Ailanthus altissima, commonly known as the tree of heaven, is a deciduous tree that originates from China. Introduced as an attractive ornamental tree, the species has been planted throughout South Africa, and they have spread from these plantings in an uncontrolled manner. Image: Ulrike Irlich

Cities invaded

Invasive species thrive in the hustle and bustle of cities. **Mirijam Gaertner**, **Ulrike Irlich**, **Vernon Visser**, **Gareth Walker** and **Phil McLean** examine the issues.

Why are invasive non-native species abundant in cities?

People collect non-native species for a range of reasons – some are serious plant or animal collectors, while others just like a variety of plants in their gardens. Cities are by definition places where large numbers of people live in close proximity, and they tend to accumulate a variety of new species in large numbers, and this (large numbers of people, a proportion of who collect a large variety of non-native species in a relatively small area) explains why such species are abundant in cities. The growth in the number and size of cities worldwide has also contributed to the problem and South African cities are no exception.

Cape Town is an example of a city where invasive species are a large and growing problem. Cape Town has a population of 3.8 million people, and it is growing more rapidly than any other city in southern Africa. Cape Town is also a focal point of the national economy and international tourism, providing avenues and opportunities for the introduction and spread of non-native species within the city and surrounding landscapes. The problems in Cape Town are particularly acute, because it is located in the Cape Floristic Region (an area of extremely high biodiversity). The city's boundaries contain 18 nature reserves, including Table Mountain National Park. Thus the risk posed to native biodiversity by non-native species that escape is extremely high.

What's the issue? Why bother?

Invasive species can displace native species and, in the worst-case scenario, completely dominate areas. From their strongholds within city environments invasive species can spread into surrounding natural areas, where they can pose significant threats to native species. Almost two-thirds of known invasive alien plants have originated from gardens. Non-native animals kept as pets (e.g. cats and many bird and fish species) can establish feral populations and become invasive if they manage to escape or are deliberately released. Escaped non-native fish and domestic cats can have significant impacts on wildlife.

In Cape Town, there are a number of examples that illustrate these problems. Pine trees (*Pinus* species), established to provide timber and to 'improve' the bare mountain slopes, and Australian wattles (*Acacia* species), planted mainly for dune stabilisation, have spread widely into natural vegetation. Invasive pines and wattles pose serious risks to humans because they increase the severity of wild fires near residential areas (see van Wilgen this issue). Another concern is that criminals use dense wattle stands to hide in. Another non-native species, the tree of heaven (*Ailanthus altissima*, planted as an ornamental street tree) is highly invasive in the urban environment, and it damages buildings and roads.

Floating water weeds (such as water hyacinth, *Eichhornia*

*Left: Non-native eucalypt species are seen as 'culturally native' in parts of South Africa. Right top: Non-native mallard ducks have established feral populations across Cape Town and are now interbreeding with indigenous ducks. Right middle: Invasive pine trees provide shade and are regarded by some people as more attractive than fynbos shrublands but they are well known for replacing native fynbos species. Right bottom: Common myna (*Acridotheres tristis*), a highly invasive bird species that is considered a serious threat to native bird species.* Image: Sophia Turner, Ulrike Irlich, Lisel McGregor, Dick Daniels (http://carolinabirds.org/)

crassipes and parrot's feather, *Myriophyllum aquaticum*) were introduced as decorative pond plants, and have spread to block waterways and negatively affect water quality. Some non-native species can also cause serious health problems. Pampas grass (*Cortaderia selloana*, a popular garden plant) and beefwood (*Casuarina equisetifolia*, widely-used as a windbreak and for shade) can both cause allergic reactions, especially to people susceptible to hay fever and asthma. Syringa (*Melia azedarach*), oleander (*Nerium oleander*) and thorn apples (*Datura ferox* and *D. stramonium*) all have potentially lethal parts (berries, leaves or seeds). In addition to plants, non-native animals such as the European paper wasp (*Polistes dominula*) and the German wasp (*Vespula germanica*) can also be problematic. These two aggressive wasp species are a serious nuisance, as well as a potential health hazard for people who are allergic to them. Another urban invader is the house crow, which thrives in an urban environment, living on refuse and becoming a nuisance and health hazard.

So let's get rid of them!

Unfortunately it's not so easy, as some species pose conflicts.

People often have strongly differing views when it comes to non-native species, and these divergent views sometimes lead to conflicts. Trees are particularly controversial, as many citizens regard the trees as attractive and ecologically beneficial, complicating the efforts to control those that are invasive. People can also establish cultural connections with non-native trees. Because they are so long-lived, non-native tress can become associated with a place and be regarded as culturally important by some city inhabitants (e.g. non-native eucalypt species are seen as 'culturally native' in parts of South Africa). Examples include Jacaranda trees (*Jacaranda mimosa*) in Pretoria and English oaks (*Quercus robur*) in Stellenbosch. Some harmful species are also simultaneously beneficial to certain groups of people or industries. For example, invasive pine trees are well known for replacing native fynbos species but they also provide shade and timber, and are regarded by some people as more attractive than fynbos shrublands. Non-native mallard ducks are another example. They were introduced via the pet trade and have established feral populations across Cape Town and now interbreed with indigenous ducks, contaminating the gene pool of these native species. People are very fond of the ducks and it is common for families to spend time at ponds, feeding these ducks. Of particular concern is the interbreeding with the indigenous yellow-billed duck. In both the cases of alien trees and ducks in the city of Cape Town, control programmes have been seriously complicated by large numbers of people expressing strong opposition to the control.

