Weeds and climate change

fact sheet

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When the climate changes, some species benefit and others lose out. This is the case with exotic weeds as well as native species. So, with global warming, might a balance of sorts be struck, with those weeds at the limits of their heat tolerance being pushed back while those that tolerate warmer conditions expanding?

That might be the case if climate change just involved increases in mean temperatures, but it is far more complicated than that.

Climate change means more extreme weather events, greater stresses on native species and ecosystems, and climate-driven activities, such as the introduction of new, hardier pasture and garden plant varieties.

Combined, these factors can be expected to push Australia towards an overall much weedier state.

Often outcompeting native species, weeds are already one of the most serious threats to Australian biodiversity.[2] There are at least 2700 exotic plants established, and many thousands more potential weeds.[3]

Native species stressed by climate change will become more susceptible to destruction or displacement by weeds. Transformed ecosystems composed largely of weeds and vigorous native species may result.[4]

With most terrestrial animals dependent on plant production, weed invasion can profoundly alter ecosystems and ecological processes.[5] In many cases the impacts of invasive species benefiting from climate change are likely to exceed the direct impacts of climate change.[6]

Here is an outline of some of the complex ways that climate change and weeds will interact to cause harm to Australian biodiversity (and agriculture as well).

Many weedy species will thrive in climate change's wilder weather

Many of Australia's worst weeds benefit from extreme events, including at least 13 of the country's 20 Weeds of National Significance.[9] Athel pine (*Tamarix aphylla*), for example, spread along 600km of the Finke River in central Australia after severe flooding in the 1970s and 1980s, replacing river red gums. It could spread much further under climate change.[10]

Photo: Athel pine infestation, courtesy Colin Wilson

Extreme weather equals more weed opportunities

When native vegetation is stressed or destroyed by droughts, fires, floods or severe storms, weeds gain new opportunities to replace native species.[7]

There is a huge pool of invasive plants available to colonise bare spaces left by drought, fire and storm damage,[8] and wind and flooding waters help spread weeds.

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Serated tussock (*Nassella trichotoma*) benefits from bare patches created by droughts, marram grass (*Ammophila arenaria*) and bitou bush (*Chrysanthemoides monillfera rotundata*) from storms, and willows (*Salix spp.*) from floods. Climate change-altered fire regimes will also favour some weeds, particularly fire-promoting exotic pasture grasses (see below).

Range shifts due to temperature and rainfall changes

As mean temperatures increase, some weeds will be able to expand their range into new areas. The tropical weed prickly acacia (*Acacia nilotica spp. indica*) is likely to spread south[11] and athel pine could spread throughout inland rivers as far south as the Murray River in Victoria.

Lowland species such as lantana (*Lantana camara*) may be able to shift into the uplands.[12] Weeds moving into alpine areas could have a particularly severe impact because many alpine plant communities are localised with rare endemic species, and there are numerous weed species at lower altitudes.[13] On subantarctic Heard Island, the weed winter grass (*Poa annua*) has been spreading rapidly on deglaciated sites.14

Weeds constrained by rainfall may also find new habitats under new climate conditions. Lantana and mist flower (*Eupatorium riparium*), for example, could expand if rainfall increased in some areas.[15]

Increased invasiveness due to carbon dioxide fertilisation

C3 weeds (using one of two types of photosynthetic pathway, which responds to higher levels of CO_2) such as parthenium (*Parthenium hysterophorus*) may grow more rapidly under higher carbon dioxide levels and become more competitive.[16]

CO_2 can affect plant and leaf size, seed size and production, the nutritiousness of leaves to herbivores, plant toxicity and pollen production.

Nitrogen-fixing weeds, such as brooms, gorse and acacias may especially benefit because growth stimulated by CO_2 will not be constrained by low nitrogen levels.[17]

Under high CO_2, C3 plants are likely to become more water-efficient,18 potentially allowing weeds such as prickly acacia and rubber vine (*Cryptostegia grandiflora*) to move into drier habitats.[19]

Vines respond strongly to higher CO_2 levels,[20] and there are many highly damaging invasive vines (eg. cat's claw *Macfadyena unguis-cati* and rubber vine) that could benefit.

Higher CO_2 levels are likely to reduce the effectiveness of glyphosate, the main chemical used to control environmental weeds in Australia.[21]

Increased dispersal & pollination of weeds from animal behaviour changes

If fruit-eating birds arrive earlier and leave later for migration, as has been occurring, fruit-bearing weeds may benefit from greater dispersal.

Higher temperatures and other factors are likely to increase insects' breeding cycles and provide more weed pollination.[22]

As animals, including invasive species, move into new areas in response to climate change, they are likely to spread weeds or create disturbance advantagous for weeds.

Transformations due to feedback loops

Some weeds create positive feedback loops that may be exacerbated by climate change, and result in ecosystem transformations.

Flammable weedy pasture grasses, such as gamba grass (*Andropogon gayanus*) and mission grass (*Pennisetum polystachion*) may convert large tracts of eucalypt woodland into treeless plains, as they both promote fire and are promoted by fire, a trend likely to be exacerbated by climate change.[23]

When weedy vines flourish after cyclones, they retard rainforest regeneration and increase the vulnerability of rainforests to future cyclone damage, which benefits vines.[24]

Native ecological communities already under pressure from weed invasions are likely to be more vulnerable to climate change, which in turn will render them more vulnerable to weed invasion, creating a feedback loop leading to greater losses of native species.

Climate change will render native species more vulnerable to weeds either directly or indirectly, for example by facilitating the spread of the serious plant disease caused by *Phytophthora cinnamomi*, which is expected to benefit from wet periods increasingly coinciding with warm soil temperatures.[25]

More weed opportunities due to human climate change responses

In their responses to climate change, humans are likely to introduce more weeds and create more opportunities for invasion.

Many crops proposed for biofuels – jatropha (*Jatropha curcas*) and giant reed (*Arundo donax*) for example – are serious weeds.[26] New hardier pasture and garden plants developed to withstand drier conditions expected under climate change are likely to have a high weed risk.[27]

Agricultural adaptations to climate change, including new products and shifts into new areas, will also create more opportunities for weeds.

More weeds will be one of the inevitable results of the proposed shift of more intensive agriculture into northern Australia. If graziers switch from sheep to cattle, prickly acacia will spread, as cattle disperse more seeds.[28]

Behavioural changes in response to extreme weather events often facilitates weed invasion: weed control is a lower priority when there are floods or droughts, clean-ups after cyclones may spread weeds and overgrazing during droughts promotes unpalatable weeds.[29]

Reducing the impacts of weeds and preventing new weeds are essential to increasing the resilience of ecosystems and giving native species the best chance to deal with the adverse impacts of climate change.

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