by Dr. Arash Ghoddousi

Building Landscapes of Coexistence-Anthropogenic resistance helps determine where wildlife could safely move within a landscape

As human-dominated landscapes increasingly fragment wildlife habitats, conservation planning requires better understanding of the impact of humans on wildlife. A new concept called anthropogenic resistance has been developed to inform connectivity planning by estimating the impact of human behavior on wildlife movement.

Recently, a wolf was legally shot in France due to complaints about attacks on livestock. Stories of wildlife, especially large carnivores, coming into conflict with people are nothing new. However, the case of GW1554m, or "Billy" (the names researchers and the public gave to this wolf), is particularly interesting as, in the two years he was roaming around western Europe, a lot of data on his movements and behavior was collected. Researchers using DNA samples, a tracking collar, camera traps and sightings understood that GW1554m was born in Germany and travelled through the Netherlands, Belgium and Luxembourg, killing dozens of farm animals along the way.

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But even a car crash did not stop GW1554m, who was one of the pioneer wolves to appear after decades of extinction in western Europe. Finally, after attacking livestock one last time, GW1554m was no longer tolerated and was "removed" as a "problem animal" in France.

Ultimately, humans decide

Despite the millions of euros spent on conservation efforts such as establishing protected areas and building "green bridges" by the countries GW1554m roamed, conflict between humans and wildlife continues to be a major problem. To some people, the loss of one wolf may not seem to be a huge conservation tragedy, but it points towards a question that is becoming increasingly important in conservation planning: *Where is coexistence between humans and wildlife possible?*

A pack of wolves crossing a "green bridge" built to connect fragmented habitats of northern Germany. Conservation Biogeography, Humboldt-University Berlin photo

There is more and more news from around the world of wildlife reappearing in their former habitats or disappearing from where they used to live. This dynamic condition is mostly due to the impacts of humans on nature. In some places, the abandonment of farmlands as people move to the cities gives space for many species to rebound, and conservationists advocate plans for restoration and rewilding of these landscapes. In other parts of the world, humans are venturing into the last wilderness areas, driving wildlife to extinction by expanding road networks, urban areas and farmlands as well as by unsustainable use. In these areas, conservationists seek to protect the last natural landscapes.

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Pilgrims unaware of a tiger in Ranthambore National Park, India. Reverence for wildlife due to cultural and religious beliefs could reduce anthropogenic resistance and facilitate wildlife movements. Soumabrata Moulick photo

These contrasting trends challenge planning in significant ways; and identifying where wildlife can roam or not has become a topical issue. While mapping and protecting or restoring wildlife habitat is of primary importance, in practice humans could overrule these considerations. Despite the availability of suitable habitats, some species may not be tolerated by humans in certain areas.

For example, one wolf study in Switzerland found that when both suitable habitat and human acceptance are considered, only around 6% of the country has favorable conditions for the return of wolves, despite the availability of vast natural landscapes.

Alternatively, humans may desire the presence of some species and provide the conditions (e.g., through supplementary feeding) that allow them to roam even in suburban or agricultural landscapes. Therefore, conservation planning requires an even better understanding of the human dimension than before.

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Human-wildlife conflict is intense in many parts of the world, heightening anthropogenic resistance to wildlife and threatening livelihoods. In 2017, lions from Etosha National Park, in Namibia, killedl 19 goats in one night outside the park. Facebook photo

Wildlife benefit from the expansion of protected areas, which now cover 15% of the world's surface, and the corridors between these habitat patches allow wildlife movement. However, it appears that human behavior towards wildlife is an important element often missing from conservation planning. In other words, where do we like wildlife to roam—or not? This is, ultimately, a decisive element. As in the case of GW1554m, wildlife, especially megafauna (species larger than 40 kilograms, 90 pounds) often come into conflict with people due to depredation on livestock or crops or threats to human safety, triggering retaliatory or precautionary persecution of these species.

