IPGRI recently underwent a consultative process to review its strategy. IPGRI’s new strategy is focused on ‘diversity for well-being’. Its aim is, “to promote the greater well-being of people, particularly poor people in developing countries, by helping them to achieve food security, to improve their health and nutrition, to boost their incomes, and to conserve the natural resources on which they depend. IPGRI works with a global range of partners to maximize impact, to develop capacity and to ensure that all stakeholders have an effective voice.”

The six principal objectives are:
● to demonstrate the social, economic and environmental benefits of agricultural biodiversity;
● to ensure that agricultural biodiversity is conserved, characterized and used to improve productivity;
● to generate knowledge about agricultural biodiversity through research, and to make such knowledge available;
● to develop human and institutional capacity to make effective and sustainable use of agriculture;
● to analyze policies and foster an environment that supports the use of agricultural biodiversity;
● to raising awareness of the value of agricultural biodiversity and the importance of the conservation of genetic resources.

(Source: IPGRI’s ‘Diversity for Well-being’ fact sheet)

The new strategy will have a bearing on IPGRI’s work on forest genetic resources (FGR), which is still recognized as a core activity. The FGR research activities will need to focus further on the conservation of FGR that benefit local communities directly. In particular, the focus will be on those resources that contribute directly to the promotion of food security, poverty eradication and environmental protection.
addition, we will play a significant role in the management and dissemination of FGR information to stakeholders. Some aspects of the Forest Genetic Resources Strategies (FGRS) project have already changed to reflect the shifts in the forestry domain. For example, *in situ* and *ex situ* conservation strategies are no longer promoted as separate measures. Instead, they are seen as components of complementary conservation strategies that seek to build on each other’s advantages to promote conservation of tree species and forest ecosystems. Our work on the conservation of genetic resources of non-timber forest product (NTFP) species will expand to include other NTFP species and not be limited to bamboo and rattan only, as in previous years. There will be an increased need to contribute to the various international processes affecting biodiversity in forest ecosystems through the Convention on Biological Diversity (CBD) and its expanded work programme on forest biological diversity, the United Nations Framework Convention on Climate Change (UNFCCC), the Inter-governmental Panel on Forests (IPF), etc. More collaborative work will need to be initiated with other actors in forestry and other sectors.

In this period, we have consolidated our work on:
- locating and monitoring genetic diversity in forest ecosystems
- policies, strategies and priority setting for FGR conservation
- complementary conservation strategies
- genetic resources of NTFPs
- capacity building
- international cooperation
- management and dissemination of FGR information.

IPGRI’s FGR team has grown over the years, and it will continue to grow as we take on more tasks in the conservation and management of FGR in all regions of the world. We believe that the expertise gained over the years plus strong commitment from our partners will contribute to the realization of our goals.

A research project on the phylogeography of neotropical trees was initiated in 2002 with the Smithsonian Tropical Research Institute in Panama. Its aims were to:
- train Latin American scientists;
- carry out studies on the geographic distribution of species in order to establish the phylogeny of some neotropical trees;
- conduct population genetic analyses on some of these trees; and
- initiate collaborative research in the Atlantic forests of Brazil.

The results to date from the various components of this project are reported below.

A study on the population genetics of Mesoamerican mahogany (*Swietenia macrophylla*) based on microsatellite variation revealed that *S. macrophylla* could be subdivided into genetically distinct subregional populations. This has important implications for the sustained management and conservation of this highly endangered

**Locating and monitoring genetic diversity in forests**

**Phylogeography of neotropical trees**

A study on the population genetics of Mesoamerican mahogany (*Swietenia macrophylla*) based on microsatellite variation revealed that *S. macrophylla* could be subdivided into genetically distinct subregional populations. This has important implications for the sustained management and conservation of this highly endangered

Composite of trunk, fruit and flowers of *Symphonia globulifera* (Panama)
species. The study used seven variable microsatellite loci to assess genetic diversity and population structure in eight naturally established mahogany populations in six Mesoamerican countries. Measures of genetic differentiation ($F_{ST}$ and $R_{ST}$) indicate significant differences between most populations. The two populations on the Pacific coast (Costa Rica and Panama) were generally distant from all the others, and from each other. The remaining populations formed two clusters: one comprising the northern populations of Belize, Guatemala and Mexico; and the second containing the southern Atlantic populations of Costa Rica and Nicaragua. Significant correlation was found between geographical distance and all pair-wise measures of genetic divergence, suggesting the importance of regional biogeography and isolation by distance that has been found across Amazon-basin *Swietenia macrophylla*. *Dinizia excelsa* is an important timber tree endemic to the Brazilian Amazon. Using microsatellite genotypes, outcrossing rates and pollen dispersal distance in remnant *Dinizia excelsa* were compared in three large ranches and in a population in undisturbed forest without bees. Self-fertilization was more frequent in the disturbed habitats than in undisturbed forest. Pollen dispersal was extensive in all the three ranches compared to undisturbed forest. Using TWOGENER analysis, a mean pollen dispersal distance of 1509 m was estimated in Colosso ranch (assuming an exponential dispersal function) compared with 212 m in undisturbed forest. The low effective density of *D. excelsa* in undisturbed forest (0.1 trees/ha) indicates that large areas of rainforest must be preserved in order to maintain minimum viable populations. However, the results also suggest that, in highly disturbed habitats, *Apis mellifera* may expand genetic neighbourhood areas, thereby linking fragmented and continuous forest populations. This work provided our partners with an opportunity to collaborate with Frederic Austerlitz (INRA, Bordeaux) in an empirical application of the TWOGENER analysis of pollen dispersal distributions. This provided the first opportunity to apply this kind of analysis to a tropical tree species. In October 2002, a month-long workshop on the development of microsatellite markers was conducted with eight students participating. Two Latin American students developed microsatellites for tropical tree species. Ivan Landires (Panama) developed microsatellites for *Symphonia globulifera* (Clusiaceae); and Catalina Perdomo (Universidad de Los Andes, Colombia) developed markers for *Inga maritima* (Mimosaceae). The study revealed the spatial extent of the three neotropical *S. globulifera* clades, which represent the trans-Andes (Mesoamerica and western Ecuador), the Cis-Andes (Amazonia and Guiana) and the West Indies clades. Strong phylogeographic structure was found among trans-Andean populations of *S. globulifera* stands in contrast to an absence of internal transcribed spacer (ITS) nucleotide variation across the Amazonian basin. This finding indicates profound regional differences in the demographic history of this rainforest tree. Drawing on these results, we can provide a biogeographic hypothesis to account for differences in the patterns of beta diversity within Mesoamerican and Amazonian forests. The broad geographic range of many neotropical rainforest tree species implies excellent dispersal abilities. The nuclear ribosomal spacer region of *S. globulifera* L.F. populations was sequenced to initiate historical analyses of such widespread neotropical trees. This study establishes three marine dispersal events leading to the colonization of Mesoamerica, the Amazon basin and the West Indies, thus supporting palaeontological data.

Several visits were made to three institutions in Brazil to lay the groundwork for collaborative research in laboratories in Brazil. Lectures were given at the University of São Paulo at Ribeirão Preto and the University of São Paulo at Piracicaba. The laboratories of Maristerra Lemes and Rogerio Gribel at the Institute for Amazon Studies (INPA) in Manaus were visited to discuss collaborative research.

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Details of these studies can be found in:
Effective conservation of biological diversity requires information on the biology of the species or system in question. The most critical biological information that is needed for plant conservation has been an issue of discussion for the last 30 years (Duffey and Watts, 1971; Franklin, 1980; Frankel and Soulé, 1981; Schonewald-Cox et al., 1983; Soulé, 1987; Lande, 1988; Falk and Holsinger, 1991; Caro and Laurenson, 1994; Gray, 1996). Most scientists promote an approach that is either ecological or genetic in emphasis. Proponents of a population genetics approach have stressed that understanding the organization of genetic diversity is key to the long-term survival of a species, as genetic variation is a prerequisite for evolutionary adaptation and short-term fitness (Berry, 1971; Lande and Barrowclough, 1987; Vrijenhoek, 1987; Hamrick et al., 1991). Others affirm that autecological research, i.e. characterizing the biotic interaction and habitat requirement of a species, is critical to sound conservation practices (Burgman et al., 1988; Simberloff, 1988; Brussard, 1991).

Assessing the status of rare dipterocarps and prioritization among conservation approaches require a good understanding of the factors that affect the number of individuals within a species. Population genetic processes can result in changes in allele number and frequency as well as levels of heterozygosity. Reduced heterozygosity can result in a decrease in population growth owing to inbreeding depression (Charlesworth and Charlesworth 1987). On the other hand, allelic richness could contribute to population growth through its effect on evolutionary potential, or the ability of a species to respond to changes in its selective environment (Koehn and Hilbish 1987). Ecological interactions between plants and their environment can influence population growth rates via their effects on fecundity, growth, or the survival of individuals (Blundell and Peart, 2001; Peters 2003; Ickes et al. 2003).

In summary, genetic, demographic and environmental stochasticities determine the persistence of populations in the long run. Ecological and genetic processes often interact synergistically to influence the numbers of individuals within a species. Thus, in addition to ecological information, the conservation and management of rare dipterocarps requires a sound understanding of genetic processes and variations within and between populations. The studies on population dynamics and demographic patterns will enhance understanding of the natural processes that operate within a population. Hence, they will enable formulation of more efficient management practices for the species in natur-
al forests as well as the development of sounder silvicultural systems for populations in which logging operations will be conducted. In addition, information about reproductive biology (e.g. pollinators, mating system and pollen-mediated gene flow) and the number of individuals required to form a viable and genetically diverse population are aspects that should also be investigated for effective in situ and ex situ conservation programmes. In order to conserve rare and endangered dipterocarps, it will be necessary to collect seeds or other propagules for ex situ conservation to provide insurance against catastrophic events and to facilitate possible reintroduction when appropriate habitats become available.

