3 Ricciardi, A. and Simberloff, D. (2009) Assisted colonization is not a viable conservation strategy. *Trends Ecol. Evol.* 24, 248–253
4 Marris, E. (2011) The end of the wild. *Nature* 469, 150–152
5 Williamson, M. and Fitter, A. (1996) The varying success of invaders. *Ecology* 77, 1661–1666
6 McFadyen, R.E.C. (1998) Biological control of weeds. *Annu. Rev. Entomol.* 43, 369–393
7 Hoegh-Guldberg, O. *et al.* (2008) Response. *Science* 322, 1049–1050
8 Dawson, T.P. *et al.* (2011) Beyond predictions: biodiversity conservation in a changing climate. *Science* 332, 53–58
9 Kier, G. *et al.* (2009) A global assessment of endemism and species richness across island and mainland regions. *Proc. Natl. Acad. Sci. U.S.A.* 106, 9322–9327

0169-5347/$ – see front matter.
doi:10.1016/j.tree.2011.06.007 Trends in Ecology and Evolution, October 2011, Vol. 26, No. 10

Letters

Jurassic Park? No thanks

Montserrat Vilà[1] and Philip E. Hulme[2]

[1] Estación Biológica de Doñana (EBD-CSIC), Avda. Américo Vespucio s/n, Isla de la Cartuja, E-41092 Sevilla, Spain
[2] The Bio-Protection Research Centre, PO Box 84, Lincoln University, Canterbury, New Zealand

The conservation of endangered species is a major concern in the face of global change, yet *in situ* efforts to maintain threatened species are often unsuccessful because the historic environmental conditions that sustained populations of endangered species have since changed dramatically. Conservationists have long considered human-assisted colonization to more suitable environments as an alternative approach [1]. The option for assisted colonization has received renewed interest in the light of predicted impacts of climate change on endangered species [2]. Thomas [3] further develops this conservation option and provocatively suggests that the UK can represent an assisted regional colonization area (ARC) for imperiled Iberian species. Although general concerns regarding assisted colonization already exist [4], we use the specific example of the UK ARC to further illustrate the pitfalls of this approach.

First, climate change is not the main threat of most imperiled species and there are few examples of global species extinctions owing to climate change [5]. For example, the population decline of the Iberian lynx (*Lynx pardinus*) over the past 50 years is a result of human persecution, landscape fragmentation and disease, factors unrelated to climatic conditions [6]. The scarcity of extensive high-quality Mediterranean shrub vegetation is a primary reason for the ineffectiveness of conservation efforts in Spain. Rabbits, although a necessary condition for population persistence of lynx, are thus not sufficient to ensure lynx survival in the UK. Therefore, simply because areas of suitable climate are available, translocating species to these regions will not necessarily alleviate the risk of their extinction [7].

Second, human assisted colonization already has a long history through the deliberate and accidental introduction of alien species worldwide, and these events have themselves increased the pressure on endangered species, even if they have resulted in relatively few species extinctions [8]. The complex and interacting negative effects of introduced species on biodiversity, human health, cultural values and ecosystem services might only become evident decades after introduction [9]. Thus, even if few species extinctions, can be attributed to introduced species and introduced species might increase the regional pool of species, it is naïve to assume that introductions are risk free.

Third, especially when advocating the translocation of iconic top predators such as the lynx, proponents need to be acutely aware of the potential for human–wildlife conflicts. Translocations of once extant predators in the UK have all met with opposition from different sectors of British society, even to the extent of persecution following release [10]. These conflicts also occur for introduced plant species regardless of the fact that they have a narrow distribution in the native range and are widespread in the UK. Public perceptions regarding rhododendron (Rhododendron ponticum) in UK are unlikely to be different if it were native, because indigenous grass, shrub and tree species that also colonize British heathlands are managed just as vigorously [11] to prevent changes in heathland ecosystem function. Thus, the suggestion that the UK should become a European wildlife park, with scant appreciation of the cultural as well as scientific value of native biodiversity, will probably become mired in the politics of public opinion, and threats to undermine such initiatives.

In sum, we advocate an integrative approach to mitigate the impacts of global change on endangered species that focuses exclusively on neither climate nor iconic taxa. We have to recognize that assisted colonization might face insurmountable governance issues. By not engaging in wishful thinking about ARCs, scientists, stakeholders and politicians will realize that only with concerted investment in *in situ* initiatives of a sufficient scale will endangered species have a future.

Acknowledgements

MV acknowledges support of the Spanish Ministerio de Ciencia e Innovación projects: Consolider-Ingenio MONTES (CSD2008-00040) and RIXFUTUR (CGL2009-7515), and Junta de Andalucía Proyecto de Excelencia RNM-4031.

References

1 Griffith, B. *et al.* (1989) Translocation as a species conservation tool: status and strategy. *Science* 245, 477–480
2 Hoegh-Guldberg, O. *et al.* (2008) Assisted colonization and rapid climate change. *Science* 321, 345–346
3 Thomas, C.D. (2011) Translocation of species, climate change, and the end of trying to recreate past ecological communities. *Trends Ecol. Evol.* 26, 216–221

Corresponding author: Vilà, M. (montse.vila@ebd.csic.es).

