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#351: Weeds girdle the globe: The marauding march of invasive plant species

VOICEOVER

This is Up Close, the research talk show from the University of Melbourne, Australia.

ANDI HORVATH
I'm Dr Andi Horvath. Thanks for joining us. Today we bring you Up Close to our planet of plants and to one remarkable group in particular which we collectively call weeds. As we will hear, weeds are emblematic of both highly successful survival strategies and damagingly pervasive pestilence. We're joined by plant population ecologist, Professor Roger Cousens, a weed specialist, to explore the ingenious natural history of various weeds and the challenges they pose economically, culturally, environmentally and aesthetically. We delve into how nature and humans help or hinder weeds' progression on their path to world domination. Roger Cousens takes particular interest in coastal weeds, and as we'll learn from some of his case studies, the story of weeds is often as compelling as alien invasions in science fiction. Welcome to Up Close, Roger.

ROGER COUSENS
Hi.

ANDI HORVATH
Roger, let's start at the very beginning. What is a weed?

ROGER COUSENS
It can be almost anything. It's in the eye of the beholder. There is no such thing as a weed species, it just depends who the person is and what their attitudes are.

ANDI HORVATH
So a gardener's definition of a weed will be different to, say, a conservationist's definition of a weed?

ROGER COUSENS
Oh, absolutely, and I'll give an example. A golf greenkeeper wants a putting surface

that contains one species and only one species. In my garden, my lawn, which is sort of equivalent, I have probably 15 or 20 species and I don't regard any of them as weeds. I have a biodiverse lawn.

ANDI HORVATH
Some of these species will be indigenous, they'll be native species. Are non-indigenous species weeds?

ROGER COUSENS
Oh, yes. It depends on how you define the weed. There are certainly groups around the world that are busy battling species that are native and which are spreading as a result of land use change, climate change.

ANDI HORVATH
Therefore is a weed a really successful plant, one that really gets the survival directive for its own species?

ROGER COUSENS
Yeah, but you can look at other species, native species in North America. The loblolly pine or something like that is very successful, it's very widespread. It's a native but that doesn?t make it a weed. I come back to saying it can be almost anything. Probably the best definition is that it's a plant out of place. Any species can be a weed according to the perception of the person. Once they've decided on what they think a weed is, that's it for them. A crop species can become a weed in another place; a native species can become a weed.

ANDI HORVATH
So a weed depends on who you ask, what country you're in, what decade you ask the question, because there are people who go around actually looking for weeds, ensuring that they don't encroach on certain national parks. Now, why are they doing that? Are some of these weeds really harmful?

ROGER COUSENS
Yes. You could argue that they're all harmful if you don't like to see them, but the ones that we go around looking for are the ones that really have specific, obvious impacts on native communities. This is an interesting thing because there's a real difference between North America and Australia in the way we define an invasive species. An invasive species, clearly we're thinking of it as coming from outside, it's just taking over, but in North America that sort of definition that they use, it's a species that is taking over and it has a real demonstrable impact. In Australia an invasive species is just any species that increases and spreads within Australia. I was talking to some Canadians about invasive species; they didn?t regard my species as being invasive at all, even though they had invaded.

ANDI HORVATH
Roger, how have humans contributed to the spread of weeds around the globe?

ROGER COUSENS
Primarily through trade. We've taken them around the world in our grain shipments, we've taken them around the world with fodder for animals, all sorts of reasons. We also in modern shipping use seawater for ballast for ships and when we take on ballast water then we take up water that could be containing all sorts of marine organisms. Then when that boat gets to the next port - it may have come from Japan and it gets to Melbourne in Australia - then when it empties that water out it will be emptying out algae and animals and all sorts of things. There's a huge international concern about how we deal with things spread by shipping and by machinery coming back from wars overseas and what we can do about it.

ANDI HORVATH
So these are unintended consequences. We didn?t plan to bring these plants out but a lot have been thought of as we must have this in the Australian colony.

ROGER COUSENS
Oh, yeah.

ANDI HORVATH
Tell us about those.

