Asia Pacific Forest Genetic Resources Programme Workshop Report 2018

Enhancing Conservation and Sustainable Use of Endangered Tree Species: Review of Available Information and Setting Priority for Action

Kunming, China 26-28 March 2018

APFORGEN APAFRI Bioversity International National Institute of Forest Science 国家林木种质资源平台 National Forest Genetic Resources Platform 国家自然科学基金委员会 NSFC

Table of contents

Background

Forest genetic resources provide the foundation for species survival, biomass production and adaptation environmental change. Anthropogenic activity, such as climate change, encroachment, overharvesting, overgrazing and fragmentation threaten the genetic diversity of socio-economically important tree species. Understanding species specific biological characteristics and integrating conservation with sustainable use of genetic resources is vital for mitigating genetic erosion of endangered species and enabling effective utilization of forest resources for restoration and poverty alleviation.

Based on an extensive global study that covered more than 80 countries, FAO developed the **Global Plan of Action on Forest Genetic Resources** (2013) that details approaches and priority actions for integrating genetic considerations in diverse aspects of forest and landscape management.

Asia Pacific Forest Genetic Resources Programme (APFORGEN, www.apforgen.org) has developed a strategy for 2017-2022 to support global plan of action in the region through collaborative efforts between member countries. A central focus of the strategy is to "Develop conservation and sustainable use strategies for regionally important and threatened tree species". Working towards this goal, APFORGEN and its regional partners met in Kunming, China from 26-27 March to identify common interests, priority species and opportunities for collaboration over conservation and sustainable use of endangered tree species.

Day 1: 26th March 2018

Opening ceremony

Opening remarks by Dr. Zheng Yongqi, Chinese Academy of Forestry and Chair of APFORGEN, followed by participant introductions.

Regional networking for the conservation and sustainable use of forest genetic resources: Asia Pacific Forest Genetic Resources Programme (APFORGEN)

Zheng Yongqi, Chinese Academy of Forestry & APFORGEN

APFORGEN is a regional network for the conservation and sustainable use of forest genetic resources in Asia-Pacific that supports the implementation of the Global plan of Action on forest genetic resources. The network has been running for 15 years and is comprised of 15 member countries and two institutional members. Its role is to mobilise political and financial support for developing conservation and sustainable use strategies for regionally important tree species- contributing to the strengthening seed supply systems, poverty alleviation and climate change mitigation and adaptation. The network is a platform for developing and

implementing collaborative research between member countries, sharing of findings through symposiums and workshops, and training for young scientists and managers. National coordinators for each of the member countries have been appointed to ensure effective communication within the region. Extending membership to other nations and orientating research to address regional and national needs, while also appealing to the commercial interests of the private sector are key objectives moving forward.

Session 1: Brief introduction of the on-going and pipelined international cooperation project under APFORGEN

NSFC-CGIAR joint project: Analysis and mapping of genetic diversity of key species of *Dalbergia* spp. in Asia Pacific

Zheng Yongqi, Huang Ping and Lin Furong, Chinese Academy of Forestry.

Dalbergia spp. is widely distributed in tropical area in Asia, African and American. The wide germplasm resources of *Dalbergia* have been destroyed and eroded as the result of anthropogenic activities and environment change, and some key species is endangered. It is significant to investigate the inventory, establish the conservation system and monitoring network, and explore and use the important trait on the conservation and sustain use of germplasm resources *Dalbergia* spp. This project is cooperated with Bioversity International to do the population genetic, phylogeography relevant research. Aim to clear the general status, evolutionary process and future development trends, construct the cross-regional conservation network, and make a scientific conservation strategy on the germplasm resources of *Dalbergia* spp. The technique and methodology of modern molecular biology, geographical informatics and computer science will be applied to study the genetic diversity, pattern of genetic variation and differentiation, and potential risk of genetic erosion for key species in *Dalbergia* spp.

Discussion

- *Are there any opportunities for member countries to contribute to this project?*
  Yes, species distribution mapping and sampling (phylogenetic and population genetic work) are areas of potential collaboration
- *Does the project look at populations from all regions of China?*
  The work on *Dalbergia* is carried out mainly in tropical regions but also in sub-tropical regions, with different species
- The conservation strategy for the *Dalbergia* spp. studied will involve surveying of the species and its distribution, collection of seed for the establishment of ex situ stands and storage. Note that seed of many of the species cannot be stored for long.

Research project - APFORGIS: Filling in the knowledge gaps for genetic conservation of tree species in Asia

Riina Jalonen, Bioversity International

Effective conservation and management strategies for tree genetic resources depend on each species' characteristics (e.g. growth rates, pollen and seed dispersal patterns, mating system). Species conservation typically requires a network of *in situ* conservation areas to adequately capture within-species diversity. Existing in situ conservation areas may not be sufficient on their own to conserve the genetic variability within a species. Conservation areas for maintaining genetic diversity and evolutionary potential may require a combination of protected forest, sustainable management units and patches of forest in agricultural landscapes. This is particularly relevant in Asian countries where human population densities are extremely high even in rural areas, and income poverty prevails.

