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## A new rare species of *Agalinis* (Orobanchaceae) from the coast of Veracruz, México

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### Abstract

A new species of *Agalinis* from the state of Veracruz is herein described, illustrated and compared with *A. flexicaulis*, *A. harperi*, *A. maritima* var. *grandiflora*, and *A. peduncularis*. This new taxon was found in a single locality in the northern coast of Veracruz, Mexico, near to a mangrove-swamp. Given its highly restricted distribution, this species is considered as endemic, being critically endangered as a consequence of local urbanization.

**Keywords:** Flora of Veracruz, *Gerardia*, mangrove swamp, Scrophulariaceae, Tuxpan

### Resumen

Una nueva especie de *Agalinis* del estado de Veracruz es descrita, ilustrada y comparada aquí con *A. flexicaulis*, *A. harperi*, *A. maritima* var. *grandiflora*, and *A. peduncularis*. Este nuevo taxón fue encontrado en una sola localidad en la costa norte de Veracruz, México, cerca del manglar. Dada su distribución restringida, esta especie es considerada endémica, estando críticamente amenazada como consecuencia de la urbanización local.

**Palabras clave:** Flora de Veracruz, *Gerardia*, manglar, Scrophulariaceae, Tuxpan

### Introduction

*Agalinis* Rafinesque (1836: 61) (Orobanchaceae), is a genus that includes approximately 40 species distributed in America, spanning from Canada to Argentina and Bolivia (Pennell 1928, 1929, Canne-Hiliker 1988, Olmstead 2016). Formerly, *Agalinis* was considered part of the family Scrophulariaceae. The early taxonomic studies of this genus were performed by Pennell (1928, 1929, 1935). With the implementation of molecular techniques, Scrophulariaceae was splitted into several smaller families, and ca. 67 genera were transferred to Orobanchaceae, including *Agalinis* (Young *et al.* 1999, Olmstead *et al.* 2001, Oxelman *et al.* 2005, Wolfe *et al.* 2005).

Some *Agalinis* species were first described as belonging to *Gerardia* Bentham (1846: 514), then allocated to *Agalinis* by Pennell (1928, 1929), and subsequently returned back to *Gerardia* by this same author (Pennell 1935). Today, *Agalinis* is the universally accepted generic name and also includes species formerly designated as *Tomanthera* Rafinesque (1836: 65) (D'Arcy 1979, Neel & Cummings 2004).

Extensive taxonomic treatments of *Agalinis* were published by Pennell (1928, 1929: North America), Canne-Hiliker (1988: Peru and Bolivia, 1991: United States and Canada). Nevertheless, an integrated treatment for the whole genus is still lacking.

Given that most species are distributed in Canada, United States and Mexico, the species inhabiting the two first countries have been studied extensively; however, the identity and distribution of the species located in Mexico remain uncertain. The latest Mexican species of *Agalinis* was described by Turner (1986). The most recent checklist of native plants of Mexico, recorded eight species for the country and three species for the state of Veracruz (Villaseñor 2016).

During the elaboration of the forthcoming treatment of Orobanchaceae for the Flora of Veracruz in eastern Mexico, we found an herbarium specimen with characters that differ from those of all other *Agalinis* species reported for Mexico. Noticeably, this species was collected from a mangrove habitat and is taller than other Mexican species.

The morphologically closest species is *A. flexicaulis* Hays (2010: 1), described from the northern Florida, and used here for comparison.

## Materials and methods

This new taxon was collected from a population with ca. 15–20 individuals distributed in an area of less than 1 ha, along the border of a mangrove swamp in Tampamachoco lagoon in the municipality of Tuxpan, state of Veracruz. Morphological descriptions and measurements were performed from two herbarium sheets (*Castillo-Campos 261*, MEXU) and ten plants collected in the field and preserved in 1:1 ethanol/water, and curated as voucher specimens (*Francisco-Gutiérrez & Castillo-Campos 177*, XAL). For drawings, reproductive structures were dissected from the ethanol/water-preserved flowers and observed under a stereoscopic microscope. Based on morphological comparisons with the closest known species of *Agalinis* (Table 1), this taxon turned out to be new to science and is described below.

