Department of **Agriculture and Fisheries**
Biosecurity Queensland

Invasive plant risk assessment

Athel pine

Tamarix spp.

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Contents

Summary

There are about 54 different species of *Tamarix* native to various parts of the Middle East, China and Europe. A number of species within the genus are very closely related and can hybridise. Several species within the genus are invasive: *T. ramosissima* (salt cedar) is one of the 10 worst weeds in the United States (US), where it infests an estimated 1.5 million acres.

It is also listed by the International Union for the Conservation of Nature (IUCN) as one of 100 of the world's most invasive species. *T. chinensis* and *T. parviflora* are also invasive in the US. In Australia, *T. aphylla* (athel pine) is one of 20 Weeds of National Significance. Currently, athel pine is a major problem along the Finke River in central Australia and is at an earlier stage of population development elsewhere in Australia. Dense, mature stands of *Tamarix* pose a serious threat to natural biodiversity and can cause localised salinity and loss of groundwater. In Queensland, *T. aphylla* has been widely planted to provide shade and ornament for many decades.

However, over the past 5–10 years it has started to spread quite noticeably at a few locations. These infestations need to be eliminated as a matter of urgency if large-scale problems comparable to those being experienced in the Northern Territory and the US are to be prevented. All arid-zone river systems that have sandy banks (and associated floodplains) and a water table that can be reached by the specialised roots of *Tamarix* species appear to be at risk of invasion.

Identity and taxonomy

Taxa: This assessment covers the entire *Tamarix* genus.

Common names: Athel pine (Australia), tamarisk (US), salt cedar (US).

Taxonomy: *Tamarix*, together with two other small Asian genera, *Myricaria* and *Reaumuria*, constitute the family Tamaricaceae (DeLoach et al. 1999). *Tamarix* is an ancient genus in Asia that is taxonomically isolated from other plant families (Baum 1967; Crins 1989).

Tamarix comprises about 54 species (DeLoach et al. 1999).

The taxonomy of the genus is unclear with multiple species being morphologically very similar. This confusion is probably due, in part, to the ability of some *Tamarix* species to interbreed. For example, in the US, DNA studies suggest that *T. chinensis* (and possibly hybrids between it) and *T. ramosissima* occur in some western areas (DeLoach et al. 1999). Some authors continue to distinguish many species, while others consider *T. pentandra, T. tetranda, T. gallica, T. chinensis, T. ramosissima* and *T. parvifolia* to be one variable species or hybridising group best designated by the single name *T. pentandra* (Sudbrock 1993).

T. aphylla, T. petandra, T. ramosissima, T. indica and *T. parviflora* have been recorded by Australian herbaria. However, the accuracy of these identifications is questionable, given the confusion that exists over taxonomy of the genus. Some references deal with the uncertainty by simply referring to a *T. ramosissima/T. chilensis* complex.

In Australia, the most problematic species is *T. aphylla*. The latter species is sometimes confused with *T. ramosissima*, which has also been commonly planted as a shade and ornamental tree.

Description

Tamarix species are spreading, often multi-branched, trees up to 12 m tall with pendulous branches (Figure 1).

T. aphylla is evergreen, whereas other congeners, including *T. ramosissima*, are deciduous. *Tamarix* species are flowering plants and are not true pines (conifers). *Tamarix* species are long-lived (50 to 100 years). Old trees have extensive lateral roots as well as deep roots that tap the water table. The minute leaves are dull grey-green and form a sheath around the fine branchlets, giving them the appearance of pine needles. The flowers are pinkish-white, small and without stalks. They occur in spikes 3–4 cm long at the ends of the previous year's branches. The fruit is bell-shaped, capped with a hairy tuft and contains numerous seeds. The seeds have a pappus and are very small (pollen-sized).

Origin

The genus *Tamarix* is native to a zone stretching from southern Europe and north Africa through the Middle East and south Asia to China and Japan. There are a few species in disjunct parts of Africa (Rodman 1989). Baum (1978) considers that *Tamarix* have one major centre of speciation in the Pakistan–Afghanistan–Iran–Turkmenistan–southern Kazakhstan–western China area and another in the eastern Mediterranean area.

Biology and ecology

While *Tamarix* species can survive when planted in a range of habitat types, they are best adapted to the sandy or gravelly banks of waterways and on sandy floodplains, especially where their roots can access underground water (Figure 1).

Figure 1. *T. aphylla* in Australia only seems to spread along the sandy banks of waterways such as rivers and lakes.