If the patterns of genetic diversity are not known, variation in the environmental conditions across the species distribution range could be used to help select populations for the conservation of different adaptive traits and seed sources for restoration. Nevertheless, for many tropical Asian tree species, information both on genetic diversity and species distribution is lacking. Improving the availability of and accessibility to information on native tree species is one of the strategic objectives of the Asia Pacific Forest Genetic Resources Programme (APFORGEN) for 2018-2022.

A new regional project "APFORGIS" that aims to fill in the knowledge gaps in species distribution and biology through regional collaboration and the application of latest spatial analysis methods. The project has the following objectives: (1) Develop dynamic distribution maps for at least 50 Asian tree species, based on available information from government and research institutions, to enable spatially defining conservation priorities; (2) develop decision-support tools for the establishment of Gene conservation units (GCU) for different species, and (3) develop a Road Map for establishing an Asian network of GCUs for ecologically and economically important tree species.

Discussion

- Member countries can contribute to APFORGIS through providing data on the traits of priority species, as well as suggestions of additional species based on national level assessments. The list of pilot species will be made available to participants.
- Criteria for pilot species selection is based on traits, environmental services & threat levels. Species will be grouped for the purpose of developing conservation guidelines.
- Information from national forest inventories would be very helpful if available
- A concern raised was that government approval is often needed in order to obtain occurrence points
- APFORGIS will be sensitive to the implications of making available georeferenced data for endangered species
- Opportunities for collaboration will be discussed further at the APFROGIS workshop, held in April in Malaysia

Research proposal - Conserving Rosewood genetic diversity for resilient livelihoods in the Mekong

John MacKay, University of Oxford

Working with forestry authorities and rural communities in four Greater Mekong Subregion countries, the project will use in situ and ex situ methods to safeguard the genetic resources of three *Dalbergia* rosewood species of high conservation concern. Simultaneously we will develop novel, and strengthen existing, capacity for seed collection, seed source and nursery management, and associated value chain development. The project will build the capacity of rural households to generate livelihood benefits from sustainable use of these resources. The presentation will also discuss recent developments in molecular techniques that may facilitate conservation genetics.

Discussion

- *How were the focal species selected?*
  Species were selected by in country partners from Thailand, Laos, Cambodia and Vietnam at the last workshop
- *Dalbergia tokinensis* is an endangered species, is there a reason why it has not been selected?
  Perhaps this is because *Dalbergia tokinensis* is not a common species across member countries. It is difficult to make changes to the proposal at this stage but this project will create capacity that will facilitate work on additional species.
- *The research hub for forest landscape restoration is Pacific focused, is there an opportunity for collaboration with APFORGEN network?*
  There is scope for the hub to focus on Asia-Pacific but there is still the potential to extend activities to other regions

Developing DNA makers to identify origin of *Dalbergia cochinchinensis* wood in selected ASEAN countries: project proposal submitted to CITES

Suchitra Changtragoon, Department of National Parks, Wildlife and Plant Conservation

The knowledge and the outcome of this research is planned to expand to ASEAN countries in natural distribution range of this species thorough the project submitted to CITES for consideration.

Discussion

- *Have you looked at alternative mechanisms for tracking origins of timber e.g. stable isotope analysis? ETH Zurich have a team working on this in Madagascar*
  We don't have expertise on that but this could be extended through collaboration.
- *Which markers will you use?*

We work with three regions in the chloroplast. This will be discussed further in the next presentation

Session 2: Overview on the endangered tree species conservation and sustainable use in Asia Pacific.

Conservation of Genetic resources of Endangered Tree Species in India

Rekha R Warrier, Institute of Forest Genetics and Tree Breeding, India

The areas that need urgent attention in the matter of biodiversity conservation including FGR conservation and management for India are: (i) integrated database development at all organizational and management levels, to effectively utilize the data for decision making and establishment of a national information system, (ii) skill development at all levels, especially related to new biotechnologies, benefit sharing mechanisms, tools in monitoring biodiversity including FGR diversity, (iii) encouraging taxonomy related research, (iv) monitoring and assessing biodiversity for representative landscapes on long term continuous basis, (v) climate change and FGR related research, (vi) elimination of invasive alien species, that threaten the diversity, (vii) incentives for sustainable utilization of resources, (viii) sustained research on genetic diversity.

Conservation and management on forest genetic resources of Rosewoods in Thailand

Woraphan Himmaphan, Royal Forest Department, Thailand

Dalbergia cochinchinensis or Siamese Rosewood is a slow-growing, large, with a spherical well-branched canopy. Its wood is heavy, very hard, and durable. It is used in making high quality furniture, carvings, and handicrafts, etc. The beautiful colour, Rosewood is categorized in high-end class and faced to the serious illegal logging in Thailand, so Thai rosewood was voted to the list under Appendix II of the CITES which regulates trade of threatened species through logging permits and agreed quotas. Not only protect illegal logging, RFD has also mission to conservation and management through ex situ gene conservation in plantation forest and also set the tree improvement project.

