

CASUARINA EQUISETIFOLIA (CASUARINACEAE) NATURALIZED IN TEXAS AND COMMENTS ON ECOLOGICAL IMPLICATIONS FOR THE TEXAS COAST

JEFFREY N. MINK

3229 Cole Avenue
Waco, Texas 76707
jeffreynormanmink@gmail.com
jmink@mclennan.edu

WALTER C. HOLMES

Department of Biology
Baylor University
Waco, Texas 76798-7388

JASON R. SINGHURST

Wildlife Diversity Program
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, Texas 78744

ABSTRACT

Casuarina equisetifolia, Australian pine, is reported here as naturalized in Aransas, Cameron, Calhoun, Kleberg, and Nueces counties of the Gulf Coast Prairies and Marshes in the Coastal Bend (mid-coast) of Texas. It is documented as reproducing and expanding from parent stands in coastal prairies, bay shorelines, and inland dunes. Based on biogeography, ecology, and performance in its naturalized state outside of Australia, southern Asia and the Pacific archipelagos, monitoring in Texas should be considered to determine potential regional expansion and ecological threats.

Casuarina equisetifolia L. ex J.R. & G. Forst. is a member of the Casuarina or Beefwood family (Casuarinaceae), commonly known as Australian pine, whistling pine, beach she-oak or horsetail tree. The genus *Casuarina* consists of 17 species, with *C. equisetifolia* native to the tropical and subtropical coastlines of Australia and offshore islands, Malaysian and Pacific archipelagos (sensu latu), including islands of New Zealand, Polynesia, and Oceania (Morton 1980; National Research Council 1984; Orwa et al. 2009; Wilson & Johnson 1989; El-Lakany et al. 1990). Distribution is currently pantropical and expanded through intentional introduction and unintentional naturalization (National Research Council 1984; Wilson & Johnson 1989; El-Lakany et al. 1990). The species is currently known to be established from Puerto Rico (Little & Wadsworth 1964), Hawaii (Degener 1963), and Florida (Morton 1980).

Intentional introductions to Florida occurred by the late 1898 with seeds brought from France by the U.S.D.A surveyor, W.T. Swingle (Morton 1980), well known for his penchant of exotic importations (see description in Mink et al. 2015). Occurrence and establishment of naturalized stands were documented since the late 1890s and early 1900s along Florida coastal dunes (Donnelly 1921; Small 1927). Barrett (1956) discussed problems with usage of *Casuarina equisetifolia* because of its invasive growth habit and aggressive choking of indigenous vegetation, clearly recognizing a problematic transformation of the landscape in 1930s Florida. It has been widely cultivated in Florida for coastal landscaping, as an ornamental shade tree and agricultural promotion -- whether as fuelwood, timber or planted as windbreaks bordering groves. These pursuits coupled with extensive naturalization have promoted, especially in the southern half of the state, *C. equisetifolia* as a ubiquitous presence throughout coastal Florida (Morton 1980).

Although various electronic sources document or discuss *Casuarina equisetifolia* as an invasive species in Texas, these sources lack adequate documentation. The mention of this species as naturalized in Texas is based upon cultivated specimens or observations without vouchers. The three counties mapped (as species waifs) for Texas in BONAP (Kartesz 2016) are based on cultivated plants or else lack documentation: Cameron Co.: San Benito, Griffing Bros. nursery, noted as cultivated, 20 May 1915, *Tharp s.n* (TEX/LL). Galveston Co. Galveston, corner of Juniper Avenue and Oak Avenue, annotated as cultivated, Clear Lake Shores, 11 Mar 1975, *Waller & Bauml 3394* (TEX/LL). Nueces Co.: mapped based upon Invasives.org observations and locations in urbanized settings. Invasives.org lists seven occurrences of *C. equisetifolia* in Texas, five from Nueces Co. and two from Cameron Co.; none are vouchered by specimens.

The following list cites specimens collected by the authors during their research of the species in Texas.