**TABLE 1.** Comparison of the morphological features of *Agalinis manglaris* with the most similar species *A. flexicaulis* (Hays 2010) and the species reported for the state of Veracruz, Mexico; characters and measures from Pennell (1929).

Character	<i>A. manglaris</i>	<i>A. flexicaulis</i>	<i>A. harperi</i>	<i>A. maritima</i> var. <i>grandiflora</i>	<i>A. peduncularis</i>
Stem length	100–170 cm	25–90 cm	40–80 cm	30–60 cm	30–70 cm
Leaf indument	Glabrescent above	Scabrous above	Scabrous above	Scabrous-roughened above	Scabrous above
Flowering pedicel length	1–2 mm	4–12 mm	0.5–1.5 mm	2–10 mm	20–50 mm
Fruiting pedicel length	2–5 mm	20–22 mm	1.5–2 mm	5–12 mm	20–70 mm
Calix tube length at anthesis	3–5 mm	2.2–2.7 mm	1.5–2.5 mm	3–4 mm	4–6 mm
Calix lobe shape at anthesis	Triangular	Deltoid to subulate	Triangular-lanceolate to triangular-subulate	Obtuse to acutish	Triangular-lanceolate to filiform
Corolla lobe shape	Oblong to orbicular	Emarginate, sometimes erose-cordate	Slightly rounded to truncate	Rounded to scarcely emarginate	Truncate-erose to emarginate
Corolla yellow guidelines	Present	Absent	Present	Present	Present
Anther length	2–2.7 mm	1.2–2 mm	1.3–1.4 mm	1.8–2.3 mm	3–4 mm
Anther indument	Glabrescent	Lanose	Lanose	Lanose-pubescent	Densely lanose
Style length	10.2–15.6 mm	5–7 mm	4–7 mm	12–14 mm	13–15 mm
Fruit length	6–10 mm	3.8–4.5 mm	4–5 mm	5–6 mm	6–8 mm
Seed length	1 mm	1 mm	0.6–0.8 mm	0.8–1 mm	0.7–1 mm
Habitat	Mangrove swamp	Mostly prairie, savanna	Sandy pineland, border of salt-marshes, mangrove wamps	Salt marshes	Pine forests, hills of bluffs in mountains

## Taxonomy

*Agalinis manglaris* Franc.Gut. & Cast.-Campos sp. nov. Figures 1–3.

*Agalinis manglaris* is most similar to *A. flexicaulis* from which it can be differentiated by its longer stems, larger leaves, shorter fruiting pedicels, yellow guidelines in the corolla and longer fruits.

Type:—MEXICO. Veracruz: Tuxpan, growing along the border of a mangrove swamp in the eastern bank of Tampamachoco lagoon 20°59'21.50", -97°19'16.29", 0 m, 05 October 2016, fl. & fr., *A. Francisco-Gutiérrez & G. Castillo-Campos 177* (holotype XAL!; isotypes CHAPA!, CICY!, CORU!, ENCB!, MEXU!, MO!).