Discussion

- *What are the characteristics of gene conservation plots?*
  Seeds from identified plus trees are used for ex situ conservation

Evaluation, Conservation and Documentation of Forest Genetic Resources

K Palanisamy, Institute of Forest Genetics and Tree Breeding, India

The strategies for conservation and management of Forest Genetic Resources have been developed. Prioritized 30 economically and environmentally valuable tree species for FGR programme. Exploration, collection of germplasm and establishment of gene bank for *Tectona grandis* and *Pongamia pinnata* in Southern India have been carried out. The distinct populations which showed desirable characteristics like good growth and tree form were selected for conservation. The established genetic resources like seed orchards, seed production areas (SPAs), clone bank, germplasm bank etc for prioritized species maintained by Research organizations and State forest departments in Tamil Nadu and Kerala have been evaluated and documented. Selected the potential seed orchards and SPAs for effective utilization.

Discussion

- *Have you studied whether bark characteristics are associated with wood quality or insect attacks?*
  Bark colour and leaf morphology are only used for selecting the population/identifying differences between populations. Characterisation allows for the identification of unique material. This is then deposited with the government and a licence fee can be paid to access it. Farmers and breeders can access information to help to identify and protect unique varieties.
- *Does the proposal ask for government or national support?*
  There is already government support but we are hoping for support from APFORGEN for last proposal mentioned

Issues and Challenges in the Conservation of the Philippine National Tree, *Pterocarpus indicus*

Enrique L Tolentino, Jr, University of The Philippines Los Baños

The Philippine national tree also known as Philippine rosewood is valued for its premium wood but was been subjected to massive exploitation and utilization both legally and illegally until now. The presentation focuses on the issues and challenges in conservation this valuable tree species.

Discussion

- A critical issue touched upon was the political disincentives for use of FGRs of high value species. This is particularly pertinent in the context of global challenges on FLR. APFORGEN is a valuable network for addressing this

Country report on FGR conservation in Cambodia

Chann Sophal, Institute of Forest and Wildlife Research and Development, Cambodia

Dalbergia cochinchinensis is native to Indochina and adjacent countries. This tree species is shade-tolerant when it is young. It usually occurs sparsely in open and semi-deciduous forests from 400-500m a. s. l., and prefers deep sand, clay, or calcareous soils. This rosewood prefers uniform rainfall that ranges from 1,200-1,650mm per year. The species requires high amounts of light to thrive, and is drought tolerant and able to grow on most soils. Within Cambodia, the species can be found in Kampongthom, Preahvihear, Rattanakiri, Pursat, Siemreap, Kratie, Koh Kong, Steungtreng, and Mondulkiri.

Dalbergia cochinchinensis is a large evergreen tree species, reaching from 25-30m in stature and producing boles to 60cm in dbh. The species is easily recognized by its light yellow bark and ramified canopies. Its wood is hard, durable, and red-colored with prominent, beautiful veins. It exhibits a density of 1.0-1.8 and is resistant to termites. The plant is identified by its pinnate leaves, which generally have 7-9 leaflets, the upper-most of which is the largest. The species regenerates naturally and copies well, but the growth rate is rather slow. *Dalbergia cochinchinensis* is flowering in May and June, while fruits ripen in November and December.

Illegal cutting in many areas because of its high values has resulted in few and sparse populations of this species. In 2002, the second CTSP meeting on the Forest Gene Conservation Strategy defined *Dalbergia cochinchinensis* as a priority (endangered) species in need of immediate conservation intervention and appropriate protection. This species is protected by Cambodian Forestry Law No. 35.

Country report on FGR conservation of endangered tree species in Lao PDR

Bansa Thammavong*, *National Agriculture and Forestry Research Institute (NAFRI), Lao PDR

The FAO Netherlands Partnership Programme have established the National Information Sharing Mechanism in Lao PDR to facilitate the exchange of information on the conservation and management of forest genetic resources. One key activity is the documentation of improved new varieties to meet the objectives of the National Biodiversity Strategy 2020.

Ex-situ plots for *Dalbergia cochinchinensis*, *Dalbergia* sp; *Erythrophoeum fordii*, *Aquilaria crassna*, *Pterocarpus marcrocarpus* have been established and in-situ conservation has been implemented for 29 tree species, over 76 sites. However, both in-situ and ex-situ conservation are in their infancy and there is a lack of species distribution data to inform conservation planning. There is a potential for information to be extracted from existing provenance trials and demonstration plots to support these conservation efforts. National efforts to rehabilitate and plant native and exotic species, using seed imported or collected from mature plantations, are often limited in their capacity to capture genetic diversity due to the issue of unknown provenance.