NEM:BA alien and invasive species regulations

In October 2014 the Alien and Invasive Species regulations of the National Environmental Management: Biodiversity Act (NEM:BA) became law. These regulations are aimed at preventing the introduction and further spread of invasive and potentially invasive species. In practice the regulations consist of a list of invasive organisms (plants, animals and microbes) and a list of species prohibited from being imported into the country. The list of invasive organisms groups species into four different categories, with specific management and control requirements for each category (Table 1). All landowners (private, business and government) in South Africa are required to comply with these requirements under the Act. The City of Cape Town, as a major landowner within the municipal boundaries of Cape Town, is no exception to this and is already in the process of implementing the NEM:BA regulations. As a first step the City needs to know what listed species are on municipal land. To this end the City is using its spotter network (on www.capetowninvasives.org.za) to record data on listed non-native species. This distribution information is then being used to support control operations aimed at (1) eradicating all category 1a species, and (2) developing a management plan for future invasive species control. The presence and density of invasive species that occur on all City-owned land is being mapped and appropriate control measures put in place to reduce the impact of such invasive species. The City of Cape Town is leading the way in this regard and it is hoped that these experiences can be used to develop guidelines for other municipalities to become compliant with the new regulations.

For more information on the NEM:BA AIS regulations visit: http://www.invasives.org.za/legislation.html

Table 1: Categories used to define legal requirements for listed invasive organisms in South Africa

Categories	Legal requirements
Category 1a	Invasive species that must be eradicated if possible (or controlled if not). Trade, planting or propagation is prohibited.
Category 1b	Invasive species that must be controlled and, where possible, eradicated. Trade, planting or propagation is prohibited.
Category 2	Invasive and potentially invasive species for which a permit is required to carry out a restricted activity. This category includes commercially important species such as pines, wattles and gum trees.
Category 3	Invasive species that need not be controlled or removed (sometimes just for particular areas or provinces). However, no further planting, propagation or trade is permitted.

The way forward: management and policies

All landowners, including municipalities such as the City of Cape Town, are obligated by South African environmental legislation (NEM:BA) to manage certain invasive species that are listed under the Act. This is especially important in Cape Town, given the juxtaposition of protected and urban areas (Box).

Cape Town's invasive species control programmes dates back to the 1940s. In 2008 the City established an Invasive Species Management Unit, with an annual budget of R1 million and a dedicated team. Since then, the programme has grown to include areas managed by multiple departments within the city. The City now manages 55 teams, averaging 10 workers each, drawn from impoverished communities. These teams are tasked with the control of invasive plants and animals in terrestrial and aquatic ecosystems. They are also responsible for the early detection of emerging invasive species and implementing control measures as quickly as possible to control and if possible eradicate them. Although originally funded by the City's ratepayers, additional and substantial funding has been obtained from the Working for Water programme and other sources, increasing the available funds to more than R20 million in 2014. Nature reserves are given first priority, followed by areas where invasive plants are a fire hazard or provide shelter for criminals and areas in which there are small populations of an invasive species which can be easily controlled.

Another approach being piloted by the City is the promotion of indigenous plant species over non-native ones. This approach is undertaken in tandem with alien species control operations so that people have viable alternatives for providing variety in their gardens, shade or screening. This positive aspect of the city's operations also helps to reduce any negative perceptions associated with control operations.

How can you get involved?

The City of Cape Town has several organisations that provide opportunities for you to get involved. You can join your local 'Friends' or NGO groups, generally associated with nearby nature reserves or conservation areas, to assist with indigenous plant monitoring and emerging weed detection. Alternatively, you can join your local hack group to assist with invasive plant clearing. You can also log records of invasive species on iSpot (www.ispotnature.org) or become a member of Cape Town's Spotter Network on www.capetowninvasives.org.za. You can join the Facebook page Cape Town Invasive Species for more information about invasive species in and around Cape Town. You can also take active measures like not planting invasive species in your garden, or being more careful about how you dump garden waste, so as not to spread unwanted species. Other cities in South Africa have similar initiatives (see for example http://www.durbaninvasives.org.za/). Q

Mirijam Gaertner is a restoration ecologist. Her research focuses on impacts and legacies of alien plant invasions and resilience of native ecosystems. She is specifically interested in the impacts of invasive alien plant species on fynbos ecosystems and has tested different restoration strategies aiming to both reduce the abundance of alien species and re-introduce native species. Since 2013 Mirijam has been coordinating the research component of Cape Town's Invasive Species Unit.

Ulrike Irlich is the Programme Manager for Monitoring and Evaluation in the Invasive Species Unit of the City of Cape Town. As part of the programme she also manages emerging weeds and target species programmes. She is also studying for a PhD, focusing on urban invasions and the management of invasive species in an urban environment.

Vernon Visser is a postdoctoral researcher at the Centre for Invasion Biology, Stellenbosch University. He is currently working on a project together with Stellenbosch Municipality and Stellenbosch University to help these two organisations become compliant with the new NEM:BA Alien and Invasive Species regulations.

Gareth Walker is a conservation ecologist with a special interest in invasion biology. He is currently enrolled at Stellenbosch University as a master's student focusing on the urban invasive species Ailanthus altissima. *His main focus includes the accurate mapping of* A. altissima *throughout South Africa and specifically in Cape Town as well as the implementation of successful management plans promoting the eradication of the species.*

Phil McLean is an invasive species specialist with extensive knowledge on the identification and treatment of invasive plants in South Africa. He is currently engaged with his master's degree through the C•I•B. at Stellenbosch University looking at the challenges faced by smaller municipalities in complying with their NEM:BA requirements.