Fellowship report

Research into the use and conservation of forest timber species is the starting point for improving the livelihoods and well-being of local communities in the Amazon

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Enriching: A seedling of quinilla (*Manilkara bidentata*), a valuable timber species, ready for planting in a secondary forest in the Amazon. *Photo: L. Rivera-Martin*

In the large and diverse Amazon region, there are many and varied ways in which to understand and manage the land and its natural resources. Indigenous and other local communities are generally selective in their forest use—in species, habitats and seasons—and historically their rates of extraction have been within the limits of the resources to recover. However, certain extractive practices are now undermining the social, cultural and economic stability of the people living in the region. A better balance is required between the modern use and conservation of natural resources (Lara and Vildes-Almonacid 2014).

Timber has been harvested commercially in Amazonia for 200 years. In Colombia, Cárdenas and López (2000) recorded 164 species with commercial potential, but only 20 of those are used currently in the market. The implementation of an adequate regime for the management, sustainable use and conservation of a timber species requires knowledge of that species' ecology and dynamics (Nebel and Meilby 2005). Existing traditional and scientific knowledge can be combined to improve resource management, and knowledge gaps can be identified.

In collaboration with local indigenous inhabitants, we undertook research into natural populations of three important Amazonian timber species: abarco (*Cariniana micrantha*), quinilla (*Manilkara bidentata*) and violeta (*Peltogyne paniculata*) at the Zafire Biological Station in the Colombian Amazon. We collected baseline data on the biology, ecology and forestry of these species in a 20-hectare plot established in 2005 and conducted germination trials in nearby natural and secondary forests. On the basis of our research, we proposed propagation protocols for the laboratory and the nursery.

Use and traditional knowledge of valuable species

The timbers of the three species are used in homebuilding and are highly prized. Poles of *M. bidentata* are valued for their strength and natural durability when in direct contact with the ground; the wood of *C. micrantha* is used for interior structural purposes; and *P. paniculata* is highly sought-after for the manufacture of utensils, flooring and interior finishes due to its brightness and colour. The three species also provide other products (Table 1): for example, *M. bidentata* produces balata (a latex); *C. micrantha* can be used as a rope fibre; and the inner wood of *P. paniculata* yields a dye.

Ecological characteristics

C. micrantha is an emergent species capable of achieving a diameter at breast height (dbh) in excess of 200 cm. It is found in upland forests in very low densities—for example, it occurs in the study area at a density of 0.4 individuals (dbh ≥ 10 cm) per hectare. A high-light-demanding species, *C. micrantha* grows at an average of 0.32 cm dbh per year (Peñuela-Mora et al. unpublished). The population structure in the study area comprises a high proportion of adult individuals relative to early regeneration stages. *C. micrantha* has a clustered diameter-class distribution because it requires large gaps to establish successfully, and these occur only rarely in natural forests. The species relies on abundant flowering and effective wind dispersal mechanisms for reproductive success.

M. bidentata is a medium-sized (dbh up to 0.8 m) canopy species inhabiting *terra firme* and flooded forests in the Amazon. A shade-tolerant species, *M. bidentata* grows

Table 1: Uses of *C. micrantha*, *M. bidentata* and *P. paniculata*

Use category	Abarco (*Cariniana micrantha*)	Quinilla (*Manilkara bidentata*)	Violeta (*Peltogyne paniculata*)
Food	Seed	Fruit	-
Artisanal handicrafts	Fruit	Latex	Heartwood
Heavy carpentry	Heartwood	Heartwood	Heartwood
Homebuilding	Heartwood	Heartwood	Heartwood
Cultural	Bark	Latex	Heartwood
Medicinal	Bark	Bark	-
Dye	-	-	Heartwood
Industrial	-	Latex	-

more slowly than *C. micrantha*, at an average of 0.14 cm dbh per year (Peñuela-Mora et al. undated); it can take more than 500 years to attain a dbh of 80 cm. The species occurs in relatively low densities (e.g. 1.2 individuals of dbh ≥ 10 cm per hectare in the study area).

The diameter-class distribution of the *M. bidentata* population in the study area is an inverted "J", with high levels of natural regeneration. This structure enables the replacement of adult individuals by any number of individuals at various regeneration stages; this constant recruitment helps maintain stability in the population. The species achieves reproductive success from the abundant production of fleshy fruits that are highly palatable to animals, which facilitates their dispersion and the establishment of seedlings in variable light conditions.

P. paniculata is an emergent species that occurs in upland forests at very low densities (0.15 individuals per hectare with dbh ≥ 10 cm in the study area). It has intermediate shade tolerance because it requires forest gaps to reach the adult stage. The diameter-class distribution indicates a clear majority of adult individuals compared with juveniles, which are scarce. Natural regeneration is limited mainly by the very low availability of seed sources, large pre-dispersal damage, limited dispersion capacity and physical seed dormancy.

How to conserve and manage populations

The intensity of harvesting and the time between cutting cycles should be based on reliable information on population density and structure and species' growth rates; harvesting must be low-impact, and appropriate silvicultural treatments must be applied to ensure the adequate regeneration and growth of future harvest trees. Supplementary enrichment planting is likely to be required for *P. paniculata* and *C. micrantha*. Seedlings of the studied species can be propagated or collected from natural seed banks and transplanted into areas where natural regeneration is inadequate, including on log landings and skid trails.

The area of secondary forests in the Amazon has expanded over time; these are potentially useful areas for conservation and sustainable-use strategies. Our study proposes techniques and guidelines for the establishment, survival, growth and quality of the three species in such forests. Enrichment-planting lines involving these species (pure and mixed) have achieved good results.

Other policy and regulatory activities that could contribute to the conservation of populations of the three species include:

- preventing the commercial exploitation of *P. paniculata* and *C. micrantha* in forests where the densities of adult trees are equal to or less than the densities found in the present study;
- determining the minimum required distance between potentially fertile individuals at which pollination, flowering, fruiting and dispersal are effective; and
- developing facilities to implement techniques for the artificial restocking or enrichment of forests under exploitation.

An urgent task is to correctly label standing trees and throughout the chain of custody to ensure traceability. It is also necessary to increase awareness among forest users that forest resources are finite and therefore should not be wasted. It is important to promote the restoration of natural forests and to restore populations of exploited species through such practices as enrichment planting and other silvicultural measures to ensure income in the short, medium and long terms.

Conclusion

The agencies responsible for forest conservation and management face huge challenges in providing training for, and increasing the awareness of, local people, loggers and officials on the requirements of sustainable forest management. Knowledge of the ecology and silviculture of Amazonian timber species, and the application of that knowledge in the field, is essential for ensuring sustainability.

The proper implementation and monitoring of various field experiments and forest management practices by forest users and government entities is a great opportunity to generate knowledge on the technical, financial and environmental sustainability of management plans and approaches for the conservation of timber resources that are agreeable to all parties. It is also possible to generate evidence on the vulnerability of some populations, thereby assisting agencies in determining whether to grant or deny logging permits.

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