Discussion

- *How do you classify the seed source populations (population size, connectivity, breeding population)?*
  Support is given from the FAO Netherlands Partnership Programme. Seed is sourced from no less than 25 mother trees.

Conservation and use of Indigenous tree species in Sri Lanka

N.D.R.Weerawardan, Research and Education, Forest Department, Sri Lanka

Large numbers of indigenous tree species are protected in-situ in natural forests in the country. In addition, they are also protected ex-situ in National Botanic Gardens in different locations in the country. Research programmes are also underway to conserve genetic resources of indigenous species. Utilization aspects of various products from these species are also being researched by various research institutes including universities.

Country report on FGR conservation of endangered species in China

Zheng Yongqi, Chinese Academy of Forestry

China has paid great attention to conservation of endangered tree species. Since 1980, IUCN has started to work in China. In 1996, China acceded IUCN, becoming a formal member country. The CITES came into force since July 1, 1975, with 145 member countries. China acceded the CITES in January 8, 1981. Since April 8, 1981, the convention came into force. Other international organizations involved in conservation of endangered species in China

include International Association of Botanic Gardens, UN Education, Science, Culture and Organizations (UNESCO), Man and Biosphere (MAB) Program and FAO.

China is one of the richest countries in biodiversity, the third largest country in number of high plants, among the 31,142 species over 50% are endemic to China, such as *Cathaya argyrophylla*, *Davidia involucra*; etc. There are more than 4,000 plant species that are facing threats, accounting for 15-20% of the total number of plant species. China has been implementing a conservation program, targeted to conserve extremely plants small of populations. In addition, conservation activities/programs are being conducted at provincial level.

Discussion

- *How many companies are involved in extraction for the timber industry?*
  There is a focus on environmental improvement in China, so there is a high demand for planting materials. Tree breeding and selling new varieties is a profitable business. The demand for timber trees is decreasing and being replaced by a demand for fruit and ornamental trees
- The plans for digital sequencing mentioned are still in progress; facilities are currently being built
- *Do you have a policy for how to integrate FGR efforts across the country? This could be a useful model/framework for FGR conservation in other countries.*
  The gov't initiated a movement to establish a science infrastructure platform to address the scattered nature of forest genetic resources and information. This improved the accessibility of data across the country.

Conservation genetics of a critically endangered CITES-listed species, *Aquilaria malaccensis*

Chai Ting Lee, Forest Research Institute Malaysia

Aquilaria malaccensis is a critically endangered tree species known for its prized resin-impregnated agarwood. Its natural populations in Malaysia have been seriously threatened by illegal poaching. As such, a comprehensive population genetic study has been carried out in recent years. Based on the findings, conservation strategies have been proposed to the forest managers, in order to safeguard the invaluable genetic resources and to ensure sustainable utilisation. The implications on conservation will be discussed.

Discussion

- *How many DNA forensic have been conducted and has it acted as a deterrent for illegal logging in Malaysia?*
  It is too early to tell whether it is acting as a deterrent. It takes years to build the databases but the application has become more frequent in the past 2 years. An SOP for the sample collection has been set up, so the foresters can do it themselves
- *Are you looking at whether neutral marker patterns are relevant for adaptive variation/where there might be incongruences between neutral marker patterns and local patterns of adaptation that could be relevant to where to plant the material?*

This point needs to be refined for the development of guidelines. We used genomic STR, they are neutral, the chloroplast regions that we use are inter-genetic.

- Need to be cautious about selecting seed zones based on structural patterns of neutral variation because you might find that a different seed zone has locally adapted material that is better for planting elsewhere

Day 2: 27th March

Session 3: Case studies on the research progress for endangered species conservation in Asia Pacific

Genetic diversity and Phylogeographic DNA markers in *Dalbergia cochinchinensis* in Thailand

Suchitra Changtragoon, Department of National Parks, Wildlife and Plant Conservation

The research on Genetic diversity and phylogeographic DNA markers in *Dalbergia cochinchinenisis* in Thailand in presented and demonstrated on the application for conservation design and DNA forensics in Thailand.

Discussion

- *Why were you focusing on the gene mentioned at the beginning (maturase K gene)?*
  It was identified in the species and it is easier to work with at the beginning, as it is shorter. We did also use rubisco.
- *Did you come across any insertion or deletion sites and if so, did you take this variation into account?*
  Yes, especially those that don't share in the same family
- *Why did you study 20 population rather than 12*
  because we wanted to reflect the whole geographic region
- *Can you say anything about the mating system based on the microsatellites e.g. levels of variation in inbreeding among the different populations?*
  Based on the genetic study of a previous research the outcrossing rate is 90%. Allozymes are costly and difficult to work with

Taxonomy of *Dalbergia* in Asia

Li Shijing, South China Botanical Garden, CAS

Ninety-two species were confirmed in the genus *Dalbergia* in Asia. 27 names were reduced as synonyms. The lectotypes of the 26 names were designated. The information provided under each species includes correct name, an elaborate description, detailed distribution data and phenology. These are again supplemented with illustrations and distribution maps.

