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INTRODUCTION

Up to eight species of *Tamarix* have been intentionally introduced to North America. Of these, five species have become invasive, including *T. parviflora*, *T. canariensis*, *T. gallica*, and the morphologically similar *T. chinensis* and *T. ramosissima*. The larger evergreen tree, *T. aphylla* or athel, has escaped cultivation at locations in California but is not considered to be as invasive as the other five species. Some of the largest infestations consist of hybrids of *T. chinensis* and *T. ramosissima*, while *T. parviflora* is primarily invasive in California. The classical weed biocontrol agents thus far established on *Tamarix* in North America primarily attack *T. chinensis*, *T. ramosissima*, and to a lesser extent, *T. parviflora*. Only these species are described in this publication.

The common name "saltcedar" derives from a combination of the superficial resemblance of *Tamarix* leaves to those on *Juniperus* (which is commonly referred to as "cedar" in the USA) and leaf salt glands that excrete salts from saline groundwater taken up by *Tamarix* roots. In many regions, the common name tamarisk is also used, and in Latin American countries it is called pino salado or tamarisco.

CLASSIFICATION

| RANKING | SCIENTIFIC NAME | COMMON NAME |
|---------------|-----------------------------------|-----------------------|
| Kingdom | Plantae | Plants |
| Subkingdom | Tracheobionta | Vascular plants |
| Superdivision | Spermatophyta | Seed plants |
| Division | Magnoliophyta | Flowering plants |
| Class | Magnoliopsida | Dicotyledons |
| Subclass | Dilleniidae | |
| Order | Caryophyllales | |
| Family | Tamaricaceae | Tamarisk family |
| Genus | <i>Tamarix</i> | Tamarisk |
| Species | <i>Tamarix chinensis</i> Lour. | Five-stamen saltcedar |
| Species | <i>Tamarix ramosissima</i> Ledeb. | Saltcedar |
| Species | <i>Tamarix parviflora</i> DC. | Smallflower saltcedar |

SYNONYMS

Tamarix chinensis: Chinese tamarisk

Tamarix chinensis, *T. ramosissima*: *Tamarix pendandra*, five-stamen tamarisk

Most *Tamarix* spp. invasive in North America: tamarisk

HISTORY AND DISTRIBUTION

Tamarix parviflora is native to the eastern Mediterranean Basin. *Tamarix chinensis* and *T. ramosissima* are native to Asia. All were intentionally introduced to North America in the 1800s, mostly for erosion control and as shade plants. *Tamarix parviflora* has since been reported in 32 states in the USA (Fig. 1a). Though *T. chinensis* and *T. ramosissima* are geographically isolated from each other in their native Asia (*T. chinensis* in the East, *T. ramosissima* in western Asia), in North America most invasive tamarisks are hybrid forms between these two taxa. Consequently, they are often reported together on state noxious weed lists and in distribution maps, and in this document this abundant form will be referred to as *Tamarix ramosissima* x *chinensis* (Fig. 1b).

