Using maths to save rare animals and plants from poachers

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Environmental scientists have developed a new, low-cost way to save rare animals and plants from poachers and plunderers – using maths.

In a new study, researchers from the ARC Centre of Excellence for Environmental Decisions (CEED), the Wildlife Conservation Society, Imperial College London and the Uganda Wildlife Authority are using a cunning mathematical model to outwit poachers in central Africa.

By studying the poachers' incursion patterns and prioritising patrols, the technology can improve protection of endangered animals and plants where they most need it, while minimising patrol and conservation costs, say Dr Richard Fuller and Dr James Watson of CEED and The University of Queensland (UQ).

"The great thing about this approach is that it can be applied anywhere in the world," says Dr Fuller. "For example we can use it to minimise disturbance of shorebirds in Queensland, or to tackle the weed invasion in Australia."

The problem of patrolling to protect endangered animals and plants is that budgets are usually tiny, Dr Fuller explains. "Patrol teams often consist of several rangers who have to cover a massive area.

"Our study in central Africa shows that patrols are usually carried out near patrol stations where rangers are based, and they aren't very effective at stopping illegal hunting beyond a few kilometres."

The scientists carried out the research in Africa's Greater Virunga Landscape – one of the most biodiverse places on Earth, with 13 protected areas covering 13,800 square kilometres. The team studied which areas had the most illegal poaching and logging, the impact on wildlife, and the cost of patrolling the threatened areas.

"We included all this information in a mathematical model that prioritises the location of patrols," Dr Watson says. "For example, since the poachers know well where the patrol bases are, patrollers should target more remote areas – a hotspot for illegal poachers – by extending their patrols."

"The study shows that this reduces the cost of meeting all conservation targets in the landscape by as much as 63 per cent. By providing a big picture view of the entire landscape, the model enables us to maximise conservation efforts on a limited budget."

Dr Fuller says that apart from deterring illegal poaching, the approach can also be used to prevent disturbance of threatened species by human activity, or to prevent major weed invasions.

Using migratory shorebirds in Queensland's Moreton Bay as an example, he explains that the State government can impose hefty fines on people whose pets and cars disturb the birds.

"They also set up patrols to enforce the rules, but it's exactly the same problem that we had in Africa – small budget, big area," Dr Fuller says. "The same goes for our growing weed problem – it's usually small teams of people trying to tackle the problem, but there are millions of hectares of Australia to be covered.

"With this model, we can now help rangers target their routes and provide the best protection for our native wildlife and plants, even when

they have a limited budget."

Dr Watson says using maths in this way is smart conservation: "It means we can protect and save more species for the same investment. The same thinking can be used to target pandemic issues like illegal hunting for the Chinese medicine trade, feral animal control, or insect and weed or disease invasions."

More information: Plumptre, A. J., Fuller, R. A., Rwetsiba, A., Wanyama, F., Kujirakwinja, D., Driciru, M., Nangendo, G., Watson, J. E. M., Possingham, H. P. (2014), "Efficiently targeting resources to deter illegal activities in protected areas." *Journal of Applied Ecology*. DOI: 10.1111/1365-2664.12227

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