Dipterocarp susceptibility to drought: a role for wood structure?

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Recent El Niño events have caused devastating droughts and fires across South East Asia. Primary lowland forests of this region are dominated by trees in the family Dipterocarpaceae, which show supra-generic variation in susceptibility to drought. The mechanism determining these differences is unknown, but variation in wood structure may predispose some species to increased risk of cavitation during extreme droughts.

Trees in the family Dipterocarpaceae are of great ecological and economic importance in the lowland forests of Southeast Asia. The effects of El Niño-Southern Oscillation (ENSO) events on these trees are thus of great concern, particularly since ENSO may be increasing in frequency and severity (Walsh & Newbery 1999). Dipterocarp timber groups, closely related supra-generic groupings which show similarity in wood properties, have been found to vary in drought susceptibility. This was first noted in the light red meranti group, whose northern distribution is limited by seasonal droughts (Turner & Whitmore 1991). Mature trees of this group are most susceptible to ENSO-related drought in primary lowland forest (Becker *et al.* 1998), and their seedlings require wetter microsites when planted in secondary forests (Moura Costa *et al.* 1996).

The reasons for this increased susceptibility are currently unknown, though variation in the susceptibility to xylem embolism has been suggested (Becker *et al.* 1998). Analysis of data collected by Desch (1941) suggests that wood structure may be important. Wood density is correlated with drought-tolerance in angiosperm trees, since denser wood contains stronger vessels that are less likely to collapse under more negative xylem pressure (Hacke *et al.* 2001). The efficiency of water transport in the xylem, and thus the maximum rate of transpiration, is proportional to vessel diameter (Tyree *et al.* 1994). Increased growth rate may cause increased susceptibility to cavitation during drought. The correlation between vessel diameter and drought-induced embolism is weak in angiosperms (Hacke *et al.* 2001), though it may be strong enough to be of evolutionary significance (Tyree *et al.* 1994).

Desch (1941) provides anatomical data for the timber of 129 Malaysian dipterocarp species in 14 timber groups. Between 3 and 49 trees were sampled per species. Mean vessel diameter varied five-fold between species, from around 50 μm in *Hopea ferrea* (malut timber group) to almost 250 μm in *Shorea ovalis* (light red meranti) (Figure 1). Timber density varied two-fold, from 480 kg m^{-3} in *S. lepidotis* (light red meranti) to 1056 kg m^{-3} in *Vatica cuspidata* (resak). Timber group is a strong predictor of vessel diameter, vessel number per unit cross-sectional area and timber density (general linear model, $p < 0.001$). The light red merantis and other fast growing, light hardwoods have wide vessels (around 200 μm) and low-density timber (around 600 kg m^{-3}), whilst slow growing, heavy hardwoods have narrow vessels (50 to 100 μm) and high-density timber (around 1000 kg m^{-3}). Timber density is negatively correlated with vessel diameter (Pearson's $\rho = -0.49$, $p < 0.001$).

Wood properties of timber groups may be compared to mortality rates observed by Becker *et al.* (1998) after the 1982 to 1983 ENSO-related drought in lowland forest of Sabah, Malaysia. The light red meranti group had high mortality (13.4 %) whilst the dense *Shorea* spp. in the balau group had low mortality (3.1 %). The very dense resak group (*Vatica* spp.) and giam (*Hopea* spp.) groups had zero mortality. Statistical analysis of this relationship is not possible given the lack of species-level mortality data.