Dipterocarps are, economically, highly valuable tree species for many countries in Southeast Asia. In addition, dipterocarp forests host a huge array of biodiversity. In Peninsular Malaysia alone, some 155 species of the family Dipterocarpaceae have been identified (Ashton 1982). However, developed conservation strategies for dipterocarp species are lacking. Since 2001, the Forest Research Institute of Malaysia (FRIM) and IPGRI have been collaborating to explore the genetic diversity of and to develop conservation strategies for Shorea lumutensis, a rare species endemic to Peninsular Malaysia. The long-term goal of this project is to give scientific support to the design of new in situ conservation areas as well as to establish an ex situ conservation programme for the species.

The genus Shorea consists of about 194 species and is widely distributed from Sri Lanka and India to Southeast Asian countries. Malaysia has 18 Shorea species (Soerianegara and Lemmens 1994). S. lumutensis has a restricted distribution area on the western coastal hills of the peninsula, mainly above 100 m above sea level. In the past decades, the population of the species has become more fragmented as a result of land-use changes. In addition, some of the remaining natural populations of S. lumutensis are also threatened by logging. For these reasons, new conservation strategies for the species need to be developed.

This project was initiated in 2001 to carry out detailed studies of the species in its natural habitat for the first time. As a result of the first year of study (ending in September 2002), some basic information on the genetics and ecology of S. lumutensis was generated on the following aspects: genetic diversity, spatial genetic structure, demographic structure, spatial distribution of individuals and association of spatial distribution, and microenvironmental heterogeneity. (For more background information on the project, please refer to the previous issue of FGR Research Highlights.) The second phase of the project identified seven major research areas:

- phenological observations;
- seed collection;
- germination test;
- mating system study;
- direct estimation of gene flow;
- short-term population dynamics;
- and preparation of planting stock using seeds.

In September 2003, two new populations of S. lumutensis were discovered in Segari Melintang and Telok Muroh Forest Reserves (FRs). In April 2004, an additional population was discovered in Pangkor Selatan FR. From this, it can be concluded that the distribution of S. lumutensis is restricted to Manjung District and can only be found in five forest reserves. Major threats to the existence of this species in its natural habitat include: logging activities (Segari Melintang FR); excavation of stone (quarry); conversion to oil-palm plantation (Lumut and Teluk Muroh FRs); and tourism development (Pangkor Selatan and Sungai Pinang FRs).

One flowering event of S. lumutensis was observed in August–September 2002 in Sungai Pinang FR. Periodic phenological surveillance of the population in Sungai Pinang has been undertaken according to the methodology identified by Appanah and Chan (1982) to determine the flowering stages, flowering intensity and fruiting stages. Flowering intensity was high for all the observed trees. The period from the tail flowering stage to mature fruit fall was about 10 weeks, and the period from the budding stage to mature fruit fall was about 16 weeks. Fruit predation was extensive with small mammals consuming the majority of fallen fruits. As the flowering event was sporadic and involved only five observed trees, a high proportion of selfing might be anticipated. Some 500 seeds were collected from four mother trees. Germination of the collected seed was poor and the growth of the seedlings became very slow three months after germination. This might indicate inbreeding depression due to selfing.

In order to aid in the assessment of genetic diversity and to identify highly polymorphic molecular markers for direct estimation of gene flow, five microsatellite markers have been developed and characterized for S. lumutensis using a genomic library enriched for dinucleotide (CT). Paternity analysis (direct estimation of gene flow via immigration of pollen) and a mating system study are currently being carried out using these markers as well as four microsatellite markers developed for S. leprosula. Subsequently, the effective breeding unit will be calculated. Outcrossing and selfing rates will be directly inferred and calculated from the multilocus genotype of half-sib progenies and mother trees.

The previous study indicated that use of wildings as planting material was not a feasible option with S. lumutensis. The planting materials currently available for ex situ conservation consist of seedlings from Sungai Pinang FR. Seed collections will be continued in the other populations to widen the gene pool. The present results and the ongoing studies on population genetic structure, mating system and population dynamics (review census) will help in the establishment of more efficient and effective in situ and ex situ conservation programmes for the species in the near future.

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Conservation and sustainable use of FGR in Argentina and Brazil

A project on the conservation, sustainable use and management of forest genetic resources (FGR) with reference to Argentina and Brazil was implemented between 2000 and 2003. This work was made possible by the support of the Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ) – the German Ministry for Economic Cooperation and Development.

The aim of the project was to develop management practices that support conservation efforts through improved understanding of the impact of human activities on the genetic diversity and ecological processes in different forest ecosystems across Brazil and Argentina. The ecosystems selected for the project were: the Araucaria araucana forests in southwestern Argentina; the Araucaria angustifolia forests in southern Brazil and northern Argentina; the Atlantic forest in southeastern Brazil; and the Amazonian rainforests in northern Brazil. The project involved researchers and partners from different disciplines (ecology, genetics and socioeconomics) carrying out research activities using a participatory approach. At each of the project sites, local research institutes have been conducting research in collaboration with local non-governmental organizations (NGOs), government representatives to: develop sustainable-use practices for timber and non-timber forest products; contribute to restoration of degraded landscapes; and explore options to minimize the impact of land-use changes.

The project has generated a wealth of baseline information on Araucaria forest ecosystems in Argentina and Brazil together with a preliminary understanding of their socioeconomic and policy context. Research partners and stakeholders have identified areas for further research, experimental application of results, and capacity building. These include:

- **Refinement of system-based models describing forest genetic, socio-economic and ecological dynamics**;
- **Better understanding of the factors that shape forest genetic diversity in Araucaria at local and regional level**;
- **Development of participatory management practices**;
- **Strengthening of institutional and community capacities**.

The project’s outcomes are expected to contribute to the development of a sustainable forest management model that can be adapted to other countries and forest types.

**Literature cited**

Achievements and findings were analysed in the light of goals set at the beginning of the project, identifying also the major gaps. The main purpose of this was to reach a general integrated view of the system under investigation, with the biological and anthropic components integrated for each site. This provided an opportunity for participants to become familiar with the details of each case study, through a series of presentations given by project coordinators. One session focused on challenges posed by the participatory and interdisciplinary approaches of the research methods. It was later agreed that a book describing the project results and various aspects of the research content should be published to give more visibility to the project outcomes. The participants agreed on a general content and structure of the publication. The publication has been finalized and published. In particular, it examines how research should be translated into practice in terms of developing guidelines, formulating recommendations for policy-making and for conservation and management plans, and developing sustainable alternatives for the FGR use. Visits were made to sites including the communities of Chiuquilihuin and Tromen.

The following partners were actively involved in carrying out research activities in the region:

- Brazilian Agriculture Ministry (EMBRAPA)
- Universidade Federal do Paraná
- Universidade de São Paulo
- National Institute for Agriculture and Technology for Argentina (INTA)
- Universidad Nacional de Misiones
- Center for International Forestry Research (CIFOR)

**FINAL PROJECT WORKSHOP**

The final workshop of the BMZ-funded project on conservation in Argentina and Brazil was held in S. Carlos de Bariloche, Argentina, from 28 April to 2 May 2003. The objective of the workshop was to bring together all partners and stakeholders in the project to: (i) share research findings and lessons learned from the different sites; (ii) find ways to translate research findings into practical recommendations; and (iii) to develop strategies to increase public awareness about the project’s outcomes and approach. It was also an opportunity for all project participants to learn more about project results, particularly from disciplines and study sites with which they were less familiar.

The project provided a good opportunity to gain a holistic view of different ecosystems, linking various disciplines, and focusing on issues outside forest ecosystems but with considerable impact on the human and environmental systems, particularly on FGR.

One of the objectives of the project was to extract some common elements across the various sites and use them for a comparative analysis. It was stressed that the historical background and the policy framework in each site were important to understanding trends in land use and the use of natural resources. It was also noted that the historical background was important to providing an understanding of how anthropic pressure had modified genetic diversity. The historical background also helped in the interpretation of the current distribution and structure of genetic diversity.

Achievements and findings were analysed in the light of goals set at the beginning of the project, identifying also the major gaps. The main purpose of this was to reach a general integrated view of the system under investigation, with the biological and anthropic components integrated for each site. This provided an opportunity for participants to become familiar with the details of each case study, through a series of presentations given by project coordinators. One session focused on challenges posed by the participatory and interdisciplinary approaches of the research methods. It was later agreed that a book describing the project results and various aspects of the research content should be published to give more visibility to the project outcomes. The participants agreed on a general content and structure of the publication. The publication has been finalized and published. In particular, it examines how research should be translated into practice in terms of developing guidelines, formulating recommendations for policy-making and for conservation and management plans, and developing sustainable alternatives for the FGR use. Visits were made to sites including the communities of Chiuquilihuin and Tromen.
Modelling for FGR Conservation

A modelling exercise within the framework of the BMZ-funded project was held at IPGRI headquarters in Rome on 29–30 October 2003. This exercise marked a conclusive step within the research activities of the project. It focused on studying the impact of human activities on FGR in different forest ecosystems in Argentina and Brazil. The workshop brought together project participants from Argentina and Brazil and modelling experts from various institutions worldwide.

In four years of research activities in collaboration with research institutions in Argentina and Brazil, data were gathered on some key species selected from different ecosystems (Amazon forest, Mata Atlantica, Araucaria araucana forests, Araucaria angustifolia forests).

The Araucaria araucana forest ecosystem was chosen as the subject of the model exercise, in view of its lower level of diversity compared with tropical forests, and taking into consideration the key role these forests ecosystems have for local livelihoods.

The main objectives of the workshop were to: (i) define suitable ways of representing the functioning of Araucaria ecosystems through modelling; (ii) perform a simulation of the impact of use of forest resources on genetic diversity, through the modelling of patterns and processes by which biological diversity is maintained and used (from genes to ecosystems); and (iii) develop a solid modelling methodology, which should be suitable for simulating biological processes and socioeconomic dynamics with reference to forest ecosystems, and one that would also serve as a guide to identification of optimal forest management options in different environmental, social contexts and spatial scales.

