

Invasive species in Australia

New species have been arriving in Australia for millions of years, ever since it first formed as a separate continent. These must often have upset the previous 'balance of nature', pushing other animals and plants to extinction or at least making them less abundant. Here we'll be considering a much more recent intensive wave of new species, associated with arrival of humans over the last 50,000 years, and their effects on general ecological processes.

The most important biological invader to reach Australia in the last 50,000 years has been humans. As we have seen in previous lectures, the aborigines and later the Europeans exerted all sorts of effects; hunting animals, burning vegetation, and later ploughing for agriculture. These have profoundly altered the landscapes of Australia, and driven many marsupials to extinction.

However, in addition both the aborigines and Europeans brought animals and plants over from other lands, and these too have had effects on the vegetation, flora and fauna. The dingo was perhaps the first and only introduction by aborigines; an Asian dog, it seems to have come over by trade from Indonesia about 7,000 years ago (the aborigines mainly seem to have kept dingos as pets rather than using them in hunting), and it often escaped into the wild.

It is not known what detailed effects the dingo has had on the faunal ecology of Australia. Maybe it made some small marsupials go extinct; we just don't know. The dingo never made it across to Tasmania (sea level rise had drowned the previous land bridge before the dingo was introduced to Australia), and interestingly the two largest marsupial carnivores, the Tasmanian wolf/tiger and Tasmanian devil, were confined to Tasmania by time Europeans arrived. These two marsupials had previously been widespread all across Australia, so their extinction on the mainland several thousand years ago is probably due to competition/aggression from the dingo.

When the Europeans started to form settlements in Australia from the 1780's onwards, they brought with them dogs and cats, and these soon escaped and began to form wild populations feeding off marsupials and native species of rodent. Many small marsupials are much less common than before, and have lost most of their previous geographical range.

Other domesticated animals that have been brought in and escaped to the wild in Australia include: camels (in the central deserts; actually the only wild populations of camels anywhere in the world), goats, and water buffalo (in the Queensland rainforests). Ecological studies suggest that these have all had big effects in modifying vegetation in some areas. Of course, many other domesticated animals have been kept (e.g. sheep and cattle) but have less often escaped to form wild populations.

Some species of birds and animals were deliberately released, either because they were seen as useful, or because they reminded the settlers of their homelands. Sparrows and starlings are an example. 'Useful' animals include foxes, introduced for hunting (and to control rabbits; see below)...being predators they now adversely affect populations of small marsupials.

Cane toads were introduced from the south-western USA to help control beetle grubs that ate the sugar cane in northern Queensland. The toads didn't bother with the grubs but thrived and are now present throughout the rainforest in the north...being poisonous they are a hazard to the only marsupial which will eat them, the marsupial cat. This often results in deaths of the marsupial cats.

Rabbits were (and still are) an especially bad problem; although their meat provided protein for poor settlers, they wreaked havoc with natural vegetation and fields. They reached very high population densities resulting in soil erosion from their burrowing. Some small rabbit-sized marsupials (e.g. hare wallabies) probably went extinct through competition with them for grazing. Extensive hunting and trapping couldn't keep up with the numbers of the rabbits. Eventually myxomatosis was brought over and devastated the rabbit populations in the 1950's....they began to recover then a new disease was brought over in the 1990's, and rabbits are temporarily rarer again. Probably the eventual balance with these diseases present will be that the rabbits are less abundant than before; a more natural balance of control will have been reached. For a truly 'natural' balance on the rabbits you'd have to let dingos and foxes get much more abundant than nowadays; they are controlled by farmers worried about livestock.

Some animals simply came across as stowaways. These include house mice and rats; they are often present in semi-natural environments (e.g. small woods or waste ground near cities). European wasps came across recently; they are spreading through Adelaide rapidly, and being a nuisance to people eating outdoors. Recently, a troublesome striped mussel shell from Asia invaded a coastal marina near Darwin, presumably carried on the hull of a boat. This mussel grows very fast, clogging discharge pipes, slowing down boats, and displacing the native coastal fauna; coastal authorities chlorinated a whole marina where it had been found (killing everything), in a last-ditch attempt to keep from spreading out along the coast. Still, it's probably just a matter of time before it turns up again.

A chronology of the striped mussel invasion near Darwin:

<http://www.nt.gov.au/news/chronology.shtml>

Pictures of the striped mussel: <http://www.marine.csiro.au/CRIMP/musselimages.html>

Plants.

Australia has 15,000-20,000 species of 'native' plants, and 1,500-2,000 'invaders' from elsewhere...so this constitutes about 10% of the flora. Around major cities, the percentage of introduced species in the plants reproducing in the wild is even greater - about 30% of the weeds and woodland plants in and around Sydney, for example.

Some of the species brought across were deliberately planted because they were seen as useful. The prickly pear (*Opuntia*) is one example...this cactus from Mexico was brought over for the Cochineal dye industry and also quite widely used as a hedging plant to keep livestock in, but by the 1920's it ran wild blanketing huge areas of rangeland until a specialized *Opuntia*-eating moth (the well-named *Cactoblastis*) was brought from Mexico; its caterpillars eat the prickly pear plant, and brought the invasion under control in just a few years. Now prickly pears are quite rare in the wild. The prickly pear story is a nice example of how when a species is brought to a new continent, it sometimes goes way out of control because the pests and diseases that held back its numbers there have been left behind. An 'invader' is often far more abundant in the new country than it ever was back home, probably for this reason.

