Thailand, restoration of seasonally dry tropical forest using the Framework Species Method

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Ecosystem type

This project is located in Doi Suthep-Pui National Park, north-west of Chiang Mai, northern Thailand (l8°51' North, latitude and 98°54' East, longitude). The area experiences a monsoonal climate with pronounced dry and wet seasons. Average annual precipitation recorded at nearby weather stations at similar elevations, ranges from 1,670 to 2,094 mm. The wet season lasts from May to October and the dry season from November to April.

The major forest types represented in the park include the deciduous forest associations of the lowlands (deciduous dipterocarp-oak, bamboo deciduous forest and mixed evergreen deciduous forest) and the evergreen forest of the uplands (*sensu* Maxwell & Elliott, 2001). The study area supports at least 493 of the 645 tree species recorded in the national park.

Pristine evergreen forest on the watershed slopes of Doi Suthep Pui National Park

Problem and threats

Tropical forest destruction represents a major risk for the seasonally dry forest of Southeast Asia's highlands, with detrimental impacts such as the degradation of water catchments, the loss of biodiversity and the worsening of rural poverty. Despite levels of biodiversity, which 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.

The Hmong hilltribe community of Ban Mae Sa Mae in the northern part of Doi Suthep-Pui National Park at c.1000m

In response to this problem, several countries in the region have banned or restricted commercial logging in remaining areas of primary forest and added former logging concessions to their already extensive systems of protected areas. Now, 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 remaining forest are not enough. To save Southeast Asia's tropical forests, destruction must not merely be halted, but actually reversed

Large parts of the National Park are deforested and are rapidly dominated by weeds

Project description

The Forest Restoration Research Unit (FORRU) of Northern Thailand's Chiang Mai University, in collaboration with Doi Suthep-Pui National Park Headquarters and Britain's Horticulture Research International (HRI), has been adapting the 'framework species method', 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). The basic structure and functioning of forest ecosystems are rapidly re-established by planting mixtures of 20-30 carefully selected native forest tree species (both pioneer and climax simultaneously). Subsequently, biodiversity is restored when the planted framework trees attract seed-dispersing animals into planted sites.

Aims of the project

The two primary aims of this project are firstly to carry out research to develop ecologically sound and socially acceptable methods to accelerate regeneration of natural forest ecosystems on degraded land, within protected areas of Northern Thailand. The second aim is to undertake education programmes, based on knowledge generated from the research, to enable local people to improve forest restoration projects for biodiversity conservation, environmental protection and enhancement of human well being.

Description of Project activities

1. Research

Our core research program is currently sponsored by the Biodiversity Research and Training Program (a Thailand Government fund) and Britain's Eden Project. It has concentrated on four main areas

i) development of criteria by which framework tree species are selected,
ii) improved techniques to grow framework tree species in nurseries,
iii) improved techniques to maximize performance of trees after planting and
iv) monitoring the return of biodiversity in planted plots.

The essential ecological characteristics of framework tree species are; high survival when planted out in degraded sites; rapid growth; dense, spreading crowns that shade out herbaceous weeds and flowering and fruiting, or provision of other resources, attractive to wildlife, at a young age. In the seasonally dry tropics, where wild fires are an annual hazard, in the dry season, an additional desirable characteristic of framework species is resilience to burning. When fire prevention measures fail, the success of forest restoration plantings can depend on the ability of the planted trees to re-sprout from their rootstock after fire has burnt their above-ground parts (i.e. coppicing).

The essential nursery characteristics of framework species include; reliable seed availability; rapid and synchronous seed germination and production of healthy seedlings in containers, preferably to a plantable size (40-60 cm) in less than 1 year. High quality seedlings important, as they have the best chance of surviving in hostile deforested environments. Consequently it is essential that good horticultural practices are adopted.

For the purpose of this project, a research nursery was established at the National Park headquarters and a community tree nursery was built at the Hmong hill tribe village of Mae Sa Mai, in collaboration with the village's grass roots conservation group. Experimental field plots were also planted near the village.

In the nursery, experiments were designed to develop horticultural practices that optimize seedling vigor and health (Blakesley et al., 2000). Germination trials were carried out on more than 400 native forest tree species (Blakesley et al., 2002). Some species germinated easily, whilst others proved difficult. So various treatments to break dormancy were tested (Kopachon, 1995; Singpetch, 2001). For those species that proved impossible to germinate, vegetative propagation from cuttings and the nurturing of seedlings dug up from the forest (Kuarak, 2002) were also investigated.
Experiments were then conducted to determine the best container types and media for seedling growth and survival (Zangkum, 1998; Jitlam, 2001) and to develop production schedules for promising tree species (Kuarak et al., 2000; Elliott et al., 2002; Blakesley et al., 2000). The aim was to develop treatment combinations to produce trees of a plantable size and quality by the first or second planting season after seed collection.