The Araucaria araucana modelling was based on the findings generated by the research carried out on human impact on Araucaria forest ecosystems. Specific information used included: maps of Araucaria distribution, and environmental degradation in Araucaria forest ecosystems; practices for natural resources management by the indigenous communities of Mapuche; the impact of seed collection and livestock grazing on forest regeneration; temporal patterns of Araucaria seed production in different regions of the Araucaria range in Argentina, in relation to precipitation patterns and degree of fragmentation; and seed predation. The model also incorporated information on the genetic characterization of Araucaria populations.

Preliminary simulations of the Araucaria forest ecosystem functioning, using STELLA modelling environment, revealed the main linkages between socioeconomic, ecological and genetic factors and the direction of positive and negative feedback between the variables identified to simulate the system’s behaviour. Preliminary thoughts were formulated with regard to the structure of the various interrelations between the human factor and environment, with a specific focus on Araucaria’s regeneration and genetic diversity in the studied systems.

A series of main linkages were identified between forest genetic diversity and other variables of the system:

- forest tree species genetic diversity is fundamental to securing resilience;
- forest tree species have key importance for the livelihoods of local communities;
- FGR management has an impact on genetic diversity (at the ecosystem level and within species).

The final outcome of the exercise was a draft model integrating information from different disciplines, specifically: forest tree species ecology, reproductive biology, genetics, and socioeconomics. The model is structured in a way to enable a comparison of alternative management options with regard to their impact on FGR, and allows identification of acceptable or sustainable levels of extraction of timber and non-timber forest products (NTFPs). The recommendation was made that the tool be made easily accessible for adoption and application to practical cases, with the objective of identifying sustainable practices in FGR management. The existing criteria and indicators of sustainable forest management were taken into account.

In the model-design phase, opinions were expressed on how to include the human component in the model. One view was to make the human component an external factor influencing the system’s behaviour. In this case, the influence of forest user groups would be expressed by various management options giving rise to different scenarios. Another view was to have a large model, inclusive of all processes (i.e. showing how genetic diversity contributes to resilience in a species and therefore has an ultimate impact on livelihoods, which is related to genetic diversity through species management). Another suggestion was to take as an assumption the value of genetic diversity, simply showing the consequences of human impact on genetic diversity.

At the end of the day, the various characteristics for a suitable modelling tool to be used in the decision-making process associated with FGR management were defined. Major components of the model were identified and suggestions were made on the most appropriate modelling environment to be used in running the model. A new project proposal that focused on improvements to the model was also discussed.

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Seed biology of *Uapaca kirkiana*, *Sorindeia madagascariensis* and *Bridelia micrantha*

For years in Tanzania and in many other countries in tropical Africa, there have been plans to plant fast-growing exotic trees to meet the growing demand for timber and other wood and non-wood forest products. Indigenous tree species were given a low priority in these planting programmes owing to insufficient information on their silviculture, especially seed handling. This was a consequence of insufficient research on indigenous trees in terms of reproductive biology and silviculture. In the past decade, there has been growing public awareness of the diverse values of indigenous trees, coupled with increased planting of indigenous trees (particularly but not exclusively on-farm). As these trees are propagated mainly from seeds, there has been a greater emphasis on the rapid expansion of seed production. Now, with the change in attitude to indigenous trees, there is a need for an in-depth understanding of their seed biology. Therefore, scientific efforts should focus on this aspect in order to contribute to indigenous tree planting programmes as well as generate information that could be useful to the management of all tree germplasm. This study focuses on three species: *Uapaca kirkiana*, *Sorindeia madagascariensis* and *Bridelia micrantha*. They were chosen for several reasons, including:

- They are indigenous to Tanzania and many other countries in Africa, hence, they are familiar to the people in the region;
- They are economically and socially important not only to local communities in Tanzania but also to communities in many countries in sub-Saharan Africa;
- The species are propagated through seed, which is produced in sufficient quantities every year;
- Their seeds are not dormant and can germinate readily under favourable conditions without any pre-treatment.

The seeds of these trees are thought to be recalcitrant and do not store well, losing viability before the following fruiting season. For such trees, even a small improvement in the maintenance of viability means a significant step towards commercial production and supply of valuable tree seed as well as contributing to more effective genetic conservation. During the plant life cycle, seed development and storability are the most critical stages for the species survival, especially if the species is to be domesticated. Thus, this study was an attempt to understand the seed biology and, in particular, to determine and improve seed viability retention in order to enable their long-term conservation. The investigations included: fruit and seed development studies; determination of chemical composition of seeds; post-harvest physiology; and seed storability.

Germination tests revealed that *U. kirkiana* and *S. madagascariensis* seeds germinate better with endocarps removed than when they are left intact. However, *B. micrantha* seeds germinated well on all media tested, regardless of endocarp removal. Germination of embryonic axes was high on all media for all three species. It is recommended that the endocarp in *U. kirkiana* and *S. madagascariensis* seeds be removed in order to enhance germination. The most appropriate germination media for seeds is Perlite and MS or WPM media for axes.

The moisture content (MC) of the seed components (viz. seed coat, endosperm, cotyledons, and embryonic axes) was determined gravimetrically, using four replicates of ten components. *U. Kirkiana* endosperm had the highest MC, followed by embryonic axis and cotyledons. The seed coat had the lowest MC. It is apparent that the relatively high MC of the whole seed is contributed mainly by the endosperm (at 37% of the entire seed weight). Mature seeds of *S. madagascariensis* have no endosperm.

Assessment of the fungal status of seeds of the three species was carried out, and responses to various antifungal treatments prior to storage were performed. The aim was to identify, locate and isolate fungi from seeds of the tree species and to develop fungicide treatments for the seeds that could be applicable for extending their life by the traditional wet storage technique. A number of different saprophytic and pathogenic fungi were detected from the entire seed as well as from components (organs) of freshly harvested seeds. Their level of infection varied from 0 to 10%. Most of the fungi were detected in association with the cotyledons. Preliminary observations suggested that the composition of the mycoflora changed during hydrated storage of the seeds.

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The destruction of tropical forests is widely acknowledged as one of Earth’s most serious environmental problems. The consequences of this ongoing environmental disaster have been well documented. They include degraded water catchments, biodiversity loss and worsening rural poverty. The seasonally dry forests of Southeast Asia’s highlands are particularly at risk. Despite levels of biodiversity that often match those of many tropical rain forests, the seasonally dry tropical forests of Southeast Asia’s monsoonal belt are thought to be more endangered than equatorial rainforests. In response to this problem, several countries in the region have banned or restricted commercial logging in the remaining areas of primary forest and added former logging concessions to their already extensive protected areas systems. The problem is that even these so-called ‘protected’ forests are often too degraded to meet the need for healthy natural forest that is capable of supporting viable populations of wildlife. It is becoming increasingly apparent that attempts to protect the remaining forest are not enough. In order to save Southeast Asia’s tropical forests, destruction must not merely be halted but actually reversed.

The restoration of highland forests is urgently needed across the region in order to ensure a sustainable future for both wildlife and local people and to fulfil national policies and international commitments to maintaining the diversity of life on our planet. Ecological restoration is rapidly becoming an important tool in conservation biology to conserve biodiversity, restore environmental services (e.g. water supply and biological control) and provide benefits for people (e.g. food, fuelwood and medicinal plants). The WWF and IUCN have proposed the all-encompassing concept of ‘forest landscape restoration’, which aims to re-establish ecological integrity and enhance human well-being in degraded forest landscapes. In order to be successful, such an approach requires an effective technique to rapidly restore forest ecosystems to degraded areas.

In response to these issues, the Forest Restoration Research Unit (FORRU) of northern Thailand’s Chiang Mai University has been working with Horticulture Research International (HRI) of the United Kingdom. The FORRU has been adapting the ‘framework species method’ in order to restore seasonally dry forests to degraded watershed sites in the mountains of northern Thailand. This method was first conceived in the wet tropical lowland rainforest of Queensland, Australia (Goosem and Tucker 1995) and subsequently adapted to the seasonally dry tropical forests of northern Thailand. The basic structure and functioning of forest ecosystems are re-established rapidly by planting mixtures of 20–30 carefully selected native forest tree species (both pioneer and climax simultaneously). Subsequently, biodiversity is restored by the planted trees attracting seed-dispersing animals into planted sites. Therefore, the essential characteristics of framework tree species are: high field performance (survival and growth rate) in degraded sites; dense, spreading crowns that shade out herbaceous weeds; and provision of resources that attract seed-dispersing wildlife (e.g. fruits, nectar, and nesting sites) at an early age. In areas susceptible to wildfires during the dry season, an additional consideration is resistance to burning or recovery after fire, such as coppicing ability. Framework species should also be easy to propagate in nurseries by local people with simple technologies. They should have: reliable seed availability; preferably rapid and synchronous germination; and rapid growth of seedlings to a plantable size (50–60 cm) in less than a year. High-quality seedlings are important as they have the best chance of surviving in hostile deforested environments. Consequently, it is essential that good silvicultural practices are adopted.

Selecting candidate framework species for FORRU’s field trials required extensive background studies. Germination trials and monitoring of early seedling growth were carried out on 400 tree species indigenous to Doi Suthep-Pui National Park (DSPNP). A detailed study was carried out on tree flowering and fruiting phenology. It involved 100 tree species with descrip-
sections, drawings and photographs of the fruits and seedlings of potential framework species. A herbarium collection of dried seedling specimens was established, along with computer databases of seed, fruit and seedling morphology. Germination was tested and seedling performance was monitored in the nursery and after planting out in degraded areas. This enabled compilation of species production schedules. DSPNP is itself a location of recognized conservation importance, owing to its high diversity of tree species. With more than 600 tree species suited to a wide range of soil and climate conditions, DSPNP could provide a valuable seed source for forest restoration projects outside the park.