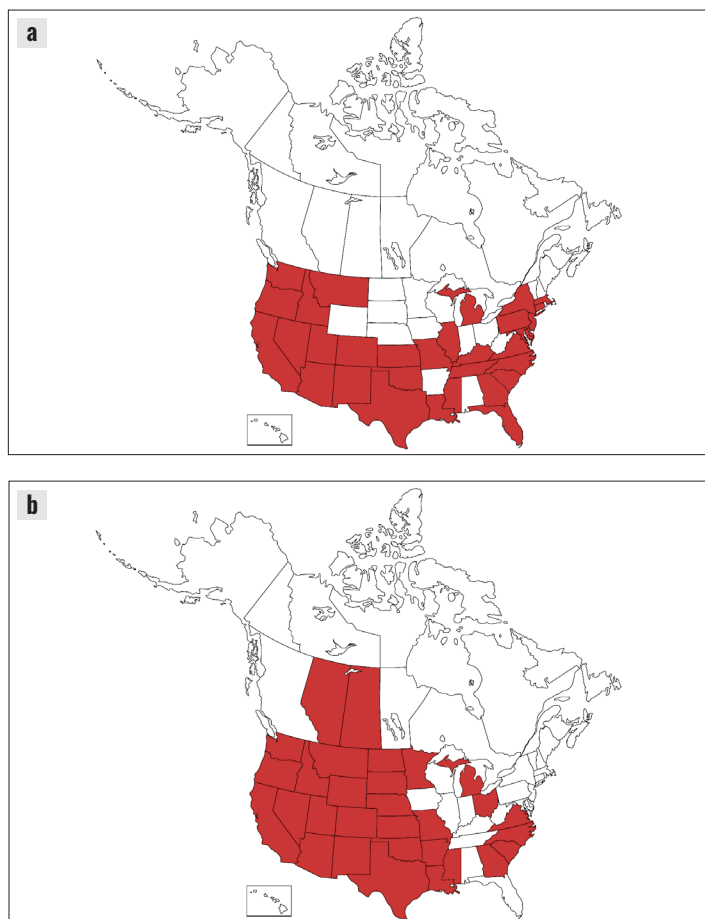


Figure 1. North American reported distribution of (a) *Tamarix parviflora*; (b) *T. chinensis*, *T. ramosissima*, and their hybrids. Some states are more heavily infested than others (Credit: EDDMapS, www.eddmaps.org; USDA PLANTS Database, plants.usda.gov [both accessed 27 November 2023])

IMPACT

Saltcedars can reduce stream flow and groundwater by their high evapotranspiration rates. Studies by the US Bureau of Reclamation and others indicate large amounts of water taken up by saltcedars, particularly from the Rio Grande and Colorado River basins. This can be explained by the high leaf or photosynthetic surface area of saltcedar as compared to native plants. These weeds also reduce water quality by increasing the salinity of streams and groundwater. They often increase soil salinity to levels that inhibit germination or growth of other plants (**Fig. 2a**). Dense thickets of saltcedar (**Fig. 2b**) displace native riparian communities, drastically degrading wildlife habitat. Saltcedar thickets are highly flammable and have led to larger and more frequent wildfires in desert riparian areas otherwise not prone to burning, which negatively impacts wildlife as well as the ranching sector.

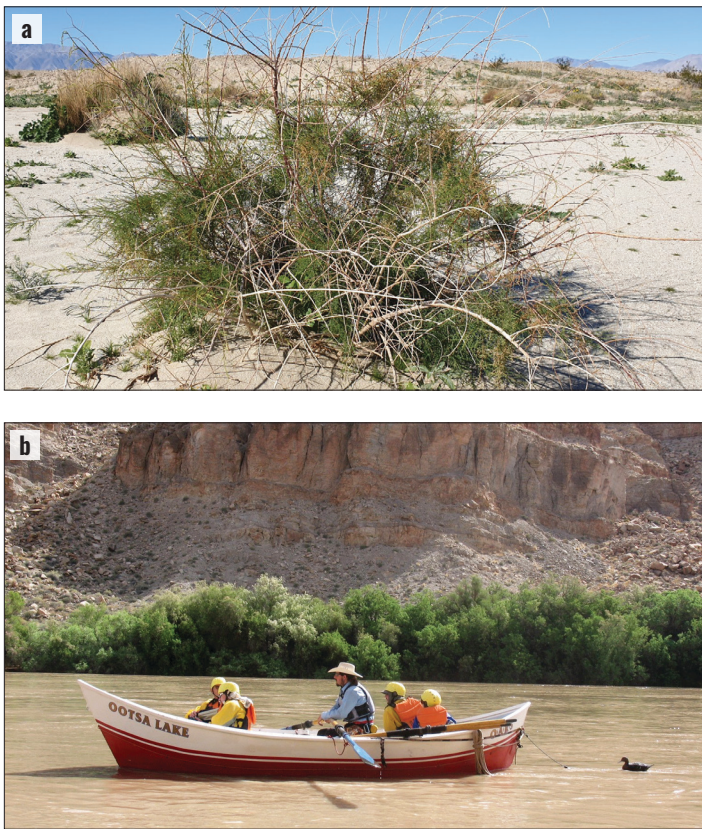


Figure 2. Saltcedar (a) reduces stream flow and increases soil salinity to levels where only saltcedar can survive; (b) forms dense thickets that displace native riparian communities (a: Fred Melgert/Carla Hoegen, iNaturalist.org CC BY-NC 4.0; b: Dan Bean, Colorado Department of Agriculture)

HABITAT

Saltcedars are typically found in moist habitats of arid regions, especially in saline soils. They invade lake and river margins and seasonal streambeds but can also be found in landscaping where they were planted intentionally for shade (**Fig. 3a–d**).