However, where conflict-mitigation measures (such as compensation schemes) are in place, people may tolerate the very same species. For example, in the Amboseli region of Tanzania and Kenya, participatory conflict mitigation schemes have resulted in a decline in poaching and reestablishment of a lion corridor between two protected areas after 20 years.

Anthropogenic resistance

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Using these observations and connecting them to some established ecological theories, recently a group of interdisciplinary researchers coined the term "anthropogenic resistance" for the impacts of human behaviors on wildlife movements. In a paper in the journal *One Earth*, the researchers argue that anthropogenic resistance is particularly important in connectivity planning—i.e., to facilitate wildlife movement so that genetic exchange between populations can be maintained.

As protected areas are often surrounded by human-dominated landscapes, the role of corridors is increasingly pivotal in allowing gene flow between different subpopulations of wildlife. However, these corridors often run close to humans, who may disrupt wildlife movements. Such an impact could result in wildlife avoiding certain areas due to the ecological phenomenon of "landscapes of fear."

This simply means that wildlife may have a difficult time near humans, as was shown for pumas who expended more energy to avoid humans than navigating through rugged terrain. When wildlife perceive corridors as landscapes of fear due to human presence, they may not use them; or, if they do, this may further heighten conflict with humans.

The concept of anthropogenic resistance builds upon previous efforts in identifying wildlife corridors using species movement behavior and landscape conditions. That is, by tracking the animals and combining the data with biophysical features (forest cover, terrain, highways) in statistical models to identify areas that could be wildlife corridors.

Based on the probability of a species using a landscape feature (e.g., a deer is more likely to use forest for movement than an urban area), different landscape "resistance" values could be developed to identify corridors most likely to be used. However, the impact of humans on wildlife is not always represented by the location of roads, towns or farmlands.

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Human behavior determines where wildlife may move and persist in a landscape, showing the importance of anthropogenic resistance. Biplab Hazra photo

There is a need to better incorporate human behaviours in connectivity planning through considering different interactions of humans with the target species. However, estimating anthropogenic resistance—estimating how and where human behaviours may impact wildlife movements—may not be a trivial task.

Three case studies, in Iran, India and the US, showcase different ways this concept could be materialized. In Washington State, it was shown that, despite vast opportunities for recolonization, negative attitudes towards wolves in some areas may challenge the return of wolves, which calls for conservation actions to reduce potential conflicts.

Another case study, originally published in *Landscape Ecology*, showed that, in the Alborz Mountains of Iran, ignoring the potential for human-leopard conflict could result in substantially overestimating the extent of the corridor between two protected areas. And finally, in the Kanha-Pench Corridor, in India, researchers used methods ranging from genetic sampling to survey questionnaires in a multi-species setting to identify a safe wildlife corridor.

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Advances in statistical modelling to predict and map conflict or poaching hotspots, as well as social-science methods such as surveys of people's attitudes towards wildlife, are avenues for estimating anthropogenic resistance and incorporating it into connectivity planning.

Contemporary approaches in conservation planning are geared towards ecological features and often leave out how people interact with wildlife. However, there are nuanced differences in how people perceive wildlife that could have important repercussions for human-wildlife coexistence. In Colorado, USA, a narrow vote led to the approval of wolf restoration. However, a closer look at the distribution of votes showed a major divide between urban and rural areas on this matter. Such stark differences in people's attitudes towards wildlife can impact conservation success. For conservation to be effective, concepts and approaches such as anthropogenic resistance are required to promote landscapes of coexistence in a changing world.

Dr. Arash Ghoddousi is a postdoctoral researcher at the Conservation Biogeography Lab of Humboldt-University Berlin. His research focuses on the effectiveness of protected areas, the development of monitoring tools and frameworks, and better understanding human-wildlife conflict and poaching.
Twitter: @ArashGhoddousi

The original paper, titled "Anthropogenic resistance: accounting for human behavior in wildlife connectivity planning," was published in One Earth *in February 2021.*

Banner image: An Asian elephant and her calf fleeing an angry mob near a village in India. Conflict between humans and wildlife is widespread around the world and has severe repercussions for both parties. Biplab Hazra photo

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