Planting trials in 1995–97 enabled identification of some species likely to perform well in degraded sites. Without such basic background information, it would have been very difficult to make sensible selections of candidate framework species for more extensive field trials. Based on all these studies, framework species have been planted in field plots each year since 1997 in partnership with Hmong hill-tribe community residents within DSPNP. FORRU helped the villagers to establish their own community tree nursery in order to test the practicability of the new nursery methods in a village environment. The planting trials were designed to provide a quantitative assessment of the degree to which various tree species meet framework species criteria. The trials helped to establish appropriate standards for the selection of tree species for forest restoration. Canopy closure can now be achieved within 2–3 years after planting. Weeds have largely been replaced with a carpet of leaf litter. Wild pigs, deer and other wildlife have been observed in the planted sites. The Convention on Biological Diversity emphasizes the importance of maintaining intraspecific genetic diversity and evolutionary potential. Consequently, adaptability and the maintenance of a broad genetic base must be ensured when undertaking a tree-planting programme. Genetic variation in a founding population is critical, particularly where restored areas are far from pollen sources. Framework species planted in degraded areas will need to be able to adapt to the ‘new’ environment of the restoration plots. They are also likely to become sources of seed for other degraded areas, both through natural dispersal locally, and through seed collection by practitioners for artificial planting.

Adaptive traits monitored included: survival in degraded plots, growth rates and canopy width. Adaptive traits provide trees with the ability to adapt to changes in their environment through natural selection. Populations with little genetic variation are more vulnerable to climate change, habitat change (planting in degraded areas), pests and disease. Molecular traits are very useful for studying genetic diversity. They are also powerful tools in the study of gene flow, i.e. the transfer of genes within and between populations by pollen and seed. *Prunus cerasoides* is an important framework tree species. Its genetic diversity was examined within and between three national parks (Doi Suthep-Pui, Doi Inthanon and Doi Ang Khang) in northern Thailand using published microsatellite primers developed for peach, sweet cherry and sour cherry (Pakkad et al. 2004). The levels of heterozygosity detected for each site over all loci indicated that each collection of parent seed trees exhibited a high level of genetic variation. This suggested that, to maintain genetic diversity, seed should be sampled from a much larger number of trees than is currently practised. While the majority of genetic diversity was contained within sites, they should also be considered as genetically distinct. However, some important questions were not addressed in this study. In particular, no gene-flow study was conducted to determine the extent of pollen exchange between the intact forest and restoration plots. Such gene flow could re-introduce genetic diversity into restored forest tree populations. Consequently, a joint IPGRI–FORRU collaborative project was set up to begin to address these issues by studying: the genetic diversity of *P. cerasoides* within an area of restoration plots; and gene flow between intact forest and the restoration plots. Pollinators and seed-dispersing wildlife species were also identified. This project is significant because it will provide information on gene flow of this species for the first time. This knowledge will be invaluable for planning seed collecting strategies for future restoration planting, helping to ensure the conservation of genetic resources of *P. cerasoides*.

For further information, please contact Dr David Blakesley, Wildlife Landscapes, UK (David.Blakesley@btinternet.com), or Dr Greuk Pakkad, Forest Restoration Research Unit (FORRU), Department of Biology, Faculty of Science, Chiang Mai University, Thailand (greukp@yahoo.com)

**COMPLEMENTARY CONSERVATION STRATEGIES**

**LITERATURE CITED**


Conservation of genetic resources of NTFP species

Bamboo and rattan

Bamboo and rattan activities were continued in 2003 to address specific needs of countries in the Asia, Pacific and Oceania Region, following strategies developed for these two non-timber forest products (NTFPs) of great economic, social and cultural importance. During the year, one project each on bamboo and rattan was completed on species mapping and patterns of genetic diversity in wild populations. Three other such studies on bamboo were done in 2004. Six new studies on priority species of bamboo and rattan were initiated with partners in five countries, namely: India, Indonesia, Malaysia, Nepal and Vietnam. These studies focus on genetic diversity aspects, impacts of management practices, and the effectiveness of conservation areas. In addition, IPGRI staff participated in the Asia-Pacific regional workshop “Forests for Poverty Reduction: Can Community Forestry Make Money?” in Beijing on 1–3 September 2003. The workshop also discussed the contribution of bamboo as a source of income and livelihoods for local communities. IPGRI also attended the “International Conference on Bamboo Resource Utilization and Processing Technology” in Yiyang, China, on 8–10 September 2003, where the importance of bamboo as a resource for industrial use as well as for local communities was demonstrated. The sustainable management of genetic diversity in extraction areas was highlighted in IPGRI’s paper to the meeting. Closer collaboration was forged with the International Network on Bamboo and Rattan (INBAR), and a workshop on bamboo hybridization and flowering will be one of the initiatives to be developed in the coming year. This collaborative effort will continue to be strengthened, particularly regarding information sharing and development of criteria and indicators for sustainable management of these species. In addition, advice and scientific services have been provided in response to numerous enquiries from the public and researchers on different aspects of bamboo and rattan genetic resources. Further details on research activities on bamboo and rattan are set out below.

Bamboo

The project “An ex situ collection of bamboo for national conservation and research” was completed successfully with IPGRI’s Malaysian partner. With an ex situ collection consisting of 67 plants that include 34 species in 7 genera, the Bambusetum is already the largest in the country and will contribute to a better understanding of species biology, growth rates and management practices. The host institution, with staff members who are already familiar with the role and functions of living reference material, will continue adding to the collection. Key species in the collection include: (i) very rare taxa such as Schizostachyum terminale and S. lengguanii; (ii) a probable natural hybrid between Dendrocalamus and Gigantochloa recognized during a field survey; and (iii) two unnamed species of Gigantochloa not previously recorded. A publication on the diversity of bamboo was completed in 2004. A study is underway on species diversity and ex situ conservation of some bamboos in Vietnam. Its aim is to solve taxonomic problems of common and unknown species. This project will serve as a basis for the implementation of conservation and management practices of candidate species.

Rattan

The study on the population demographic status and genetic variation of Calamus manan, an economically valuable rattan, has been completed in Indonesia. The results have shown the possible use of isozymes to distinguish the genetic variation of C. manan in Sumatra. There is also an indication of correlation between the stage of seedling growth and isozyme
patterns. This could have practical implications for assessing the growth of seedlings. The diversity measured by isozyme analysis and grouped into dendrograms has shown a serious reduction in variation within populations in the study site. Hence, urgent efforts have to be made to conserve this species.

A study on gap analysis of protected areas in the Western Ghats, India, for conservation of bamboo and rattan resources has been initiated with a partner from India. This study addresses the conservation status of bamboo and rattan in the Western Ghats. It also examines the extent to which the ‘protected areas’ in the Western Ghats are able to meet the conservation requirements of these two species for the sustainable livelihood of the local community. A publication on the status of bamboo and rattan resources in the Western Ghats was compiled in 2004.

For further information, please contact: Hong Lay Tong, IPGRI Asia, Pacific and Oceania (HongLT@ipgri-apo.cgiar.org), or Dr Ramanatha Rao, IPGRI Asia, Pacific and Oceania (Vrao@ipgri-apo.cgiar.org)

Workshop on conservation of genetic resources of NTFP species in Ethiopia

A workshop on the conservation of genetic resources of non-timber forest products (NTFPs) in Ethiopia was held in Addis Ababa on 5–6 April 2004. The workshop was organized by IPGRI in collaboration with the Ethiopian Agricultural Research Organization (EARO). It brought together more than 32 participants from various research institutions and universities in the country. This workshop arose out of a mission to Ethiopia by one of the IPGRI FGR staff in February 2003. The purpose of the visit was to solicit partner support for our proposed work on the restoration of dry forest ecosystems and on expanding the scope of IPGRI’s work on NTFPs. One of the major outcomes of this visit was the need to bring together stakeholders in Ethiopia to discuss the state of conservation and management of genetic resources of NTFP species in Ethiopia and to identify potential areas of intervention. Arrangements were made to hold this meeting early in 2004. It was anticipated that the workshop would also be an entry point for future collaboration between IPGRI and partners in Ethiopia to promote the conservation and sustainable use of forest genetic resources (FGR) in the country. The outcomes of the workshop were expected to contribute to the development of a broader work programme on the restoration of dry forest
ecosystems not only in Ethiopia but also in the entire sub-Saharan region. More than ten papers on various aspects of NTFPs in Ethiopia were presented during the two days, including those discussing individual NTFP species and those covering a whole range of NTFP species from a particular region in the country.

A major outcome of the workshop was the recognition of the need to promote the conservation of genetic resources of the major NTFP species, particularly those threatened by over-exploitation and habitat loss, as well as to make full use of those species that are valuable but receive little attention. The best example given in this second category was bamboo (*Arundinaria alpina*), which has numerous potential uses but is currently used for fuelwood and fencing, and to a limited extent as a source of food-bamboo shoots for some communities. Another species identified as being in need of immediate intervention was *Boswellia papyrifera*, which is a source of locally and internationally valuable frankincense.

The workshop recommended more research into the reproductive biology of the major NTFP species to provide information useful for their conservation and domestication. It also recommended: collaboration and networking between the various Ethiopian institutions engaged in NTFP research and development; dissemination of information relating to the conservation and use of NTFPs to a wide range of stakeholders in the country; and promotion of small-scale enterprises based on NTFPs.

The participants called for a follow-up of the recommendations of the meeting into some concrete actions in the country and a regular holding of such meetings to share experience among the various stakeholders. It was also suggested that future meetings should have adequate coverage of the policy and legal framework and institutional issues relating to genetic conservation and use of NTFP species. The following Ethiopian institutions were represented at the workshop:

- Ethiopian Agricultural Research Centers (including the Forestry;
- Research Center, Pawe Research Center, Essential Oils Research Center, Holetta Research Center, and Melkasa Research Center);
- Oromiya Region Agricultural Research Institute (Sinana Research Center);
- Wondo Genet College of Forestry (Debub University);
- Mekele University;
- Addis Ababa University (Biology Department);
- Institute of Biodiversity Conservation;
- ZEF–COCE Project;
- Amhara Region Agricultural Research Institute;
- Jimma Agricultural Research Center (EARO).

