

Castilleja halophila* (Orobanchaceae): A new species from the Texas Coastal Bend*Jason R. Singhurst**Nongame and Rare Species Program, Texas Parks and Wildlife Department, 4200 Smith School Road,
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ABSTRACT

Castilleja halophila is here proposed as a new species endemic to saline to hypersaline soils and shell barrens of the barrier islands and near coast of Aransas, Nueces and San Patricio counties of the middle Gulf Coast of Texas. The new species is apparently a local derivative of *C. indivisa*, the most common species of *Castilleja* of the eastern third and coastal areas of the state. *Castilleja halophila* is characterized by its early flowering January to April (rarely June); distally white bract coloration occasionally suffused with pale pink; strict growth habit and usually solitary, unbranched stems reaching 45-74 cm in height. Specimens collected were hemiparasitic on salt tolerant species of *Iva* (Asteraceae). The new species can tolerate both hypersaline soils and soils of lower salinity but appears unable to compete with *C. indivisa* in non-saline areas thus making the two species more or less parapatric in distribution. Low population numbers, limited distribution, and sea level rise are considered major risk factors associated with the continued survival of the species. We suggest the species be assigned a Global rarity classification of G1. Published on-line www.phytologia.org *Phytologia* 102(3):208-218 (Sept 21, 2020). ISSN 030319430.

Key Words: *Castilleja halophila*, *Castilleja indivisa*, Texas Seaside Paintbrush, Gulf Coast, Coastal Bend, hypersaline, saline soils, competitive exclusion principle, early flowering period

Castilleja is primarily a New World genus of approximately 200 species, twelve of which are native to Texas (Kartesz 2015; Egger et al. 2019). *Castilleja lindheimeri* was the only known Texas endemic until now. Recent field study in the mid-Texas coastal plain has resulted in the discovery of an annual species of *Castilleja*, the second known endemic species for Texas, which is described herein.

The earliest mention of strictly coastal, white-bracted populations of what was referred to as *Castilleja indivisa* Engelmann in the mid-Gulf Coastal Plain of Texas was by Pennell (1935). On page 541, Pennell states in footnote 304, "Albino specimens, with snow-white bracts, reported as forming entire colonies on shell and sand reefs between Aransas Pass and Port Aransas, San Patricio Co., Texas, April 21, 1935; specimens from G. W. Goldsmith in Herb. Academy of Natural Sciences of Philadelphia." It is apparent that Pennell never visited the area, as he did not report traits such as the height of the plants, distribution of individuals in the colony, branching pattern, etc., which also differ from typical *C. indivisa*. Pennell gives the location as between Aransas Pass and Port Aransas, San Patricio County. The county cited is in error, as this geographic location is in Nueces County. At this locale, the Nueces-San Patricio county line is near the eastern shoreline of Aransas Pass, just west of the Gulf Intracoastal Waterway. The

Waterway was not constructed at this location until 1941, at which time it was extended south to Corpus Christi (Leatherwood 2010). The entire area east of the mainland is part of Nueces County.

The second mention of this white-bracted population is in the *Flora of the Texas Coastal Bend* (Jones 1975, 1977, both p. 180; 1982, p. 181). Jones states, "a form occurring on shell islands in Redfish Bay and on adjacent mainland around Rockport and Aransas Pass has white instead of red bracts and calyces. Very attractive and showy. March to May, rarely in Sept. and Oct." The word "form" is apparently used in a general sense, and not as the English version of *forma*. The color of the bracts and calyces is given as white instead of red. It may be noted that some specimens of *Castilleja indivisa* may be described as red but are better characterized as predominantly coral or orange-red. Large populations may contain occasional individuals with whitish, cream to yellow, or rose-tipped bracts. The description ends with "very attractive and showy" which is used by Jones throughout the book's editions as a descriptor to designate such handsome plants. Redfish Bay includes the waters near the main shore, which is also the main route of the Gulf Intracoastal Waterway from Corpus Christi Bay north to Traylor and Talley islands.

A third mention of these "albino" *Castilleja* plants is in Lehman et al. (2005), the book being a rewrite of Jones' *Flora of the Texas Coastal Bend*. It includes on p. 293 a verbatim repeat of the *Castilleja* treatments from Jones (p. 180; p. 181).

Lastly, Egger et al. (2019), in a treatment of *Castilleja* in the *Flora of North America*, specifically mentions the undescribed *Castilleja* species closely related to *C. indivisa*, on Stedman Island, near Aransas Pass, Nueces Co., Texas. They recommend that the plant be given nomenclatural recognition. For this *Castilleja*, the process to recognition as a species took 85 years and six mentions in the literature.

