Institution: Liverpool John Moores University (LJMU)		
Unit of Assessment: UOA 14 Geography and Environmental Studies		
Title of case study: Improving the outcomes of threatened species translocations		
Period when the underpinning research was undertaken: 2013 - present		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	**Role(s) (e.g. job title):**	**Period(s) employed by submitting HEI:**
Sarah E. Dalrymple David Bourke Christopher Williams	Senior Lecturer in Conservation Ecology Senior Lecturer in Conservation Ecology Senior Lecturer in Invertebrate Biology	May 2013 – present September 2014 – present January 2016 - present
Period when the claimed impact occurred: August 2013 - present		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact

Conservation translocations, or the movement of individual plants, fungi and animals for conservation benefit, are prone to failure. Climate-induced mechanisms of translocation failure and problems arising from release design have been investigated in research on conservation translocations of invertebrates, amphibians, reptiles and plants profiled in this ICS. The impact is evidenced in the production of the International Union for the Conservation of Nature (IUCN) Guidelines for Reintroductions and Other Conservation Translocations which has in turn informed international legislation and codes of best practice, been incorporated into specific reintroduction programmes, and influenced a change in the IUCN Red List category Extinct in the Wild.

2. Underpinning research

Sustained research on the effectiveness of conservation translocations to reverse declines of threatened species has contributed to three areas of impact-generation (detailed below). Conservation translocations include interventions such as reintroduction of threatened species to native habitat, and assisted colonisation, the translocation of threatened species to formerly unoccupied areas in order to escape widespread threats in their native range. The six references listed in section 3 were co-authored by SD in conjunction with LJMU colleagues (DB and CW) and students, and collaborators in France, Italy, Belgium, UK and USA representing universities, conservation organisations and botanic gardens.

a) Influencing international policy and legislation around conservation translocation

Conservation translocations often fail but the literature is biased towards mammals and birds. To address this, we conducted a meta-analysis of insect translocations identifying the number of released individuals as a significant explanator of success (UR1). We also demonstrated that weather and climate are cited as probable causes of failure but practitioners rarely assess climate suitability at the release site. We subsequently showed that in 102 translocations of threatened ectotherms (insects, amphibians and reptiles) failure was significantly more likely with lower climate suitability at the release site (UR2). In UR3, we provide a decision framework for assisted colonisation, a controversial intervention that is increasingly discussed as an alternative to reintroduction. This framework asks translocation practitioners to evaluate the potential for hybridisation, ensure ecological similarity between donor and release sites, and in doing so,

encourages a proportional approach to evaluating assisted colonisation as an option for threatened species.

Conservation interventions were tested and compared in UR4, a synthesis of a number of projects and studies incorporating ex situ and in situ management of a nationally scarce plant species *Melampyrum sylvaticum*. We identified that release sites should be carefully matched to those supporting donor populations, especially where populations were potentially isolated and genetically adapted to local conditions. We also found that short-range translocations to areas immediately neighbouring wild populations or at least, within geographical features such as watersheds, were much more successful than trying to reintroduce the species to sites using seed from distant donor populations.

b) informing the use of *ex situ* conservation for threatened plant species recovery

UR5 highlighted the advantages and constraints to using *ex situ* conservation methods i.e. botanic gardens and seed banks, for the protection of threatened plants. We highlighted the fact that only 0.09% of seed collections have been used in threatened species reintroductions. We also listed the potential limitations of both living collections in botanic gardens and seed banks, with the former being vulnerable to reduced genetic diversity with successive generations of plants, acclimation to horticultural conditions and genetic drift rendering species substantially genetically different to their wild counterparts and therefore unsuitable for reintroduction. We built on these themes in UR6, a short communication that focussed on problems with classifying species as Extinct in the IUCN Red List despite being conserved in seed banks. Until we published this paper, there had been no recognition of *ex situ* seed banks in the Red Listing protocols, despite the many advantages of seed storage over maintain living plants in gardens. We recommended that the Red List Guidelines were changed to reflect this.

c) providing guidance and training to conservation translocation practitioners

All of the research findings described above have been published with the intention of improving conservation translocation practice. The translation into policy and practice is described in more detail in section 4.