For further information, please contact: Wubalem Tadesse, Forestry Research Centre, Ethiopian Agricultural Research Organization (ntsp@telecom.net.et or wubalem7@yahoo.com), or Michael Mbogga, IPGRI Sub-Saharan Africa (Mmbogga@icraf.cgiar.org)
IPGRI sponsors two fellowship programmes: the Abdou Salam Ouédraogo Fellowship and the Vavilov–Frankel Fellowship

Abdou Salam Ouédraogo Fellowship

The Abdou Salam Ouédraogo Fellowship was created to honour the memory and celebrate the contribution of the late Dr Abdou Salam Ouédraogo to the conservation and use of plant genetic resources. Dr Ouédraogo led IPGRI’s forestry programme from 1993 to 1999. He left an indelible mark on IPGRI and the world forestry community as a whole. At the time of his death in a plane crash in January 2000 in Abidjan, Côte d’Ivoire, he was exploring ways to bring young scientists from Africa into the international research environment. His ideas live on in the Abdou Salam Ouédraogo Fellowship scheme. The scheme offers support for research on the conservation and use of forest genetic resources (FGR) and involves linking young African scientists with international research institutions in forestry and natural resources management.

The Abdou Salam Ouédraogo Fellowship is funded by donations from Dr Ouédraogo’s friends, colleagues and institutional collaborators. Donations from other sources are matched by a donation from IPGRI. For details, visit the IPGRI Web site www.ipgri.cgiar.org under Training.

Recent Abdou Salam Ouédraogo Fellowship Research

Impact of domestication on genetic diversity of Uapaca Kirkiana in Malawi

William Chrispo Hamisy (Tanzania) 2003

Uapaca kirkiana Kuell. Arg (wild loquat) is one of the species in the Euphorbia (Euphorbiaceae) family. The genus Uapaca contains approximately 60 species of which 49 are restricted to mainland Africa with the rest occurring in Madagascar (Thiselton-Dyer 1913). U. kirkiana is a southeast African fruit tree found in Angola, Burundi, Democratic Republic of Congo, Malawi, Mozambique, Tanzania, Zambia and Zimbabwe. The species occurs on well-drained, infertile and acidic soils at altitudes of 500–2000 m in frost-free areas, subject to a dry season lasting 5–7 months with unimodal annual rainfall of 500–1400 mm (Ngulube et al. 1995).

U. kirkiana is among the multipurpose tree species of the miombo woodlands. It is reported as providing edible fruits, fuelwood, building materials, medicines and shade to the rural communities in its growing areas (Mbuwa et al. 1994; Mwamba et al. 1992). Its fruits can be eaten raw, made into jam and sweetmeats or used to produce a refreshing drink and a variety of wines (Mwamba 1989). The fruits contain: 27.4% dry matter, 86.5% total carbohydrates, 8.4% fibre, 1.1% fat, 8% crude protein, with vitamin C contents of 16.8 mg/100 g fresh weight (Saka and Msonthi 1994). Because of the extended period of fruit ripening through the dry season, U. kirkiana serves as an important famine food reserve. It ranked first in a fruit-tree priority setting exercise conducted in Malawi. Furthermore, the development of cottage industries in Malawi and Zambia has opened an attractive market for the fruits. Large quantities are now required to sustain these industries as well as meet the growing demand for whole fruits in rural and city markets (Ngulube et al. 1997).

Throughout its natural range, the fruits of U. kirkiana are collected from the wild. As a result, several organizations in southern Africa have begun programmes to domesticate indigenous fruit trees of the miombo woodlands. This process involves selection, characterization, production and adoption of desirable tree germplasm in a process that involves farmers directly in research. Extensive germplasm collection was made from a number of countries between 1995 and 1997, and populations are currently being evaluated in multilocation field trials to identify superior material. Furthermore, the International Center for Research in Agroforestry (ICRAF) – Southern African Region Programme (Malawi office) has initiated the domestication process of U. Kirkiana. This involves selection of superior mother trees through participatory rural appraisal (PRA) in four sites at which farmers identified superior trees based on criteria such as fruit sweetness, bearings and size. Following the PRA, seeds were collected from the selected
D. Odee

The sample consisted of: random amplified polymorphic DNA (RAPD). The sample consisted of:

- random sample involving both male and female *U. kirkiana* trees from the wild populations in Dedza and Malosa (25 trees from each population);
- identified mother trees from the two populations (25 trees from Dedza and 15 trees from Malosa);
- 100 progenies raised from seeds collected from four mother trees in Dedza and Malosa (25 progenies from each mother tree).

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**LITERATURE CITED**


**ENHANCING THE CONSERVATION AND UTILIZATION OF *MELIA VOLKENSII* THROUGH DEVELOPMENT OF VEGETATIVE PROPAGATION PROTOCOLS IN KENYA**

Abwao Stephen Indieka (Kenya) 2004

Abwao Stephen Indieka, who previously worked as a research assistant at the biotechnology laboratory of the Kenya Forestry Research Institute (KEFRI), is currently pursuing an MSc in biotechnology at Kenyatta University. This work forms part of a larger KEFRI project funded by the International Service for the Acquisition of Agri-biotech Applications (ISAA) focusing on domestication of *M. volkensii*. The project involves: the identification and collecting of germplasm; and the planning, designing and undertaking of propagation experiments (micropropagation and macropropagation).

*M. volkensii* is among the indigenous tree species that thrive in the arid and semi-arid lands (ASALs) of Kenya and is also popular among farmers. It is valued for timber, fuelwood, termite-resistant poles and fodder, among other uses. Overexploitation and settlement in the ASALs has led to loss and fragmentation of natural populations of this species. Conservation and replanting of *M. volkensii* has been hampered by a lack of adequate planting materials resulting from difficulty in propagation through seed. This necessitates the development of appropriate alternative mass-propagation techniques to alleviate the problem. Clonal propagation using micropropagation and macropropagation techniques offers a viable alternative means as it has proved successful with other woody species such as *Eucalyptus* and *Balanites* spp. One of the main factors limiting conservation and replanting of *M. volkensii* is seed dormancy (Teel 1985). Much research has been conducted on breaking the dormancy (Milimo 1989a). However, propagation through seed using methods suggested in literature has so far proved generally cumbersome and difficult to optimize. Existing vegeta-
tive propagation methods described by Kidundo (1997) and Milimo (1989b) are not easily applicable to mass propagation. Multiplication of tree species has enabled foresters to develop and operate highly successful clonal forestry and breeding programmes (Denison and Quaile, 1987; Ikemori et al., 1994). A combination of micropropagation and macropropagation techniques is especially important for tree species because of their complementarity. Micropropagation and macropropagation offer a rapid means of producing planting materials in mass and can easily be applied to clonal multiplication of *M. volkensii*.

The major aim of the study is to develop appropriate alternative propagation methods with the emphasis on vegetative/clonal propagation protocols for *M. volkensii* using rejuvenated plant materials. The study will attempt to achieve the following objectives: development of *in vitro* multiplication and *ex vitro* rooting protocols for *M. volkensii*; a multiplication protocol using rejuvenated leafy cuttings; and determining optimum hormone levels (auxins and cytokinins) for *in vitro* multiplication and rooting. In addition, efforts will also be made to compare *in vitro* performance variation in relation to explants source (clonal variations) and rooting performance, and subsequent establishment of *in vitro* multiplied cuttings and field-sourced macrocuttings under mist propagator conditions, together with determination of clone (tree) on the rooting performance of macrocuttings.

At least ten *M. volkensii* trees will be selected on different farms within Kitui District. Trees will be selected on the basis of age (3–10 years old) and tree form (at least 4 m of straight bole and less branching). Results of this study are expected to benefit farmers, forest departments, community-based organizations (CBOs) and non-governmental organization (NGO) stakeholders involved in tree planting, forestry and agroforestry in the drylands of Eastern Africa. Conservation/reforestation/replanting of *M. volkensii* will be expedited, hence, enabling sustainable and sufficient use of its products in ASALs, with spin-offs of rehabilitation and conservation in these zones.

For further information, please contact: Abwao Stephen Indiieka (hswilwa@yahoo.com) Kameswara Rao, IPGRI Sub-Saharan Africa (Krao@icraf.cgiar.org)

**Literature cited**


International symposium of wood biotechnology, Tokyo University of Agriculture and Technology, Tokyo.


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**Vavilov–Frankel Fellowship**

IPGRI established the Vavilov–Frankel Fellowship to commemorate the contributions made to plant science by Nikolai Ivanovich Vavilov of Russia and Otto Frankel of Australia. The fellowships are intended to enable young scientists to carry out relevant and innovative research outside their countries, thus contributing to their own professional development and to the ability of their countries to manage and conserve crop diversity.

**Recent Vavilov–Frankel Fellowship research**

*Genetic diversity and gene flow in oriental beech (Fagus orientalis L.) populations in Iran*

Parvin Salehi Shanjani, Research Institute of Forests and Rangelands, Tehran, Iran (2003).

Oriental beech forests are the most valuable forests in the Caspian zone and an important source of timber for Iran. They are distributed on the northern slopes of the Alborz Mountains, at 500–2100 m above sea level and form a belt 700 km long (Figure 1) These forests cover three provinces in Iran: Gilan, Mazandaran and Golestan. Pure and mixed *F. orientalis* forests comprise the most important forest type, covering about 17% of the total Hyrcanian forest area and constituting about 25% of the country’s forests. The species exists in Mesophilous forest vegetation on the Caspian coast of Iran. Its floristic characteristics indi-
conditions. For example, there is more precipitation in the west while the east is drier experiencing longer drought periods (Figure 2). In the east, basic rocks predominate whereas those underlying the west are more acidic in nature. All these aspects have a bearing on the quantitative and qualitative genetic characters of *F. orientalis* populations in Iran (as seen in the wide variation in morphological characteristics of the species). Average tree height in the easternmost Gorgan region is much higher than that in Asalem further west. In addition, Marvie Mohadjer (1976) found the Asalem region to have the lowest percentage of forked trees and number of branches in the first 10 m of trunk.

