

Proposal for the establishment of a Seed Conservation Specialist Group Under the IUCN Species Survival Commission

Introduction

The IUCN Species Survival Commission (SSC) is a global network of more than 9000 scientific experts, working together to achieve “A just world that values and conserves nature through positive action to reduce the loss of diversity of life on earth.” The SSC includes over 130 Specialist Groups, organized taxonomically, regionally, or by discipline. Currently there are no Specialist Groups focusing on seeds. Here, we propose to establish the IUCN SSC Seed Conservation Specialist Group (SCSG).

“Seed conservation” is here defined as banking seeds of wild species, with emphasis on those that are threatened (Red List categories CR, EN, VU) or near threatened (NT), primarily for *ex situ* germplasm storage, research, and future reintroduction. This proposal is put forth by experts including native seed bank managers, conservation program managers, national/international coordinators, and other seed specialists from around the world, who will ultimately form the constituent experts of the SCSG. The work we do reduces risks faced by species and ecosystems, and improves the status of biodiversity by safeguarding genetic diversity, species and ecosystems. The global seed conservation community will benefit from the proposed SCSG by expanding networks and providing a platform for sharing information and ideas, enabling all to be better conservation stewards.

Rationale

1) Why is this specialty area appropriate for the establishment of a new Specialist Group?

Habitat degradation and fragmentation of ecosystems is decreasing plant biodiversity. Restoration is often slow and requires a great deal of resources, including pre and post restoration scientific investigation, to be successful. Although environmental laws are strengthening, a large number of vulnerable areas are deleteriously impacted by human activities (e.g. mining, agriculture, invasive species introduction). Therefore, *in situ* conservation must be linked to *ex situ* conservation strategies to buy the time necessary for suitable habitat to be prepared and managed. The conservation of seeds is often the most cost-effective way to conserve plant species and genetic diversity.

Restoration and reintroduction programs are dependent upon high quality seeds. Options for the active return of plant species to degraded sites include direct seeding, planting of seedlings, and the spreading of appropriately managed topsoil containing seeds. Each of these methods can be used exclusively or in combination, but in all cases seeds are fundamental to generating the required plants. The Convention on Biological Diversity’s Global Strategy for Plant Conservation 2011-2020 Targets 4 and 8 pose ambitious global goals for restoring degraded habitat as a means of conserving species. To achieve these targets, the critical role of seeds in restoration and conservation must be globally recognized and facilitated.

The creation of a SCSG will provide: (1) a network for the interchange of experiences and knowledge-sharing in different ecosystems around the world, (2) the identification of regional and ecosystem gaps in *ex situ* seed conservation and aid in prioritization according to vulnerability, and (3) the creation of conservation and restoration policies according to the Convention on Biological Diversity.

The aim of seed conservation is to combat ongoing loss of plant diversity at both genetic and species levels. This can be supported by the *ex situ* conservation of wild species' seeds and making those seeds available for use in reintroduction and other restoration projects, particularly with threatened or near-threatened plant species. The creation of a SCSG will (a) promote seed conservation as a realistic and achievable objective that supports on the ground conservation, (b) promote coordination among partner organisations, (c) support and engage with the work of the Reintroduction Specialist Group, and (d) provide tools and information such as seed conservation guidelines, networking resources, and publications.

2) Is there a clear gap for the group to fill, and a value-added benefit that the formation of the group would deliver, rather than duplicate efforts of existing Specialist Groups, stand-alone RLAs, or IUCN partner institutions?

There is a definite need for the SCSG, which will provide leadership in seed conservation. It will learn the best practises for seed conservation from each other's experience and share them with the broader community to increase the quality of conservation work that we do. A great strength of the IUCN SSC groups is mutual cooperation and exchange of ideas that leads to conservation policy and action. A few plant conservation specialist groups have *ex situ* sub-groups within them. A less duplicitous model would be for one group to focus on seed conservation. This group will create technical guidelines for best practices in the field with the objective of increasing the quality of seed conservation, which will be shared amongst members of the group as well as with other SSC groups at the taxonomic and/or regional level.

