Science AMA Series: I'm Helen Roy, a Professor in Ecology at the NERC Centre for Ecology and Hydrology. I do research on invasive non-native species and their effects on biodiversity. AMA!

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Abstract

Hi Reddit! As we travel around the world and our economies become more globalised, plant and animal species are declining and in some cases disappearing due to the arrival of invasive non-native species. Invasive Non-native species are a huge cost to the global economy and pose a serious threat to the environment. My research focuses on the effects of environmental change on insect populations and communities, especially invasive non-native species and their effect on biodiversity. I also lead the UK Ladybird Survey, a citizen science initiative that links into my research focusing on the invasive harlequin ladybird. I'm part of the Sense about Science Plant Science Panel, an online group of over 50 independent plant science researchers. You can ask them any questions to do with plants, food or the environment on Twitter (@senseaboutsci #plantsci) Facebook or via the website. Answers are sent back within a couple of days and posted online. The Panel has answered close to 400 questions over the last three years and it's a great way to cut through the noise around what can often be very polarised debates. I'll be back at noon EST to answer your questions, AMA!

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REDDIT

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HELEN_ROY R/SCIENCE

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Hi Professor Roy,

How do populations of an introduced insect like the Harlequin become so successful? Are they somehow better adapted to a foreign environment than the native equivalent, or do they claim a niche in the environment that was previously unoccupied?

Grain-Fed

Scientists are intrigued by just this question - why are some non-native species so successful? The harlequin ladybird provides an excellent example of a successful invader that has spread around the world. Native to Asia it was introduced into the US as a biological control agent of pest insects in 1916 but it was not until the 1980s that it began to spread into the wider countryside. At this time introductions were being made in a number of places throughout Europe. It has a number of so called invasive traits - rapid reproduction, highly opportunistic both in terms of where it will live and what it can eat, high resistance to attack from parasites and predators. We have been working on a citizen science project to track the harlequin ladybird and increase our understanding of the ecology of this new arrival - see - https://www.ceh.ac.uk/news-and-media/blogs/decade-recording-harlequin-ladybirds-uk

Do you have any specific advice for someone who would like to be a scientist?

A bit cliche maybe, but I really want to be a scientist.

kinataki

Science is amazing and being a scientist is so rewarding. A life time of exploring the natural world is an utter privilege. I followed a very conventional route - BSc, MSc, PhD and then into academia. I have enjoyed every moment. I think perhaps curiosity, enthusiasm and passion are the most important traits of a scientist. Sharing your excitement for a subject is a great privilege but also important for developing a career in science. So get involved, volunteer and share your ideas. Happy to take any follow on questions - some good advice here too - http://www.britishecologicalsociety.org/learning-and-resources/career-development/career-development-resources/

Thanks for the great work and the AMA!

In certain situations monitoring and inhibiting the movement of invasive species makes total sense to me, like when there is a negative ecological effect on local wildlife and/or agriculture (such as with the Cane Toad in Australia), however this ladybird one confuses me a little. Do the bigger, spottier ladybirds actually pose any negative effects besides replacing their own kind, or is it just the principle of "But those are OUR two-spot ladybirds! We must protect them!"

Oh plus the STD thing. Good old tabloid press.

HerbziKal

Harlequin ladybirds have been correlated with native ladybird species in the UK (and indeed other places) - see

https://www.ceh.ac.uk/press/invasive-alien-predator-causes-rapid-declines-european-ladybirds

The 2-spot ladybird has declined dramatically. From the perspective of controlling pest insects it might be that the harlequin is better than the 2-spot ladybird but each ladybird is likely to have its own specific role within the ecosystem and replacing one with another could affect the resilience of the system - we just don't know that magnitude of the effects of the harlequin ladybird on populations and communities yet...but we are working on it!