Previous studies have revealed significant allelic frequency differences and low genetic differentiation in populations of *F. orientalis* in Hyrcanian forests. The aim of this work was to collect information to help in the establishment of gene conservation resources within the *F. orientalis* range in Iran. This work is also expected to contribute to the development of a gene conservation strategy for Iran, which is currently one of the priorities of the Iranian Forest Service.

Dormant buds were collected from 13 natural *F. orientalis* populations covering a large part of its distribution range. Care was taken to ensure optimum representation of the different *F. orientalis* populations. Nuclear and chloroplast simple sequence repeats (SSRs) analysis was carried out on at least 40 and 14 trees in each of the populations, respectively. In a second phase, nuclear SSRs analysis was carried out on progenies of ten trees from each population to analyze the mating systems and monitor gene flow within and between the stands. Results indicate considerable variation within and among populations. Ten haplotypes were found, and almost all haplotypic variation resides among populations with a clear geographic distribution of the genetic diversity of *F. orientalis* in Iran.

The mean observed heterozygosity (He) over all investigated loci ranged from 0.59 (Gorgan–1400 and Sangdeh–1900) to 0.66 (Sangdeh–900), which does not show significant differences. However, allelic richness shows more important differences.

Plots of pair-wise comparison of beech populations showed a very strong correlation between genetic diversity and geographic distance, thus more distant populations are more differentiated. The same results were found by a two-dimensional graph using the ordination scores of the principal coordinate analysis based on Nei’s genetic distances between investigated beech populations (Figure 3).

The analysis of molecular variation (AMOVA) highlighted the moderate level of genetic differentiation within populations (91.7%).

Mean $F_{ST}$ for all loci was 0.058, indicating a low level of genetic differentiation. The range of variation of the values of $F_{ST}$ for each locus was also low. The mean $F_{IS}$ was low, indicating that within population structure (inbreeding) was not significant. However, some loci had high values of $F_{IS}$, indicating deficiency or excess of heterozygotes.

People use and manage Hyrcanian forests in a number of ways. They have been managed under the shelterwood system for more than 40 years, so that 914 000 ha (45% of these forests) are currently managed by governmental, private sector and cooperative contractors in 392 districts. In the past decade, considerable changes have been made in forest-management and plant-selection.
sent or potential socioeconomic value and their conservation status. Many factors have been considered in the investigation of conservation status of Hyrcanian forests, including:

- past and present geographical distribution;
- prevailing use patterns in the form of logging and planting;
- changing land-use patterns; population growth;
- infrastructure development;
- distance to close settlements;
- occurrence of the species in protected areas.

A geographical information system (GIS) has proved a valuable tool in this process.

The second step will be the establishment of a network of conservation populations for sampling purposes and to secure the genetic diversity of the target species. Knowledge of the distribution of genetic variation within and between geographic regions is important in this process. Because biochemical and molecular studies are expensive and time consuming, genetic studies are rarely available (Salehi Shanjani 2002). The results of this research on genetic diversity and gene flow have provided information on geographic patterns of genetic diversity and key factors shaping diversity (gene flow and mating system). This information will be valuable for the identification of specific conservation requirements or priorities. Typically, this will be at the population level in order to identify the geographical distribution and number of populations to be conserved and for selection of specific populations to be included in the network of in situ conservation stands.

For further information, please contact: Dr Parvin Salehi Shanjani, Research Institute of Forests and Rangelands, Tehran (psalehi@rifr.ac.in), or Dr G.G. Vendramin, Istituto di Genetica Vegetale, Sezione di Firenze, Plant Genetics Institute, Florence Division. Consiglio Nazionale delle Ricerche, Florence, Italy (giovanni.vendramin@igv.cnr.it)

Figure 3. Two-dimensional graph based on the ordination scores of the principal coordinate analysis


EFFECT OF BARK AND LEAF HARVESTING ON THE GENETIC DIVERSITY OF KHAYA SPECIES IN BENIN

Orou G. Gaoue, Laboratoire d’Ecologie Applique, Faculté de Sciences Agronomiques, University d’Abomey-Calavi (Benin) 2004

The full title of Gaoue’s study is: “Impact of bark and foliage harvesting by indigenous people on genetic diversity of Khaya spp. in Benin, West Africa”. It will be carried out at the Department of Botany, University of Hawaii-Manoa, USA, where he is currently pursuing a PhD.

The study will look in detail at the status of Khaya senegalensis and K. grandifoliola, two African mahoganies exploited extensively in Benin. The IUCN Red Data Book lists both species as vulnerable, and some stands have been heavily exploited for generations. Heavy harvesting can affect the physiology and reproductive ability of the tree species, and this may have affected the genetic structure and variation of the populations. The study intends to use molecular techniques to map the genetic diversity of the trees in areas that have experienced different levels of bark and foliage harvest. In this way, it will discover whether there is a link between the harvesting pressure on a population and its within genetic diversity. In addition, questions relating to what extent tree populations in protected areas represent a richer sample of diversity than trees elsewhere, and to whether plantations of Khaya contribute to the conservation of genetic diversity will be answered.

The specific objectives of the study are:
- understand how genetic variation is distributed within and among Khaya spp. populations throughout the country, with special regard to the impact of different indigenous (traditional healers and fulani) harvesting intensities of bark and foliage on the genetic diversity parameters;
- assess the relevance of the existing protected areas (in situ) and the contribution of Khaya spp. plantations (ex situ) established throughout the country, in terms of conservation of the genetic resources of these tree species in Benin.

Measurement of harvest and pruning pressure will use both indigenous-stakeholder and literature-based methods. An ethnological survey will be conducted through the villages in the natural range of the two studied species. Its aim will be in order to identify, with the local harvesters (traditional healers and fulani), the different possible levels of bark and foliage harvesting intensities (quantity and frequency). The pruning pressure will be estimated through the percentage of branches defoliated and the percentage cover of the remaining foliage. The bark harvesting pressure will be measured by the percentage of the total volume of bark removed out of the total volume of the stem bark. Genetic parameters will be compared between seedlings and sapling populations with different harvesting intensities in order to assess the impact of harvest on the genetic diversity.

The study is expected to:
- generate a distribution map of the genetic diversity within the Khaya species;
- identify Khaya spp. populations outside the protected areas that need to be part of the conservation network (protected areas or as ex situ collections);
- identify the protected areas critically important to capturing as large a part as possible of the genetic diversity within Khaya species in Benin.

Through this study, the Vavilov-Frankel Fellowship will provide Benin with one of its first genetic diversity analysis on forest tree species. It will help in the establishment of ex situ collection of Khaya species in the country. Hence, the distribution map of the genetic diversity within Khaya species will be an important tool for forest managers and authorities when sampling populations to establish the country’s ex situ collection. The map will also be used to select the most important Khaya spp. populations to conserve in situ. This project will provide the chance to bring together forest authorities, non governmental organizations (NGOs) working on natural resources conservation, university scientists and the Forest Genetic Resources Committee of the Benin National Programme on Genetic Resources (IPGRI). In the course of two public conferences and working sessions, these parties will be able to share the conclusions of the study and discuss short- and medium-term actions that need to be taken.

The results of this research will be presented to at least one international meeting on forest genetic resources and published in peer-review journals.

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OTHER VAVILOV-FRANKEL FELLOWSHIPS 2004

The following fellowships were also made available in 2004 with the generous support of the Grains Research and Development Corporation of Australia and Pioneer Hi-Bred International Inc., a DuPont company: Study of the molecular basis of resistance to rust diseases in Triticum timopheevii, a species of wheat endemic to Georgia

Tamar Jinjikhadze (Georgia) 2004

Further information on and application forms for the Vavilov–Frankel Fellowship are available on the IPGRI Web site: (http://www.ipgri.cgiar.org/system/pages/p?frame=training/vavilov.htm)
Regional Programmes on FGR

APFORGEN: Asia, Pacific and Oceania – launching the FGR programme

Asia is characterized by a vast diversity in terms of biological resources as well as cultures managing the biological diversity. More than half of the world’s population is located in this region, which has less than 15% of the world’s forests. Moreover, the region is split into many floristic regions with distinctly different ecological features. The Asia Pacific Forest Genetic Resources Programme (APFORGEN) is a programme to support forest genetic resources (FGR) conservation and management in South, East and Southeast Asia and the Pacific (Box 1).

<table>
<thead>
<tr>
<th>Box 1. The objectives of APFORGEN</th>
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<td>● Strengthen national programmes on forest genetic diversity in the participating countries.</td>
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<td>● Enhance regional networking and collaboration on FGR conservation and management.</td>
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<tr>
<td>● Locate, characterize, conserve and facilitate exchange of genetic diversity of selected priority forest species.</td>
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<td>● Promote sustainable utilization of genetic diversity in natural and human-established forests.</td>
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<td>● Enhance linkages with other regional and international networks.</td>
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**APFORGEN Inception Workshop**

The APFORGEN inception workshop was held on 15–18 July 2003 at the Forest Research Institute, Malaysia, with participants from 13 countries (Bangladesh, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Nepal, Pakistan Philippines, Sri Lanka, Thailand and Vietnam), IPGRI, the Asia Pacific Association of Forestry Research Institutions (APAFRI), the Food and Agriculture Organization of the United Nations (FAO) and the Danida Forest Seed Centre (DFSC). The objectives of the workshop included:

- document the status of FGR conservation and management in the region;
- develop a work programme on FGR for APFORGEN;
- identify effective means for dissemination of FGR information among participating partners;
- discuss the development of a database for FGR information for the region;
- assess the activities undertaken Southeast Asian countries since the 2001 workshop in Thailand and learn about the status in the South and East Asian countries;
- identify priorities for APFORGEN.