One of FORRU's researchers monitors seedling growth in the research nursery

Trees were planted out in field trials to assess the relative performance of various "potential" framework species (Elliott et al., in press). Survival and growth were monitored, as well as ability to shade out weeds and resilience to fire. Various silvicultural treatments, to enhance performance of the planted trees were also tested. These included different weeding methods, mulching and fertilizer application regimes (Elliott et al., 2000). An essential characteristic of framework tree species is attractiveness to seed-dispersing wildlife. Therefore, planted trees were checked regularly for production of any resources that might attract birds or mammals (e.g. fruits, flowers etc.). Surveys to assess the species richness and composition of the ground flora and bird (Chantong, 1999) and mammal communities were also carried out.

2. Restoration Activities

Candidate framework species were initially selected from amongst a local tree flora of more than 600 species by consulting CMU's existing Herbarium database, nursery research on seedling and by pilot planting trials in 1995-1997. From 1998, experimental plots have been established annually in partnership with an Hmong hill-tribe community resident within DSPNP. FORRU helped the villagers to establish their own community tree nursery to test the practicability of the new nursery methods developed in the research nursery, in a village environment. The planting trials had three main objectives i) to provide a quantitative assessment of the degree to which various tree species meet framework species criteria; ii) to test various silvicultural treatments to maximize field performance and iii) to monitor biodiversity recovery. As the more successful species and techniques have been adopted and less successful rejected, the success of these experimental plots has gradually improved.

Increases in insects in planted plots might also attract seed-dispersing birds and mammals with mixed diets. However, further research on the diet and general ecology of seed-dispersing animals would improve the selection of framework tree species that are most likely to attract them into plots of young restored forests growing in open degraded areas.


Closed canopy forest planted three years earlier

Trees species that are most likely to attract such animals produce small to medium-sized fleshy fruits (e.g. *Callicarpa arborea, Ficus semicordata, F. subulata, Phoebe lanceolata, Prunus cerasoide,*) or flowers with copious quantities of nectar (e.g. *Erythrina subumbrans*) less than 4 years after planting. Tree species used by birds as nesting sites, within 4 years after planting include *Balacata baccatum, Erythrina subumbrans, Eugenia albiflora, Ficus subulata , Ficus glaberima, Ficus semicordata, Helicia nilagirica, Hovenia dulcis, Prunus cerasoides, Quercus semiserrata, Rhus rhetsoides,* and *Turpinia pomifera.*

3. Education

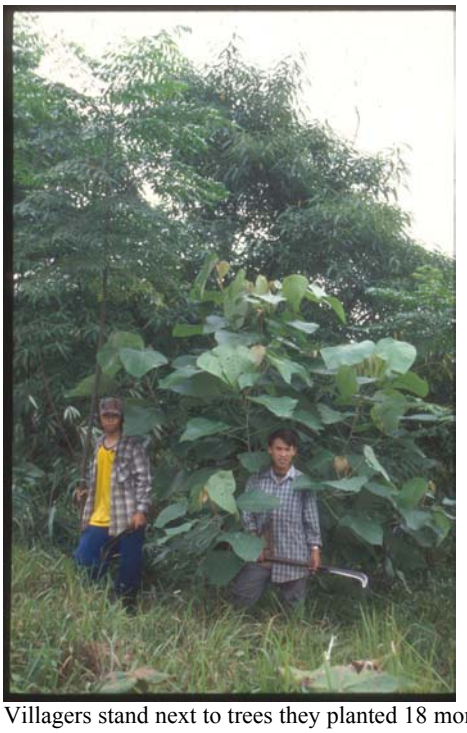
Demand for the information generated by FORRU has become overwhelming. New knowledge, arising from our research, is being disseminated to a wide range of groups/individuals involved in forest restoration, by a complementary project "Education and for restoring tropical forest biodiversity", funded by Britain's Darwin Initiative. This will allow us to build lasting local capacity to accelerate natural regeneration and recovery of biodiversity in degraded seasonally-dry tropical forests. The education project is providing skills and knowledge to key personnel and groups involved in restoring Thailand's forests enabling them to improve forest restoration techniques and biodiversity monitoring practices; A major output from the project will be the publication of a definitive manual, detailing the best techniques to restore forest ecosystems for biodiversity conservation.

One of FORRU's researchers teaches a visiting group about caring for planted trees

Results

One of the most important outcomes of FORRU's research has been the identification of those species that can rapidly restore forest structure and function, whilst simultaneously enhancing natural forest regeneration and biodiversity recovery.

The project has shown that forest cover can now be returned to highly degraded forestland (at 1,300 m elevation) within 3-4 years. Canopy closure starts to occur by the end of the second year after planting and is nearly complete by the end of the fourth. Weeds are shaded out and leaf litter starts to accumulate, re-establishing nutrient cycles. The trees attract seed-dispersing bird species resulting in the establishment of additional (non-planted) tree species and a gradual return to the tree species composition of the original forest.



Villagers stand next to trees they planted 18 months previously. The *Melia toosendan* on the left is 7m tall, whereas the *Macaranga denticulata* to the right has grown about 4m

Lessons learned

The framework species approach proved to be suitable to restore evergreen forest at higher elevations in Southeast Asia. FORRU's immediate priority is to extend this approach to the restoration of northern Thailand's deciduous forest ecosystems at lower elevations.

The increasing demand for information and the need for improved capacity has led FORRU to develop education and training programmes to make existing research results available to all those interested in restoring Thailand's once magnificent forests and to spread this approach to neighbouring countries.

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