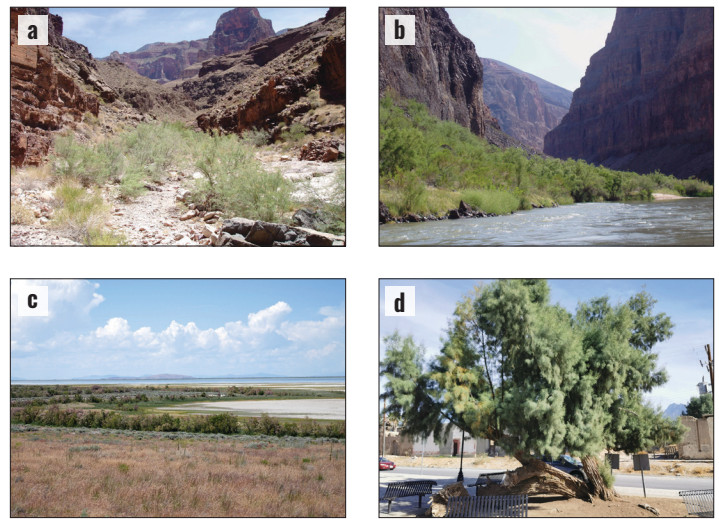


Figure 3. Saltcedars are frequently found (a) in seasonal streambeds; (b) along riverbanks in arid regions; (c) along lake shores in saline soil; (d) and in landscaping in arid regions (a,b: John M. Randall, The Nature Conservancy, Bugwood.org CC BY-3.0 US; c: Travis McMahon, MIA Consulting; d: Román Castañeda Vázquez, iNaturalist.org CC BY-NC-SA 4.0)

IDENTIFICATION AT A GLANCE

Saltcedars are perennial shrubs or small trees which develop long taproots with extensive creeping lateral roots. *Tamarix chinensis* and *T. ramosissima* are similar in appearance, differing only slightly in the shape of their floral parts so that the more common hybrid forms are indistinguishable except by molecular genetic testing. *Tamarix ramosissima* x *chinensis* is typically 13–20 ft (4–6 m) tall (**Fig. 4a**) while *T. parviflora* is similar in size but tends to be more spreading in its growth form (**Fig. 4b**). Saltcedar stems are green and flexible when young, becoming reddish-brown to brown and woody with age. Leaves are tiny, gray-green, and scale-like, and salt-secreting. The foliage is deciduous in cold climates. Saltcedar flowers are produced in tight clusters on branch tips. Flowers of *T. ramosissima* x *chinensis* appear after the foliage, and each has five pink petals. Flowers of *T. parviflora* appear before foliage, and each has only four pink petals. Fruits of all saltcedars are capsules that contain many tiny brown seeds, each topped by a tuft of hairs.

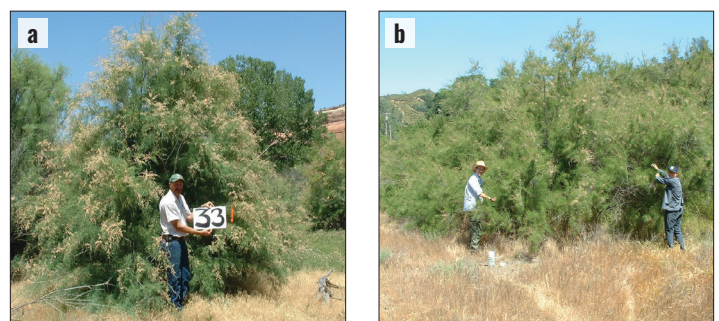


Figure 4. (a) Typical *Tamarix ramosissima* x *chinensis* hybrid; (b) *T. parviflora* tends to be more spreading in its growth form (a,b: Dan Bean, Colorado Department of Agriculture)

