

From strategy to action – the first steps in the ESCAPE project

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Abstract

The Finnish *ex-situ* conservation strategy for plants includes five targets: to (i) secure the extant collections; (ii) increase the number of conserved taxa; (iii) develop *ex-situ* conservation for northern species; (iv) incorporate *ex-situ* conservation into reintroduction programmes, and (v) increase the use of collections in education and public outreach. To achieve these targets a five-year EU Life+ funded project was launched in autumn 2012. Here we present the first steps of the project: establishing a national seed bank, ensuring the storage of micro-propagated tissues in a cryogenic unit, preparing assisted migration trials based on *ex-situ* material, and initializing *ex-situ* conservation of bryophytes.

Keywords

Assisted migration, botanic garden, conservation strategy, cryogenic storage, endangered taxa, *ex-situ* conservation, micro-propagation, seed bank

Introduction

Biodiversity loss has been recognized as a threat to human well-being (Cardinale et al. 2012) and several strategies and targets for limiting the losses have been agreed upon. However, the targets have not all been successfully fulfilled. In Europe, the conservation status of more than half of the habitats and species listed in the annexes of the EU Habitats directive is classified as unfavourable, and the EU Biodiversity Action Plan target of halting biodiversity loss by 2010 was never achieved. The Global Strategy for Plant Conservation (GSPC), including several outcome-oriented global targets for 2020, was approved in Nagoya in the Conference of the Parties (COP) to the Convention on Biological Diversity (see UNEP/CBD/COP/10/19). Target number 8 includes a commitment for the *ex-situ* conservation of threatened species: '75 per cent of threatened plant species in accessible *ex-situ* collections, preferably in the country of origin, and 20 per cent of them included in recovery and restoration programmes'.

A national *ex-situ* conservation strategy and action plan for Finnish plants (Hyvärinen et al. 2011) was produced in the EU project VACCIA (Vulnerability assessment of ecosystem services for climate change: impacts and adaptation) in November 2011. Subsequently, many elements in it were incorporated in the national strategy and action plan for conservation and sustainable use of biodiversity in Finland 2013–2020 (Heikkinen 2013) when it was renewed in order to take into account the accumulating evidence of rapid changes in climate and to extend the period to 2020.

The Finnish national *ex-situ* conservation strategy and action plan sets two general scheduled goals for *ex-situ* conservation: 'By 2016 40 % of threatened plant species (VU-CR) and by 2020 75% of them should be found in Finnish *ex-situ* collections. In practice this means the collection of 180 taxa on top of those already found in botanic gardens. Those taxa in *ex-situ* conservation will represent known accessions of native Finnish origin and they will be stored separately from any potential sources of cross-breeding (e.g. close relatives). Moreover, in order to conserve the genetic diversity of a species a sufficient number of its populations must be collected. Once a solid and sufficiently large collection is established, the material should preferably be used for re-introductions *in-situ* or for assisted migration (AM) programmes.'

The five main objectives of the strategy are to (i) secure the extant collections; (ii) increase the number of conserved taxa; (iii) develop *ex-situ* conservation for northern species; (iv) incorporate

ex-situ conservation into reintroduction programmes, and (v) increase the use of collections in education and public outreach. These objectives will be achieved by twelve concrete actions that are linked to relevant stakeholders who are responsible for implementing them.

Moreover, the strategy recommends several areas for future research: (i) Evaluation of the conservation status of cryptogamic taxa and assessment of feasible *ex-situ* methods for them, (ii) development of scientific criteria for the selection of plant taxa to be conserved *ex-situ*, (iii) development of scientific criteria for the selection of plant taxa to be considered for assisted migration, (iv) analysis of biological criteria together with socio-economic constraints and (v) development of potential new solutions for economically viable *ex-situ* conservation.

In order to turn this national *ex situ* strategy into action, a new Life+ Biodiversity funded initiative called ESCAPE (*Ex-Situ* Conservation of Finnish Native Plant Species) was launched in September 2012. The project is coordinated by the Finnish Museum of Natural History (University of Helsinki), which houses two botanic gardens (Kaisaniemi and Kumpula BGs). Other parties in the project are the Botanical Gardens of the University of Oulu, the Finnish Environment Institute, and the Natural Heritage Services of Metsähallitus.

The first objective of the project is to reach the *ex-situ* conservation level, indicated in the *ex situ* conservation strategy by the year 2016 (40% target), and to increase the number of endangered vascular plant taxa in *ex-situ* conservation to 118 (60% target) by the end of the project. The participating institutions will continue this work after the project and the level of 75% will be achieved by the end of the decade.

