

# Explaining the variation in the impacts caused by alien ungulates worldwide

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Impacts made by alien ungulates are known to have dramatic effects on native species in the introduced environment. However, because of inter and intraspecific variation, impacts are not consistent and are thus context dependent. A major gap in our knowledge is identifying the factors causing this variation. Through understanding the causes of context dependency, we can improve impact predictions for different invasion scenarios, and help prioritisation for management purposes.

In this study we aim to identify the conditions in which alien ungulates cause variation across different impacts. We investigated factors that could affect either the vulnerability of the environment or the potential for an alien species to cause impacts in the recipient environment. Factors included abiotic and biotic environmental characteristics, species' traits and impact mechanisms associated with alien ungulates. We assessed the impacts of alien ungulates worldwide using the Environmental Impact Classification of Alien Taxa (EICAT) framework, followed by multivariate analyses to test if we find higher impacts in

- (i) stressful environments characteristic of arid climates, open habitats and islands
- (ii) alien populations with high body mass, high habitat generality and grazing as the type of herbivory
- (iii) Through direct mechanisms such as herbivory, competition, predation and disease transmission.

Our results suggest that higher impacts of alien ungulates are associated in environments with high precipitation, shrublands, on islands, high body mass and through indirect mechanisms such as structural damage. We also propose that environmental variables and traits of alien ungulates not only cause variation of impact by affecting the susceptibility of the environment but also by favouring the potential for the alien to cause impacts.

Understanding the causes for variation of impacts caused by alien species will help prioritise species and environments for management purposes.

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