3. References to the research

All underpinning research has undergone rigorous peer-review via anonymous review, or in the case of UR4, by the editors of the compiled volume.

UR1: Bellis J, Bourke D, Williams C, **Dalrymple S**. 2019. Identifying factors associated with the success and failure of terrestrial insect translocations. *Biological Conservation*. 236:29–36. doi:10.1016/j.biocon. 2019.05.008.

UR2: Bellis J, Bourke D, Maschinski J, Heineman K, **Dalrymple S**. 2020. Climate suitability as a predictor of conservation translocation failure. *Conservation Biology*. cobi.13518. doi:10.1111/cobi.13518.

UR3: Abeli T, **Dalrymple SE**, Mondoni A., Orsenigo S, Rossi G. 2014. Integrating a biogeographical approach into assisted colonization activities is urgently needed. *Plant Biosystems*. 148(6):1355–1357. doi:10.1080/11263504.2014.980362.

UR4: **Dalrymple SE**, Crichton RJ, Scobie AR. 2015. Small cow-wheat. Version 1.0. In: Gaywood MJ, Boon P, Thompson DBA, Strachan IM, editors. The Species Action Framework

Handbook. Battleby, Perth: Scottish Natural Heritage. ISBN 978-1-78391-478-4. Available at: https://www.nature.scot/species-action-framework-handbook

UR5: Abeli T, **Dalrymple S**, Godefroid S, Mondoni A, Müller J V, Rossi G, Orsenigo S. 2020. Ex situ collections and their potential for the restoration of extinct plants. *Conservation Biology*. 34(2):303–313. doi:10.1111/cobi.13391.

UR6: **Dalrymple SE**, Abeli T. 2019. Ex situ seed banks and the IUCN Red List. *Nature Plants*. 5:122–123. doi:10.1038/s41477-019-0366-3.

4. Details of the impact

To translate research findings into improvements in practice, we have engaged with the community of conservation professionals undertaking species translocations via policy mechanisms, best practice documents, training courses, and membership of steering groups.

a) Influencing international policy and legislation around conservation translocation

There is a growing awareness of the impacts of global environmental change, not just on threatened species, but also on the way we attempt to conserve them. The recent proliferation of conservation translocation policies and legislation is in part, response to the increasing threat of climate change and consequent shortcomings in conventional conservation measures. Measures such as translocation typically assume that species could be restored to former habitat, but the findings of our work suggest otherwise and our recommendations are an important contribution to global policy as follows.

The International Union for the Conservation of Nature (IUCN) revised its guidance for conservation translocations and the Task Force undertaking the revision included SD as an expert on plant conservation (membership May 2010 - March 2014). The resultant IUCN Guidelines (source A) directly incorporated UR4 recommendations pertaining to release site selection (Annexe 7, point 5), demographic monitoring (Annex 8, section 8.2) and monitoring for adaptive management (Annex 8, section 8.3, point 4). The IUCN Guidelines also includes the recognition that climate change will impact upon current practice (p.1) and this is underpinned by work culminating in UR1. The global reach and impact of the IUCN Guidelines is evident in large numbers of citations in conservation reports (e.g., 125 case studies reported since publication; source B: Resources), many adaptations for specific taxa or regions, and incorporation into law in Canada and Europe in 2015 (source B: Policy) and Costa Rica (source C) in 2017. The World Association of Zoos and Aquariums and the British and Irish equivalent have also issued directives that members must utilise the IUCN Guidelines (source B: Policy).