Discussion

- *Why didn't you visit the herbaria in Laos & Thailand?*
  Specimens collected from Thailand were checked in other herbaria and a colleague visited Thailand several times
- *Why is timber from some Dalbergia species more expensive than others?*
  It is to do with supply and demand/companies driving the market price e.g. the cost of garlic increased 20 fold in half a year
- It would be useful if you could share the occurrence coordinates collected from the Herbaria
- *For the species with global distribution, was distribution influenced by humans?*
  It is natural – seed are dispersed in water across the sea

Forest fragmentation and its implications for forest genetic resources of high value tree species in Asia

Christopher Kettle, Bioversity International

Forests across Asia are highly fragmented reducing population size and increasing isolation of remnant populations of the foundation tree species. This has implications for gene flow, natural regeneration and the ability of tree populations to adapt to future environmental change. Many of these forest patches are also vital for provisioning seeds or planting material for restoration of degraded forest. The presentation provided an overview of the importance of forest genetic resources (FGRs) for meeting sustainable development goals, some of the challenges we face and why FGRs central to forest landscape restoration. With a focus on the Dipterocarpaceae, several case studies were presented from high-value tree species across Asia and what we know about the different ways they are vulnerable to forest fragmentation. The presentation concluded with a discussion of what might be some of the most important ecological traits of tree species in determining their sensitivity to fragmentation and how we might be able to integrate this information into priority setting.

Discussion

- *It is remarkable that there was a result for the evaluation of multi-locus heterozygosity in Parashorea. The markers are linked to adaptively variant regions.*
  It is important to be careful when interpreting data. It shouldn't be assumed that patterns of fine scale genetic structure are associated with local adaptation but it could be that they are signals of those patterns.
- Some species are much less vulnerable to inbreeding because they've adopted a strategy over a long evolutionary time, so the deleterious effects of inbreeding are likely to be much lower. Understanding mating system is fundamental to priority setting.
- A key output of the project was to communicate with the farmers that the trees are a high value genetic resource. A lack of tenure rights limits the ability of farmers to capitalise on the resource. There are little incentives to plant native tree species despite the high value
- Seed dispersal is exclusively restricted to 60-70m (hornbills don't carry seeds far). If you want trees to be in sacred forests, need to assist regeneration

- *Why is wood density associated with fine-scale spatial genetic structure?*
  The more climatic species (higher wood density) tend to persist in the shade and are less dependent on gap regeneration for establishment, so seedlings aren't as clustering
- *Is there a potential for the development of decision support tools based on the factors mentioned (wood density, flower size etc.) to inform species prioritisation?*
  Yes, data on reproductive ecological traits can be integrated into threat mapping
- Flower size correlates with insect size (related to longer dispersal distance) in dipterocarps and this can inform the conservation approach. There are no general rules in ecology but such studies can guide us in conservation planning

Conservation strategies of endangered subalpine pine species in South Korea considering their genetic diversity

Hong Kyung Nak, National Institute of Forest Science, Republic of Korea

Korea Forest Service in 2016 announced a plan to conserve endangered subalpine conifer species and to restore their damaged forests in South Korea. In particular, it emphasized the establishment of strategies considering genetic diversity. *Abies koreana* is an endemic species in South Korea. However, about one-third of the habitats are damaged probably due to the warming of the Korean Peninsula and the increase of climbers. We intend to reintroduce seedlings (or saplings) considering the genetic diversity in order to restore the damaged *Abies koreana* forest. For this purpose, the genetic structure of the species, the selection criteria of mother trees, nursery management of seedlings for the reintroduction and the environmental conditions are studied. A similar strategy has been applied to conservation action of *Pinus pumila* in Mt. Seorak which is an endemic species in South Korea.

Discussion

- Low inbreeding coefficient in natural seedlings but high in restoration material, could this be explained by inbred material surviving in nursery but selected out in natural forest?
- There are a small number of seedlings regenerating naturally, so there was a need to transplant the seedlings (supplementary planting)
- *Are you only using seedlings of high genetic diversity for restoration?*
  Seedlings are selected. We want to analyse the change in genetic diversity so we can simulate it during restoration
- The outcrossing rate for *Pinus* species is over 90%. It is different in Thailand for *Pinus merkusii*- over 50% inbreeding
- *It is surprising that an inbreeding coefficient of 0.1 equates to 90% outcrossing*
  If we collected another sample the result would likely change. Microsatellite markers were used, which can give slightly higher rate. In total 100,000 seedlings were grown but only 0.1% of seedlings were sampled to test inbreeding before transplanting, we should test all seedlings
- *Does the more endangered species have less genetic diversity?*
  No difference between the genetic diversity of the two species