*Herb*, hemiparasitic and annual, roots fibrous, with haustoria present. *Stem* 4–10 mm × 1–1.7 m, erect to slightly curved at base, sub-terete below becoming four-angled above, stem faces glabrous, callous angles glabrous, single from the base up to 20–50 cm, dark brown at the base and upper branches yellowish to greenish, turning to blackish upon drying. *Branches* ascending-spreading at 40–60° from the main stem, ascending, some occasionally entangled with the surrounding vegetation. *Leaves* often opposite or sub-opposite, axillary fascicles absent, leaves of the lower branches not seen, leaves of the upper branches 12–27 × 0.5–2.5 mm wide, linear to linear-lanceolate, glabrescent in abaxial surface with few white to silver hairs, glabrous in adaxial surface, the abaxial surface slightly concave, not fleshy. Internodes 1.3–2.5 cm long. *Inflorescence* indeterminate, racemose, up to 29–37 cm removed from the main stem on larger plants. In some plants, solitary flowers grow in the main stem below the lower branches. 3–9 floriferous nodes per inflorescence, alternate, rarely one node with paired flowers, 3–9 flowers. *Pedicels* slender, terete, ascending, glabrous, green, 1–2 × 0.7–0.8 mm long at anthesis, 2–5 mm long in fruit. *Bracts* 7–15 × 0.8–1.2 mm, linear-lanceolate, ascending-appressed with the pedicel, glabrous, apex acute, not reduced upward along the inflorescence axis. *Calix* at anthesis campanulate, glabrous, tube 3–5 mm long, green; lobes 5, triangular, 1.2–2.4 × 2 mm, apex acute. *Corolla* zygomorphic, as measured from the base of tube to apices of upper lobes 12.5–20.5 mm, tube 7–9 mm long, whitish at base and gradually rose-pink in lobes, the throat paler than lobes, with many rose-pink spots linearly arranged and two blurred yellow guidelines abaxially; throat narrow, glabrescent to puberulent, erect. Lobes 5, similar, spreading, shorter than the tube, 3.8–6.2 × 3.8–7.6 mm, oblong to orbicular, surface of all lobes glabrous externally and internally, apex emarginated and white-ciliated. *Stamens* 2.6–9.5 × 0.3–0.6 mm, didynamous, glabrous. *Anthers* 4, 2.2–2.7 × 0.4 mm, apices rounded, longitudinal dehiscence, brownish. *Style* 10.2–15.6 × 0.6 mm, curved, exerted, glabrous, white-greenish, persistent in fruit. *Stigma* 1 mm long, white. *Ovary* a capsule, 2.2–2.6 × 1.6–2.2 mm. *Fruit* a capsule, 6–10 × 4–5 mm at maturity, obovoid to ovoid, apex brown or black when mature. *Seeds* 1 mm long, testa reticulate, brown to black. Parasite on *Asclepias curassavica* Linnaeus (1753a: 215).