The SCSG would fill a clear gap within the SSC. Currently the closest related Specialist Groups are the Conservation Breeding and the Reintroduction Specialist Groups (both focused solely on animals). The Seed Conservation Specialist Group will complement the Crop Wild Relative Specialist Group (CWRSG), which has expertise in conserving seeds of a small subset of our target area (i.e. all native seeds). While the CWRSG recognizes the importance of *ex situ* conservation, their current efforts have been focused on *in situ* conservation, so we would collaborate with them to help address *ex situ* needs for crop wild relatives, making full use of resources developed for the Crop Wild Relatives project (led by Royal Botanic Gardens Kew's Millennium Seed Bank Partnership and the Global Crop Diversity Trust). Likewise, we have reached out to the Conservation Genetics Specialist Group and they are happy to collaborate to expand their plant-related efforts. One of the deliverables envisioned for the new SCSG would be to produce IUCN Guidelines on seed conservation similar to these: <http://www.iucn.org/theme/species/publications/guidelines>. There is one guideline on *ex situ* management, but it only mentions seeds in one paragraph. The situation is the same in the guidelines for reintroductions, with seeds only briefly mentioned a few times. Creating these types of guidelines and then being available to provide input to IUCN on conservation assessments and strategies would fill a very clear gap. Plants are often underrepresented at various scales, so this is also an opportunity for this group to internationally represent plant conservation through seeds, across the relevant conservation sectors.

Additionally, the group would create an international directory of seed banks and individuals with seed conservation expertise, a resource that is currently not available. The goal would be to make it easy for all these individuals to connect with each other, regardless of the scale of their operation or career advancement and whether or not they are part of any formal partnership. Another goal is to begin ranking priorities of species not currently in *ex situ* seed collections, including those with "exceptional" seed storage behavior, to help guide future efforts on a worldwide scale.

Building on current activities, the SCSG will have a strong partnership and connection to Botanical Gardens Conservation International (BGCI) through its Global Seed Conservation Challenge network. This is an international network of botanic gardens conserving species through seed banking. The network proposed by this IUCN Specialist Group will however include partners outside the botanic garden community to find expertise within other sectors, including forestry, agriculture, and *in situ* conservation agencies. There are several national seed partnerships which use this framework, and the SCSG will reproduce this at the international level when it is established.

3) Will the activities of the group contribute to the relevant objectives of the draft IUCN Programme 2017-2020?

The group would specifically contribute to the Global Result 1 that seeks to reduce the risk of species and ecosystems, including sub-results 1.1, 1.2 and 1.3:

1.1. Credible and trusted knowledge for valuing and conserving biodiversity is in place leading to better policy and action on the ground: Seed bank databases are valuable resources for detecting vulnerable species and ecosystems through quantifying population characteristics such as low seed viability, low seed production, recruitment limitation in their natural habitats, levels of desiccation tolerance, and success of *ex situ* seed storage. For example, there are ecosystems that can be very vulnerable to climate change and anthropogenic activities but have species that are under-represented in *ex situ* seed banks. It is important to share experience and knowledge through groups that help to identify gaps and inform world policies based on the status of monitored ecosystems. For many species we may not even have this information at the species or population level. Through the SCSG, seed banks can be linked to generate greater knowledge to identify and solve conservation gaps such as these. It can in particular encourage improvements to seed banking processes in countries of Latin America, East Asia, and other areas that are identified as regions with high conservation needs.

1.2. Accelerated implementation and enforcement of improved policies for the valuation and conservation of biodiversity leading to action towards the achievement of biodiversity conservation: One of the most cost-effective ways to conserve biodiversity and genetic diversity are seed banks. The acceleration in degradation and fragmentation of ecosystems continues in many regions. The group will contribute to or propose policies related to *ex situ* seed conservation. BGCI is contributing efforts in this arena and is a valuable network, but we have to ensure that the information that is being generated can be useful for the elaboration and improvement of world policies. Seed banks should be recognized as an environmental necessity linked to the Convention on Biological Diversity (CBD) – Aichi Biodiversity targets, especially “improve[ing] the status of biodiversity by safeguarding ecosystems, species and genetic diversity”; as well as the CBD Global Strategy For Plant Conservation, Objective II: “Plant diversity is urgently and effectively conserved” - Target 4: “At least 15 per cent of each ecological region or vegetation type secured through effective management and/or restoration,” and Target 8: “At least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes.”