Texas. Aransas Co.: 1.4 mi S of Bahama Rd and North Fulton Beech Rd on North Fulton Beech Rd, E side of road, growing along edge of Aransas Bay, plants reproducing, including seedling trees, 9 Jun 2009, *Singhurst 18189* (BAYLU); 0.1 mi N of jct. of Laguna Vista Drive and N Fulton Beach Rd on N Fulton Beach Rd, E side of N Fulton Beach Rd., growing along Aransas Bay shoreline, 8 Mar 2016, *Singhurst 21040* (BAYLU). Cameron Co.: Jct. Co Rd 228 and FM 1421, NW corner of junction, invading agricultural field, 8 Dec 2015, *Singhurst 21033* (BAYLU); 0.4 mi W jct. of Cavaxos Omoti Rd and New Carmon Ave on Cavaxos Omoti Rd, S side of Cavaxos Omoti Rd, invading agricultural field, 8 Dec 2015, *Singhurst 21034* (BAYLU). Calhoun Co.: Port Lavaca, Lighthouse Beach Park, along Lighthouse Beach Road, several age classes throughout Noble Point, 14 Apr 2015, *Holmes, Singhurst, & Mink 16435* (BAYLU). Kleberg Co.: Padre Island National Seashore, 1 mi N of Bird Island boat ramp, along the E shore of Upper Laguna Madre (photo; Figure 4). Nueces Co.: 0.1 mi N of Park Rd 22 and Elbow Street on Park Road 22, W side of Park Rd 22, growing in coastal prairie, plants reproducing, including seedling trees, 11 Jun 2009, *Singhurst 18190* (BAYLU); 0.3 mi. E of Park Rd 22 and Viento Del Mar Road in Padre Bali Park, 12 Jun 2009, *Singhurst & Ilfrey 18192* (BAYLU); intersection of Park Rd 22 and Nemo Court, 7 Mar 2016, *Holmes, Singhurst, & Mink 16643a* (BAYLU); confluence of JFK memorial causeway and Park Rd 22, 7 Mar 2016, *Holmes, Singhurst & Mink 16643b* (BAYLU); Port Aransas, Hwy 361 along Palmilla Beach golf course, 7 Mar 2016, *Holmes, Singhurst, & Mink 16646* (BAYLU).

The *Casuarina equisetifolia* stand in Aransas County occurs along Aransas Bay where it appears to have recently arrived from nearby parent trees and is reproducing. Since our initial collection (2009), it was revisited in December 2015 and the plants were producing abundant woody, cone-like structures. During that site visit this stand was observed to have been recently stump cut (past year or two) to be eradicated. However, individuals were resprouting to 10 feet in height from the trunk bases and flowering. This small stand of *C. equisetifolia* was growing with *Avicennia germinans*, *Distichlis spicata*, *Heliotropium curassavicum*, *Hydrocotyle bonariensis*, *Lycium carolinianum*, and *Sesuvium portulacastrum*.

A stand of *Casuarina equisetifolia* at Padre Island National Seashore (PINS) in Kleberg County was brought to our attention by Charles Sassine and Alicia Walter, science staff with PINS. The National Park Service has been treating a stand of *C. equisetifolia* in an attempt to eradicate it and prevent it from expanding along the Upper Laguna Madre shoreline (Figure 4). We visited the stand and observed that about half of the stand was dead and the other half was thriving with numerous seedling trees of varying age establishing from 3 to 20 meters away from parent trees. This stand of *C. equisetifolia* was associated with a *Schizachyrium littorale-Paspalum monostachyum* dominated coastal prairie. Other flora present included *Andropogon virginicus*, *Distichlis spicata*, *Fimbristylis castanea*, *Linum* sp., *Polygala polygama*, *Rhynchospora* sp., *Spartina patens*, and *Xyris jupicai*.

The Nueces County stands of *Casuarina equisetifolia* were all reproducing and expanding at varying age classes from parent plants into coastal prairie (Figures 1-3, 5). These stands were associated with a *Schizachyrium littorale*-*Paspalum monostachyum* dominated coastal prairie. Other flora present included *Baptisia sphaerocarpa*, *Conoclinium betonicifolium*, *Croton capitatus*, *C. glandulosa*, *Dichantheium acuminatum*, *Eleocharis* sp., *Heterotheca subaxillaris*, *Hydrocotyle bonariensis*, *Ilex vomitoria*, *Morella cerifera*, *Physalis cinerascens*, *Polygala polygama*, *Rayjacksonia phyllocephala*, *Sisyrinchium* sp., and *Solidago sempervirens*.

The *Casuarina equisetifolia* stands in Cameron County appear to be established as wind breaks or shade trees near entry roads into agricultural fields (Figure 6). Various age classes of *C. equisetifolia* were documented as expanding into adjacent agricultural fields. Indeed, in areas without repeated periodic disking and plowing of fields the aggressive spread and disruption of *C. equisetifolia* is evident. These stands of *C. equisetifolia* were associated with *Dichanthium annulatum*, *Pennisetum ciliare*, and *Prosopis glandulosa*.