In 2014, it was decided to expand the literary study to include field investigations to relocate the populations, determine the number of individuals, compare them with *Castilleja indivisa*, and determine the taxonomic and conservation status of those plants occurring on the shell and sand islands of Redfish Bay, Stedman and Harbor islands, the adjacent mainland, and nearby areas. The results of this investigation are given following, in essence, recognition of the population of plants with distally pure white bracts as a new species of *Castilleja*.

Castilleja halophila J.R. Singhurst, J.M. Egger, J.N. Mink, and W.C. Holmes sp. nov.

TYPE: UNITED STATES. TEXAS. Nueces County. Stedman Island (in Redfish Bay), 2.9 km E. of jct. of Hwy. 90 and Hwy. 361 on north and south side of Texas Hwy 361, 0.9-2.4 m elevation, ca. 1 m above m.s.l.; flowers white (drying cream-colored), hypersaline soils, saline flats and saline coastal prairies, 24 February 2015, *J. R. Singhurst 21335* (holotype: BAYLU, isotype: TEX) (Figure 1).



Figure 1. Photograph of *Castilleja halophila* holotype from Stedman Island, 24 February 2015. (Photo by J.N. Mink & W.C. Holmes).

Similar to *Castilleja indivisa* but differing in flowering January to April (rarely to early June), white-tipped bracts infrequently suffused with pale pink; stems slender, solitary and unbranched, 45-74 cm height, and occurrence in hypersaline and shell barrens on coastal barrier islands (Figures 2 and 3). *Castilleja indivisa* flowers most profusely in March through May, though flowering specimens are recorded virtually year round, and usually has coral to orange-red or red-tipped bracts, with occasional yellowish or rose variants; stems usually well-branched from near the base to about 35 cm height, and does not occur in hypersaline and coastal shell barrens.

Annual herb. Taproot slender, to 10 cm long, secondary roots slender. Stem slender, strict, rarely branched, glabrate to villous and often stipitate-glandular distally, 45-74 cm tall, discernably 4-angular, reddish to purple. Leaves rather clustered at the base, but not forming a distinct rosette, becoming sparse with relatively wide internodes on the stem; leaf bases sessile to obscurely clasping; blades narrowly lanceolate to linear, 5-10 cm long, to about 1 cm wide, entire to occasionally with a pair of short, spreading, linear-lanceolate lobes, glabrate to short hirsute. Inflorescence spicate, unbranched 10-15 (25) cm long, pilose with longer, non-glandular hairs and an underlayer of minute, stipitate glandular hairs. Bracts 1.5-3 cm in length, lanceolate to oblanceolate, apices rounded, the bases green, abruptly turning white about midway to the tip, irregularly suffused with pale pink when not fully mature; veins 5, conspicuous, originating at the base, somewhat curved and ending at the apex. Flowers sessile; calyx tubular, 20-26 mm long, the right pair and the left pair laterally fused into one segment each, which is cleft into 2 terminal segments about 10 mm from the rounded to emarginate apices; proximally green to about midway to the tip or higher, the distal portion white; corollas 18-30 mm long, the tube whitish, the beak (upper lip) about 1/5 the length of the corolla, pale green to pale yellow, stipitate-glandular, slightly falcate, included to weakly exerted to about 8 mm from the calyx at maturity (Figure 7); teeth of the lower corolla lip three, obscurely saccate to leaflike, green; stigmas exerted, capitate to shallowly bi-lobed, yellow to yellow-green or cream. Capsule ca. 1.2 cm long, 2 carpellate. Seeds pale straw-colored, +/- 1.0 mm in diameter along longest axis; seed coats loose-fitting, shallowly reticulate, radial walls smooth, inner tangential walls mostly ruptured at maturity.