4 Ricciardi, A. and Simberloff, D. (2009) Assisted colonization is not a viable conservation strategy. *Trends Ecol. Evol.* 24, 248–253
5 Parmesan, C. (2006) Ecological and evolutionary responses to recent climate change. *Annu. Rev. Ecol. Evol. Syst.* 37, 637–669
6 Ferreras, P. *et al.* (2010) Iberian lynx: the uncertain future of a critically endangered cat. In *Biology and Conservation of Wild Felids* (Macdonald, D.W. and Loveridge, J.A., eds), pp. 507–520, Oxford University Press
7 Ibáñez, I. *et al.* (2006) Predicting biodiversity change: outside the climate envelope, beyond the species–area curve. *Ecology* 87, 1896–1906
8 Gurevitch, J. and Padilla, D.K. (2004) Are invasive species a major cause of extinctions? *Trends Ecol. Evol.* 19, 470–474
9 Vilà, M. *et al.* (2010) How well do we understand the impacts of alien species on ecosystem services? A pan-European cross-taxa assessment. *Front. Ecol. Environ.* 8, 135–144
10 Heydon, M.J. *et al.* (2010) Wildlife conflict resolution: a review of problems, solutions and regulation in England. *Wildl. Res.* 37, 731–748
11 Gimmingham, C.H. (1992) *The Lowland Heathland Management Handbook*, English Nature

0169-5347/$ – see front matter
doi:10.1016/j.tree.2011.06.010 Trends in Ecology and Evolution, October 2011, Vol. 26, No. 10

Letters Response

Anthropocene Park? No alternative

Chris D. Thomas

Department of Biology, University of York, York, YO10 5YW, UK

Vilà and Hulme [1] and Webber *et al.* [2] raise several issues about translocation as a conservation strategy [3], in the context of climate change. Climate change is likely to be on a par with other threats, and possibly the greatest threat, during the 21st century [4–7], even if it was not the greatest cause of extinctions in the 19th and 20th centuries [1]. I agree that we need integrated approaches that consider the combined impacts of climate and other pressures [1], and that 'relatively' unmodified habitats should remain the key focus for biodiversity conservation [8,9]. These will remain key places for both *in situ* and *trans situ* conservation.

Vilà and Hulme's [1] 'Jurassic Park' title resonates with the core of my argument, that we cannot go backwards. Given that every habitat in the world is to some extent affected by human activities [3], we already inhabit an Anthropocene Park, within which every action we take or decide not to take (including the control of greenhouse gas emissions) has consequences. Vilà and Hulme [1] and Webber *et al.* [2] clearly think that translocation is generally an action that we should decide not to take; I have already laid out my arguments for the circumstances under which translocations might be used as a means of saving species from extinction [2]. Webber *et al.* [2] suggest that *ex situ* conservation would be better; but this is only realistic if we store most endangered species in seed banks and frozen zoos. Once frozen, how will future generations decide when and where to bring them back? How will they assess the risks in restoring them to ecosystems that no longer contain them, and where the environment has continued to change since the day of their incarceration? Restoring thousands of species after 200 or more years on ice does not seem realistic.

Vilà and Hulme and Webber *et al.* also suggest that society would be reluctant to undertake such initiatives, using terms such as 'environmental or social harm' [2] and 'scant appreciation of the cultural as well as scientific value of native biodiversity' [1]. An underlying sentiment is that change is equivalent to harm, and that active translocation of endangered species will be the main cause of change. It won't be. I agree that societal views will generate constraints, but opinions are liable to change. The recent re-establishment of beavers in Britain (and many other European countries) would have seemed completely out of the question only 40 years ago. Attitudes change in the fullness of time, and UK public opinion might well endorse other translocations that aim to help save species from extinction, promote wildlife tourism and 'put right' some of the damage caused by UK greenhouse gas emissions.

Vilà and Hulme [1] question the sense of concentrating on introducing top predators, and specifically on introducing the endangered Iberian lynx, *Lynx pardinus*, to Britain. I did not emphasise top carnivores any more than other types of species (plants and insects): I did not personally select the TREE journal cover to be an image of a lynx; I emphasised to the media (who emphasised lynx and Imperial eagle) that translocation programmes would predominantly involve non-pest plants, specialist insects and other invertebrates; and I did not choose to write a high proportion of my original article about the lynx (whereas Vilà and Hulme [1] did, in their reply). It is others who are putting the furry carnivore spin on this. And I disagree entirely with Webber *et al.* that translocation will only be an option for ecological generalists [2] – Iberian lynx are rabbit specialists, and narrow serpentine endemics that cannot cross non-serpentine soil types would be further prime candidates for translocation.

Note that the species listed in my Box 1 [3] are ones that 'could be considered for translocation', not a list of species that will necessarily be found suitable for translocation, once this consideration has taken place. Webber *et al.* [2] would argue that few combinations or species and recipient locations will be found compatible, after consideration. OK, but let that consideration take place. If, say, 10% of the species threatened with extinction by climate change could be saved by translocation, that might amount to saving more than 1% of the world's species. It is entirely possible that Iberian lynx might be considered unsuitable or unnecessary for translocation [1], although I do not personally think that this is an inevitable conclusion. Iberian lynx is an example of a species for which original endangerment

Corresponding author: Thomas, C.D. (Chris.Thomas@york.ac.uk).