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Commentary

Species Distribution Models: exploring patterns and processes in mammal ecology

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Abstract

Modelling species distribution is one of the most widely used approaches used by modern ecologists to predict species occurrence as well as to explore the environmental variables that determine the presence of a species in an habitat.

Given the outstanding importance of mammals in the context of conservation or management actions, it is not surprising that an ever increasing number of mammalogists have successfully employed species distribution models over the last few years. As a scientific journal devoted to mammal natural history, Hystrix, the Italian Journal of Mammalogy is pleased to present a collection of articles forming a special issue that deals with such an important and timely matter.

Modelling species distribution is one of the most widespread approaches used by modern ecologists to detect which environmental variables influence current species occurrence, and may also be successfully applied to infer past or future distribution patterns. This method has a wide array of applications for ecological and conservation studies, making it possible to provide answers to many questions, the most basic of which is to identify areas where a given species is likely to occur. More sophisticated theoretical goals may also be tackled, from assessing the role of factors that shape biodiversity patterns in time and space to exploring niche segregation in sympatric species (Russo et al., 2014, 2015). Undoubtedly, what has made such techniques especially attractive is the relevance they have for conservation or management purposes, e.g. they may: help to focus survey work on areas where a target taxon is more probably present, making field operations more cost-effective (Rebelo and Jones, 2010); detect regions of high habitat suitability in need of protection, or those in need of appropriate restoration (Razgour et al., 2011); predict invasion patterns by alien species (Di Febbraro et al., 2016, this issue); inform managers about the best places to carry out reintroduction or restocking (Wilson et al., 2011); help carry out effective gap analysis (Bosso et al., 2013).

Given the outstanding importance of mammals as targets of conservation or management actions, it is not surprising that an ever increasing number of mammalogists have successfully employed species distribution models (SDM) over the last few years. As a scientific journal devoted to mammal natural history, Hystrix, the Italian Journal of Mammalogy is pleased to present a collection of articles forming a special issue that deals with such an important and timely matter.

The collection of papers provides a broad overview spanning across different subjects, time and spatial scales. A community-scale assessment is provided by Gomes Vale et al. (2016, this issue), who employed GIS and ecological niche analysis for a 22-species strong mammal assemblage in West Sahara-Sahel to identify the main areas of occurrence, explore biogeographic relationships, and detect species richness hotspots. A similar objective is pursued by Cooper-Bohannon et al. (2016, this issue), but their distributional analysis has concerned 58 bat species from South Africa, showing how species of high conservation value may occur in low-species richness areas, which should therefore not be neglected by conservationists. In another study, Razgour et al. (2016, this issue) offer a review of SDM studies on bats remarking that despite the increased popularity of this approach among bat specialists, there is still much space for enhancing scopes and applications by including factors such as dispersal, landscape connectivity and biotic interactions in bat models.

Other articles focus on single species of management importance and show how spatial and time scales influence model outputs with clear conservation implications. Puddu and Maiorano (2016, this issue) present a novel approach to map not only high suitability patches, but also the potential corridors connecting them for the mouflon (*Ovis aries*) in Sardinia, whereas Jones et al. (2016a, this issue) predictions on how different forest management options may affect survival of European red squirrels (*Sciurus vulgaris*) at two UK sites make it possible to identify felling and restocking adjustments that may lead to a dramatic survival increase.

One of the possibilities offered by SDM is to explore how interactions between factors may ultimately shape species distributions. An interesting example is given by Jones et al. (2016b, this issue), whose prediction of the potential distribution of African wild dogs *Lycaon pictus* under future climate and land use changes also incorporates the influence of its potential competitor, the leopard *Panthera pardus*. Time is certainly a crucial variable that may challenge model reliability, yet few studies have dealt with this important aspect, even since the start of the research with SDM. We present one exception by Areias-Guerreiro et al. (2016, this issue) who tested the current validity of past models of otter (*Lutra lutra*) distribution in Spain generated from 1998 records using a new dataset, coming up with the encouraging conclusion that otters expanded towards the predicted areas, thus remarking the usefulness of medium term models. Tackling the species scale from a differ-

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ent perspective, Di Marco et al. (2016, this issue) examine how to scale population persistence targets from populations up to species using the European ground squirrel (*Spermophilus citellus*) as a case-study.

Given the ever growing concern caused by biological invasions and the threat posed by alien squirrels, two papers refer to this topic. Di Febbraro et al. (2016, this issue) offer a global picture of predicted current and 2070 potential distributions of eight squirrel species, identifying current potential hotspots of invasion and assessing climate change influences by 2070, whereas White et al. (2016, this issue) model how squirrelpox may spread in the well known red and grey squirrel system. Their model includes a realistic representation of habitat in Southern Scotland and provides important management insights.

Overall, although this special issue has inevitably missed some aspects of the vast universe of applications of SDMs to mammal studies, it showcases an attractive selection of articles highlighting the latest trends in SDM research while also providing much needed cautionary notes on the use of this technique.

Overall, we are confident that our readers will enjoy the articles and that this special issue may boost further developments on this theme.

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