Besides future advances in human health and their intrinsic value, why is biodiversity important? Is the quality of biodiversity (a island with 10 endemic organisms vs an island with 10 invasive) more important than the quantity (10 organisms that fill 10 niches vs 20 niches)? This may be a little bit farther, but how do you think the thesis in the paper "Ecological responses to habitat fragmentation per se" by Fahrig published in annual reviews of ecology, evolution and systematics (2017) will effect how we go about trying to maximize biodiversity? How strong do you think it is in the Sloss debate? What are your suggestions for a potential grad student trying to join your lab or a lab like yours? What books/papers have most helped you in your career or changed your thinking the most? What should an American who wants to work in the EU/UK do in their graduate studies to make them more marketable for labs like yours? Lastly, this is more of a statement, congratulations on who you are and what you do. I know it seems mundane when you're surrounded by people who do as amazing work as you do, but you and your colleagues are doing great and important work. Keep it up.

nana_nana_batman

Thank you for your encouraging words. There are many reasons why halting biodiversity loss is important - the services that biodiversity provides to humans is immense and many frameworks are grappling with quantifying the value of nature - see http://valuing-nature.net/

My advice to a student wishing to pursue a career in ecology is get involved, share your ideas and passion, be open to new adventures and opportunities. Volunteering is a fantastic way of gaining experience while showing your commitment. Perhaps one of my favourite recent papers is:

http://www.cell.com/trends/ecology-evolution/abstract/S0169-5347(02)02495-3

I am fascinated by ecological network analysis and complexity and enjoyed this paper immensely:

http://science.sciencemag.org/content/335/6071/973

I'm a forager and wild edibles enthusiast, but I've always had doubts about "eat the weeds" as a method of invasive control, specifically around garlic mustard and japanese knotweed. What are your thoughts on that, compared to something like spraying for them?

PM_ME_YOUR_KOALAZ

There is lots of thoughts around controlling invasive non-native species through consumption. I think it is obviously important to be careful what you eat and also to ensure that consumption doesn't lead to additional spread - this is a concern with consumption of crayfish for example.

For a sense of scale approximately how long would it take for a native insect population to adapt/evolve to a new invasive specie? How long are we talking decades? Centuries? Millennia?

NegativeCubed

Each non-native species will interact with a range of other species - some will be fit in straight away - perhaps filling a "vacant niche" or remaining in low numbers. However, others will have drastic effects on the assemblage of species with which they find themselves interacting. It is very hard for scientists to predict the outcomes of these interactions but we are trying hard and we arre making progress using new techniques to thoroughly explore these novel ecological networks alongside evidence-based risk assessments. Some communities are more resilient than others. Some will shift to a new ecological state. Some of the new arrivals will be beneficial (perhaps enhancing control of some pest insects) but the detrimental effects of others will be seen as unacceptable.

Hi! Japanese knotweed is getting out of control here in the UK. Since there is no money to be made out of it, the research on how to eradicate/control it is quasi non existent. Gardeners and councils have been using glyphosate, but I don't want to go down that road. I have heard about an insect(thryp) that could help manage the spread. Any news on that? many thanks!

Skeggs

Japanese knotweed is a complicated problem! Not only is the taxonomy of this species tricky - there are various hybrids - but as you mention it can be problematic around buildings. The project you mentioned is an exciting development. Led by CABI it has involved the release of a tiny insect called a Psyllid at some experimental sites. Years and years of testing have been undertaken to check the safety of this approach - find out more here - http://www.cabi.org/projects/project/32999

I'm currently an Ecology undergraduate (2nd year out of 4) how much volunteering and low position jobs did you do to gain experience before getting a higher position job? I feel like all the exciting jobs always ask for at least a couple years experience! Thank you in advance!

indi1297

What an exciting degree to be studying! I have always been a keen natural historian and spent my teenage years volunteering for a local bat group. Volunteering is a fantastic way to get experience and show your commitment while really doing something beneficial. I still volunteer - now through leading a national survey on ladybirds www.ladybird-survey.org

Volunteering is fun, worthwhile and does look good on your CV. Good luck! It is such an exciting career to be aspiring towards!