Cryopreservation of embryogenic cultures of ten Magnoliaceae species

Lin Liang, Kunming Institute of Botany, CAS

More than 50% of the world's critically endangered Magnoliacese species distributed in China. The germination level of 93.3% of seeds of Magnoliaceae species (11 genera) stored at -20 °C in The Germplasm Bank of Wild Species (Kunming, China) is Zero. Cryopreservation is considered an ideal method for long-term conservation of Magnoliaceae species. Embryogenic cultures of ten Magnoliaceae speices, namely, *Magnolia officinalis*, *Magnolia tripetala*, *Magnolia delavayi*, *Manglietia insignis*, *Manglietia duclouxii*, *Michelia chapensis*, *Michelia maudiae*, *Michelia yunnanensis*, *Michelia sphaerantha* and *Michelia floribunda* were induced using immature and mature zygotic embryos as explants. A simple and efficient cryopreservation protocol was developed for Embryogenic cultures of Magnoliaceae species by vitrification and droplet vitrification method. The protocol provided 100% regrowth for embryogenic cultures of tested Magnoliaceae speices. Plantlets were successfully regenerated from cryopreserved embryogenic cultures. In 2018, the tested embryogenic cultures will be stored in the cryobank of Germplasm Bank of Wild Species for long term preservation.

Discussion

- *What is the percentage germination after storage using cryopreservation?*
  A key study indicates that Magnolia species loose viability within one year at room temperature, after storage at -20 degrees
- *How long after establishment does it take a cryopreserved plant to produce flowers?*
  The comparison has not been carried out, the oldest plant from cryopreserved cells is 3 years and it hasn't flowered yet
- *How many individuals are the embryo genic cells developed for within a single species for each accession? Is 200 accessions for each species feasible?*
  Yes, it is possible but requires money, time and labour.

A spatially explicit threat mapping framework for tree species: case studies from Central Asia and Burkina Faso

Hannes Gaisberger, Bioversity International

There is a general agreement on the need to ensure the in situ conservation and availability of valuable genetic resources of wild tree species. In order to be able to adopt adequate conservation measures a spatial assessment of their distribution and a sound analysis of the causes of and their sensitivity to threats is required. Two projects led by Bioversity International in Central Asia and Burkina Faso gave us the opportunity to develop a spatially explicit threat assessment methodology with focus on expert feedback, as there is no comprehensive and standardized approach available at the moment.

Relevant threats were identified guided by literature and through consultation of local experts during the initial phase of the projects. Once determined the most important ones (i.e.

overexploitation, overgrazing, climate change etc.) we identified openly accessible datasets suitable to represent the spatial patterns of threat intensities throughout the study areas. Now we needed to transform the threat intensities into potential impact over the target species distribution ranges. To do so the distribution and threat sensitivity of priority tree species were assessed by local and international experts that were asked to rate on a five-point scale different distribution models and the sensitivity to threats. The survey was analyzed and the most consistent distribution model and threat specific sensitivity rating for each species was identified. The potential impact of climate change was modelled using Global Circulation Models (GCM's) deriving from the fifth assessment of the Intergovernmental Panel on Climate Change (IPCC5) in 2014.

The results were then used to calculate and create individual and combined threat potential maps that enable the identification of areas where species are highly threatened. The spatial patterns of the threat levels provide evidence to prioritize tree populations with relative urgency for undertaking conservation actions.

Discussion

- *What type of data is the most limiting/would most likely affect accuracy of estimates? How can this be solved for the Asia-Pacific region?*
  Expert feedback (foresters, local communities, species specialists) was a crucial element in the Central Asia project. We got very clear results regarding the evaluation of species distribution models whereas the evaluation of threat sensitivity produced diverse results. To improve the results it would make sense looking at species characteristics/traits in literature and combine this with expert opinion in order to get more reliable results for threat sensitivity
- Climate change modelling was done for each species based on the ecological niche but further species specific characteristics to react to this threat were not looked at. With this approach we predicted the degree to which threats are driving a species to its limits/boarder of suitable habitat.
- *Have you developed action plans for the local government based on your findings?*
  A regional strategy couldn't be achieved in Central Asia because of political reasons but one output of the project was to establish in-situ conservation sites (Forest Farms) in each of the three target countries. These are long term monitoring and protection sites. The project results in terms of threat intensity maps were useful to show to our partners using/managing the forests the high threat levels these unique walnut forests are exposed to. In particular there is an imminent need to fence parts of these forests to protect from livestock grazing in order to guarantee natural regeneration for long-term sustainability of these unique resources.

Planning of future activities

APFORGEN workshops

The next annual workshop would be held in before March 2019, possibly in Korea, Thailand or Cambodia. Bioversity International can support the logistic planning and coordination if the workshop if needed.

Proposed workshop topics:

- A workshop on species distribution mapping and threat analyses was proposed, building on the APFORGIS workshop in April 2018. The follow-up workshop would contribute to developing teams of species specialists in the region, and help plan future collaborative activities
- A workshop to organise funding was proposed. Potential donors (e.g. ITTO) and non-member countries in Asia-Pacific that could contribute financially to APFORGEN activities, such as Japan and Australia, are to be invited. This could be organised in connection with other conferences. On the other hand, 'back to back' meetings could lead to missing key participants. Invitations need to be more targeted to specific individuals within organisations.