ROGER COUSENS
Well, it's not just in the Australian colony. All over the world people have imported species for ornamental purposes to grow in their gardens and in their ponds. There's a famous case of water hyacinth that was taken from its native South America. It was shown in New Orleans in the late 1800s and people liked it so much that it was quickly spread to gardens, it went overseas and now it's in just about every tropical and subtropical country clogging waterways and really having major issues. I've seen a picture in Bangladesh of a river, and because people couldn't actually use their boats to go across because of this water weed, they tied all their boats together and made like a pontoon bridge out of it, and they're walking across.

ANDI HORVATH
So humans have accelerated the spread of weeds but nature does its own thing as well. Nature is dynamic; there are populations that rise and fall. How do these happen in the world of the plants? What sort of mechanisms allow certain plants to dominate?

ROGER COUSENS
This has almost been the holy grail of plant ecology for many years, trying to say just how particular species become abundant. It almost seems to be every species has a different way. Some have small seeds which helps them get around on fleeces of animals; some have large seeds which allow them to spread by other means. Almost any combination of plant traits can help them to become abundant. That's abundance in one place but then there's the natural dispersal mechanisms like wind and animals and water that help them to move. It's not that particular species are very adaptable, it's just that we have so many species, there's going to be at least

one for every situation.

ANDI HORVATH
I'm Andi Horvath and you're listening to Up Close. In this episode we're talking about weeds as they take over planet earth with plant population ecologist Roger Cousens. Okay, let's look at the situation of exotic weeds and native landscapes and wilderness, and let's look at Australia in particular. What's the impact of these weeds? I suppose in some ways you're going to tell me it depends on who's talking, whether it's a politician, a farmer, a gardener or a conservationist. What is the impact? Give us a picture of some of the dynamics of plants.

ROGER COUSENS
Another variable that you could add also is the ecosystem. It's going to be very different whether you're talking about an intact wilderness forest or whether it's a coastline or whether it's in agriculture. Weeds cost agriculture billions of dollars a year. Then again in say a coastal area, it's almost impossible to calculate any economic value even though they're clearly having huge impacts. If you were to stand on one of Australia's iconic beaches and instead of looking out to sea, look inland and what you will see is nothing like the vegetation, the landscape that you would have originally seen in Australia. Because of introduced species the sand dunes are steeper, they get closer to the shore so the beach itself is narrower. Almost every plant that you can see looking back up at the dunes is an introduced species. I won't call it a weed, it's an introduced species.

ANDI HORVATH
Is that the same for Western Australia, which is very famous for its wildlife flowers?

ROGER COUSENS
Yeah, but most of the wildlife, the biodiversity is not on shores. Around the world the plant communities, the animal communities on sandy coastlines in particular is very poor. There are very few species adapted to those very harsh conditions. That actually makes it easier for an invader to come in. It doesn?t have as many things to compete against.

ANDI HORVATH
Tell me about the Western Australian pamphlet that advertises its wildflower season.

ROGER COUSENS
Oh look, this was many years ago now but there was a famous occasion on which the Australian tourism people decided to advertise as they do every year for people to come and see the wonderful wildflowers. Their front cover of this pamphlet was a picture of Watsonia, which is an invasive weed from South Africa. People over there just saw it as a really nice pretty plant, come and see our wonderful show of colour. They didn?t see it as a weed because it was part of the Western Australian landscape now.

ANDI HORVATH

What has been the impact of say Australian plants on the rest of the world?

ROGER COUSENS
Look, we've introduced plants into South Africa, into the Fynbos there, which is a very, very diverse area where the proteas and things come from. It wasn?t the Australians that did it, but South Africans decided that they wanted our acacias and other species and they introduced them there for tannin production for leather. They've introduced our species into Florida for example; the Everglades are now being overrun by two species of trees, casuarina and melaleuca. These are huge problems. They introduced these Australian trees to grow on the levee banks to help them in draining wetlands, which was something they saw as necessary. Now we look at those wetlands and say hey, look, these are wonderful biological reserves. In many cases these things were introduced before we had a real concept of just how bad species invasions could be.

ANDI HORVATH
Tell me about the eucalypt plant. Now, that seems to be ubiquitous.

