holotype: P-02141454; Isotypes: MO, NY, P, US, W).

Distribution: China.

Noccaea zaffranii F.K.Mey., Willdenowia 15: 389. 1986. TYPE: GREECE. Crete, Lefa Ori, Volkias, 1,700 m, 3 Aug. 1966, *J. Zaffran 1684* (Holotype: B).

Homotypic synonym: *Thlaspi zaffranii* (F.K.Mey.) Greuter & Burdet, Willdenowia 15: 420. 1986.

Distribution: Greece.

Noccaea zangezurica (Tzvelev) Al-Shehbaz, *comb. nov.*

Basionym: *Thlaspi zangezuricum* Tzvelev, Bot. Mater. Gerb. Bot. Inst. Komarova Akad. Nauk S.S.S.R. 19: 9. 1959. TYPE: ARMENIA. Dist. Megri, "in rupibus regionis montanae superioris prope trajectum trans jugum Zangezuricum supra pag. Vardanadzor," 5 July 1956, *T. V. Egorova, N. N. Tzvelev, and S. K. Czerepanov 1941* (Holotype: LE).

Homotypic synonym: *Atropatenia zangezurica* (Tzvelev) F.K.Mey., Feddes Repert. 84: 467. 1973; *Apterigia zangezurica* (Tzvelev) V.I.Dorof., Konspekt. Fl. Kavkaza 3(2): 459. 2012.

Distribution: Armenia.

EXCLUDED NAMES

Names in boldface are the currently accepted placements of excluded *Noccaea* taxa, and all are currently assigned to tribe Descurainieae.

- Noccaea affinis* (F.W.Schultz) Rouy & Foucaud, Fl. France 2: 90. 1895. = **Hornungia alpina** (L.) O.Appel.
- Noccaea alpina* (L.) Rchb., Fl. Germ. Excurs. 663. 1832. = **Hornungia alpina** (L.) O.Appel.
- Noccaea brevicaulis* (Spreng.) Rchb., Fl. Germ. Excurs. 663. 1832. = **Hornungia alpina** (L.) O.Appel.
- Noccaea auerswaldii* Willk., Willk. & Lange, Prod. Fl. Hisp. 3: 780. 1880. = **Hornungia alpina** (L.) O.Appel.
- Noccaea crassifolia* (Corbiière) Rouy & Foucaud, Fl. France 2: 91, 92. 1895. = **Hornungia procumbens** (L.) Hayek.
- Noccaea diffusa* (Jord.) Rouy & Foucaud, Fl. France 2: 91, 92. 1895. = **Hornungia procumbens** (L.) Hayek.
- Noccae maritima* (Jord.) Rouy & Foucaud, Fl. France 2: 91, 92. 1895.. = **Hornungia procumbens** (L.) Hayek.
- Noccaea pauciflora* (Koch) Rouy & Foucaud, Fl. France 2: 92. 1895. = **Hornungia procumbens** (L.) Hayek.
- Noccaea procumbens* (L.) Rchb., Fl. Germ. Excurs. 663. = **Hornungia procumbens** (L.) Hayek.
- Noccaea prostii* (Jord.) Rouy & Foucaud, Fl. France 2: 92, 93. 1895. = **Hornungia procumbens** (L.) Hayek.
- Noccaea revelieri* (Jord.) Rouy & Foucaud, Fl. France 2: 91, 93. 1895. = **Hornungia procumbens** (L.) Hayek.
- Noccaea speluncarum* (Jord.) Rouy & Foucaud, Fl. France 2: 91, 93. 1895. = **Hornungia procumbens** (L.) Hayek.
- Noccaea tournefortii* (DC.) Rouy & Foucaud, Fl. France 2: 91, 92. 1895. = **Hornungia procumbens** (L.) Hayek.

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