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Foreword

The extreme and large-scale drought and heat wave that affected Western and Central Europe during summer 2003 was unprecedented in the records of modern forestry and forest research. Record air temperatures (around 40 °C) affected Middle European regions such as northern France and southern Germany at a time when soil water reserves were completely depleted in many forest ecosystems, exposing trees to a very severe drought stress. Visible symptoms such as foliage yellowing and browning, branch dieback and premature leaf loss affected many stands. This raised an immediate concern among foresters who were asking whether such an event would bear severe consequences for forest health. The main concern was that such an extreme event could induce a severe and long lasting decline in forest stands.

Extensive research during the 1980s highlighted that temporary summer drought impacted tree growth and forest productivity, as well as many other forest ecosystem functions. The large inter-annual variability in diameter growth recorded in trees was largely explained by fluctuations in water availability. Moreover, drought stress was considered, alone or in combination with biotic constraints (phytophagous insects), as a primary inciting factor for decline processes in a range of forest ecosystems in Western Europe. A wealth of scientific knowledge and information was therefore available for an analysis of the 2003 situation, but this knowledge was in places fragmentary, and had never been synthesised in detail.

A French-German initiative was therefore launched at the end of 2003 to jointly organize and carry out an expertise in order to assess the impacts of the 2003 drought and heat event on forests. The coordination group was composed of French (G. Landmann, GIP ECOFOR, E. Dreyer, INRA, F. Charnet, IDF) and German (H. Spiecker, IWW University of Freiburg, K. von Teuffel and H. Delb, FVA) scientists, with an important contribution of K. Makkonen-Spiecker (IWW Freiburg) and S. Landeau (GIP ECOFOR) as administrative coordinators. Experts from different countries were contacted in order to synthesize the available knowledge around a series of scientific and technical questions. An account of the expertise, the scientific events organised and its outputs is available at http://www.gip-ecofor.org/ecofor/publi/page.php?id=1735.

This scientific expertise aimed at: (i) synthesizing the available knowledge and know-how about the effects of drought and heat on tree physiology and forest ecosystem processes; thus contributing to a broader understanding of the short- and long-term consequences of 2003 drought; (ii) identifying needs for future research in this field; (iii) suggesting management strategies for mitigating the impact of such events in the future. The very high incidence of forest fires across Southern Europe was one of the major consequences of the 2003 drought. Because of its specificity, this natural risk was not included in the scope of the present expertise.

The expertise aimed at producing several outputs, among which the present synthesis of the scientific information available on several key issues. A detailed account of the 2003 event from a climatic point of view was unbearable (Rebetez et al, this volume); a clear consensus is that even if the 2003 was the result of a rare conjunction of climatic processes. Forest monitoring networks have been developed over the last decades and new monitoring tools are available; ground based monitoring relies on dense networks of observation stations; new approaches in remote sensing provide data at improved spatial resolutions and with increased recording frequencies but are still not fully operational to document short term events like this one (Deshayes et al., this volume). Drought stress is suspected to modulate the resistance of trees to pathogens, but the data documenting this aspect are still scarce and scattered; Desprez-Loustau et al. (this volume) produced a comprehensive discussion on this question. Drought and heat has also well documented consequences on the population dynamics of insect pests, and particularly bark beetle attacks are known to increase immediately after dry years; this is synthesised by Rouan et al. (this volume). Water shortage and heat have severe impacts on canopy processes like carbon assimilation and transpiration. The network of canopy exchange monitoring, and the development of water balance models offered an opportunity to quantify the impact at the scale forest stands; that switched from carbon sink to carbon source during peak drought (Bréda et al.). Finally, drought and heat probably impacted forest biodiversity, but the amount of changes are poorly known and Archaux and Wolters (this volume) attempted a synthesis of this particularly difficult question.

The six reviews gathered in this special issue of *Annals of Forest Science* do not cover the full range of potential consequences of the 2003 event. There is more to come in future issues, particularly dealing with ground monitoring of the impact on forests of drought and heat, and with consequences for management practices.

We do hope the presented syntheses will provide insight into available knowledge on drought and heat effects on forests tress, a first overview of the effects of the 2003 summer, and contribute to the identification of bottle necks in our understanding of the processes underlying this impact, and finally some avenues for future research.

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