ROGER COUSENS
Eucalypts are very good timber trees. Like many species, if you take a species away from its natural enemies, its natural predators, insects and so on, it will grow even better than it does in its native region. They've been taken to Madagascar where the Madagascans use them for making charcoal and they see it as very useful. Whereas when I drove around there I saw all these weeds everywhere. If you go to parts of Spain you'll see eucalypts growing wild there.

ANDI HORVATH
Roger, let's look at the impact of weeds on agriculture. Obviously a lot of herbicides are being used to try and manage that. Is that unsustainable?

ROGER COUSENS
Most ecologists would say no; most agriculturalists would say look, they are very useful, they're part of our armoury and in fact, without herbicides we would not be able to produce the high yields that we currently do. Herbicides are based on fossil fuels and fossil fuels will eventually run out so we won't always have herbicides, and weeds are becoming resistant to herbicides. The attitude now amongst agriculturalists is very much one of let's come up with integrated packages where we don't just use herbicides, we use other things like cultivation and the timing of what crops we put in, using more competitive crops and so on, so that herbicides are just part of the system, but we've known that for 20, 30 years now and still farmers are driven by profit.

The impact of having herbicides on their ability to go on holiday; they don't have to sit on a tractor all the time ploughing because these herbicides are making their life easier; they don't have to employ as many people. There are all these impacts on the farmers that affect the way they run the system. But most agriculturalists would not argue that everyone has to go over to being organic and having a completely

herbicide-free system, because with current demand for grain we just wouldn't be able to support the population of the planet.

ANDI HORVATH
How do governments step into the definition of weeds? Do some weeds have must eradicate, are others sort of tolerated within regions? Can you give us a little bit of insight into the politics of weeds?

ROGER COUSENS
Once a weed has become widespread governments largely treat that as being a private [could]. It's really up to the landholder to manage them. For species that are just coming in, invasive species which we've decided will have high impacts, then the Federal Government and the state governments decide on species that they want to keep out, or once something gets in they decide whether they want to eradicate it or not. Then we have the quarantine system and in fact, the Australian quarantine system has been applied all around the world, in the US, in Pacific Islands. They've found that our system works very well.

ANDI HORVATH
You're talking about our biosecurity system.

ROGER COUSENS
Yes.

ANDI HORVATH
Roger, have we actually won the war on any of our weeds here in Australia or have we had to concede defeat?

ROGER COUSENS
Oh, we've certainly won the war on a number of species. Prickly pear, opuntia, was driving people off the land it was so abundant throughout much of New South Wales and Queensland. And we introduced a biological control agent and that really has successfully reduced the abundance. You'll still see the odd prickly pear plant around but really nothing like it was.

ANDI HORVATH
What was the biological control agent?

ROGER COUSENS
It was a moth, cactoblastis, from Central and South America. Eradication rarely succeeds unless you find something really early. Once it gets to be more than a hectare in area or something like that it becomes almost impossible. Our state and Federal governments have had attempts to eradicate things, spent a lot of money and most of them haven?t succeeded, but some have. For example, a species that North Americans call kocha - we call it kocha [pronounced differently], that was introduced into Western Australia by farmers. They did absolutely nothing wrong according to the law. They brought it in and immediately someone said hey, that's

actually one of the biggest weeds in North America. Immediately both the farmers and the government authorities went in and they knew exactly where it had been planted and they succeeded in eradicating it.

ANDI HORVATH
The scenario with the prickly pear and the moth, did the moth eventually become a pest or did it just disappear with the prickly pear?

ROGER COUSENS
It just disappeared - well, it's still out there, as is prickly pear. What happens is that we choose a pest from its home range that is specific to that weed so that when you bring it in to the country that's being invaded it's only got one thing it can eat so we don't have that problem of going off and eating native species. But it's potentially a real problem. It's happened in animals with cane toads in Australia.

ANDI HORVATH
It's like the woman who swallowed the fly and then used the spider and the whole scenario.

ROGER COUSENS
Yeah, but in this case if you are careful about what you do, if you have lots of testing of the species before they even get imported into a country and you follow all the right protocols, then it shouldn?t happen, but many people think that it will, it's too risky. So again we come down to social decisions about what is worth taking the risk.

ANDI HORVATH
So Roger, have we had to concede defeat on some other weeds, and can you give us some examples? I imagine we've conceded defeat because the resources weren't there and plus it had gone too far?