1.3. Improving the status of biodiversity by safeguarding ecosystems, species and genetic diversity: This sub-result is the aim most related to seed banking and seed conservation. Seed banking is an *ex situ* strategy precisely for safeguarding species and genetic diversity. Additionally, if seed banks are integrated with restoration projects, they can be a seed source for generating propagules, which is one of the limitations of restoration projects. The scale of seed supply for restoration is often overlooked. In many regions, large numbers of seeds are needed to address global restoration targets (thousands of tonnes or

more). In this context, *ex situ* seed banking also provides the opportunity to build sufficient seed resources (i.e. numbers) to provide for restoration. It allows one to capitalise on years when seed production is abundant, thereby smoothing seed supply in future years when seeds are less available (e.g. during drought). Genetic diversity is also safeguarded through the collection of seeds from different localities that may be separated by genetic barriers. In food species seed banking can target the conservation of new varieties, for example, varieties that are stress tolerant that can provide a seed source for adaptation and mitigation against changing climatic conditions (flooding, drought, high temperature).

Also, the group would contribute to Global Result 3: **Healthy and restored ecosystems make cost-effective contributions to meeting societal challenges of climate change, food security, and economic and social development.** Specifically sub-result 3.3: ***Degraded landscapes and seascapes are effectively and equitably restored to directly address major societal challenges including climate change, food security, and social and economic development:*** As mentioned in sub-result 1.3, the absence of propagules is one of the limitations facing restoration projects since the species of interest often disperse in short seasons and viability may depend on prevailing climatic conditions during fruit maturation and population status. Therefore, the existence of seed stocks with continuous propagation and research on best practices for survival, including seed germination requirements, substrates, containers, and effective seed broadcasting/direct seeding methods to enhance seed regeneration in the field, are vital for restoring degraded landscapes, which provide ecosystem services associated with climatic change. Seed banks are critical to the restoration of ecosystems, providing the information associated with seed germination requirements, survival, propagation, and other parameters required for restoration planning.

4) Is there a unique/core group of relevant experts willing to dedicate energy, time, and expertise towards undertaking the activities of the new Specialist Group?

Member	Institutional Affiliation	Title
Tesfaye Awas	Ethiopian Institute of Biodiversity	National coordinator Medicinal plant Unit
Chris Baraloto	National Tropical Botanical Garden	Director of International Center for Tropical Botany
Steven Blackwell	Desert Botanic Garden	Conservation Collections Manager
Ruth Bone	Kew Millennium Seed Bank Partnership	International Projects Officer (Pacific)
James Brazill-Boast	NSW Office of Environment and Heritage	Senior Project Officer for Ecosystems & Threatened Species
Elinor Breman	Kew Millennium Seed Bank Partnership	MSBP Administrator
Jie Cai	Kunming Institute of Botany	PhD Candidate
Angelino Carta	Università di Pisa	ENSCONET Steering Committee
Marian Chau	Lyon Arboretum - Hawaiian Rare Plant Program	Seed Conservation Laboratory Manager
Imad	Moulay Ismail University (Morocco)	Associate Professor in Ecology

Cherkaoui		
John Clark	Center for Plant Conservation	Director
Margaret Clark	National Tropical Botanical Garden	Science and Conservation Specialist
Anne Cochrane	Threatened Flora Seed Centre - Western Australia Dept of Parks & Wildlife	Senior Research Scientist
Susan Deans	National Tropical Botanical Garden	Intern
Maïté Delmas	Muséum National d'Histoire Naturelle	Directrice Relations Europées
Don Drake	University of Hawai'i at Mānoa, Department of Botany	Professor
Rob Fiegenger	Institute for Applied Ecology	Director, Native Seed Network
Candido Galvez	Semillas Silvestres	Technical Director
Uromi Manage Goodale	Guangxi University - College of Forestry	Associate Professor
Patrick Griffith	Montgomery Botanical Center	Executive Director
Ed Guerrant	Berry Seed Bank	Director
Megan Haidet	National Institute of Food and Agriculture	Program Specialist
Kayri Havens-Young	Chicago Botanic Garden	Senior Scientist
Abby Hird Meyer	Botanic Gardens Conservation International	Program Director - U. S.
Sean Hoban	Morton Arboretum	Researcher - Tree Conservation Biologist
Hosang Kang	Seoul National University	
Matt Keir	Laukahi Hawaii Plant Conservation Network	Coordinator
Michael Kiehn	University of Vienna	Director, Core Facility Botanical Garden, ENSCONET Steering Committee
Codi Kozacek	Circle of Blue	Reporter
Tim Kroessig	Lyon Arboretum - Hawaiian Rare Plant Program	Seed Conservation Laboratory Technician
Gary Krupnick	Smithsonian Institution	Head of Plant Conservation Unit
Penny Levin	E Kupaku Ka Aina	Conservation Planner
Manuel Lima Jr	Native Seed Center of Amazonas	Director
Pedro León Lobos	Instituto de Investigaciones Agropecuarias	Genetic Resources Analyst
Charlotte Lusty	Global Crop Diversity Trust	Genebank Programmes Coordinator