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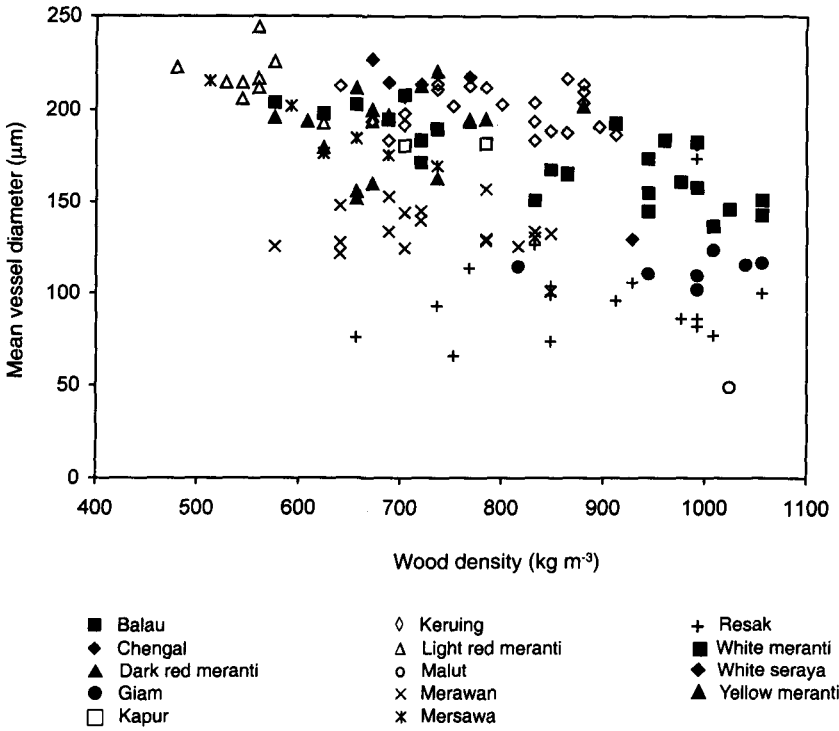

Figure 1 Mean vessel diameter against timber density for Malaysian dipterocarps. Data are taken from Desch (1941).

Information on site conditions and other anatomical and physiological adaptations to drought are required to gain a fuller understanding of dipterocarp drought susceptibility. Unfortunately, only a handful of data on embolism vulnerability are currently available for dipterocarps (Tyree *et al.* 1998), but the expected increase in ENSO events will provide ample opportunities for such studies in the future.

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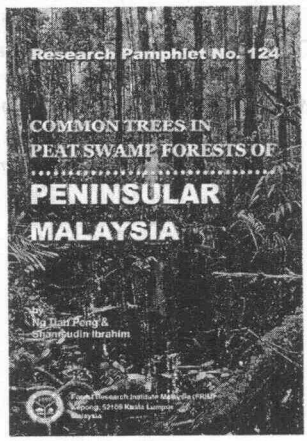
BOOK REVIEW

NG, T. P. & SHAMSUDIN, I. 2001. **Common trees in peatswamp forests of Peninsular Malaysia.** Research Pamphlet No. 124. Forest Research Institute Malaysia, Kepong. 96 pp. US$80. ISBN 983-2181-07-0



Peatlands are waterlogged wetland ecosystems in which the extremely slow rate of decomposition results in the accumulation of dead plant matter ("peat"). Although they only occupy 3 to 7% of the Earth's land area, the peat in peatlands accounts for nearly one-third of the global pool of soil-bound carbon. In recent years, there has been a great deal of research focused on whether global warming will result in accelerated rates of decomposition in peatlands and a release (primarily as methane) of the carbon stored in peatland soils. Since methane is a potent greenhouse gas, release of this gas from peatlands could result in a positive feedback loop: methane release accelerates global warming, which in turn accelerates drying, decomposition, and consequently, further methane release in peatlands. Most of the research on peatlands and global climate change in recent years has focused on peatlands in boreal North America and Europe. This is because of the extensive peatlands on these continents, resources available for research, and the ready availability of identification guides to the plants.

Tropical peatlands have received far less attention from researchers. Unlike their boreal cousins, tropical peatlands are dominated by trees. Although the species diversity of tropical peat forests is much lower than that of the better-known upland rain forests, the peat forests nonetheless support a wide range of species that have broad economic and ecological importance. This new research pamphlet provides foresters and researchers with a much-needed field guide to 56 of the most common tree species of the peat swamps of Peninsular Malaysia (out of a list of 130 species that occur in these swamps). The authors also provide a brief introduction to the ecology and management of these peat swamp forests.