Climatically, *Tamarix* species are best suited to arid and semi-arid zones within subtropical to tropical latitudes. *Tamarix* species have evolved several features that enhance their growth and survival along the banks of waterways, when faced with episodic disturbance events such as drought and flooding. Firstly, *Tamarix* species are hydrophytes (phreatophytes), which means they have specialised roots that can draw water from deep underground. Mature specimens use large quantities of water. Along the Brazos River floodplain in Texas, *T. ramosissima* dominates about 7000 ha and is estimated to use more than 93 million cubic metres of water annually (Busby & Schuster 1971). Secondly, *Tamarix* species tolerate saline water and exude large quantities of salt through their specialised leaves. Lastly, they can survive prolonged periods of inundation (Frasier & Johnsen 1991). *Tamarix* species are well adapted for survival in arid and semi-arid climates and, once established, not even dramatic changes in soil moisture will completely eliminate them, provided abundant groundwater is available (Frasier & Johnsen 1991).

Reproduction and dispersal

Tamarix species reproduce from broken stem fragments and from seeds. Vegetative reproduction is particularly successful when branches are broken up by floodwaters and carried downstream.

Flowering normally starts in about the third year of life and continues annually thereafter (CRC for Weed Management 2005). A single mature specimen can produce hundreds of thousands of seeds each year (Sudbrock 1993). The tiny, hairy, pollen-sized seeds are widely dispersed by wind and water throughout the growing season, and they will germinate within 24 hours of moistening. In Arizona (US), seeds of *T. ramosissima* have been known to germinate while floating on water. They subsequently become established when they float to the shoreline and settle on saturated soil as the water recedes (Frasier & Johnsen 1991). In Queensland, seedlings of *T. aphylla* have been observed emerging in the middle of sandy river beds (Figure 2).

Figure 2. Young *T. aphylla* colonising freshly disturbed sand within the bed of the Flinders River near Hughenden

Seeds are viable for a short time (Zohary 1956; Waisel 1960). Seeds germinate most of the year, provided sufficient moisture is available, with most germination in autumn. Seedlings establish readily on saline and alkaline soils and can reach 60–100 cm in height within the first year. Subsequent growth is rapid with trees increasing in height between 2–5 m per annum under favourable conditions (Parsons & Cuthbertson 1992).

History as a weed overseas

Tamarix species were first introduced into the US in 1823, after which they were widely planted as ornamentals, for windbreaks and for stream bank stabilisation (Brotherson & von Winkel 1986; DiTomasco 1988). Of some 10 species of *Tamarix* that were introduced into the US, *T. ramosissima* is the most invasive. *T. ramosissima* spread explosively after the late 1920s and today occupies an estimate 1.5 million acres of floodplains, riverbanks and lakeshores in western US (Robinson 1965; Horton 1977; DeLoach et al. 1999). Another species, *T. parviflora* is currently invading coastal and central areas of California (DeLoach et al. 1999). Unlike the situation in central Australia, *T. aphylla* is only mildly invasive in North America.

DeLoach et al. (1999) state that *T. ramosissima* is 'one of the worst ecological disasters ever to befall western riparian ecosystems in the United States.' Similarly, Frasier and Johnsen (1991) consider *Tamarix* to be 'one of the 10 worst noxious weeds in the United States.' *T. ramosissima* has become so dense along many river systems and floodplains, especially in western US, that it has completely replaced native vegetation, reduced biodiversity, and currently threatens the survival of several endangered species (DeLoach et al. 1999). In a study of habitat use by birds along the lower Colorado River, Anderson and Ohmart (1977) found that *Tamarix* stands supported only four species per hundred acres, as opposed to 154 species per hundred acres of native vegetation.

Dense, mature stands of *Tamarix* use huge amounts of water and lower water tables below the root zone of locally native tree species (DeLoach et al. 1999). A single large plant can absorb 200 gallons of water a day (Hoddenbach 1987). *Tamarix* species utilise saline groundwater and excrete the excess salts through specialised leaves that accumulate on the soil surface, killing saline intolerant native plants. Fallen foliage of *Tamarix* species is highly flammable and causes increased wildfires (DeLoach et al. 1999). Dense stands of *Tamarix* also alter stream channel morphology, interfere with recreational activities, create potential flood hazards and reduce livestock carrying capacity (DeLoach et al. 1999; Frasier & Johnsen 1991). Even iconic landscapes such as the Grand Canyon have been degraded by *Tamarix* species with dense infestations along its riverbanks.

T. ramosissima and *T. parviflora* are current targets for biological control in the US (DeLoach et al. 1999).

Distribution and history of spread in Australia

Various species of *Tamarix* were introduced into Australia to provide shelter against wind and sun, and for use as ornamantals. They were planted extensively around Broken Hill and Whyalla in the 1930s and 1940s and soon after in other states, particularly around homesteads, stockyards, bores and other hot, exposed sites on grazing properties and towns. Planting in the Northern Territory resulted in naturalisation along the Finke River. Spread appears to have been most rapid soon after extensive flood events in the 1970s. Elsewhere in Australia, spread has been less rapid. For example, in Queensland spread appears to have only started in the last 10–20 years. The reason for the long 'lag time' between planting and noticeable spread is unclear.