Hong Truong Luu	Vietnam Academy of Science and Technology	Vice Director, Southern Institute of Ecology
Gary Man	US Forest Service	Forest Health Protection
Kimberlie McCue	Desert Botanic Garden	Assistant Director, Research, Conservation, and Collections
David Merritt	Kings Park & Botanic Garden	Senior Research Scientist
Mari Miranto	University of Helsinki	ENSCONET Steering Committee
Thomas Mirenda	Smithsonian Gardens	Orchid Collection Specialist
Katherine O'Donnell	Botanic Gardens Conservation International	Seed Conservation Coordinator
Peggy Olwell	US Bureau of Land Management	National Plant Materials Program Lead
Mariana Pascual	University of British Columbia	
Laura Victoria Perez-Martinez	Jardín Botánico de Bogotá	Seed Bank Leader
Oliver Ryder	Zoological Society of San Diego	Director of Genetics
Casey Sclar	American Public Gardens Association	Executive Director
Julia September	South African National Biodiversity Institute	Project Coordinator for MSBP at Kirstenbosch
Paul Smith	Botanic Gardens Conservation International	Secretary General
Richard Sniezko	US Forest Service - Dorena Genetic Resource Center	Center Geneticist
Lucy Sutherland	Australian Seed Bank Partnership	Coordinator
Matt Taylor	Longwood Gardens	Horticultural Research
Christian Torres-Santana	Luis Muñoz Marín Foundation	Arboretum Doña Inés Park Director
Gemedo Daye Tussie	Ethiopian Institute of Biodiversity	Director General
Pati Vitt	Chicago Botanic Garden	Conservation Scientist
Seana Walsh	National Tropical Botanical Garden	Conservation Biologist
Christina Walters	USDA ARS National Center for Genetic Resources Preservation	Research Leader
Michael Way	Kew Millennium Seed Bank Partnership	Conservation Partnership Coordinator
Lauren Weisenberger	University of Hawaii, Pacific Cooperative Studies Unit	Rare Plant Program Manager
Dennis Whigham	Smithsonian Environmental Research Center/North American Orchid	Principal Investigator, Senior Scientist

	Conservation Center	
Dustin Wolkis	National Tropical Botanical Garden	Seed Bank Manager
Alvin Yoshinaga	University of Hawai'i, Center for Conservation Training and Research	Retired Seed Conservation Laboratory Manager

5) Is clear leadership available?

At the 2016 IUCN World Conservation Congress Knowledge Café on establishing this SCSG, the following constituents were nominated as Co-Chairs:

Dr. Marian Chau, Seed Conservation Laboratory Manager at Lyon Arboretum/University of Hawaii;

Marian earned her Ph.D in Botany at the University of Hawai'i at Mānoa (UHM) in 2012, after spending six years focusing on ecological and genetic research on conservation of endangered Hawaiian plants. She completed a year of postdoctoral research, then spent six months on the island of Moloka'i propagating native plants from seed and managing a restoration project. Marian has managed the Seed Conservation Laboratory at Lyon Arboretum for over three years, where she works in collaboration with various agencies to prevent extinction of Hawai'i's hundreds of rare plant taxa through adaptive *ex situ* conservation and propagation. She is invested in carrying forward over 20 years of intergenerational research on seed storage behavior, dormancy, and longevity, with particular interest in the unique occurrence of a high proportion of intermediate seeds in the Hawaiian flora. Marian is also a 10-year member of the SSC Hawaiian Plant Specialist Group, and is a trained Red List Assessor who contributed to successful efforts to assess over 200 Hawaiian plant taxa in the year preceding the 2016 World Conservation Congress.