Training activities

Training for non-specialists

- Training sessions with non-specialists, including policy makers and the private sector are important for raising the profile of FGR research
- Another workshop to 'train trainers' was also discussed
- China Happy Ecology Ltd. is in support of adopting a new model for the next APFORGEN training session. This could take the form of a study tour for APFORGEN member countries, coupled with well-presented examples of FGR conservation and use (e.g. in the style of TED talks).
- Careful planning of workshops to target specific people is needed e.g. it should be ensured that senior representatives (of select agencies) attend the workshop focused on attracting donors

PhD students

Proposed activities

- Coupling PhD students to foster exchange of ideas and act as a support mechanism
- Promote participation of students from local institutions in APFORGEN activities
- Develop financing mechanisms for scholarships within APFORGEN

Mobilizing financial & political support

Clear and attractive objectives:

- APFORGEN needs funding for the operation of the network. To date funding is short term and per project.
- It is important to stay grounded to the objectives defined in strategy and fit within these the key themes that have been identified, including restoration, adaptation of forests to climate change and timber tracking
- It is important to report on the progress of achieving the objectives of the strategy: develop a monitoring mechanism for each objective and relate projects ongoing within member countries to these targets
- APFORGEN needs to be made more visible in the global restoration community, as there is a disconnect between the knowledge held by APFORGEN and decisions that are being made on delivering on restoration targets
- Relating projects to the sustainable development goals will help to gain financial support from donors and governments
- Communicating with politicians about the short term value of FGR for risk management may help to secure funding by breaking down ideas that FGR research will only have an impact in the long term

Opportunities for funding

- The Green Climate Fund: many of the subjects being studied among APFORGEN member countries are related to restoration and climate change mitigation and therefore may be eligible for funding from the green climate fund
- Global timber tracking network (GTTN): molecular approaches to tracking illegal logging were discussed in several presentations. This research theme could be built upon through collaboration with the GTTN. ITTA might be interested in funding this. The method will take a long time to refine but efforts can be strengthened through coordinated efforts across countries i.e. sharing of country databases.
- Agencies involved in Bonn challenge: there could be an opportunity to increase visibility of FGR at high level meetings. UNEP would be very receptive.
- Attracting higher income member countries as members

Networking

Sharing lessons learnt among regional forest genetic resources networks

- It would be beneficial to have a platform for sharing of knowledge between the networks
- EUFORGEN is particularly interested in sharing lessons learnt regarding mobilising funding and resources as well as approaches to transferring genetic resources (the concept of transferring genetic resources from North Africa to Europe to promote adaptation to climate change was proposed by the network)

Communication: improving the reach of APFORGEN

- Visibility and support could be increased through reaching out to a wider audience by communicating the importance of FGR through video. FAO might be able to provide support on this.
- Improve communication within APFORGEN through a messaging app e.g. LINE, WeChat
- Improve the visibility of APFORGEN activities through setting up a twitter account
- Translate the APFORGEN strategy into the national languages of member countries to improve communication - China, Korea, Thailand have agreed to this

Appointing APFORGEN management staff to improve the sustainability of the network

- Financial, communications and administrative staff are needed to extend the reach of the APFORGEN network and develop strong documentation to attract funding from the government and private sector
- APFORGEN could provide a platform for writing strong proposals. There is a need for a facilitator of regional proposal development. This would only require a 50% position, preferably to be filled by a researcher from the region

Annex 1: Workshop programme

Time	Activity	
Monday, 26 March		
Opening ceremony		
9:00-9:15	**Opening ceremony** • Welcome and introductions to the workshop • Review of cooperative activities in 2016-2017	**Moderator:** APFORGEN secretary *Enrique L Tolentino, Jr*
9:15.-9:25	Regional networking for the conservation and sustainable use of forest genetic resources: Asia Pacific Forest Genetic Resources Programme (APFORGEN) *Zheng Yongqi, Chinese Academy of Forestry & APFORGEN*	
Session 1: Brief introduction of the on-going and pipelined international cooperation project under APFORGEN • Share the cooperative project information • Seek more future cooperative opportunities under APFORGEN		
09:25-09:40	**NSFC-CGIAR joint project** Analysis and evaluation on the genetic diversity of *Dalbergia* spp. in Asia Pacific. *Zheng Yongqi and Huang Ping* *Research institute of forestry, Chinese Academy of Forestry*	**Moderator:** *Enrique* L *Tolentino*, Jr
09:40-10:00	**APFORGIS:** Filling in the knowledge gaps for genetic conservation of tree species in Asia *Riina Jalonen* *Bioversity international*	
10:00-10:20	**Darwin Research proposal** Conserving Rosewood genetic diversity for resilient livelihoods in the Mekong. *John Mackay* *University of Oxford*	
10:20-10:35	***Project proposal submitted to CITES*** consideration on Developing DNA makers to identify origin of Dalbergia cochinchinensis wood in selected ASEAN countries *Suchitra Changtragoon* *Forest and Plant Conservation Research Office, Department of National Parks, Wildlife and Plant Conservation*	
10:35	Group photo and Coffee break	