Going to get a little specific here -

I manage a small game reserve in Southern Africa, we have many invasive plants, from poisonous Datura to cactus as well as invasive native species that have proliferated because of disturbance of the prior cattle grazing. Most interventions we consider seem to encourage the weeds, because interventions are by their very nature, just more disturbance. For instance, we were pulling out the young Datura by hand before it had time to grow seeds, but those areas were thicker with the weed after a few weeks, so we tried to mow the area and leave the ground undisturbed - that didn't help either. While the cactus species are anywhere/everywhere on the reserve - the Datura is very limited to the places where the cattle were corralled, so I feel like the problem is inherent in the soil (e.g. high nitrogen or other nutrients, as well as a substantial seed bank). Otherwise, after 40 years, the Datura should have spread from those limited areas?

I've really struggled to find specific resources to deal with the Datura issue - we are spreading cochineal to control the Prickly-pear cactus, and very happy with the progress. I thought maybe you could point me in the direction of better resources, general or specific things to try? We have time, and I'm willing to try several interventions in pilot study plots.

Are there any recommended interventions we should consider? How drastic should we consider? I've thought about large earth moving project, where the top layer in these areas is buried deep, or potentially grinding or cooking the soil in situ (inspiration from this Australian machine that was recently in the news).

Looking forward to hearing from you, keep up the important work.

cannibalismo

There is some fantastic research ongoing in South Africa on non-native species - see as example - http://academic.sun.ac.za/cib/

As you describe it is extremely difficult to manage some invasive non-native species once they arrive and that is why preventing their arrival in the first place is so important. However, once they arrive minimising spread through effective biosecurity is really important.

I would strongly recommend contacting scientists at the Centre for Invasion Biology.

As far as I understand, non-native plants are less likely to support as many insect species, e.g leaf-eating lepidoptera, due to specialized defense against poisons/tannins. On the other hand, they often have tons of flowers/nectar, which provides much more visible services to insects/ecosystems.

Is it possible to say whether leaves or nectar is more important to the overall insect biomass which then feeds birds etc?

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*(I am a landscape architect in Norway, and would love to use more native species, but have a hard time convincing colleagues to change their habits)

CarlSatan

That is an excellent question. It will depend on the species concerned but many of the herbivorous insects rely on the leaves, roots, stems or seeds of plants and certainly such insects, including moth and butterfly caterpillars, will form the biomass that feeds birds. Nectar is an important energy source for many insects particularly pollinating insects such as bees. Perhaps an aspect of the plant to consider is the flower structure - simple flowers are more easily accessed by pollinating insects for the nectar - see -

https://www.ceh.ac.uk/news-and-media/news/big-bumblebee-discovery-initial-citizen-science-project-results

First question: What is your opinion of initiatives to help honey bees throughseed giveaway campaigns like the one done by Kellogg's Cheerios? I hear that many of those seeds are quite invasive.

Second question: do you think it is possible to feed the human population without the current system of massive monoculture farms? I am concerned about the effect of monocultures have due to their need for pesticides

Kalzenith

There are so many native species of plant that can be used as a nectar source for pollinating insects - many of the seed mixes that are given away contain native species. However, it is important to remember that not all non-native species are problematic - indeed of the approximately 1600 non-native plants in the UK only 6% cause any problems.

Welcome,

Are you familiar with a program run by Ottawa County in West Michigan that uses a small herd of female goats to clear invasives like buckthorn, oriental bittersweet, and autumn olive in areas where the native plants have been overrun?

https://www.youtube.com/watch?v=_xEJiIp5kSw&t=2s

adenovato

I'm not but I will take a look - large herbivores have been used successfully in many conservation projects for example -

https://www.nationaltrust.org.uk/wicken-fen-nature-reserve/features/extensive-grazing-

I always hear about invasive species doing this or that bad thing to its new habitat and about the efforts to stop it. Are there any success stories about one being stopped in its tracks?

iReddit2000

The control of the ruddy duck in the UK has been successful. This non-native species poses a threat to white-headed duck because it hybridises with this species - see -

http://www.nonnativespecies.org/index.cfm?pageid=244

Management is expensive (and so prevention is the most effective way of reducing the threat posed by invasive non-native species) but it can be effective through early response. The Asian hornet was recorded in the UK in 2016 and it is thought that rapid response has eradicated this species from the UK.