PARATYPES: UNITED STATES. TEXAS. Texas. Aransas County: Aransas Pass (on mainland), Jct. of W Strapp Ave. and N Rife Street on N side of N Rife Street, remnant saline coastal prairie, 4 March 2019, *J. N. Mink, W. C. Holmes, J. R. Singhurst* and *D. Ilfrey 1886* (BAYLU); Nueces County: Port Aransas, 21 April 1935, *G. W. Goldsmith s.n.* (PH, TEX); North side of St. Rt. 361 on Stedman Island, 1.3 road miles ESE of RR crossing on E edge of city of Aransas Pass, 275335N, 970730E, 3 April 1992, *W. R. Carr 11714* (TEX); Along causeway between Aransas Pass and Port Aransas, 18 March 1996, *P. A. Fryxell 5062* (TEX); Stedman Island, 27°53'37.56"N, 97°07'35.60E, 1 m elevation, 13 June 2014, *W. Franks s.n.* (WTU), in seed and late flowering; Stedman Island, 2.9 km east of Aransas Pass, Texas on Hwy 361, 6 March 2016, *W. C. Holmes, J. R. Singhurst,* and *J. N. Mink 16540* (BAYLU), specimen includes host plant; Adjacent to both side of TX Hwy. 361 on Stedman Island between Aransas Pass and Port Aransas, 2 April 2016, *J. M. Egger 1570* (CAS, GH, MO, US, WTU); Harbor Island, 7.24 km E of jct. of Hwy 90 and Hwy 361 on north side of Hwy 361, flowers white, 1.5-2.1 m elevation, coastal prairie and hypersaline flats, 5 April 2019, *J. R. Singhurst 22275* (BAYLU).



Figure 2. Photograph of *Castilleja halophila* taken at the type locality on Stedman Island, 24 February 2015. (Photo by J.R. Singhurst).



Figure 3. Photograph of *Castilleja halophila* habit and habitat taken at the type locality on Stedman Island, 24 February 2015. Note the scattered occurrence, strict habit, unbranched, solitary stems, and extended flowering period indicated by brown bracts and flowers. (Photo by J.R. Singhurst).

Phenology: *Castilleja halophila* was observed flowering in January to early April, though occasional plants in flower are found among those in seed as late as mid-June (e.g. *W. Franks* s.n., WTU) (Figures 5 & 6.).

Habitat and distribution: saline to hypersaline soils and shell barrens in herbaceous vegetation, including *Borrichia frutescens*/*Spartina spartinae* Shrubland, *Spartina spartinae*-*Monanthochloe littoralis*-*Sueda linearis* Herbaceous Vegetation and infrequently in *Avicennia germinans*/*Batis maritima* Shrubland (NatureServe Explorer 2020); 0.5-2.0 m above sea level; Stedman Island and Harbor Island, Nueces County and sporadic in Aransas Pass, Aransas County, Texas (Figure 4). Reported on sand islands in Red Fish Bay (Nueces, Aransas, and San Patricio counties) by Jones (1975, 1977, 1982), though he cited no specimens nor specific locations.