The University of Hawai'i is the only university in the United States to support a tropical rainforest botanic garden. The 193-acre Harold L. Lyon Arboretum was established in 1918 as the Mānoa Arboretum, but was closed to the public. Since 1970, Lyon Arboretum has welcomed the public, offering a variety of public garden programs and services. It is located in upper Mānoa Valley and consists of unique managed collections of more than 5000 native and non-native plant species, and serves as a biological field research site for tropical botany and ecology. The mission of Lyon Arboretum is to increase the appreciation of the unique flora of Hawai'i and the tropics, by conserving, curating, and studying plants and their habitats; providing inclusive educational opportunities; encouraging use by the broader community; and supporting the educational, scientific, and service activities of the University of Hawai'i. The Lyon Arboretum Hawaiian Rare Plant Program (HRPP) was established in 1992 and utilizes seed banking, micropropagation, and greenhouse propagation as tools for plant germplasm conservation, and is the primary propagule repository for rare species from across the Hawaiian Islands. The HRPP seed bank and *in vitro* plant collections include 258 Red List assessed endemic Hawaiian taxa, most of which are Critically Endangered (CR). In the HRPP Seed Conservation Laboratory (SCL), over 16 million seeds are banked, representing more than 550 taxa (40%) of the native flora. Of these, over half are federally listed as endangered and/or ranked as threatened on the IUCN Red List. Prior to the establishment of the SCL in 1995, little was known about seed storage of native Hawaiian plant species. Two decades of ongoing research have informed the methods for seed conservation for the state. The SCL was a founding member of and serves as lead research institution for the Hawai'i Seed Bank Partnership, and collaborates with international partners

such as the USDA ARS National Laboratory for Genetic Resources Preservation, Kew Millennium Seed Bank Partnership, and BGCI.

Dustin Wolkis, Seed Bank and Laboratory Manager at National Tropical Botanical Garden;

After graduating from Arizona State University with a B.S. in Conservation Biology and Ecology, Dustin Wolkis joined the Research Conservation and Collections department at the Desert Botanical Garden (DBG) in Phoenix, Arizona. There he, among other tasks, coordinated DBGs efforts' in the United States National Native Seed Collection Program. While continuing his work at the DBG, Dustin simultaneously earned his M.S. in Plant Biology and Conservation at Arizona State University under the direction of Dr. Julie Stromberg. In 2016 Dustin relocated to the Hawaiian island of Kaua'i to manage the National Tropical Botanical Garden's Seed Bank and Laboratory. Dustin specializes in *ex situ* seed conservation biology with an emphasis on seed and pollen storage behavior, seed longevity and aging kinetics, seed pathogen abatement, and seed dormancy and dormancy alleviation of native Hawaiian plant species of conservation importance. His research aims to understand how seeds respond to desiccation and subfreezing temperatures, identifying regeneration intervals, and determining optimal seed propagation techniques.

Chartered by Congress in 1964, National Tropical Botanical Garden's (NTBG) defined mission is "to enrich life through discovery, scientific research, conservation, and education by perpetuating the survival of plants, ecosystems, and cultural knowledge of tropical regions." As a result of that mission, conservation is at the heart and core of NTBG's work. They believe the most effective long-term response to preserve endemic plant populations in Hawai'i and elsewhere is to protect their habitats and to manage threatened plants within those habitats. Their conservation activities extend beyond *in situ* habitat management to incorporate a coordinated strategy that integrates conservation with education, scientific research, curation of living collections, and propagation of at-risk plants *ex situ*. The extensive capabilities of the National Tropical Botanical Garden Seed Bank and Laboratory are designed to facilitate research in seed conservation. The Seed Bank and Laboratory provides laboratory space for studying seed and pollen storage behavior, seed germination ecology and dormancy, seed longevity, and other aspects of seed biology. In alignment with the Global Strategy for Plant Conservation, the Hawaii Strategy for Plant Conservation, and the National Seed Strategy the NTBG is investigating methods to preserve and protect Hawaiian species of conservation importance *ex situ* in the Seed Bank and Laboratory. Their emphasis is determining seed and pollen storage behavior, seed longevity and aging kinetics, seed pathogen abatement, and seed dormancy and dormancy alleviation of native Hawaiian plant species of conservation importance. Their research aims to understand how seeds respond to desiccation and subfreezing temperatures, identifying regeneration intervals, and determining optimal seed propagation techniques. NTBG's Seed Bank and Laboratory was a founding member for the Hawaii Seed Bank Partnership, and collaborates with international partners such as the USDA ARS National Laboratory for Genetic Resources Preservation, Kew Millennium Seed Bank Partnership, and BGCI.