What are some characteristics that most invasive species have?

JordanofFjorden

It is so hard to generalise but there has been lots of thinking around this topic. A study a few years ago highlighted the importance of so called "propagule pressure" for birds whereby the probability of bird establishment increases with the number of individuals released and the number of release events. However for plants if the species has a history of invasion elsewhere and reproduces vegetatively than it is likely to be invasive. Escape from predators and parasites has also been shown to be important in some cases. However, it is likely that traits of the habitat being invaded also have an effect - so disturbed habitats are considered to be more likely to be invaded than less disturbed habitats.

Hello! How exactly do invasive species effect the global economy? Is it just that we have to spend money to maintain wildlife diversity? Would you be able to provide any specific examples? Thank you

squidqid

Invasive non-native species can be directly and indirectly costly. So a direct cost might be damage to a building such as that caused by Japanese knotweed. An indirect cost might be the loss of income as a consequence of damage by an invasive non-native species to forestry. The report by Williams et al provides a good overview for Britain -

http://www.nonnativespecies.org/index.cfm?pageid=258

Certainly management (and subsequent habitat restoration) of invasive non-native species can be extremely costly. These calculations get very complex and can involve lots of assumptions but the above report outlines a number of examples -

So for Zebra mussel "...based on the prices of cleaning and painting per metre discussed above, the number and length of leisure vessels in British waters, and assuming that 80% of boat owners carry out the hull cleaning on an annual basis as recommended we estimated for the cost of fouling at £21,367,735. Using the distribution of population between the three countries the costs are estimated to be England £18,441,535, Wales £1,073,135 and Scotland £1,853,735."

Hi Professor Roy! I'm studying environmental science and in my ecology and sustainability classes, we've talked about this subject a lot. Have you found any invasive species that actually lead to an increase in biodiversity? If you have, how did the invasive species open the path for new species to thrive?

whywouldineedthis

In some species poor habitats non-native species can increase biodiversity but it is always dangerous to play such numbers games - because some habitats are characterised (and valued) because they are species poor. In some cases a non-native species will be problematic in one place but not others. Much of the research on non-native species focuses on the detrimental impacts but there are sometimes benefits - while risk assessments focus on the negative impacts people making decisions will consider the services and disservices provided by non-native species.

So I've learned from my studies that invasive species do one of 4 things:

1. Invade and establish without any negative impact on existing communities.
2. Invade and establish permenantly but in doing so cause extinctions of other species
3. Invade but fail to establish and so die out
4. Invade, establish and cause extinctions and then the invasive species itself dies out.

Which of these is most common and why?

hotpoodle

Often we don't know how many non-native species have arrived and failed to establish but we know of those that do establish only about 15% cause problems to biodiversity, society or the economy. We have been developing databases to try and unravel these patterns and you might be interested in some of these used within this paper (which highlights how the number of non-native species is accumulating globally and showing no signs of saturation):

http://www.nature.com/nature/journal/v543/n7643/full/543009e.html

What is a particular area in ecology that fascinates you, which you haven't had the chance to write about yet?

It_Is_Known

I am intrigued by ecological networks - I love the complexity of natural systems and thinking about all the possible interactions between species within a community...I am hoping over the next decade to develop my research (and write more) on ecological networks and get a better understanding about the resilience of natural systems.

I remember hearing (a few years ago now) about a group of researchers in Utah releasing genetically altered mosquitos into local populations with the hope that the altered genes would ultimately spread and kill the whole group over a few generations. Are mosquitos a special case, or would something similar work on other invasive insects?

Kira37

There are a number of examples of management using genetic techniques beyond mosquitoes. I heard a fascinating talk on this by Dan Simberloff - see -

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4447029/

in which Simberloff describes novel management methods such as "use of species-specific genetic and pheromonal methods."

I am in New Zealand and a keen hobby hot pepper (chili) grower. I read about Psyllid's being introduced by accident and 6 months latter they wiped out my chili plants almost entirely with Psyllid yellows.