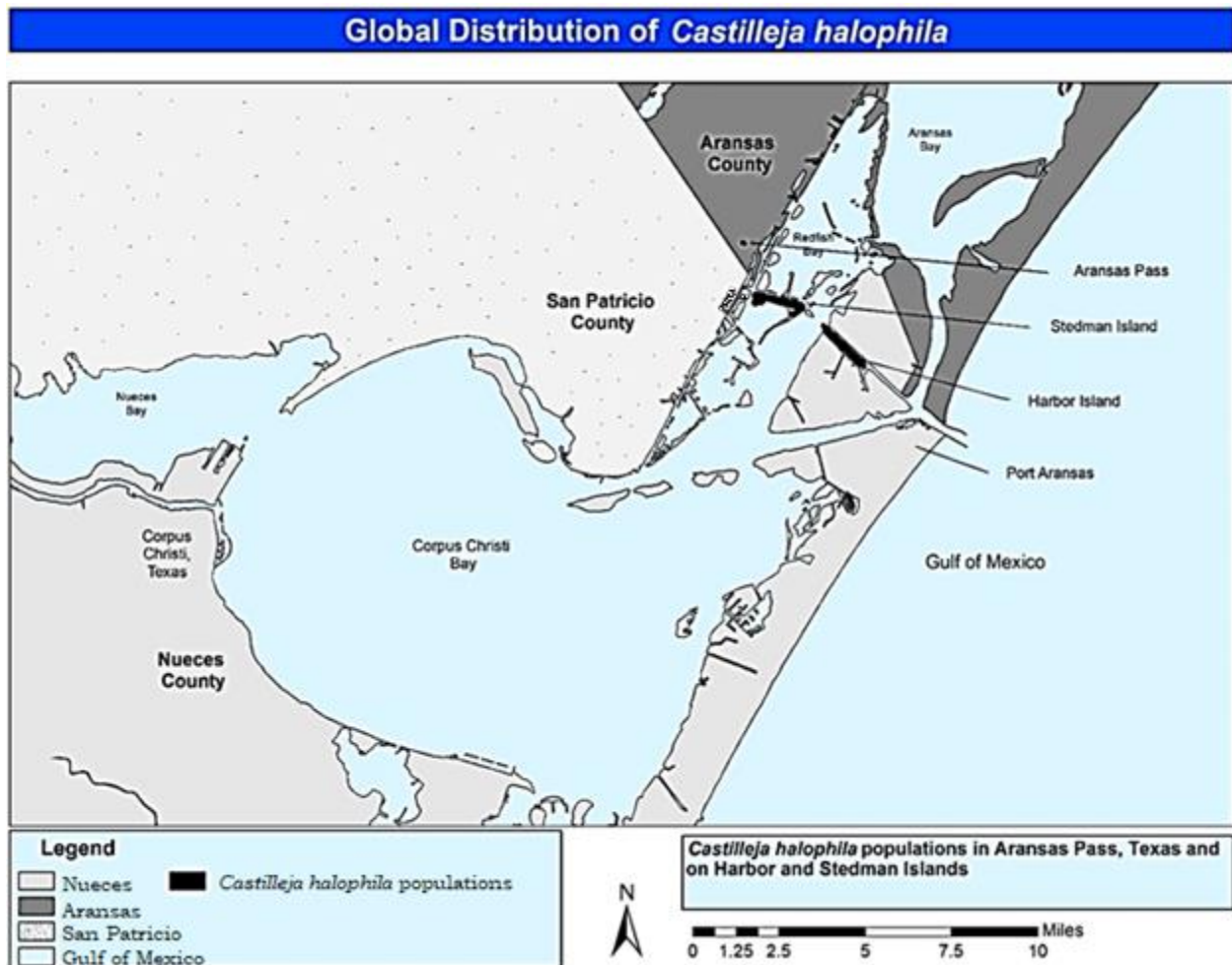


Figure 4. – Known global distribution of *Castilleja halophila*. Map by J.R. Singhurst & J.N. Mink.

Castilleja halophila is hemiparasitic on halophilic species of *Iva* (Asteraceae), *W.C.Holmes* et al. 16540 (BAYLU), and is apparently limited to areas of high salinity, as indicated by nearby species. These include *Avicennia germinans*, *Batis maritima*, *Borrichia frutescens*, *Cakile geniculata*., *Conoclinium betonicifolium*, *Distichlis spicata*, *Fimbristylis castanea*, *Flaveria brownii*, *Heliotropium curassavicum*, *Iva texensis*, *Lycium carolinianum*, *Monanthochloe littoralis*, *Paspalum monostachyum*, *Rayjacksonia phyllocephala*, *Schizachyrium littorale*, *Sesuvium portulacastrum*, *Spartina spartinae*, *Sporobolus virginicus* and *Suaeda linearis*. Other peripheral species occurring in close proximity include the woody exotics *Leucaena leucocephala*, *Nerium oleander*, *Schinus terebinthifolius* and *Tamarix* spp. Several

occurrences of *C. halophila* have been confirmed from Aransas Pass on the mainland, these being taller and with tips of bracts white colored, but most individuals exhibiting hybridization and introgression. Most *Castilleja* in Aransas Pass appear nearer to *C. indivisa* as to bract tip and flower color, size of plants, and branching. Other species within this habitat are typically found in prairies rather than coastal marshes indicating that the soil has less salinity. No plants with distally coral, orange-red, or red bracts have been found in the hypersaline sand and shell islands.



Figures 5 & 6: Photographs of *Castilleja halophila*, dehiscent seed capsules (L) and superior view of inflorescence with bracts, calyx lobes, and corolla beaks (R) taken at the type locality on Stedman Island, 24 February 2015. (Photo by J.R. Singhurst)



Figure 7: Photograph of *Castilleja halophila*, close up of flower showing the shortly exerted corolla with bi-lobed stigma taken at the type locality on Stedman Island, 2 April 2016. (Photo by J.M. Egger)

Relationships and Identification: Evidence indicates *Castilleja halophila* is a local derivative of *C. indivisa*. This is supported by the general morphological similarity of the two species, the inclusion of the white-bracted plants within *C. indivisa* by Pennell (1935), Jones (1975, 1977, 1982) and Egger et al. (2019). Jones' decision to use the name *C. indivisa* may have been influenced by the treatment of the genus in the *Manual of the Vascular Plants of Texas* by Holmgren in Correll and Johnston (1970), newly published and considered to be the authoritative source on the Texas flora, which excluded any mention of these coastal white-bracted populations. Also, of the known species of *Castilleja* distributed in the eastern third and coastal areas of Texas (Turner et al. 2003; Kartesz 2015), *C. indivisa* is the most common and widely distributed species of the genus (Nesom 1992).

