1 Introduction

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"The endless horizons, unspoilt nature, clear streams and the beech trees standing guard over the breath-taking natural world were well complemented by the warmth and friendship that the Ukrainians emanated. Perhaps it is the philosophy of life – 'everything in due course' – that has allowed the forests to last so long."

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Typical appearance of the primeval beech forest of Uholka-Shyrokyi Luh, with uneven-sized beech trees, lying deadwood, regeneration, and a multilayered structure. Photo V. Chumak.

European forests have been used and altered by humans for thousands of years, with the most rapid changes occurring during the Middle Ages (Küster 1998). The expansion of human settlements not only led to the forest area diminishing fast, but also to more intensive use of the remaining forest. Wood continued to be the main resource for heating, energy and construction far into the 19th century, and the increasing demand was met by exploiting and clear-cutting forests even in remote areas. Forests were also used for grazing, leaves were cut as fodder and litter was collected as bedding for livestock and humans.

Only scattered relicts of primeval forest, also known as virgin or primary forest, have survived in mountainous areas, mainly in the geographic regions of the Carpathians, the Balkans and the Alps (Leibundgut 1982; Mayer *et al.* 1989; Korpel' 1995; Průša 1985; Diaci 1999; Giurgiu *et al.* 2001; Brändli and Dowhanytsch 2003; Hamor *et al.* 2008). These virgin forest relicts have a high value for biodiversity conservation (Paillet *et al.* 2009), but they are also unique objects for ecological and forest research as they provide unique opportunities for studying the complex natural structures, processes and ecosystem functions of forests undisturbed by man.

The value of such old-growth forests was already recognized in the 19th century, when the first forest reserves were established in Poland and the Czech Republic (Zielony 1999; Hort *et al.* 1999). Since then, most European countries have protected and set aside near-natural forests as reserves where old-growth structures can, in the long run, develop again. It may take centuries, however, before such formerly managed forests become like virgin forests again and provide the same kind of ecosystem functions as the long-lost primeval forests.

In recent decades, various international conventions and resolutions on biological diversity, sustainable forest management and climate change have been passed and have led to an increasing demand for reference values from undisturbed forests. The Ukrainian Carpathians harbour some of the largest remnants of primeval forest of European beech (*Fagus sylvatica* L.). If humans had not interfered, beech forests would today cover extensive areas of Central Europe, from the Alps

Fig. 1.1. Sign with information about the 10 ha research plot of CBR and WSL in the Uholka administrative unit. Photo U.-B. Brändli.

across the lower mountain ranges down to the lowlands. The Carpathian relicts of primeval beech forest are therefore of special interest for research. In 1998, WSL initiated a co-operation with the Carpathian Biosphere Reserve (CBR) and other Ukrainian institutes to study the structure and diversity of virgin forests. In 2000, a 10 ha research plot (Fig. 1.1) was established in the primeval forest of Uholka (COMMARMOT *et al.* 2005). Since then, detailed measurements have been carried out every five years to follow the natural forest dynamics. This research plot allows insights into the small-scale spatial structures and their dynamics, and also into the interactions between individual trees and different species, but it cannot be considered representative of the approx. 14000 ha of primeval beech forest still preserved in the Krasna Massif of the Ukrainian Carpathians (HAMOR *et al.* 2008). Large-scale systematic (random) sampling was therefore needed to obtain representative data from these forests.

At the conference "Natural Forests in the Temperate Zone of Europe – Values and Utilisation", which was jointly organised by the WSL and the CBR in 2003 (COMMARMOT and HAMOR 2005), the idea was born to carry out such a large-scale virgin forest inventory. During the next few years, this idea was further developed and discussed with possible partners and sponsors in Ukraine and Switzerland, and presented at a conference at CBR in 2008 (COMMARMOT *et al.* 2008). With financial support from the State Secretariat for Education, Research and Innovation SERI, Switzerland, it was at last possible to start the project. In 2010, WSL, CBR and the Ukrainian National Forestry University (UNFU) carried out a sampling inventory over the whole forest area in the Uholka-Shyrokyi Luh protected massif within the CBR, 8800 ha of which are thought to be primeval forest (BRÄNDLI and DOWHANYTSCH 2003; BRÄNDLI *et al.* 2008; SUKHARYUK 2005). To our knowledge, this is the first systematic inventory of such a large virgin forest area in Europe. In this report, we describe the sampling design and the parameters assessed, the planning and organisation of the field work, and the management and analysis of the data collected in the terrestrial survey. We also present findings about basic forest characteristics, habitat structures, site factors and anthropogenic traces. The report is intended to give an overview of the inventory methods and basic calculations we used and to serve as a reference and basis for more thorough analyses and inventories in future. Not included in this report are detailed structural analyses and comparisons with other reserves or managed forests, as they are the topics of separate scientific papers.

The report is intended for scientists working with data from this inventory, forest ecologists, biologists, conservationists and other people interested in reference data from virgin forests. Researchers planning to carry out a similar inventory should also find it useful.

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