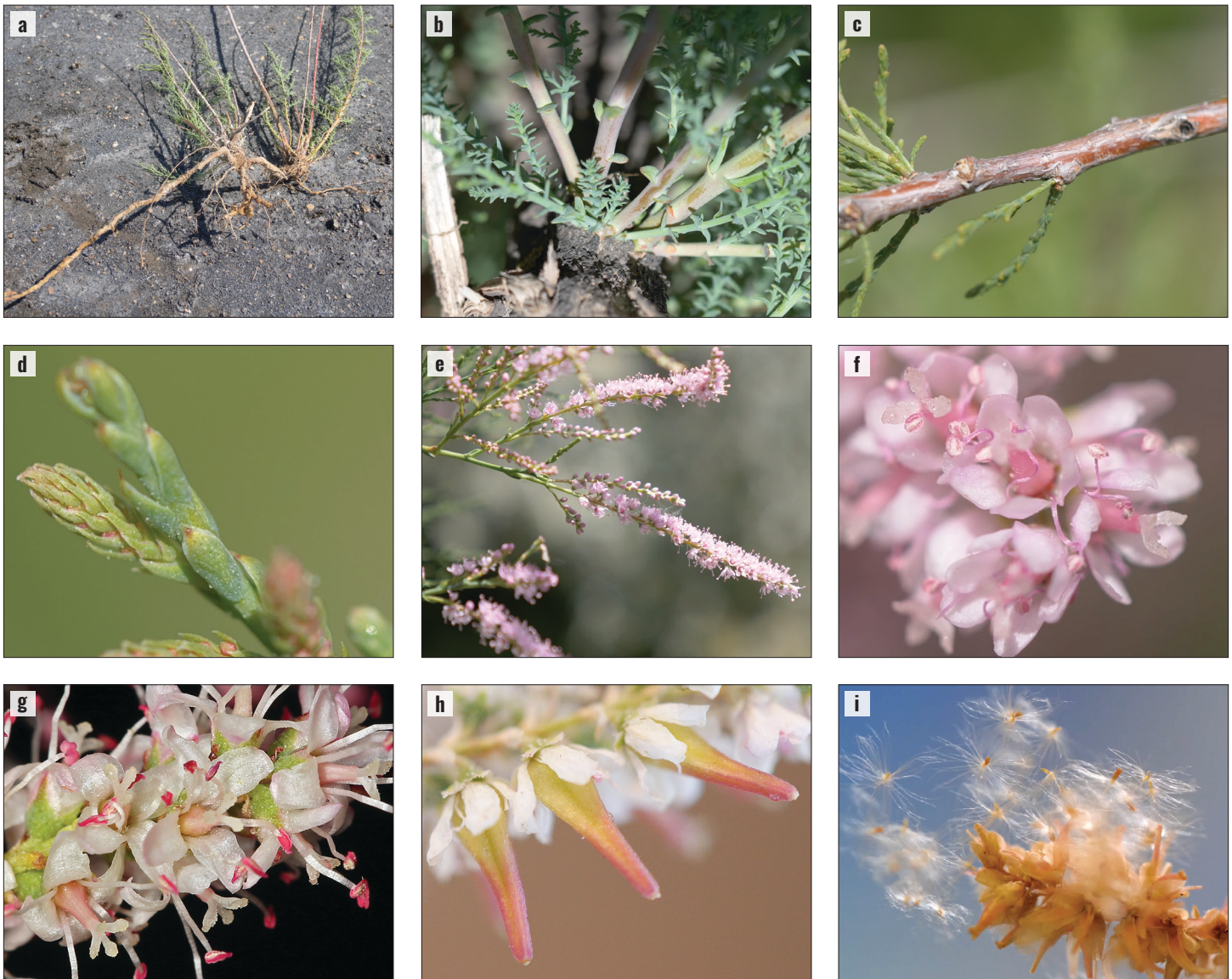


Figure 5. Saltcedars (a) produce a long taproot with extensive creeping lateral roots. Stems are (b) green and flexible when young, becoming (c) brown and woody with age. Leaves (d) are tiny, scale-like, overlapping, gray-green, and salt-secreting. Flowers are produced in (e) tight clusters at the ends of branch tips. Flowers of (f) *Tamarix chinensis*, *T. ramosissima*, and their hybrids have 5 petals while those of (g) *T. parviflora* have 4 petals. Saltcedar fruits (h) are capsules that produce (i) tiny seeds brown seeds topped by tufts of fine hairs (a–f,h,i: Travis McMahon, MIA Consulting; g: Matsonburger, iNaturalist.org CC BY-NC 4.0)

Roots

Young saltcedar plants quickly develop an extensive root system with a primary root that grows with little branching until it reaches the water table, at which point secondary roots tend to branch out. Roots of mature plants can produce secondary stems that give rise to new plants (Fig. 5a).