Ecological Implications for Texas: Floral and Faunal

Casuarina equisetifolia has several life history traits that make this species particularly invasive: prolific seed production with fecund propagation (hundreds of cones per tree consisting of 40-60 seeds per cone) (Long & Lakela 1971), salt tolerance-growing even in front-line dunes (Watkins 1970), ability to fix nitrogen and thus tolerate poor soil regimes (Diem et al. 1982), drought tolerance, survive prolonged saltwater saturation and oxygen deficiencies (Orwa et al. 2009), and an ability to coppice. With rapid growth, dense shade, dense litter accumulation, and other competitive advantages, these plants displace and are destructive to native vegetation regimes (Nelson 1994).

Parrotta (1999) demonstrated in an understory successional, mixed-species plantations that *Casuarina equisetifolia* had lower plant biodiversity than either *Eucalyptus robustus* or *Leucana leucocephala* in Puerto Rico. Additionally, *C. equisetifolia* needles, cones, and mats of litter possess allelopathic properties which can depress germination rates and a natural herbicide that promotes species homogeneity within stands (Suresh & Vinaya 1987; Batish et al. 2001). Given their robust dissemination and propagule pressure colonizing disturbed or exposed habitats, short sub-reproductive period, accelerated growth and ability to grow substantially well at high densities make them desirable ornamentals and useful windbreaks (Rockwood & Geary 1991); however, these traits contribute to their invasive potential and hamper competitive ability of native species.

Casuarina equisetifolia may contribute to dune destabilization and encourage beach erosion by displacing deep-rooted native vegetation (Klukas 1969). Root structure and coppicing interferes with nesting areas of green and loggerhead (*Chelonia mydas*, *Caretta caretta*) sea turtles and American crocodiles (*Crocodylus acutus*) in Florida and Neotropical coasts (Klukas 1969; Moler 1991). Terrestrial areas of gopher tortoise (*Gopherus polyphemus*) distribution are potentially threatened by *C. equisetifolia* invasion in areas of Florida (Klukas 1969). Texas has a state-threatened tortoise (*Gopherus berlandieri*) in addition to the same species of threatened and endangered sea turtles that nest in coastal areas of Florida (Conant & Collins 1998).

Three sympatric populations of rodent species — *Oryzomys palustris*, *Peromyscus gossypinus* and *Sigmodon hispidus* — were found to be depauperate in established *Casuarina equisetifolia* stands in Florida Everglades. Mazzotti et al. (1981) described these effects, noting an absence of reproductive animals trapped in *C. equisetifolia* habitat sample sites, low abundance of cotton mice (*P. gossypinus*), and exclusion of cotton rats (*S. hispidus*) and rice rats (*O. palustris*). Smith & Vrieze (1979) studied *C. equisetifolia* impact on faunal populations and potential detriment to their important role in the Everglades ecosystem. Davis (1943) documented *C. equisetifolia* alterations to the physiognomy of the Everglades.

The rapid establishment of *Casuarina equisetifolia* outside its native range and its fecundity, accelerated growth, salt and drought tolerance, and allelopathic toxins create an ecological threat in coastal areas of Texas. The species reduces diversity of native flora and suppresses various faunal components. The impact of this species in Texas may necessitate its removal from known areas and prevention of reestablishment. Monitoring with periodic environmental assessments and formulation of management plans may be necessary.



Figure 1. *Casuarina equisetifolia* pistillate flowers in small, axillary clusters in Nueces Co., Texas. Photo by Jason Singhurst, 8 March 2016.



Figure 2. *Casuarina equisetifolia* staminate flowers on terminal spikes in Nueces Co., Texas. Photo by Jason Singhurst, 8 March 2016.



Figure 3. *Casuarina equisetifolia* woody, cone-like fruits in Nueces Co., Texas. Photo by Jason Singhurst, 8 March 2016.



Figure 4. *Casuarina equisetifolia* reproducing after herbicide treatment, Padre Island National Seashore, Kleberg Co., Texas. Photo by Jason Singhurst, 8 March 2016.



Figure 5. *Casuarina equisetifolia*, Nueces Co., Texas. Photo by Jason Singhurst, 8 March 2016.



Figure 6. *Casuarina equisetifolia*, Cameron Co., Texas. Photo by Jason Singhurst, 8 December 2015.

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