INTRODUCTION

Ecological restoration is a global priority but is generally constrained by the lack of appropriate native plant material. In the United States, the National Seed Strategy for Rehabilitation and Restoration has been developed to address this issue. The strategy was developed by a partnership of 12 US federal agencies and over 300 non-federal cooperators within the US, and was launched in 2015. Implementation aims to ensure the availability of genetically appropriate native seed for ecological restoration across the country. The vision of the strategy is "The right seed in the right place at the right time," and the mission is "To ensure the availability of genetically appropriate seed for healthy and productive plant communities."

The restoration of degraded habitats in response to a range of human impacts is a requirement for various federal land management agencies in the US, and the use of native plant material is encouraged or mandated by national environmental policies. Currently the availability of native seed of a sufficient range of species and of appropriate genetic provenance for ecological restoration does not match the need locally, regionally or nationally. The increasing incidence and intensity of extreme weather events, including drought and related wild fires, hurricanes and flooding is increasing the need for restoration to build greater ecological resilience at landscape level. Securing native plant resources helps prepare and plan for future adverse weather events and allows options for adaptive land management in the face of a changing climate.

FEDERAL APPROACHES TO NATIVE SEED

Different US federal agencies have traditionally approached the supply of native seed in different ways. The National Park Service has, for example, concentrated on developing plants from material within national parks for local restoration purposes. The US Forest Service (USFS) has long recognised the need for collecting tree seed at the provenance level for good quality timber production. The USFS National Seed Laboratory has tested seed for forest restoration for over 50 years, initially working with conifers and now working with all native plant species. The USFS has committed, through the global Bonn Challenge, to the restoration of 15 million ha of degraded land by 2020. Working in partnership with a wide range of organisations, the various aims of this national commitment include the creation of more climate-resilient ecosystems, restoration of watersheds, increase in biodiversity and reduction of materials that fuel wild fires.

The Bureau of Land Management (BLM), which manages about 10% of the land in the US, has responsibility for restoring degraded forests, rangelands and wetlands. BLM has built up native seed stocks for ecological restoration through key partnerships within the federal, non-profit and private sectors. Regional initiatives supported by the BLM are described further below.

The BLM has worked closely with the USFS on seed issues since US Congress directed the two agencies to work jointly on restoration and rehabilitation following catastrophic wild fires in 1999 and 2000. The House Interior Appropriations Conference Report 106-914 called for the development of a stable and economical supply of native plant material for restoration and rehabilitation efforts on public lands. As a result, the Native Plant Materials Development Program and the Native Plant Restoration Program were established in 2001. These two initiatives have been very successful in boosting the supply of native plant material, particularly for use on the vast public lands in the western US. Despite their success, action needs to
be scaled up to address national ecological challenges and the shortage of native seed (Oldfield & Olwell 2015).

Collecting seed from the wild is generally the first requirement for developing native plant materials for restoration. The Seeds of Success (SOS) programme, managed by BLM, was established in 2001 to boost seed collection in support of the Native Plant Materials Development Program. The SOS National Collection now includes seed of over 6000 native plant species, approximately 33% of the US flora. The most commonly collected species are grasses important for range-land restoration, together with forbs of the Asteraceae family. Seed collected through the SOS programme is stored in a range of seed banks maintained by federal and nonfederal partners. All seed collections are divided into two samples: one for immediate use or short-term storage and one for long-term storage in the National Plant Germplasm System (Haedet & Olwell 2015). The National Plant Germplasm System is managed by the US Department of Agriculture (USDA) and operates as a partnership between the public and private sectors.

Seed collected from the wild can be stored in seed banks for long-term conservation or in seed warehouses for more immediate use in restoration. Some of the wild-collected seed is used to grow plants in nurseries of the various federal agencies and some is made available to develop native plants for commercial-scale production. The Native Plant Materials Development Program has made over 120 native plant species commercially available and developed germination and propagation protocols for additional native plant species. Whereas seed of the most common native grasses has long been grown in agricultural seed fields, production of native forb seed is a more recent priority, stimulated in part by concerns about the decline of pollinators. Targeted research is generally needed to develop appropriate cultural practices for individual native plant species.

REGIONAL INITIATIVES

Various regional initiatives are increasing the availability of native plant material in the US. BLM has ecoregional native plant material development programmes for the Colorado Plateau, Great Basin, Mojave Desert and Pacific Northwest. The Great Basin Native Plant Program, for example, is a collaborative research project initiated in 2001 by BLM and the USFS Rocky Mountain Research Station, as part of the response to the major wild fires. The programme now involves more than 30 federal, state and private cooperators. The goal of the programme is to increase seed availability and develop the ability to restore native plant communities across millions of acres of burned lands, with a focus on restoring native sagebrush habitat and increasing native forb production. The Great Basin has about half of the remaining sagebrush communities supporting the iconic greater sage-grouse and over 200 other species of conservation concern. Across the western US, more than 1.4 million acres of sage-grouse habitat burned in 2017. The Great Basin Native Plant Project has evaluated 225 native plant taxa from 92 genera including sagebrush (Artemisia). About 80% of these species are forbs. This represents about 15% of the regional flora (Dumroese et al. 2015). Over 30 plants are now in production for restoration purposes.