In 2018, the UK Government issued their 25 Year Environment Plan (source D) which pledged to utilise the IUCN Guidelines as a basis for future restoration of species. However, the Scottish Government pre-empted this and developed their own guidance which SD was asked to co-author. The result was the Scottish Code for Conservation Translocations and accompanying Best Practice guidance (2014; source E) which included advice on working with locally adapted species to ensure that release sites are ecologically similar to those from where donor individuals were collected (UR4; source E, Appendix 2); the recommendation that the potential for hybridisation or genetic introgression was investigated and avoided (UR3; source E, p 32 & 37); and the observation that “recent occurrence of a species… should not be taken as an indicator of habitat suitability” (UR1: source E, p34). The Scottish Code is recognised to be the first of its kind in terms of a guidance document that was produced with input from a wide range of land management and

conservation organisations, and received 'highly commended' in the Nature of Scotland awards 2016 (source F).

b) Informing the use of *ex situ* conservation for threatened plant species recovery

Many translocations work with species which are too rare to be simply moved from a healthy wild population to a new site, and these require the involvement of *ex situ* conservation such as zoos, aquaria and botanic gardens. Research into *ex situ* facilities (UR6) led to the recommendation that the IUCN Red List definition of Extinct in the Wild is changed to more accurately reflect the involvement of seed banking facilities of which there are more than 370 globally. This was adopted by the Red List Committee of the IUCN in August 2019 (source G) and is currently being used by Botanic Gardens Conservation International to deliver more accurate extinction status of some of the world's most threatened plant species. The need to improve the *ex situ* conservation of plants (UR5) has been acknowledged by a group of plant conservation professionals across Europe (including SD) funded by the COST Action scheme ConservePlants and seed collection and storage protocols are currently being developed (source H).

c) Providing guidance and training to conservation translocation practitioners

Translation of research into conservation translocation practice has been facilitated through the delivery of an ERASMUS-funded course by Prof Thomas Abeli and SD entitled 'Plant translocation: theory and practice'. This 4-day course, run in 2018 and 2019, took 12-15 students including practitioners and researchers from Lancashire Wildlife Trust, Natural England, Chester Zoo and the North West Rare Plants Initiative. Teaching materials directly cite the IUCN Guidelines, the Scottish Code and IUCN Red List, and have been developed into open-source content such as analytical code and training materials.

SD is an advisor to the Greater Manchester Wetlands reintroductions programme currently translocating 15 species of declining plants and insects to degraded peatbog habitat (source I). She is Chair of the 'Back on our Map' programme Steering Group, funded by the Heritage Lottery Fund and aiming to reintroduce 12 species into Cumbria.

5. Sources to corroborate the impact

A. IUCN (2013). IUCN Guidelines for reintroductions and other conservation translocations. Available in eight languages from https://portals.iucn.org/library/node/10386

B. IUCN Conservation Translocation Specialist Group website: https://iucn-ctsg.org/ See pages for Policy (https://iucn-ctsg.org/policy/) and case study reports in Resources > Books (https://iucn-ctsg.org/resources/ctsg-books/)

C. Costa Rican Ministry for the Environment and Energy, Executive Decree no 40548-MINAE on Wildlife Regulation, Page 30. Section IV. Article 62. Available at: http://www.sinac.go.cr/ES/normativa/Paginas/decretos.aspx

D. HM Government (2018). A Green Future: Our 25 Year Plan to Improve the Environment. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/693158/25-year-environment-plan.pdf

E. National Species Reintroduction Forum (2014). The Scottish Code for Conservation Translocations. Scottish Natural Heritage. Available at: https://www.nature.scot/scottish-code-conservation-translocations

F. Nature of Scotland Awards, 2016, see 'Innovation Award': https://www.rspb.org.uk/about-the-rspb/at-home-and-abroad/scotland/nature-of-scotland-awards/winners-and-finalists/2016/

G. Section 11.1 p 81 IUCN Standards and Petitions Committee. 2019. Guidelines for Using the IUCN Red List Categories and Criteria. Version 14. Prepared by the Standards and Petitions Committee. Downloadable from http://www.iucnredlist.org/documents/RedListGuidelines.pdf.

H. European Co-operation in Science & Technology (COST) Action ConservePlants, Working Group 2: Sharing experience in plant ex situ conservation, website: https://conserveplants.eu/en/working-groups/wg2

I. Summary of Lancashire Wildlife Trust's Greater Manchester Wetlands Species Reintroduction programme: https://www.lancswt.org.uk/species-reintroduction