Many pasture grasses were introduced from Europe and now occur 'semi-wild' along roadsides, dominating the vegetation.

Northern Hemisphere pine trees have been extensively planted as timber trees in Australia, and they often seed themselves and invade the bushlands, shading out native species of trees and shrubs. Ornamental garden plants and flowers also sometimes escape into the wild. In Adelaide you will often

see the fan palm establishing itself at the sides of pavements and other dry places.

Many species of weeds have come over accidentally with crop seed or with soil on the roots of plants. Most of the field and garden weeds seen in Australia come from other continents, especially Europe.

Web link on the problems caused by introduced weeds in Australia:

<http://wwwcomm.murdoch.edu.au/webster/A15.html>

Australia's revenge: antipodean species invading other continents.

Ecologists have often noted that Australia has received far more invading species than the number of Australian species which have invaded elsewhere. It has been suggested that Oz species are somehow 'weaker' competitors due to the relative isolation of the continent from the tough 'mainstream' of evolution. This may be true for the marsupials, or at least some of them...they do tend to do badly in competition with introduced placental mammals (though kangeroos and wallabies are an exception). Australia has worn-out nutrient poor soils that are rarer on other lands, so its plants may not be well suited to invading the more fertile soils abroad. However, it does have at least some areas of good soils, which is where the plants from elsewhere have mainly made their homes in Australia...but as such soils are rarer in Australia, maybe fewer native plants evolved to suit those soils.

But to some extent it is just that that the main direction of human movement was towards Oz and not away from it. If aborigines had discovered agriculture first perhaps they might have been taking Australian weeds with them in their seed corn as they colonized new lands. And nowadays, with a more even flow of people and products we do indeed see Australian species invading other continents. An Australian tree species is spreading everywhere in Florida, and introduced Eucalyptus seeding themselves are often a problem in California and southern Europe. There is even a population of wild wallabies (escaped from parks) established in Wales, UK.

A global problem.

Though Australia has suffered particularly badly, more and more examples are coming forward around the world of serious disruption to natural flora and fauna from species brought in from elsewhere. With international trade continuing and becoming ever greater, we can expect more and more of these instances to occur on all the continents.

Summary.

- 1) Australia has always been subject to species arriving from elsewhere; its just that previously they arrived naturally (e.g. seeds drifting across the sea).
- 2) Humans, especially Europeans, greatly speeded up the rate of arrival of new species.
- 3) The invading species that have established populations in Australia are many and varied. Weeds were brought over accidentally. Garden plants escaped and became a pest. Some mammals and birds were introduced deliberately for amenity or economic reasons.
- 4) The problem is, invaders cause problems. They often displace Australian species, through competition or predation. Weeds are a cost to farming. Rabbits cause soil erosion and eat grazing meant for sheep. Introduced species spoil the 'feel' of the landscape for those who know that they are looking at an introduced species. Most invasive species actually do not cause a big problem, but a few invaders are

really very troublesome.

5) Most invaders will never be eliminated. Some can be brought under control, becoming less of a problem, through biological control.

6) Biological invasion is a worldwide process that has been accelerated by extensive trade and travel between lands that were formerly separated by sea.

Conclusions.

Biological invasions have always occurred when species hopped from one continent to another, often by floating across seas, or perhaps as seeds carried by birds...an ongoing invasion of Australia by S.E. Asian species has been occurring for around 20 million years and many native Australian plants, birds and small placental mammals are ultimately of this origin.

With Europeans on the scene, the rate of arrival of new species has speeded up enormously. Biological invasions in Australia have depleted the natural flora and fauna by competition and predation, and spoilt the 'look' of natural landscapes, at least for those who know that a particular species is just an invader and not part of the natural Australian heritage. Biological invasions have also cost billions in economic damage of one form or another. These are reasons for restricting import of exotic plants and animals that might cause further problems.

Only a small proportion of the many thousands of species of plants and animals which have been kept in gardens or wildlife parks have successfully established wild populations in Australia, and only a small proportion of those have become abundant enough to be seen as a problem. Perhaps in many cases they just haven't made the leap into the wild yet, but will do so over coming decades or centuries? It could be that they need to change genetically by evolution before they can establish themselves in Australia. People have looked for characteristics which might explain why some species of plants and animals make 'successful' invaders whereas others stayed put and did not form escaped populations; this will be the subject of a 'guest' lecture later this semester.

Do bear in mind that quite a large proportion of the invading species in Australia are only associated with 'human-made' environments; fields, roadsides, towns and building sites. If humans were to vanish, these invaders would probably vanish too (e.g. sparrows and starlings). However, many other introduced species which are now present will probably never be successfully eliminated. They and their evolutionary descendants will simply become part of the natural Australian flora and fauna, just like so many other plants and animals have done over the millions of years since arriving on the island continent.

A web link on salvation Jane/Patterson's curse: http://www.mtx.net.au/~mlrapcb/news_articles.htm

A general page on the worldwide problem of biological invasions:
<http://www.wri.org/wri/wr-98-99/bioinvas.htm>

Biological invaders in the USA: <http://www.enn.com/enn-news-archive/1999/01/012699/aliens.asp>

A general page on biological invasions; very readable:
<http://www3.hmc.edu/~mwright/exotic/ecology.html>



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