As with most field guides, the strengths of this book are the detailed descriptions of each tree and the exceptional photographs of each species. The authors have gone to great lengths to obtain wide-angle photographs, in the field, of the boles in the forest, and detailed close-up photographs of the bark, leaves, fruits, seeds and seedlings. While fewer than half of the tree species of these peat swamp forests are illustrated, nearly two-thirds (25 of 39) of the families are represented. In contrast to the detailed descriptions to enable the identifications of each tree, the attention given to the ecology and distribution of the trees is less rewarding. The type of data given is inconsistent (for example, neither elevational limits, nor restrictions to the eastern or western sides of the peninsula, nor the range outside of Peninsular Malaysia of all species are given). The authors provide a short description of the current commercial uses for each species. What makes this field guide useful to ecologists as well as foresters is that the authors included descriptions of many species that have no commercial use. Thus, the reader gets a good overall feeling for the diversity in these peat swamp forests, not just their utility as lumber sources.

The first few pages of the book provide a brief introduction to the ecology and management of peat swamp forests. This section is much less satisfying than the species descriptions. The description of the forest's distribution, hydrology and structure is scant and will not help a newcomer to these forests understand them better. The presentation of

forest production, conservation and threats to these forests is even-handed, but I also was left hoping for much more detail on all of these.

Overall, this book will be an excellent resource for foresters and ecologists trying to learn how to identify the common trees in peat swamp forests of Peninsular Malaysia. Although the book is expensive (similar books in the United States would sell for about one-quarter the price of this one) and its tight focus on Peninsular Malaysia will limit its sales outside of that area, the authors and FRIM are to be commended for producing a first-rate field guide.

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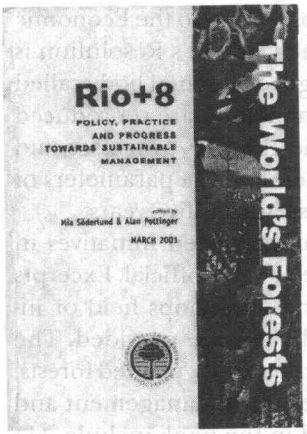

SÖDERLUND, M. & POTTINGER, A. 2001. **Rio+8: Policy, Practice and Progress Towards Sustainable Forest Management**. The Commonwealth Forestry Association, Oxford, UK. 310 pp. US$20. ISBN 0-9515059-3-9.

Over the last decade, beginning with the 1992 UN Conference on Environment and Development (UNCED) in Rio de Janeiro, Brazil, a number of international initiatives and intergovernmental policy dialogues on forest issues have taken place. This publication represents a compendium of the forest policy developments aimed at sustainable forest management that have taken place under the Intergovernmental Forum on Forests (IFF) as well as under other international and high-level initiatives. Some people (be they national negotiators, officials or scientists working in the forestry field) may have an interest to learn more about international forest issues and intergovernmental negotiations of such issues. However, they may have no or little previous knowledge on the subject matter, insufficient time or perseverance to minutely plough through an almost infinite number of often scattered official IFF documents written in UN format as well as not easily obtained official reports, case studies, keynote and background papers. In such a case this book presents them a quick but useful reference point for all important international forest policy developments during the period 1997–2000. In this regard, the contributing authors to this volume have done a superb job in facilitating access to such information to all those interested and fulfilled one of the objectives of the Commonwealth Forestry Association, that is, to exchange information on forestry and forest policy through its range of publications.

The first part of the book takes the reader on a familiarisation course on the outcomes achieved at the IFF process which took place between 1997 and 2000. The IFF process demonstrated the international community's political will to reach consensus on many complex sustainable forest management issues and the need for sustained efforts to implement proposals and programmes. The most concrete outcome of the process was the formulation of a wide-ranging set of proposals for action (PFA) tabled during the

fourth and final meeting of the IFF. Part One of the book provides an excerpt from the Report of this fourth session, touching on the conclusions reached and the PFA of two core areas on: (1) promoting and facilitating the implementation of the PFA of the intergovernmental panel on forests (IPF) and (2) monitoring progress in implementation of the IPF-PFA in terms of existing or new legislation, policies, programmes and processes.