Overtime will predators species likely have a population boom, combating these pests or is it more likely to require an evolutionary timescale correction?

photonrain

There are many reasons why some non-native insects become pest species and just as you suggest one reason can be that they escape their natural enemies. By moving into a new region some are considered to be in "enemy free space" - that is the native predators and parasites are not adapted to attack them. This can change very rapidly particularly with predatory or parasitic insects because some can have so many generations in a very short space of time. It will be interesting to watch your psyliids and see what happens!

Has the Brown Marmorated Stink Bug and any negative effects in the United States, other than being extremely annoying pests?

BuffaloSol

There is an excellent overview of the impacts here -

http://www.cabi.org/isc/datasheet/27377

Mainly crop damage (a huge range of crops are affected).

It can be depressing to see the vast extent of how much damage we humans have done to the environment, including the spread of invasive species. Do you ever feel hopeless when researching something that's so hard to combat like invasive species?

ajaxia

There is no doubt that humans are having a major impact on the environment. Non-native species are species that have been introduced to a new region by humans; invasive non-native species are the non-native species that cause some kind of problem. The number of non-native species arriving in new regions globally is increasing at an unprecedented rate. However, we can be hopeful - there are many recent advances in biosecurity, surveillance and risk assessments. We can all make a difference too by ensuring that through our behaviour we don't accidentally introduce problematic species - see - http://www.nonnativespecies.org/checkcleandry/

Why would it be a bad idea to infest drug-related crops with invasive species to shut them down? For example, Kudzu on Opium or marijuana fields (Specifically in enemy countries that are growing drugs to ship to other countries).

esquemo

There have been a number of cases where insects, and also plant diseases, have been introduced as biological control agents see -

http://www.cabi.org/projects/project/32944

With careful testing and thorough risk assessments this can be a way forward for controlling a variety of problematic plants.

Is everything in Hawaii considered an invasive species?

LV_Mises

Invasive non-native species are a major cause of biodiversity loss on Islands worldwide. There are still

native species on Hawaii but there are many non-native species - see - http://dlnr.hawaii.gov/hisc/info/

Do you know of anything on the horizon for control of the Quagga mussels in the Colorado River? The mussel problem has apparently gotten so bad that boaters are being taxed for the cost of dealing with them, since boats are one of the main ways they get carried from one waterway to another (and, of course, CA is always looking for excuses to extract more money out of taxpayers.) The mussels have so far not invaded the reservoirs of the California Aqueduct system bringing water from the Sacramento Delta, so they are being extra cautious to inspect all boats that people bring to those lakes.

DesertTripper

Quagga mussels are invasive non-native species in many places around the world. They are termed "ecosystem engineers" because of the dramatic impacts they can have on biodiversity and also the surrounding environment. Preventing their spread is important and following Check, Clean, Dry protocols before moving boats, angling equipment etc could make a difference. Dr David Aldridge at Cambridge University is working on management methods:

http://www.zoo.cam.ac.uk/departments/aquatic-ecology

How does someone who is interested in the field of invasive species management find work in it? Is it mostly just government jobs or is private industry working on invasives as well?

Bugle_photographer

There are many different routes whether it be developing management strategies through research through to implementing them on the ground through consultancy or NGOs. Private industry plays a part too in developing methods. Working at the science-policy interface is also an exciting way to get involved and make a difference.

Hello Professor,

Do you have any advice for someone that wants to be an ecologist? Specifically natural restoration. Anything I can focus on to make a bigger impact, or tips I might need in the future?

junkyardog77

It is a great career! See - http://www.britishecologicalsociety.org/learning-and-resources/career-development/career-development-resources/

I think getting involved through volunteering is a great way to have fun and there are many restoration projects which you could contribute towards. Communication is really important - share your ideas and show your passion.

Cockroaches, how important are they to the environment because i think we should carry out a mass extermination

Zelonius333

Every species plays a part in our rich ecosystems. Some cockroaches, mostly those that live closely alongside humans are often unpopular, but they are a diverse group of insects with some truly

exquisite native species such as those belonging to the genus Ectobius see - http://species.orthoptera.org.uk/species_dictyoptera.aspx?userid/[user:uid]