The inability of *Castilleja indivisa* to withstand saltwater and hypersaline soils apparently prevents colonization of the barrier islands. The near total exclusion of *C. halophila* from mainland areas (i.e., the coastal ridge) seems related to it being outcompeted by *C. indivisa*, which apparently possesses attributes conducive to non-hypersaline soils and a non-aquatic environment, while *C. halophila* is largely tied to such substrates. This may represent an example of the Competitive Exclusion Principle. *Castilleja halophila* can apparently occupy both the barrier island niche and the adjacent non-hypersaline mainland but is limited almost completely to the barrier islands because it cannot compete successfully with or is genetically swamped by interactions with *C. indivisa* populations in the non-hypersaline mainland habitats. Additional studies are planned.

Castilleja indivisa may be distinguished from *C. halophila* by its coral, orange-red to red tipped bracts. These colors suggest that *C. indivisa* is pollinated diurnally by hummingbirds, butterflies, and/or bees, this being supported by Grant and Grant 1968, Duffield 1972, and Egger et al. 2019. However, large populations (100-200 or more individuals) of *C. indivisa* usually have several plants with creamy-white to yellow or rose-tipped bracts, which are easily distinguishable from the white bract tips of *C. halophila*. The white bracts of *Castilleja halophila* suggest pollination by crepuscular and/or nocturnally active insects such as flies and moths (Baker 1961; Fægri and Pijl 1979; Goyret et al. 2008). Attempts in February and March to capture pollinators failed. We do note that *C. halophila* has a very long flowering period (January to June and occasionally longer). This could be an adaptation to compensate for uncertainty of pollination during periods of unpredictable weather events, high coastal winds, flooding, excessive rain, higher than normal spring tides, etc., which may affect both the plants and pollinators, thus hindering pollen receipt.

Other field characteristics that reliably distinguish the two species include the following. *Castilleja halophila* is mostly strict, with unbranched, solitary stems, 45-74 cm tall, grows in open colonies, often with 2-5 m or more distance between individual plants, has white bracts tips sometimes suffused with pale pink, flowers mostly January to mid-April, and is tolerant of hypersaline soils and apparently able to withstand periods of salt water flooding and occasional hurricanes. *Castilleja indivisa* usually has coral, red-orange, or red tipped bracts, is 25-35 cm tall, considerably branched from the base, and occurs in dense colonies, with the plants often touching to overlapping.

Differences between these two species are summarized in the following couplet:

1. Distal portions of bracts pure white, sometimes suffused with pale pink; stems strict, rarely branched, 45-74 cm tall; known only from the mid-Texas Coastal Bend in Nueces, Aransas, and San Patricio counties, restricted to saline to hypersaline flats and shell barrens on saline coastal prairies.....*C. halophila*
1. Distal portions of bracts usually coral, red-orange, or red, with occasional variants pale yellow, creamy-white, peach, or rose; stems ascending-erect, usually branched from near the base, 25-35 cm tall; found throughout eastern and coastal Texas on non-saline substrates.....*C. indivisa*

Etymology of names: Scientific name from the genus *Castilleja*, for Domingo Castillejo (1744-1793), an 18th century Spanish botanist at Cadiz, Spain, and the species name from the Latin, *halo* (salt) and *phila* (loving), a reference to its occurrence in hypersaline (maritime) areas. For a common name, the authors recommend Texas Seaside Paintbrush, from the habitat preference.

Conservation status. *Castilleja halophila* is of critical conservation concern because of its highly restricted distribution (see Figure 4) and low population, estimated counts consist of about 1275 individuals (1200 on Stedman Island, 50 on Harbor Island, and 25 in Aransas Pass).

Although storms and hurricanes may negatively impact *C. halophila* habitat, this species has presumably evolved and locally thrived under these weather cycles. We believe that human impacts represent the greatest threat to these populations. These threats include

1. Sea level rise due to global warming.
2. Maritime transports and commerce, including effects of large ship and barge traffic, dredging, channelization, and related maintenance factors.
3. Recreational use and development for fishing, marinas, and motorized vehicle traffic.

Considering these threats and the low population numbers cited above, we recommend a status of G1 worldwide and S1 for the state of Texas.

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