The conclusions and the PFA of issues that were too contentious for agreement by all Parties or those that required further discussions or clarification are also highlighted in this first section. The three issues left pending were the need for financial resources, trade and environment and transfer of environmentally sound technologies to support sustainable forest management. At least eight areas were identified in the text as issues that needed further clarification. These include causes of deforestation and forest degradation, traditional forest-related knowledge, conservation and protected areas, forest research, valuation of forest goods and services, economic instruments, supply and demand for wood and non-wood forest products and services and rehabilitation of forest cover in critical areas.

At the closing of the IFF process, governments recognised the need to consolidate decisions and to proceed from dialogue to action by implementing the IPF/IFF PFAs and other forest-related international agreements. This decision was forwarded to the Economic and Social Council of the United Nations for further action. The Council's Resolution is reproduced in Part One. It calls for the establishment of an intergovernmental body called the United Nations Forum on Forests (UNFF) and its working modalities are reproduced here. In addition to continuing the agreed programmes of the IPF/IFF processes and tackling unresolved issues, the UNFF is also tasked with recommending the parameters of a mandate for developing a legal framework on all types of forests within five years.

Part Two of the book delineates the government and organisation-led initiatives in support of the IFF process. However, these initiatives are considered as non-official. Excerpts and summaries of the initiatives from the experts' meetings and workshops held or in-depth studies undertaken, which took place between 1998 and 1999, are provided. The IFF issues covered are deforestation, conservation, low forest-cover countries, planted forests, national forest programmes, research, financing of sustainable forest management and forest instruments. Among the more notable initiatives featured in the book include: (1) Initiative on underlying causes of deforestation and forest degradation (Costa Rica, 1999), (2) International Experts Meeting on protected areas (Puerto Rico, 1999) (Malaysia is a member of the informal contact group established), (3) Initiative on the special needs and requirements of developing countries with low forest cover (Islamic Republic of Iran, 1999), (4) Six-country initiative on the implementation of IPF PFA (Germany, 1998), and (5) ICRIS Initiative–International consultations on research and information systems in forestry (Austria, 1998).

High-level initiatives with strong political commitments are described in Part Three of the book. This section provides a concise backgrounder on the processes surrounding the development of criteria and indicators (C&I) and certification as assessment and monitoring tools for sustainable forest management. There is also a list of the 150 countries participating in on-going international processes on C&I for sustainable forest management at various levels and ecosystems. The processes are the ITTO Process, Dry-Zone Africa Process, Pan-European Forest Process, Montreal Process, the Tarapoto Proposal of C&I for Sustainability of the Amazon Forest, the Near East Process, the Lepaterique Process of Central America, African Timber Organization Process and the Regional Initiative for Dry Forests in Asia. Another significant parallel process, the World Commission on Forests and Sustainable Development (WCFSD) and the recommendations by the Commission, is also a worthwhile feature of the book.

The book concludes in Part Four with an assessment of the progress achieved by the international forest policy processes since Rio. The evolving perspectives, policies and practices of intergovernmental deliberations on forestry issues over the last decade are synthesised in this final chapter by Dr Jagmohan Maini, who is the Chairman of the Commonwealth Forestry Association and also the Coordinator and Head of the Secretariat of the UNFF. He brings us issues that first sparked off the international forestry debate and the international resolve to find solutions to the issues of deforestation, threats to traditional livelihoods and increased demand for forest products and its international trade. Dr Maini's perspective of the current status is that the IPF and IFF processes have facilitated consensus building and the bridging of differences between the North and South, moving towards steady realisation that sustainable management of the world's forests is our common responsibility. This publication does not illuminate critical light onto the status of international forestry processes that have taken place thus far; it being a text comprising excerpts and summaries of the various processes and decision texts of international deliberations. However, it does provide in one place the necessary issues, facts and events for one so interested to begin an in-depth analysis.

A highly useful feature of the book is the detailed bibliography, reproduced at the end, covering all documents produced during the IFF4 and other documents of the initiatives highlighted. The list of acronyms and abbreviations provided is also useful for one wishing to become "UNFF jargon-savvy".

In sum, this is a book that comes highly recommended to those wishing to acquire valuable insights into the issues and the development of the intergovernmental processes that surround the international forest policy dialogue since Rio. But beware ... unless one has a ready penchant for reading dry UN-style decision texts, be prepared to be lulled into some rather dry, tedious reading!

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