The largest infestations of *Tamarix* in Australia are along the banks of the Finke River in the Northern Territory. The material at this site is believed to be *T. aphylla*. An estimated 600 km of the Finke River are infested. Other smaller infestations exist along ephemeral creeks in western New South Wales. A large infestation was found at Starvation Lake in 1990 and Tilcha Flow (a stream flowing from Tilcha Bore) in South Australia. Other sites include the lower Gascoyne (found in 1991) and Avon Rivers in Western Australia. Several other rivers in inland Australia (e.g. Todd River, Ross River and Palmer River) are being, or have the potential to be, invaded (Griffin et al. 1989). The *T. ramosissima*/*T. chinensis* complex is currently spreading on saline flats of the Murray River near Berri, South Australia (Gavin 2002).

Thousands of *T. aphylla* trees have been planted as ornamental and shade trees across Queensland, the vast majority seemingly failing to naturalise.

In Queensland, T. aphylla has naturalised and is spreading at the following locations:

1. on vacant crown land at Gemfields, near Emerald, central Queensland (Figure 3)
2. on a mine near Blackwater, central Queensland (detected 1999)
3. along a drainage line on a degraded landscape on the Mount Isa Mines lease (N March, pers. comm.)
4. along the bed and banks of the Flinders River, Hughenden.

Wild populations of *T. aphylla* probably exist elsewhere in Queensland and the challenge is to detect these populations before they become intractable problems. Since *T. aphylla* has been so commonly planted as shade/shelter trees and ornamentals, there is significant scope for additional wild infestations to develop over time.

Figure 3. *T. aphylla* starting to spread near Emerald in central Queensland.

Existing and potential impacts

Various species of *Tamarix*, especially *T. aphylla* and the *T. ramosissima/T. chinensis* complex, have the potential to dominate sandy riparian habitats and sandy or saline floodplains over much of arid and semi-arid Australia. Inland river systems such as the Finke River appear particularly vulnerable. If permitted to spread, *Tamarix* species could generate impacts comparable to those being experienced in western US. Potential impacts include:

Loss of biodiversity: If permitted to spread, *Tamarix* species can exclude all other vegetation and cause substantial loss of natural biodiversity. Along some parts of the Finke River, native river red gums (*Eucalyptus camaldulensis*), an icon species of central Australia, have been replaced by athel pines (Griffin et al. 1989). Unlike eucalypts, athel pines do not provide nesting hollows or the same quality of food or habitat for native wildlife.

Increased soil salinity: The leaves of athel pine exude salt which raises the salt content of the soil, leading to loss of saline-intolerant native plants and pasture.

Agricultural impact: Dense stands of athel pine can hinder stock mustering and replace pasture grasses.

Localised drop in underground water tables: Extensive mature stands of athel pine use large amounts of water and are capable of lowering the water table, causing waterholes to dry up.

Social impact: At some sites, athel pines are damaging the foundations and walls of historic buildings.

In recognition of these impacts and the potential for further spread, athel pine has been listed as one of 20 Weeds of National Significance (ARMCANZ 2001).

Preferred habitat

A curious feature of athel pine in Australia is its ability to naturalise and spread in some areas but not others, despite being widely planted across the landscape. This variation in 'invasion success' might be due to species-level or biotype-level genetic variation, or it may be a reflection of very specific habitat requirements. It is difficult to determine whether any species within the genus are non-invasive, since most species seem to spread if they are widely planted and if local conditions are suitable.

This study speculates that perhaps seeds of *Tamarix* can only germinate and survive in very specific habitats since most naturalised populations in Queensland and other states seem to exist only on exposed, freshly disturbed sand and gravel where there is an underground moisture supply (e.g. underground water exists below the sands of the Finke River and the Flinders River, and below the dams and mining depressions where athel pines are spreading in central Queensland). *Tamarix* species are well adapted to take advantage of underground water supplies and may even rely on such features for survival.

Successful invasion may also require specific disturbance events such as flooding, since *T. aphylla* only spread explosively along the Finke River after major flood events had disturbed existing riparian habitats and deposited extensive fresh alluvial deposits. Also, certain species of *Tamarix* seem to spread successfully on saline areas (e.g. *T. ramossissima/T. chinensis* complex is invasive on saline flats of the Murray River near Berri, South Australia). Again, saline areas tend to be free of other vegetation, so it may simply be an expression of the exposed nature of these sites. *Tamarix* species are pre-adapted to saline conditions (since they have specialised leaf glands that exude excess salts) and as such, these habitats may be at particular risk of invasion.

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