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The threat of invasive Tamarix species to riparian ecosystems in South Africa

Prof. Solomon Newete
ARC-Natural Resources and Engineering

Tamarix species (common name: Tamarisk), also known as 'salt cedars', are native to the Euro-Asian region and some parts of Africa. It is one of the most prolific terrestrial plants on Earth and has invaded all continents where humans live. Its rapid spread is facilitated by several factors including, among others, its facultative phreatophytic and halophytic properties that enables the plant to grow not only in wet and hyperarid conditions but also in highly saline environments. Unlike many riparian plants, *Tamarix* has an adaptive strategy to strike a balance between extreme saline conditions and resisting water stress effects. It can extract water from deep groundwaters using its long roots (which can grow up to 50 cm) and water is brought up to the top layers of the soil through hydraulic lift where most of the water-absorbing fine roots occur. Its characteristic foliar salt glands enable the salt cedar to grow in extreme saline conditions with concentrations equivalent to those of seawater. The excess salt is excreted through foliar salt glands that appear as white crystal gypsum on the surface of the *Tamarix* leaves and the salt deposition on the soil below the canopy through either littering or sap dripping (guttation), which acts as an inhibitor of seedling growth in the surroundings of the *Tamarix* plants.

Two of the three *Tamarix* species in South Africa are exotic (*T. chinensis* and *T. ramossisima*) and are declared as invasive 'category 1b' weeds according to the Alien and Invasive Species regulations of the National Environmental Management: Biodiversity Act 2014, which enforces their immediate removal under all circumstances. Despite the presence of the indigenous *T. usneoides* in the country, the two exotic *Tamarix* species are believed to have been imported as ornamental garden plants or for dust suppression and phytoremediation in mining areas. They have now spread to different parts of the country with a serious ecological footprint in several riparian ecosystems.

The Agricultural Research Council - Natural Resources and Engineering (ARC-NRE), in collaboration with the University of the Witwatersrand and the University of Fort Hare, has been investigating the extent and distribution of the exotic *Tamarix* species, their phylogenetic relationship to the indigenous *T. usneoides*, and their impacts on soil salinity and moisture levels. A survey was conducted in 11 riparian sites spanning the Northern Cape, Eastern Cape, and Western Cape provinces, where the *Tamarix* invasion is most pervasive. The results showed that about 73% of the *Tamarix* plants are exotic and hybrids

Figure 1: Dense invasion of alien Tamarix plants on the banks of the Olifants River near De Rust, Western Cape Province, in 2014. The big trees with light pink flowers along the river on the left and right are the exotic Tamarix species and those in the middle are reeds.

produced predominantly from the two exotic species. The Western Cape had the highest invasion with an estimated *Tamarix* population of about 122 523 (unpublished data) and the Olifants River near the town of De Rust recorded the highest plant density (Figure 1).

While hybridization between the exotic and indigenous *Tamarix* species could be a potential threat leading to gene dilution and eventual decline in the indigenous *Tamarix* population, the main impact of the invasive species is the alteration of the riparian ecosystem. This is because the exotic *Tamarix* species replace the co-occurring plant species, narrow the water courses leading to frequent flooding, choke water systems dry, increase the frequency of fires (while they themselves are known for exceptional tolerance to fire), increase soil salinity in the area and inhibit the growth of other plants through allelopathy. *Tamarix* can grow from adventitious roots vegetatively or from seeds during favourable conditions. The seedlings can survive waterlogged conditions for a period of 3-4 weeks and can therefore occupy the watercourses of rivers and flood plains (Figures 2 and 3).

The soil electro-conductivity under the exotic *Tamarix* species in the Olifants River reached up to 3000 mS/m (19 500 ppm) at a depth of 30-40 cm, which is well within the reach of many non-halophytic plants and hence their growth could be affected by the elevated soil salinity levels. A soil moisture content of 20-40% was found at 30-40 cm depth under the exotic *Tamarix* canopy, suggesting the extraction of water though hydraulic lift nearer to the fine roots of the plant. Thus, the widespread invasion by exotic *Tamarix* species modifies the soil properties and reduces the riparian plant biodiversity.

For further reading on *Tamarix*, please see the following peer-reviewed scientific articles:

Figure 2: *Massive recruitment of saplings from seeds invading the centre of the watercourse of the Swart River near Prince Albert, Western Cape Province, in 2015. The large trees on the right side of the river are exotic Tamarix species.*

Figure 3: *Large number of exotic Tamarix species growing in the watercourse of the Olifants River, by surviving waterlogged conditions during the wet seasons, near De Rust, Western Cape Province, in 2015.*

- Newete, S.W., Abd Elbasit, M.A & Araya, T. (2020). Soil salinity and moisture content under non-native *Tamarix* species. *International Journal of Phytoremediation*, 22(9): 931-938 https://doi.org/10.1080/15226514.2020.1774503
- Newete, S.W., Mayonde, S. & Byrne, M.J. (2019). Distribution and abundance of invasive *Tamarix* genotypes in South Africa. *Weed Research*, 59: 191-200. https://doi.org/10.1111/wre.12356

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For more information:
Prof. Solomon Newete
ARC-Natural Resources and Engineering
Tel: 012 310 2638
E-mail: NeweteS@arc.agric.za

Figure 4: Tamarix field survey in Olifants River near De Rust, Western Cape Province, South Africa