GIS-integrated agent-based simulations to model wolf reintroduction management scenarios in Ireland.

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Abstract

The conservation and management of large carnivores is a challenging task for researchers seeking to foster human-wildlife coexistence. Agent-based models (ABMs) allow researchers to design realistic simulations of their study system, including environmental, anthropogenic and ecological agents and their characteristics to examine interactions at landscape scales and investigate how interventions may alter potential outcomes. Including high-resolution Geographic Information Systems (GIS) data and real-world ecological data streams in ABMs represents an innovative approach for site-specific investigations into how best to manage the return of large carnivores. We used GIS-integrated ABMs to study the outcome of wolf reintroduction to Ireland's national parks with respect to wolf ecology and wolf-livestock interactions. We introduced management strategies and policy interventions to assess how wolf-livestock interactions could be influenced by wildlife managers and whether outcomes were site-specific. Our study found that wolves could persist past the initial introduction in each protected area regardless of which reintroduction strategy is utilised, however, human-wildlife conflict warning signs emerged. Wolves extensively disperse outside protected areas, den-sites are located close (c. 1.5km) to park boundaries and livestock-depredations do occur. Management and policy interventions significantly reduced the likelihood of human-wildlife conflict by reducing the number of livestock depredations and creating ecological buffers that reduce wolf-human interactions, however, the individual characteristics of the protected area determined the success of each management and policy intervention. This analysis reveals nuanced differences in the response of each study area to the same management and policy interventions, demonstrating that the outcome of management and policy interventions is highly dependent on specific ecological conditions captured in GIS data. This underscores the importance of integrating high-resolution GIS data into ecological ABMs and the power that such integration can bring to these models for delivering tailored recommendations to decision-makers enabling human-wildlife coexistence with large carnivores in complex landscapes.

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