STEMS AND LEAVES

Saltcedars typically produce numerous sprawling stems (Fig. 2a). *Tamarix ramosissima* x *chinensis* can grow up to 26 ft (8 m) tall (but more typically 13–20 ft or 4–6 m), while *T. parviflora* typically only grows up to 16 ft (5 m) tall. Stems of all saltcedars are green and flexible when young (Fig. 5b), becoming reddish-brown to brown and woody with age (Fig. 5c). Leaves are up to 1/8 in (3 mm) long, gray-green,

overlapping, and scale-like, with salt-secreting glands (Fig. 5d). The foliage is deciduous, although plants at warmer, southern latitudes may remain green in all seasons.

FLOWERS

Flowers of *T. ramosissima* x *chinensis* are produced in tight clusters 1–3 in (2½–8 cm) long on branch tips (Fig. 5e). Their individual flowers have five pink petals ~2 mm long (Fig. 5f). Inflorescences of *T. parviflora* are similar though they typically only grow to 1 in (2½ cm) long, and the individual flowers have only four pink petals <2 mm long (Fig. 5g).

FRUITS AND SEEDS

Fruits of all saltcedars are capsules (Fig. 5h) that contain many tiny brown seeds, each topped by a tuft of fine hairs

(Fig. 5i) that enable long-distance wind dispersal. A large plant may produce several hundred thousand seeds in a single growing season.

ECOLOGY

Saltcedars recruit almost entirely by seed but can also sprout from root and stem fragments. If stem pieces come in contact with water, they can root and produce new plants (Fig. 6a). Saltcedar seeds readily spread along river and stream corridors where they are deposited by wind and water, especially following flooding events. Stem fragments also disperse downstream where they may resprout.

Seeds germinate rapidly if they have direct contact with water (Fig. 6b), and germination can occur throughout the year. Seeds are short-lived in the field, surviving only a few days, meaning they cannot form persistent seed banks. Some plants begin to flower their first year, but most flower in their third. Flowering of all saltcedars peaks in spring, though *T. ramosissima* × *chinensis* may continue to produce flowers through fall. In cold climates, plants lose their leaves over winter (Fig. 6c), while plants can grow year-round in warmer climates.



Figure 6. Saltcedar (a) stem segment growing new leaves and roots and (b) seedlings; stem/root segments and seeds readily sprout following contact with water. In cold climates, plants are deciduous (c) and sprout new leaves in spring (a,c: Travis McMahon, MIA Consulting; b: Eric Coombs, Oregon Department of Agriculture, Bugwood.org CC BY-3.0 US)

SIMILAR SPECIES

The scale-like and gray-green foliage of saltcedars resembles that of western juniper (*Juniperus occidentalis*). Western juniper (Fig. 7a) is an evergreen conifer that produces

berry-like cones (Fig. 7b) instead of the pink flowers and capsule fruit produced by saltcedars. Athel (*T. aphylla*) is a frost-sensitive evergreen congener used in the arid West for horticultural purposes. It has similar coloration, flowers, fruit, and seeds. Athel can be readily distinguished from the shrubbier tamarisks × saltcedars because it has a tree growth form (Fig. 7c), and its leaves are united around stems (Fig. 7d) rather than being scale-like.