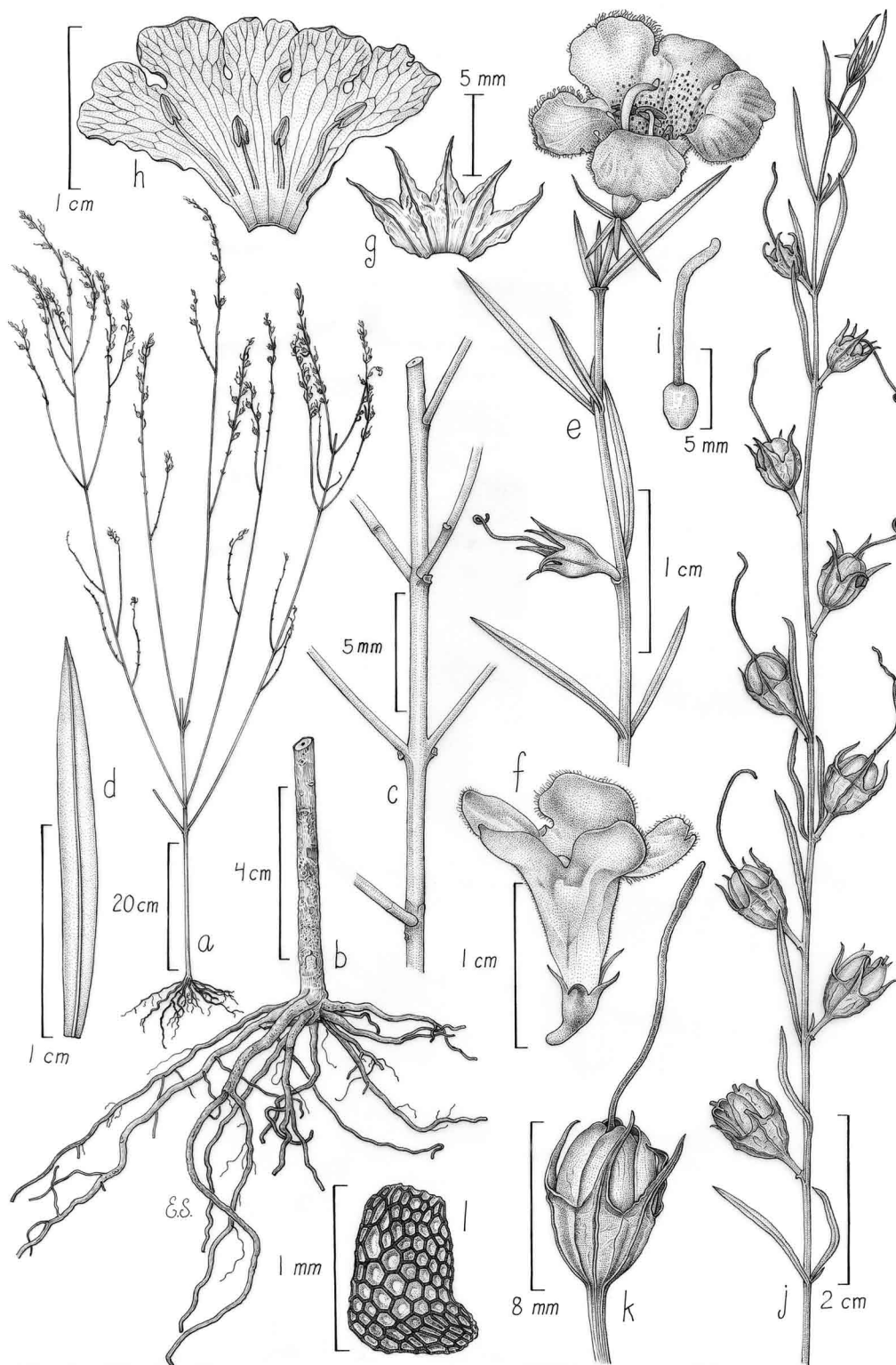
**Geographic distribution & ecology:**—Known from one population in the municipality of Tuxpan, found in the mangrove swamp adjacent to the Tampamachoco lagoon, in the north of the state of Veracruz in eastern Mexico. This species inhabits the marsh of a mangrove-swamp dominated by *Laguncularia racemosa* (Linnaeus 1759: 930) C.F. Gaertner (1807: 209) (Combretaceae), *Avicennia germinans* (Linnaeus 1759: 1122) Linnaeus (1764: 891) (Acanthaceae), and cultivated *Cocos nucifera* Linnaeus (1753b: 1188) (Arecaceae). Close to the new species the following were also found: *Phragmites australis* (Cavanilles 1799: 100) Trin. in Steudel (1840: 143) (Poaceae), *Ageratum conyzoides* Linnaeus (1753b: 839), *Solidago sempervirens* Linnaeus (1753b: 878) (Asteraceae: Astereae), *Asclepias curassavica* L. (Apocynaceae), *Typha domingensis* Persoon (1807: 532) (Typhaceae), *Smilax bona-nox* Linnaeus (1753b: 1030) (Smilacaceae).

Some roots of the new *Agalinis* were penetrating the roots of *Asclepias curassavica* (Apocynaceae) through small and spherical haustoria (Fig. 3).

**Phenology:**—Flowers and fruits are produced from September to October. The specimen designed as holotype was collected in October in its late flowering stage with the majority of its fruits opened, seeds dispersed and leaves shed (Fig. 2).

**Etymology:**—The specific epithet meaning “of the mangrove” was selected due to the type of vegetation where the species occurs, which differs from habitats of the other known species of *Agalinis*.