The workshop discussed the operational structure and governance of APFORGEN. The three-day programme enabled the drawing-up of the framework for the operation of APFORGEN and the identification of ten concept ideas on various FGR-related topics with regional focus. Twelve practical recommendations were made for the development of the programme. Presentations at the workshop included country status reports from 13 countries as well as two technical papers, one on ex situ conservation and one on the application of molecular methods for conservation.

The workshop compiled a list of priority species for the region to be used as a guide for collaborative research and development (R&D) in FGR, bearing in mind the limited trained human resources for FGR work in the region. Another area identified as being in need of attention was that of improving the flow and accessibility of FGR information in the region. Participants endorsed the setting up of the APFORGEN Secretariat to improve the situation, in addition to other ways of communication.

Many common areas of interest were identified, including:

- ex situ and in situ conservation;
- germplasm management;
- exchange of genetic material;
- domestication and tree improvement;
- strengthening national FGR programmes through networking, extension, public awareness, human resources development and training;
- evaluation, documentation and characterization of FGR information;
- social aspects of the protection of FGR (local communities, gender issues, etc.);
- inclusion of FGR into national policies and strategies.

Priority species as well as priority areas for capacity building and training were also identified separately for South Asia and Southeast Asia. The country status papers clearly indicate a great need for improved management and more sustainable use of FGR across the region. The downward trend in forest area and quality is still prevalent in most member countries, with some exceptions. As a result of overexploitation and illegal logging, many important and commercially valuable species are becoming rare and even extinct. In addition, there are still many unidentified forest species. On the other hand, forest resources are important to all the countries in the region. The great importance of FGR for local rural communities in supporting their livelihoods was highlighted in almost all the papers.

FGR conservation is commonly carried out in the form of nature reserves whose main focus is ecosystem conservation. Many new nature conservation areas have been designated in the last few decades in the Asia Pacific region. However, only a small portion of all local timber species with potential commercial value is protected effectively through focused conservation programmes. A large part of tree improvement and ex situ conservation activities is focusing on introduced species. This is reflected by the fact that, in plantation programmes, fast-growing exotic species are much more widely used than indigenous tree species. The availability of reproductive materials of local species for plantation or rehabilitation activities is often poor in both quantity and quality. In addition, ex situ conservation of local species is regarded as too costly in many cases. Additional national and international focus and resources are needed to support FGR programmes in the region. In this regard, APFORGEN aims to function as a facilitator, assisting national programmes in resource generation and regional collaboration. Developing integrated conservation programmes that include in situ and ex situ conservation, community forestry and domestication has been suggested as a way to help conserve plant genetic resources. Some countries, such as India and Nepal, are promoting FGR conservation through community forestry programmes.

Conservation needs are often well acknowledged by national forestry research institutions. However, a lack of resources and perhaps of political will to increase support for FGR conservation seems commonplace. FGR conservation is not considered a priority activity. Moreover, in some cases, training in FGR management is inadequate in the education of professional foresters. As a consequence, the capacity for research on FGR is still rather low in some countries. Supporting training of forestry professionals as well as local communities in FGR conservation is one of APFORGEN’s priority activities.

In the country papers, some reports on introduced tree species becoming invasive were presented, e.g. Acacia mangium and A. nilotica in Indonesia; Prosopis juliflora in Sri Lanka; Leucaena leucocephala in India; and Swietenia macrophylla in the Philippines.
However, the problems are still restricted to certain areas. The institutional framework for FGR conservation has been developing fast in many countries in the region. National forest policies and/or legislation were revised in the 1990s in many South and Southeast Asian countries. Generally, the revised forest policies attach a high priority to biodiversity conservation. However, links between FGR conservation and overall biodiversity conservation need to be defined. Fiscal deficits remain a major constraint on the successful implementation of the reformed policies on FGR. The proceedings of the inception workshop are available from IPGRI APO and at: www.apforgen.org. The APFORGEN Secretariat that runs the day-to-day activities of the programme has been jointly established by APAFRI and IPGRI, and is currently hosted by APAFRI in Kuala Lumpur, Malaysia. National coordinators (official country representatives) were identified for the programme. More countries are expected to join the programme as it develops.

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**CWANA: Central and Western Asia, and North Africa**

**Regional FGR database established in Central Asia**

Forests in the region of Central Asia and the Caucasus (CAC) are the richest storehouse of the most valuable and unique specific and intraspecific biodiversity in the world. The uniqueness of this forest-growing region is determined by the combination of specific physical, geographical, soil and climate conditions. There are desert, mountainous and riverside forests in the region. These forests provide valuable ecosystem services such as protection of hydrological function, climate stabilization, and biodiversity conservation. However, increasing farming activity is affecting the environment negatively, and the irrational use of forest resources is causing degradation of natural habitat of forest trees and a reduction in agricultural production. In addition, there is a narrowing of forest species diversity because of the unsustainable use of forest genetic resources (FGR). The loss of plant species diversity and degradation of genetic potential of natural forest stands could lead to a weakening of forest ecosystem stability and productivity. Therefore, conservation and the rational use of FGR should be important issues in the broad range of nature conservation measures undertaken as a basis for improving the status of forests. The Central Asian countries of Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan are similar to each other in terms of their physical and geographical conditions. Hence, the structure of their forest vegetation is also similar. This is why these countries have realized the need for close cooperation in conservation and sustainable use of biodiversity, including FGR, in the region. In October 1996 at the first international workshop on plant genetic resources in Central Asia (Tashkent, Uzbekistan), representatives of all five Central Asian countries agreed to establish the Central Asian Network on Plant Genetic Resources (CAN–PGR). In 1999, the CAN–PGR was renamed the Central Asian and Transcaucasian Network on Plant Genetic Resources (CATCN–PGR). The working group on FGR was one of the first of nine crop working groups established within the network. The first meeting of the Regional Working Group on Forest Genetic Resources of CAN–PGR was held in August 1997 in Bishkek, Kyrgyzstan. Participants at the meeting selected priority species for conservation in the region and agreed on the need to start development of national programmes on the conservation and sustainable use of FGR. Development of a computerized regional database on FGR based on available passport data of forest species was one of the priority activities among the collaborative efforts agreed by the country representatives. Following this decision, the establishment of a database in Central Asia was launched by the Uzbek Research Institute of Forestry with the support of IPGRI in 1999. The main objective of this initiative was the compilation and computerization of available data on FGR in Central Asian countries, which at that time were dispersed and recorded in notebooks, cards, etc. and unfriendly for users. The database contains up-to-date passport data on more than 154 trees of priority species (Juniperus seravchanica, J. semiglobosa, J. turkestanica, Haloxylon aphellum, Pinus Pallasiana, P. silvestris, Picea sibirica and P. excelsa), more than 12 tree plantations (Picea Shrenkiana, Haloxylon aphellum, Ficus carica, Juniperus turkomanica and Punica granatum), 2 genetic reserves (Picea Shrenkiana and Juniperus seravchanica), 6 field collections (Amygdalus communis, Juglans regia, Populus alba var. Stremitelnyi, P. alba var. Pervenetz Uzbekistana, and P. alba var. Pyramidalnity Uluchennyi), 19 permanent forest-seed production plots (Picea sibirica, P. excelsa, P. Shrenkiana, Haloxylon aphellum, Ficus carica, Punica granatum and Juniperus turkomanica).
and 108 promising forms of grapevine and nut-bearing species (Vitis vinifera, Amygdalus communis, Juglans regia and Pistacia vera). IPGRI is now working with national partners in the region to make the database accessible via the Internet.

**FOURTH MEETING OF FGR WORKING GROUP OF CATCN–PGR**

The fourth FGR Working Group meeting of CATCN–PGR was held on 11–13 August 2003 in Bishkek, Kyrgyzstan, with the support of IPGRI. The meeting was hosted by the Institute of Forest and Nut Industry of the National Academy of Sciences of the Kyrgyz Republic.

Representatives from member countries (Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan) participated in the meeting.

The meeting, also attended by staff of State Forestry Service of the Kyrgyz Republic, was opened by HE Dr Turatbek Musuraliev, the Minister and Chairman of the State Forestry Service. The Minister noted that in spite of forests in CAC being limited in extent, they are of great importance because they play a major role in environmental sustainability in the region and are a source of many types of non-timber forest products (NTFPs) for local people such as wild nuts, fruits, berries, medicinal plants, honey, and cattle forage. He challenged participants to develop new ways of strengthening collaboration in FGR conservation among CAC countries.

The meeting was briefed on progress made by the FGR Working Group in 2000–02, particularly about its activities at regional and national levels in the areas of:

- collaborative research
- FGR documentation
- public awareness
- technical publications
- training
- international collaboration.

A draft format of the regional strategy on FGR in CAC was discussed and participants made their recommendations for its improvement. Draft recommendations on the conservation, regeneration and sustainable use of rare, endemic and endangered forest species were also finalized.

A draft concept note was presented regarding a regional project proposal on “Conservation of indigenous forest species and their use in combating land degradation and improving living conditions in mountainous area in CAC countries”. Following discussion, the purpose of the project was modified, additional activities were included, and expected outputs were clarified more precisely. The FGR Working Group developed its work plan for 2003–05. The following meeting of the FGR Working Group was scheduled for August 2005 at the Uzbek Forestry Research Institute.

Participants emphasized the importance of collaboration and pooling efforts in the study, conservation and sustainable use of FGR in the region, which is in a dry area with little precipitation and poor soils. Information on the meeting was disseminated by the media in Kyrgyzstan.

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**EUFORGEN enters phase III**

In the past ten years, the European Forest Genetic Resources Programme (EUFORGEN) has actively facilitated regional collaboration and strengthening of national efforts to manage forest genetic diversity in Europe. The work has been carried out following the recommendations of the Ministerial Conferences on the Protection Forests in Europe (MCPFE), the political process that initiated and endorsed the establishment of the EUFORGEN in the early 1990s. In April 2003, the fourth Ministerial Conference stressed the need to integrate conservation of forest genetic resources (FGR) into sus-
tainable forest management and continue pan-European collaboration in this field.