The second objective is to develop methods and new combinations of conservation means that can help increase the population size and the genetic diversity of threatened plant species in Finland. This entails encouraging a more extensive use of *ex-situ* methods in combination with *in-situ* conservation. Bryophytes that have largely been ignored in *ex-situ* conservation thus far are included in the development of new innovative methods of *ex-situ* conservation. Another methodological development scheme is micro-propagation and cryopreservation of plants, which will increase the possibility to achieve the above targets.

The third objective is to test the possibilities for using *ex-situ* conserved plant material in reintroduction and assisted migration programmes (AM, i.e. translocation to new sites that become favourable under climate change). In this project, both methods will be tested with three carefully selected species. This is particularly important for the future possibilities to achieve the second obligation of GSPC Target 8 (20% of endangered species in restoration programmes).

Methods

Seeds for long-term storage are collected and stored according to the protocols published by the European Native Seed Conservation network (ENSCONET 2009a & 2009b) with minor modifications. As there are several endangered taxa that either do not set seed at all, or often fail to produce living ones, some taxa are propagated vegetatively, either with traditional methods such as cuttings or in pure culture in the laboratory. This requires a thorough screening of suitable methods and often prior testing with closely related species.

Ex-situ propagation and storage methods have also been tested in practice on selected bryophytes, including some of the species that have previously been tested in the Micro-propagation Unit of Kew Gardens (e.g. Rowtree, 2006) and on some rich mire species such as *Meesia longisetata*, which is considered endangered in Finland because of habitat deterioration and climate change.

The actual micro-propagation and cryopreservation tests in ESCAPE take place in the BG of the University of Oulu, while the Helsinki BG is responsible for the conservation of seeds and scientific

advice in case of bryophytes. *Ex-situ* conservation in living collections takes place in both Gardens. A six-scale vitality index has been adopted to assess the condition of living collections.

Assisted migration (AM) and reintroduction are both tested using three different species. In order to assess the feasibility and the probability of success of AM, a set of AM criteria was formulated.

Results and discussion

The seed bank located in Kumpula BG, Helsinki, was started in summer 2013. During the first collecting period, seeds of 27 endangered taxa from 39 populations were collected and the seeds stored in the seed bank. Initial germination tests for most of them have been carried out. Also micro-propagation methods for three species have been developed and one species' seeds have been stored cryogenically.

The living collections of threatened native species in Oulu and Helsinki (Kumpula) BGs have already markedly increased. At the moment, the former harbours 24 threatened native taxa in 29 accessions, whereas the latter contains 16 taxa in 19 accession.

Reintroduction and assisted migration experiments have been designed and a set of criteria for AM has been published on the Project webpage (www.luomus.fi/escape). The Project has also published a priority list of focal taxa to be included in the *ex-situ* conservation scheme, seed collection instructions and a compilation of *ex-situ* conservation methods (the latter two in Finnish) on the website. AM and re-introduction experiments in natural sites will start in 2014.

Some AM experiments involving collaboration between Finnish, Norwegian and Estonian gardens with the threatened species *Primula nutans* ssp. *finmarchica* var. *jokelae* (Siberian primrose) are already taking place. These are managed by a multidisciplinary research project called CO-ADAPT (Constraints and Opportunities of Assisted Migration of Plants in Climate Change Adaptation – biological, legal and ethical analyses) funded by the Academy of Finland in 2013-2017 and based at the Finnish Museum of Natural History. ESCAPE collaborates with CO-ADAPT on the multitude of scientific, legal and ethical aspects and problems connected to AM. The objectives of the proposed research are to (i) develop biological theory for selecting plant species, populations, and sites suitable for AM; (ii) analyse current national, EU, and international regulations in relation to AM and offer recommendations; and (iii) set an ethically and conceptually viable framework for AM. The Project includes a number of researchers from the fields of biology, law and practical philosophy.

Given the initial success in the launch and establishment of ESCAPE, the first part of the GSPC Target 8 can hopefully be reached during the post-Project era by 2020. It is obvious that the first steps of ESCAPE have already significantly improved the *ex-situ* conservation status of native threatened plant taxa in Finland, as the situation a couple of years ago was far from satisfactory (see Miranto et al. 2012). Nevertheless, instead of concentrating on the percentage of threatened species in *ex-situ* conservation, it is very important to analyse how the most vulnerable and endangered taxa are to be conserved and what combination of methods should be used to obtain the best results. This requires careful consideration of the genetic representation in *ex-situ* accessions and also needs analyses of the risks of causing maladaptive microevolution in *ex-situ* conserved populations. These are challenges also for the future *ex-situ* conservation research projects.

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