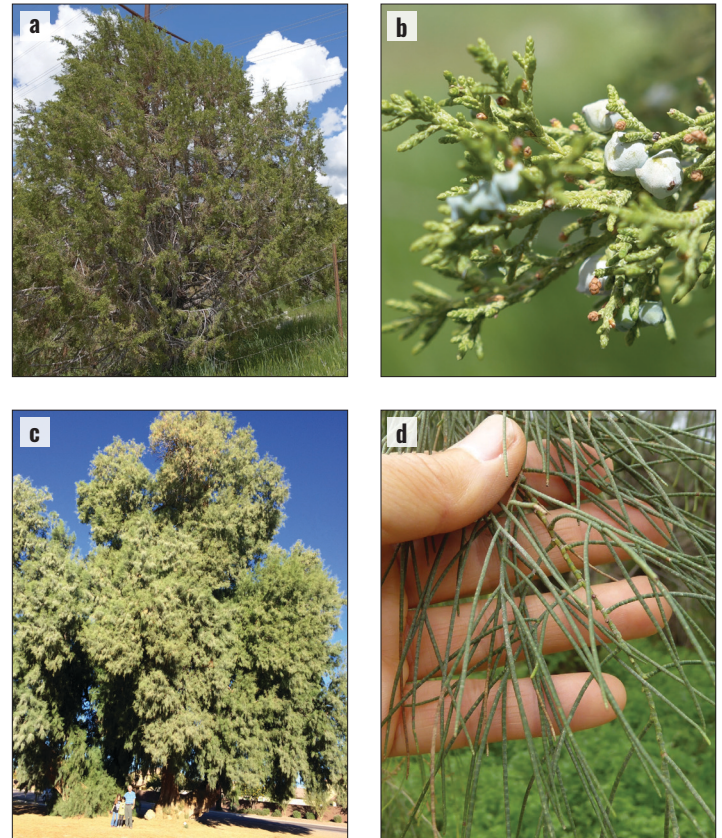


Figure 7. Western juniper (a) resembles saltcedars with its (b) scale-like, overlapping, gray-green foliage; however, it produces gray-blue berry-like cones instead of the capsule fruits produced by saltcedars. Athel (c) is a related species that has similar coloration, flowering/fruiting structures, and habitat; it differs from saltcedars by growing as a large tree, and its leaves (d) are united around stems rather than being scale-like (a,b: Travis McMahon, MIA Consulting; c: Zeynep Özsoy, Colorado Mesa University; d: Hikingsandiego, iNaturalist.org CC BY-NC 4.0)

DIFFERENTIATING SALTCEDARS

Tamarix parviflora differs from *T. ramosissima* × *chinensis* in a number of ways. It tends to grow up to 16 ft (5 m) tall but spreads to be a much wider plant (Fig. 4b) as the branches often ‘layer’ to form adventitious roots. Its flowers are smaller and have only four petals (Fig. 5g), the flower clusters are only up to 1 in (2½ cm) long, and the clusters appear before foliage in spring (Fig. 8a). In contrast, *T. ramosissima* × *chinensis* grow up to 26 ft (8 m) tall, their five-petaled flowers are slightly larger (Fig. 5f), and their flower clusters are 1–3 in (2½–8 cm) long. *Tamarix ramosissima* × *chinensis* flowers appear after foliage in spring (Fig. 8b), and their flowers may be present from spring through fall.

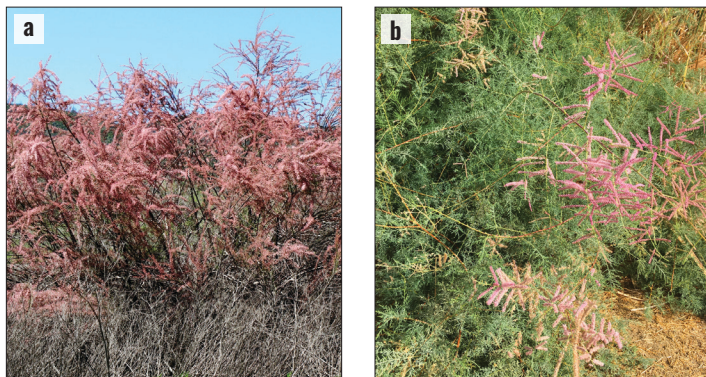


Figure 8. (a) *Tamarix parviflora* flowers appear before foliage in spring while (b) the flowers of *T. chinensis*, *T. ramosissima*, and their hybrids appear after foliage in spring (a: Subhashc, iNaturalist.org CC BY-NC 4.0; b: Inaturalistsa, iNaturalist.org CC BY-NC 4.0)

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SUGGESTED CITATION

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