Following the same approach, the Colorado Plateau Native Plant Program was established by BLM in 2009. The Colorado Plateau covers a huge area of nearly 400,000 km² with much of the land in public ownership. It shares similar ecological issues and restoration needs with the Great Basin and, in addition, has greater reclamation needs following oil and gas extraction. The Colorado Plateau Native Plant Program aims to provide genetically appropriate native plant material that can be used to restore ecosystem function to degraded sites that can persist as diverse native plant communities. An initial first step was to assemble a list of 44 priority species with high potential for successful use in large-scale restoration (Wood et al. 2015).

Another initiative supported by the BLM is the development of plant materials for coastal ecosystem restoration following the devastating impact of Hurricane Sandy. BLM is working with Chicago Botanic Garden, Mid-Atlantic Regional Seed Bank, North Carolina Botanical Garden and New England Wild Flower Society to collect seed from the eastern seaboard to supply locally adapted plant material for coastal restoration projects. A list of over 40 essential foundation or ‘workhorse’ species has been developed to ensure priority plants are available for ecological restoration of coastal ecosystems. This will help build resilience and help buffer the impact of future coastal flooding. Additional species are necessary to ensure local variation at coastal sites. In 2015, seed collections were made for 211 species found in sub-tidal habitats, beaches and dunes, wetlands, coastal forests and inland rivers and streams. More species will be added to develop a long-term conservation resource in the form of banked seed available for future resource management and restoration.

COLLABORATIVE ACTION

Building on these and other initiatives to restore forests, prairies and other degraded ecosystems, undertaken by federal agencies and non-governmental organisations, the National Seed Strategy will help to bridge the gap between seed requirements and seed availability at a national scale. The four main goals of the strategy are: (i) identification of seed needs and availability of genetically appropriate seed; (ii) research to improve seed sourcing, seed production and ecosystem restoration; (iii) development of decision-support tools for ecological restoration; and (iv) communication and outreach. Implementation of the four goals is underway simultaneously with coordination among different organisations and across the four goals. The very important step of identifying seed needs and capacity was initiated through a scoping workshop undertaken by the National Academy of Sciences in February 2017. This work will highlight the sheer scale of native seed requirements but also the diversity of ongoing initiatives that support the strategy.

Ultimately success of the National Seed Strategy will be achieved through the establishment of nationwide networks of native seed collectors, farmers and growers working to develop seed, nurseries and seed storage facilities to supply adequate quantities of appropriate seed, and restoration ecologists who know how to put the right seed in the right place at the right time. Progress in achieving these ambitious aims is at least in part dependent on making a compelling case for the need for diverse native plant communities to ensure ecological resilience.

With the increasing occurrence of both anthropogenic and natural landscape-scale disturbances, native seed is increasingly
required in large quantities to build ecological resilience. Implementation of the strategy is crucial for federal, state and non-governmental agencies, together with the private sector, to be prepared to respond to impacts of extreme weather events. The strategy recognises the importance of healthy native plant communities as an essential foundation for ecosystem integrity and diversity, providing ecosystem services that sustain people, their communities and their economies.

The linkages between the National Seed Strategy and ecological resilience were discussed at the National Native Seed Conference held in Washington DC in February 2017, with case studies presented from around the US. One case study noted that the State of Colorado experienced record wild fires and floods in 2012 and 2013 that inflicted nearly US$5 billion in damage to housing, infrastructure and the environment. The state dedicated US$1.7 million to funding watershed master plans and supporting the formation of watershed coalitions as a critical first step in watershed recovery. At the same time, the state began development of an integrated resiliency roadmap to address social, environmental, economic and built environment considerations. The Colorado Resiliency Framework, adopted in 2015, represents a commitment to a more resilient future, through action and partnership. Initiatives to develop native plant material clearly fit within this framework, helping to achieve successful outcomes for native plant diversity at state level.

Communicating the fundamental importance of the National Seed Strategy remains important to help ensure effective implementation. Nationally, the practical challenges of collecting native seed and developing native plant materials for restoration remain considerable but achievable given sufficient resources. Havens et al. (2015) offers the following recommendations:

1. Prioritise action on essential or ‘workhorse’ species that define the landscape and act as framework elements of ecosystems. Develop regional lists of these species and bulk up large quantities of their seed with the source of the material identified.
2. Collect and bank genetically diverse seed sample of as many other native plant species as possible to provide a full complement of botanical diversity for restoration and an insurance policy against climate change.
3. Increase short-term (cool) and long-term (frozen) seed storage capacity for workhorse species and the additional range of native plants appropriate for different ecoregions.

FUTURE PROSPECTS

The United States has a diverse native flora with over 18,000 plant species. Ensuring ecological resilience requires effective use of the regenerative capacity of native seed. Seed as a natural resource has been undervalued in the past, but the National Seed Strategy provides the ambitious vision needed to address a major ecological challenge and an opportunity for diversification of rural livelihoods through growing more native species and restoring the land. The current needs and capacity assessment being undertaken to support the strategy will help to quantify the scale of the tasks and highlight the range of opportunities it provides.

REFERENCES