ROGER COUSENS
Oh yeah. The issue now though is having failed on eradicating some recent invasions - there was one called branched broomrape, which is a parasitic plant and another one which we call Siam weed, Chromolaena, which we spent a large amount of money on and a couple of years ago we had to decide we could no longer try and eradicate them and so they just became a management issue. But that's life; you don't win every battle.

ANDI HORVATH
Roger, I'm going to put it to you: what would happen if we just let the weeds grow unabated, that we just all just gave up and said right, let nature take its course?

ROGER COUSENS
This has been a real political hot potato in recent times. What would happen is that you would have fewer of your native species, your landscape would change. Whether or not it would be unacceptable again depends on the eye of the beholder. Many people who like their bushland would not like to see lots of invasive species,

even if their own species are still there hiding. If you really think Australia or South Africa or North America has special communities of plants and animals then my feeling is that you should try and protect them rather than risk them becoming extinct or even just their character changing. I wouldn't like to be in the Everglades looking at all the wonderful bird life surrounded by eucalypts and other invasive species.

ANDI HORVATH
I'm Andi Horvath and you're listening to Up Close. In this episode we're talking about weeds and exploring how to manage them with Roger Cousens, a plant population ecologist, and he's also an expert in coastal communities. Roger, why are coastal regions important when it comes to weeds?

ROGER COUSENS
They're probably important because no one takes any action for most of them. We brought in many of the problem species themselves. Marram grass from Europe, deliberately planted it to stop sand dunes from blowing away. The same thing happened on the west coast of North America. These things are occupying the habitat of just about all our marine birds. They may spend most of their time out to sea but they nest on land and it's usually very close to the sea. We have enormous numbers of birds that are perhaps found nowhere else. They are not only being invaded by weeds, they're being tested by tourists, human development, towns, caravan parks all coming up and they're really under threat. Weeds are probably equally as serious as some of those other factors.

One of our weeds that most people in southern Australia don't even know about is a thing called sea wheat-grass that comes from Europe. That is quite salt tolerant and it's invaded a zone where there are really only a handful of native species. It's become really abundant and not only does it possibly exclude other species but it just changes the shape of the toe of the dunes. Instead of being a nice sloping beach, it can be quite flat, like a pasture almost. It binds the sand together so well that when we have storms it washes away the sand but it can't wash away all the sand which is what would have happened in the past because of this invasive species binding it together. What you're left with after a storm is a little cliff that may be half a metre, a metre or more in height.

Okay, so what? Well, if you're a baby plover and you've just been down to the sea with your mum and dad to feed and you want to go back because the tide comes in, you want to go and hide, and hide from predators, you can't get up. If you can't fly you can't get up a slope like that. At Phillip Island, which is a major tourist attraction in Australia, which is where people come as dusk rolls in to see the little penguins, and a little penguin faced with a cliff like that just simply cannot jump up over the little cliff face. What the people at the nature park have to do is they have to get out there with pickaxes and chop away these sections of these cliff faces to make ramps that the penguins can walk up to get to their nests. The impacts of these species, once you start to look at them there are just so many impacts.

ANDI HORVATH

Let's talk about coastal weeds internationally. Are other countries other than Australia also facing these types of issues?

ROGER COUSENS
Oh yes. There are similar things in the west coast of North America with marram grass affecting the breeding areas of shore-nesting birds again. A really good example is cord grass, spartina. There are native species of cord grass on both North America and Europe. What's happened there is that a couple of species have hybridised then increased their chromosome numbers and become fertile again. Those species are just really creating havoc with salt marsh areas around the world, creating salt marshes where there was no salt marsh before. In the Wirral in England there is a small village where a local port was actually closed down because this thing built up the silt to such a level that they could no longer get ships in. The esplanade in that village, which is a roadway along the sea, you stand on the esplanade now and you can't actually see the sea. All you can see is this habitat which is nothing like it used to be. Most people are not happy. A lot of nesting birds are not happy. That same species is infesting Australian rivers. Rivers in Tasmania, instead of being a nice wide river are a narrow channel just surrounded by acres of this mud which has built up around the cord grass.

ANDI HORVATH
Roger, then what are the research frontiers for plant population ecologists and others when it comes to weeds?