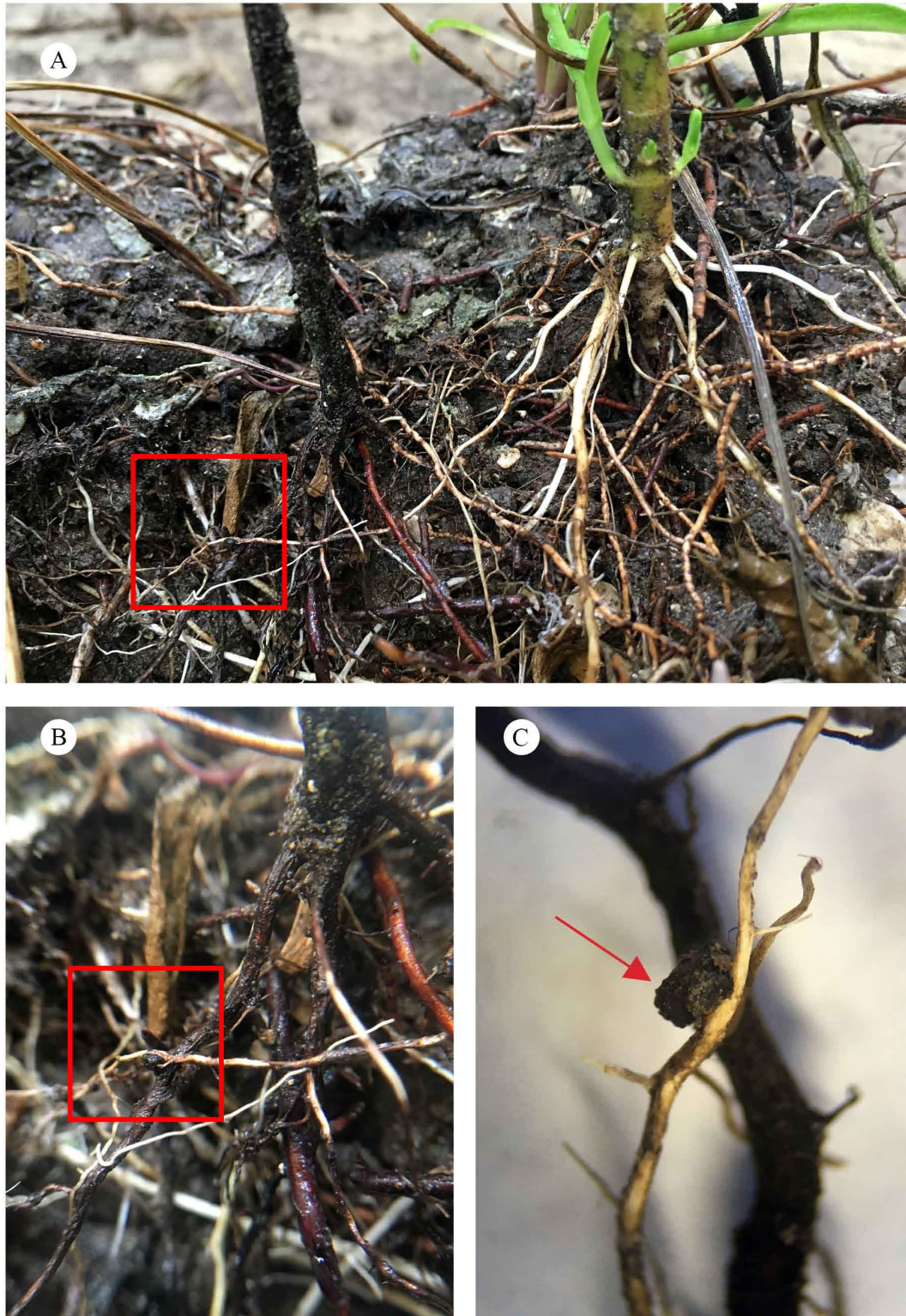
**Paratypes:**—MEXICO. Veracruz: Tuxpan, Barra N de Tuxpan, 0 m, 19 September 1978 (fl., fr.), *Castillo-Campos 261* (MEXU!, XAL!).