Time	Activity	
Session 2 Overview on the endangered tree species conservation and sustainable use in Asia Pacific. • General introduction of FGR conservation for endangered tree species in Asia Pacific region. • Discover a mutual interest in future research in Asia Pacific region. • Discuss the future development of APFORGEN		
11:00-11:20	Conservation of Genetic resources of Endangered Tree Species in India *Rekha R Warrier,* *Institute of Forest Genetics and Tree Breeding, India*	**Moderator:** *Zheng Yongqi*
11:20-11:40	Conservation and Management on Forest Genetic Resources of Rosewood in Thailand. *Woraphan Himmaphan* *Silvicultural Research Division, Foresearch and Development Bureau, Royal Forest Department, Thailand.*	
11:40-12:00	Evaluation, Conservation and Documentation of Forest Genetic Resources *K Palanisamy* *Forest Genetic Resources Division, Institute of Forest Genetics and Tree Breeding, India.*	
12:00	Lunch	
Continue Session 2		
13.30-13:50	Issues and Challenges in the Conservation of the Philippine National Tree, *Pterocarpus indicus* *Enrique L Tolentino, Jr* *Institute of Renewable Natural Resources, College of Forestry & Natural Resources, University of The Philippines Los Baños*	**Moderator:** *Suchitra Changtragoon*
13:50-14:10	Country report on FGR conservation in Cambodia *Chann Sophal* *Institute of Forest and Wildlife Research and Development, Cambodia*	
14:10-14:30	Country report on FGR conservation of endangered tree species in Lao PDR *Bansa Thammavong* *Forest Science Research Center, National Agriculture and Forestry Research Institute (NAFRI), Lao PDR.*	
14:30-14:50	Conservation and use of Indigenous tree species in Sri Lanka *N.D.R.Weerawardane* *Research and Education, Forest Department, Sri Lanka*	
14:50	Coffee break	
15:20-15:40	Country report on FGR conservation of endangered species in China *Yongqi Zheng* *Research institute of forestry, Chinese Academy of Forestry*	**Moderator:** *Riina Jalonen*

Time	Activity	
15:40-16:00	Conservation genetics of a critically endangered CITES-listed species, *Aquilaria malaccensis* *Chai Ting Lee* *Genetics Laboratory, Forestry Biotechnology Division, Forest Research Institute Malaysia*	
16:00-16:20	Summary and discussion	
16:20-17:30	**Discussion APFORGEN future development** ● Activity plan ● Seek funding ● Member development (country member, institute member etc.)	
19:00	Welcome dinner	
Tuesday, 27 March		
Session 3 Case studies presentation in research progress on FGR conservation for endangered tree species • **Share the research experience and advance** • **Improve the academic communication**		
8:50-9:00	Recap of day 1	**Moderator:** *Enrique* L *Tolentino*, Jr
9.00-9.25	Genetic diversity and Phylogeographic DNA markers in *Dalbergia cochinchinensis* in Thailand *Dr. Suchitra Changtragoon,* *Expert office, Forest and Plant Conservation Research Office, Department of National Parks, Wildlife and Plant Conservation*	
9:25-9:50	Taxonomy of *Dalbergia* in Asia *Li shijing* *Plant Science Center, South China Botanical Garden, CAS.*	
9:50-10.15	Forest Fragmentation and its implications for forest genetic resources of high value tree species in Asia. *Chris Kettle,* *Bioversity International*	
10:15	Coffee break	
10:45-11:10	Conservation strategies of endangered subalpine pine species in South Korea considering their genetic diversity. *Hong Kyung Nak* *National Institute of Forest Science, Republic of Korea.*	
11:10-11.35	Cryopreservation of embryogenic cultures of ten Magnoliaceae species *Lin Liang* *Kunming Institute of Botany, CAS*	**Moderator:** *Zheng Yongqi*

Time	Activity	
11:35-12:00	A spatially explicit threat mapping framework for tree species. Case studies from Central Asia and Burkina Faso. *Hannes Gaisberger* *Bioversity International*	
12:00	Lunch	
13:30-14:45	*Group discussion* G1: APFORGEN strategy 2018-2022 G2: UK Darwin proposal G3: *Dalbergia* workgroup	**Moderator:** *Zheng Yongqi and Riina Jalonen*
14:45-15:00	Reporting back and plenary discussion	
15.00	Coffee break	
15:30-17:00	*Group discussion* Future cooperative opportunities e.g. Scholar exchange; Joint project; Academic visit.	
17:00-	Summary and close	
Wednesday 28, March		
8:30	Field trip	
12:00	Back hotel	
Thursday 29, March		
9:00	Departure	

Annex 2: List of participants

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