In addition to facilitating exchange of information and genetic material, EUFORGEN has produced other outputs, such as gene conservation strategies for target forest tree species, descriptors, databases, and technical guidelines for genetic conservation and use (Table 1). The technical guidelines are available online at: www.euforgen.org. They have been developed to specifically target practical forest managers and provide summarized information on: biology and ecology of the species, distribution ranges, importance and use, genetic knowledge, threats to genetic diversity, and recommendations for genetic conservation.

In Phase II (2000–04), EUFORGEN also initiated development of so-called ‘common action plans’, which aim at sharing responsibilities for FGR conservation in Europe. The common action plans are an effort to create pan-European networks of primarily in situ conservation units for selected tree species throughout their entire distribution ranges. This effort involves obtaining georeferenced data on these units for further analyses and action. Ex situ conservation units outside species’ natural distribution ranges can also be included if they contribute to dynamic gene conservation.

Common action plans can help to identify gaps and overlaps in gene conservation efforts at both national and pan-European level.

Subsequently, countries can assess which gene conservation units under their responsibility are the most valuable ones from the pan-European perspective. They can then prioritize the use of their human and financial resources accordingly. This will bring long-term benefits for the countries and ensure that common goals can be accomplished at minimum cost.

National coordinators and focal persons from 30 countries met at the fourth meeting of the EUFORGEN Steering Committee in Zidlochovice, Czech Republic, on 26–29 May 2004. The meeting reviewed the progress

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<th>Table 1. Tree species included in the technical guidelines</th>
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<tr>
<td><strong>Latin name</strong></td>
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<tr>
<td>Abies alba</td>
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<tr>
<td>Acer pseudoplatanus</td>
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<td>Alnus cordata*</td>
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<td>Alnus glutinosa</td>
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<td>Castanea sativa</td>
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<td>Fagus sylvatica*</td>
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<td>Fraxinus excelsior</td>
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<td>Juglans regia*</td>
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<td>Larix decidua*</td>
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<td>Liquidambar orientalis</td>
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<td>Malus sylvestris</td>
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<td>Picea abies</td>
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<td>Taxus baccata*</td>
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<tr>
<td>Tilia cordata</td>
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<td>Tilia platyphyllos</td>
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* To be published by end 2005.
made in Phase II and discussed the implementation of future activities. The Steering Committee also endorsed continuation of the programme to Phase III (2005–09). Currently, 32 countries are participating in EUFORGEN by providing financial and technical support.

In the new phase, the challenge is to translate the various recommendations and guidelines into practice. This means stronger incorporation of genetic issues into national forest programmes, which provide the framework for implementing all forest-related policies at country level. At operational level, there is a need to increase awareness among practical forest managers on the role of FGR in sustaining forestry and helping to cope with the effects of climate change. Information management in FGR work has also been identified as an area where improvement can considerably support the implementation efforts. Harmonizing the collection and management of information will help countries in Europe to better monitor their FGR and share responsibilities for conserving these resources.

For Phase III, the Steering Committee decided to streamline the EUFORGEN structure and merge the current five species networks [i.e. Conifers, Mediterranean Oaks, Noble Hardwoods, Populus nigra (black poplar), and Temperate Oaks and Beech] into three new ones: conifers, broadleaves with scattered occurrence, and broadleaves with continuous occurrence.

New thematic structures, namely the Forest Management Network and the Information Working Group, will be established to complement the species networks. Through these thematic arrangements, EUFORGEN will promote implementation of the recommendations presented in the technical guidelines and support integration of gene conservation issues into national forest programmes and policies. Furthermore, the programme will focus on developing protocols to evaluate genetic consequences of different silvicultural practices and identifying genetically appropriate practices in collaboration with forest managers and policymakers. The Information Working Group will streamline information management among all networks and serve as a platform for inter-network collaboration.

Before the Steering Committee meeting, EUFORGEN networks had discussed various topics at their recent meetings. The Populus nigra Network had its eighth meeting in Germany on 22–24 May 2003. Among other issues, participants from 17 countries discussed the local situation along the River Oder and provided recommendations for overcoming the problems in natural regeneration of the black poplar stands. Similar problems persist in other river systems in Europe as a consequence of habitat alteration by agriculture, urbanization of floodplains and hydraulic engineering of rivers.

The Temperate Oaks and Beech Network held its fifth meeting in Slovakia on 21–23 June 2003 with representatives from 21 countries. The meeting included a seminar on the distribution of the species in the Carpathian Mountains, the taxonomical position of minor white oak species within the Q. robur, Q. petraea and Q. pubescens complexes, and the differences in genetic diversity and morphology between the two beech species occurring in Eastern Europe (Fagus sylvatica and F. orientalis).

The Conifers Network held its fourth
REGIONAL PROGRAMMES ON FGR

SAFORGEN

Conservation of FGR in Central Africa

The Food and Agriculture Organization of the United Nations (FAO) in collaboration with the Sub-Saharan Africa Forest Genetic Resources Programme (SAFORGEN), the African Timber Organisation (ATO), the United Nations Development Programme (UNDP) – Cameroon, and partners in Central African countries organized a workshop on the conservation and management of forest genetic resources (FGR) in Central African countries. The workshop was held in Pointe Noire, Congo, on 14–15 October 2003 and the following countries in the sub-region were represented: Cameroon, Congo, Democratic Republic of Congo, and Sao Tome and Principe.

The main aim of the workshop was to produce an action plan for the conservation and sustainable use of FGR in the region. Country reports on the status of FGR in Central African were presented and discussed. The participants then agreed on a list of priority species for the region and interventions that could help in their conservation.

Three items were identified by participants as having genetic considerations that could be important for decision-makers:

● seed origin (for natural and artificial regeneration and for plantations);
● tree provenance and genealogy distribution (provenance behaviour/growth);
● vegetative propagation applied to the selection and domestication of fruit and medicinal trees.

It was the opinion of the participants that the value added by the genetic component to the forest management process will only be recognized by forest technicians, managers and decision-makers if the information generated is operational, simple and practical. The participants also recognized the need to collate, process, synthesize and disseminate existing information for selected representative tree species on diversity, physiology, reproductive biology and seed management.

Considering the limited number of forest research institutions in the sub-region dealing with FGR issues, participants highlighted the importance of networking and international cooperation based on exchange of experiences, expertise and information.

SAFORGEN was asked to play an even greater role to facilitate networking and collaboration among the different players in FGR work not only in humid Central Africa but also in the entire sub-Saharan Africa region.

This workshop in the humid Central African region is part of a series of workshops organized by FAO with IPGRI–SAFORGEN collaboration in sub-Saharan Africa. The first meeting was organized in 1998 in Ouagadougou, Burkina Faso, for the Sahelian and north Sudanian dry zones. The second workshop was organized in Arusha, Tanzania, for the countries of the Southern African Development Community (SADC). The last one is this one for the humid Central African region. The major aim of these meetings has been to assess the state of FGR in each of the countries and to use this assessment to develop a regional action plan for their conservation and sustainable use.

For further information, please contact: Dr Oscar Eyog-Matig, Coordinator of SAFORGEN, IPGRI West and Central Africa (OscarE@iitab.cgiar.org), or Pierre Sigaud, Forest Resources Division, FAO (pierre.sigaud@fao.org)

meeting in the UK on 18–20 October 2003. Network participants from 26 countries addressed the issue of conserving and using exotic conifer species in Europe and learned about relevant experiences from several countries. Countries with low forest cover, such as Iceland, Ireland and the UK, make widespread use of exotic conifers, not only for forestry purposes but also for protecting the environment. This may lead to the emergence of landraces. The participants stressed that such locally adapted genetic material should be conserved using appropriate methods. The network recommended that the gene conservation of exotic tree species receive more attention in Europe.

The Mediterranean Oaks Network held its third meeting in the Former Yugoslav Republic of Macedonia on 6–8 November 2003 with participants from 26 countries. This meeting focused on the effects of climate change on the Mediterranean oak forests. Genetic aspects and functional response of different oak provenances to changing environmental conditions were discussed as was the increasing occurrence of forest fires (based on case studies from the Former Yugoslav Republic of Macedonia, and Portugal).

On 22–24 April 2004, the meeting in Italy of the Noble Hardwoods Network brought together participants from 27 countries. As part of the meeting, gene conservation, tree breeding and the uses of noble hardwoods were highlighted through a seminar and a field trip to mixed noble hardwood plantations, which had been established on wasteland following mining activities.

Further details on the outputs of these meetings and other network activities are available at the EUFORGEN Web site (www.euforgen.org).

For further information, please contact: Dr Jarkko Koskela, EUFORGEN Coordinator, IPGRI Europe (jkoskela@cgiar.org)
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FOREST GENETIC RESOURCES CONSERVATION AND MANAGEMENT, VOL. 1.
Overview, general concepts and systematic approaches
2004. FAO, DFSC, IPGRI, Rome, Italy.

FOREST GENETIC RESOURCES CONSERVATION AND MANAGEMENT, VOL. 3.
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Report of seventh (2-27 October 2001, Osijek, Croatia) and eighth meetings
(22-24 May 2003, Treppeln, Germany)

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IPGRI Technical Bulletin
Sutherland J. R., M. Diekman and P. Berjak (eds.) 2003 IPGRI, Rome, Italy.
DEVELOPMENT OF APPROPRIATE CONSERVATION STRATEGIES FOR AFRICAN FOREST TREES IDENTIFIED AS PRIORITY SPECIES BY SAFORGEN MEMBER COUNTRIES

PROGRAMME DE RESSOURCES GÉNÉTIQUES FORESTIÈRES EN AFRIQUE AU SUD DU SAHARA

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Alternatively, please contact Barbara Vinceti (bvinceti@cgiar.org).

NOBLE HARDWOODS NETWORK,
Report of the fourth meeting, (4-6 September 1999), Gmunden, Austria and fifth meeting, (17-19 May 2001), Blessington, Ireland
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