Dr. Uromi Manage Goodale, Associate Professor at Guangxi University.

Dr. Uromi Manage Goodale is an American citizen currently living and working in Guangxi, P.R. China. Dr. Goodale has conducted extensive research on the germination and seedling regeneration of tropical and subtropical plants through her research career. She obtained her undergraduate degree from University of Colombo, Sri Lanka specializing in Botany and received a Master's in forest science in 2001 and Ph.D. focusing on tropical ecology and plant ecophysiology in 2009, both from Yale University, School of Forestry and Environmental Studies. After graduating from Yale, she received the National Institutes of Health, Institutional Research and Academic Career Development Award for researching

climate change effects on the regeneration dynamics of coastal sage and chaparral species in Mediterranean southern California. Her second postdoctoral appointment with the Chinese Academy of Sciences (CAS) brought her to Xishuangbanna Tropical Botanical Garden, where she focused on research on seed bio-physiology, germination and long term storage of tropical tree, shrub and epiphytic species. Currently she is an associate professor at Guangxi University, at the Guangxi Key Laboratory for Forest Ecology and Conservation. Her main research focus is seed bio-physiology and conservation. Dr. Goodale is the recipient of the American Association for the Advancement of Science and National Science Foundation, “Women in International Scientific Cooperation Award” in 2001 and the “Outstanding Individual Achievement Award for International Exchange and Academic Cooperation” award from Guangxi University in 2017. Dr. Goodale is also the Editor in Chief of the Journal of Sustainable Forestry. Her research profile can be found at: www.researchgate.net/profile/Uromi_Goodale/.

Guangxi University was established in Wu Zhou, Guangxi, P.R. China in 1928 and became a national university in 1939. By 1949, Guangxi University developed in to a comprehensive university with five colleges, culture and education, law and business, science, engineering, and agriculture. In 1997, Guangxi University merged with Guangxi Agricultural College and founded the current Guangxi University. At present the university constitutes of 31 colleges, with 98 undergraduate majors, 36 first-class master's degrees, 60 doctoral studies programs and 10 postdoctoral research flow stations. The university houses, one national key laboratory and one provincial department to build a national key laboratory cultivation base, and four key laboratories and one Engineering Research Centre of the Ministry of Education. Being located in the second most biodiverse province of China and with its strong focus on agriculture, the university hosts several seed conservation and bio-resource development programs that have resulted in new varieties of fruit and agricultural crops as well as a large agricultural and forestry landholdings that house an *in situ* collection of agricultural and forest tree plantation varieties and species. It is renowned scientific advancements in rice biotechnology and new variety development, water buffalo breeding and waste water recycling and management. The current student body exceeds 80,000 undergraduate students, 7735 graduate students and 2158 full time teaching faculty and over 3000 staff members. The university main campus is spread in 350 ha of land and operates on a 1.5 billion RMB teaching and research equipment annual budget. Guangxi University hosts the China-ASEAN Regional Development Synergy Innovation Center and as such uniquely situated to collaborate within the Asian region countries for the development and prioritization of seed conservation and research.

Each of the proposed Co-Chairs has multiple years of experience with seed conservation practice and/or research, and they have all accepted and agreed to serve through 2020 if this Specialist Group is confirmed and are supported by their institutions in this endeavour.

BGCI will provide the Secretariat and act as host institution to the SCSG. As the world's largest botanic network organisation, BGCI has the experience in providing the leadership to the plant conservation community. BGCI, having a good overview of the work currently ongoing in seed conservation in botanic gardens, would ensure that the SCSG builds on current activities that are already in place as well as determining innovative activities that can advance seed conservation. BGCI currently provides the Secretariat for the Global Tree Specialist Group and sits on the Plant Conservation Sub-Committee.