**FIGURE 1.** *Agalinis manglaris*. A: habit, B: radicular system, C: detail of stem internodes and branching angles, D: leaves, E: inflorescence with flower at anthesis, F: flower, G: dissected calyx, H: dissected corolla and detail of stamens and anthers, I: ovary and style, J: infructescence, K: fruit with persistent style, L: seed. Illustration by E. Saavedra (from *Francisco & Campos 177*, XAL—holotype).



**FIGURE 2.** *Agalinis manglaris*. A: flower in lateral view, B: flower in frontal view, C: infructescence, D: base of the main stem (indicated with red arrow).



**FIGURE 3.** *Agalinis manglaris*. A: view of radicular system of *A. manglaris* (left) and root system of *Asclepias curassavica* (right), with red square marking the location of one haustorium, B: detail of the haustorium of *A. manglaris* shown in A, intercepting the root of *A. curassavica*, C: haustorium (red arrow) as viewed under a stereoscopic microscope showing the union between haustorium and root.

*Agalinis manglaris* is considered to be endemic to the state of Veracruz due to its narrow distribution range. The examination of materials from the three largest herbaria of Mexico (MEXU, ENCB & XAL, respectively), revealed that this species has not been collected in any site other than the type location. The specimens of *Agalinis* reviewed for Mexico show a distribution in the highlands and mountains, mainly represented by *A. peduncularis* (Bentham 1835[1836]: 209) Pennell (1918: 135).

The species with the closest morphological similarities to *Agalinis manglaris* is *A. flexicaulis*, which it was described by Hays (2010). Remarkable characters that differentiate both species from the others recorded for the state of Veracruz, Mexico, are shown in Table 1.

Additionally, *A. manglaris* also differs from the group of South American species of *Agalinis* in several morphological features, according to Canne-Hilliker (1988): *A. manglaris* does not develop a rhizome from which stems arise; in addition, leaves are alternate rather than decussate in the Andean species. Furthermore, unlike the annual Andean species, *A. manglaris* possesses terminal inflorescences in the apex of branches on which they develop and lack tandem regions of vegetative and reproductive structures. Peruvian and Bolivian species have bracts of similar size along the inflorescence, contrasting with *A. manglaris*, while North American species have bracts progressively reduced upward along the inflorescence axis.

This new taxon could potentially inhabit a small and restricted area surrounding the mangrove swamp of the municipality of Tuxpan, which is adjacent to petrochemical companies and is being gradually occupied by human settlements.

### Key to *Agalinis* species reported for Veracruz State, Mexico

1. Stems 100–170 cm tall, leaves glabrescent in abaxial surface and anthers glabrescent ..... *A. manglaris*
1. Stems 30–80 cm tall, leaves scabrous in abaxial surface and anthers lanose to densely lanose ..... 2
2. Flowering pedicels 20–50 mm long, fruiting pedicels 20–70 mm long, calix tube 4–6 mm long, anthers 3–4 mm long .....  
..... *A. peduncularis*
2. Flowering pedicels 0.5–10 mm long, fruiting pedicels 1.5–12 mm long, calix tube 1.5–4 mm long, anthers 1.3–2.3 mm long ..... 3
3. Leaves 0.5–1 mm wide, flowering pedicels 0.5–1.5 mm long, fruiting pedicels 1.5–2 mm long, style 4–7 mm long, seeds 0.6–0.8 mm long ..... *A. harperi*
3. Leaves 1–3 mm wide, flowering pedicels 2–10 mm long, fruiting pedicels 5–12 mm long, style 12–14 mm long, seeds 0.8–1 mm long ..... *A. maritima* var. *grandiflora*

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