ROGER COUSENS
We always claim when we're applying for research grants that we need research on the species because if you understand them then you can better manage them, better control them, but there are very few examples where that has actually been the case. It's usually the land managers such as farmers who come up with the innovations that help us to manage things. The place of science in the system I believe is as much as anything to give proof of concept and to justify what people are saying. Okay, here is a new wonderful way of killing weeds, scientists can go in and test it. One thing is to work out does it actually have any effect but the other one is to understand why it's having an effect because it may not be as simple as we think. In fact, there may be longer-term negative impacts. I think really rather than expect population biologists, ecologists, scientists to come up with innovation, we're more there as the - policeman is probably not a good term - but the check and balance in the system.

ANDI HORVATH
Roger, I'm fascinated by the idea of weeds hybridising with each other and creating a whole new different life form. How common is that?

ROGER COUSENS
It's being recognised increasingly as being very common. Quite a few examples were described in North America where a non-native species hybridised with a native species and that has produced a new, hybrid entity which is now recognised as a

species in its own right. By hybridising they can produce new combinations of genes that each of the species couldn't before and then that becomes much more successful, but that's not always the case. I think people now are looking at hybrids and saying hey, look, lots of our problems are due to hybridisation. They're not. Most are just species where perhaps there have been no modifications the species was able to get in itself or you've actually had hybridisation between different populations of weeds from other countries.

You can take a species that is adapted to one habitat in its native range and another part of that native range where it's adapted slightly differently, you put them into a new country and let them hybridise and away they can go. It's not just hybridisation between species, it's actually within species as well. We have two species in Australia of sea rockets, the same two species have invaded the west coast of North America, they've invaded New Zealand. Each of them has invaded a number of different islands as well. These species aren't really of any concern to humans but what we're finding in Australia is that where they come into contact the two species are hybridising and we think the hybridisation may actually be allowing one of the species to be more able to invade.

ANDI HORVATH
Roger, how quickly do weeds adapt and become resistant to, say, herbicides? Therefore how often does the farmer need to renew their strategy?

ROGER COUSENS
As with all things in science, it depends. The very first cases of resistance were only found after 20 or 30 years of repeatedly applying the same herbicide, but with other cases in more recent years where species have become resistant in only five years or so, we now understand perhaps the reasons for those, but certainly it can be very rapid. If you look at the data from around the world the number of herbicides and weed combinations that are resistant is huge. What happens is that if a farmer uses the same thing over and over again, well obviously you're going to be selecting for those genetic types that are resistant.

We find that species become resistant to a herbicide that they've been facing, but also they've become resistant to other types of chemical which have a slightly different chemistry and they might be affecting the plants in a different way, a different - what we call a mode of action, or they could just be a similar mode of action but sold by a different company. So now what we do is we have a lettering system that is on the products when they buy it and the letter tells them about the mode of action of the active ingredient. The message that we're putting out to them is to chop and change the herbicide mode of actions by using a product with a different letter as often as possible, because if you keep the weeds guessing that will delay resistance.

ANDI HORVATH
Roger, global warming is charging ahead. How will the weeds fare in this new sort of climate?

ROGER COUSENS
I don't think the weeds will actually fare any different than other species. Species have their environmental conditions which they can tolerate and if you change the climate in one place you'll be changing it in another. The weeds, just like the native species, could spread to somewhere else. Rather than have more weed problems in a given area you'll just have different weed problems. If we have a dry climate then we will have perhaps more Mediterranean species; if we have a wetter climate we'll have more temperate species. I have seen it said that under climate change we'll have worse weed problems. I really don't see the justification for that.

ANDI HORVATH
Roger Cousens, thanks for being our guest on Up Close.

ROGER COUSENS
You're welcome.

ANDI HORVATH
We've been speaking about the complex dynamics of weeds with plant population ecologist Professor Roger Cousens. You'll find a full transcript and more info on this and all our episodes on the Up Close website. Up Close is a production of the University of Melbourne, Australia. This episode was recorded on 8 September 2015. Producer was Eric van Bemmel, audio engineering by Gavin Nebauer. Up Close was created by Eric van Bemmel and Kelvin Param. I'm Andi Horvath. Cheers.
