Top: Pines are often introduced as a source of timber in South Africa, but they also need a lot of water, increase fire hazards, and harm the native vegetation.

Risk assessment
a key tool for reducing the incidence and impacts of invasions

Sabrina Kumschick takes a look at the interface between science and practice in the biology of invasions.

Most alien species are introduced to a new area because they provide some sort of benefit for at least part of society. Mammals, reptiles and birds are often introduced as pets, attractive plants as garden plants, and trees to provide building material. Alien species are also crucial for the survival of humankind, considering that most crops and livestock used worldwide are not native to most parts of the planet where they are grown. However, we need to keep in mind that some alien species are not beneficial to the environment and economy where they are introduced, and in some cases the damage they do is greater than the benefit they were introduced for.

For example, the giant African landsnail (*Achatina fulica*), originally occurred on the coast of East Africa, but as it is a good source of protein, it was introduced around the world as a food source. However some snails escaped from their breeding farms and are now living in the wild and causing severe problems in the ecosystems where they occur. For example, they can be hazardous to drivers, causing cars to skid. They also alter soil properties due to the composition of their shells, which can lead to different plants growing where they are present. Potentially even worse, however, is another snail, the rosy wolf snail (*Euglandina rosea*) which was introduced to control its 'big brother'. It is highly predatory and, like many humans, eats snails. But of course it doesn't mind whether the snail it eats is a giant African landsnail or an indigenous snail. It eats whatever snail it can find and has led to the extinction of several native snails on the Pacific islands. Unfortunately, there is clear evidence that it effectively controls populations of the giant African land snail.

The giant African land snail – not only used as a food source, but also popular as pets. Image: Sabrina Kumschick

Using risk assessment

Assessing the risk of an alien species becoming problematic is a way to prevent such damage from occurring. Risk assessment can advise on which species to stop before problems become too big to handle. If people had carefully studied the generalist diet of the rosy wolf snail before introducing it, it would have been obvious that its introduction might lead to severe negative consequences for the endemic local snails. Risk assessment is important for predicting which species may become invasive and cause problems for humans or local biodiversity.

Risk assessment tools look at a specific event that is considered to be risky or uncertain, for example the rosy wolf snail (or any other alien species) becoming a problematic invader, and assess the likelihood of such event occurring, and the consequences should they occur.

Let's take the hypothetical example of a polar bear being introduced to South Africa: The likelihood of a polar bear establishing and thriving in South Africa is low. Polar bears live in Arctic conditions. Most of South Africa is warm and temperate. So the chance of the polar bear becoming invasive in South Africa is close to zero. However, if you look at the consequences if the polar bear were to become established in South Africa, namely the negative impacts

A kangaroo is better adapted to the South African climate than a polar bear, but the consequences for local fauna and humans could be huge due to the polar bear's appetite, should a polar bear be introduced and establish. All these factors need to be taken into account when determining the risk of these species becoming problematic invaders in South Africa. Image: Wikimedia Commons

the polar bear could cause, the picture changes. Being top predators, they could have a huge impact on our fauna, especially on our seals, and of course on humans.

Protocols for risk assessment have been developed to help separate benign from the harmful alien species *before* they become problematic. For example, when considering importing new alien species, risk assessments would recommend that the benign species be allowed in, whereas the potentially harmful ones would be prohibited.

The risk assessment tools used most often rely on scoring systems that ask a set of questions linked with the likelihood of the species becoming invasive and the consequences if it does. The questions that are asked are about the species' behaviour in other areas where it has been introduced (its 'invasion history'), the species' biological and ecological features, the suitability of the new environment and climate into which the species might be introduced, and any undesirable characteristics that the species might have – such as toxicity for plants. Each answer is linked to a score that reflects how much the given factor is thought to influence a species' success in its new range. The polar bear would, for example, get a low risk score in a South African context because of the poor match between the climatic features of its native range and those that exist in South Africa.

However, if a similar exercise were carried out for a kangaroo, for example, this species would get a high score for suitable climate, since Australia has a very similar climate to South Africa.

The sum of scores leads to a decision on a species' risk – if the score is higher than a certain threshold, a species is considered as potentially harmful and rejected, if it is lower than the threshold defined it is probably safe for import and could be allowed in (sometimes subject to certain conditions).

Risk assessment methods developed to date are not without flaws, and incorrect decisions do occur. The nature of the incorrect decision influences the costs associated with it, and which stakeholders are involved (see the box). Apart from a few incorrect decisions, risk assessment tools have proved to be hugely beneficial in other countries. Preventing the introduction and spread of harmful invaders through risk assessments would protect South Africa's native species from the negative effects of new harmful alien species. Furthermore, they can save a lot of money as management actions are much more effective and cheaper when the alien species is tackled before it has become widespread and caused substantial damage. **Q**

Sabrina Kumschick is a core team member at the Centre for Invasion Biology and works on risk assessments of alien species. She is interested in what makes some species more problematic than others and how to predict impact.

Examples of questions used to assess the risk of alien plants

The questions are taken from the Australian Weed Risk Assessment scheme, one of the most widely used schemes applied to alien plants.

- Has the species become naturalised where grown?
- Is it a domesticated plant, which has been introduced from another region, and is it growing, reproducing and maintaining itself in the introduced range?
- Broad climate suitability (environmental versatility) – Score 'yes' for this question if the species is known to grow in a broad range of climate types. Use the map of climatic regions available in a comprehensive atlas.
- Produces spines, thorns or burrs – the plant possesses a structure known to cause fouling, discomfort or pain to animals or man. If it is thornless subspecies, variety or cultivar, then there must be good evidence that it does not retain the capacity to revert to a thorny form.
- Unpalatable to grazing animals – consider the plant with respect to areas where the plant has the potential to grow and if the herbivores present could keep it under control. This feature may be found at any stage of the lifecycle of the plant and/or over periods of the growing season.
- Well controlled by herbicides – documented evidence is required for effective chemical control of the plant. This control must be acceptable in the situations in which it is likely to be found. The chemical management should be safe for other desirable plants that are likely to be present. This information will be poorly documented for most non-agricultural plants.

False negatives and false positives in risk assessment

False positives

Generally, a false positive occurs when something is shown to be true or positive when it is actually false or negative – positive in our case means that an alien species is harmful. False positives will lead to alien species being managed or rejected for entry when they pose little risk, leading to a loss in income or undue restriction regarding its use. For example, if a beautiful, orange flowering tree species is not allowed to be imported even if it is actually safe, the nursery industry would suffer from losing out on potential sales of the species.

False negatives

A false negative occurs when something is shown to be negative but is actually positive. False negatives in the case of alien species risk assessments will lead to a species not being managed or being accepted for entry when it poses a substantial risk. This leads to new invasions and negative impacts, which can result in high costs caused by the alien species. A hypothetical rainbow-coloured daisy may not be identified as posing a high risk when evaluated and could be accepted for importation and sold in nurseries. It may, however, then escape from gardens and invade natural areas, supressing native species. In this case, the nursery industry would have made profits on its sales, while the costs of subsequent invasions and impacts caused by the species would be borne by society at large.

It is therefore important when developing risk assessments and thresholds for import to keep false negatives to a minimum, while false positives do not usually have a large effect.