1 Introduction

Trees are an accepted presence in the urban landscape as individuals in streets, parks and gardens or as components of woodlands as "relics" surviving from forest before urbanization, or as planted and spontaneous regenerated blocks on derelict sites. These trees are labeled *urban trees* in contrast to *forest trees*. The concept of urban forestry was developed first in Canada, during the 1960s, and was defined as a practice proposing a global approach of tree management with a view to integration with urban activity and population.

In planning housing development in urban and suburban areas, a major challenge is to manage the native forest trees as well as exotic trees. Because of the urban environment, trees could decline (Fig. 1.1), changing their size and silhouette, while at the same time being (from the pathological point of view) sound trees. Good selection criteria should be used when retaining trees on a specific site, determined by urban morphology. Generally, the criteria used for the selection and planting of urban trees are: the growth requirement of each species as described by sylvicultural practice and specific features evaluated for individual trees and stands, having in mind that trees are very long-lived individuals (300, 900 or 2000 years) if air, water, minerals from the soil and sunlight are supplied. The policy of the Green Areas and Environment Departments in many cities in the world is to preserve and develop the green heritages which have an important social, aesthetic, cultural, educational or climatic role. The need to inform and instruct people about various aspects of environmental protection is generally accepted today. The management of green urban areas requires a wider political, administrative and technical approach (Council of Europe 2004). Selection of species and technological innovations (container grown techniques, automatic watering, etc.) are crucial issues in tree renewal politics.

According to the botanical system of classification, trees fall into two groups: (a) coniferous, known as evergreens, needle-leafed trees or softwoods and (b) deciduous, known as broad-leafed trees or hardwoods. Mature softwoods have a straight central trunk, with side branches which spread to form a conical or columnar crown. The form of the hardwoods has a broad rounded crown with long branches. As a guide to general appearance, tree silhouettes are given in Fig. 1.2. For tree identification, botanists use the scientific name which consists basically of two terms: the generic name (genus) and the specific

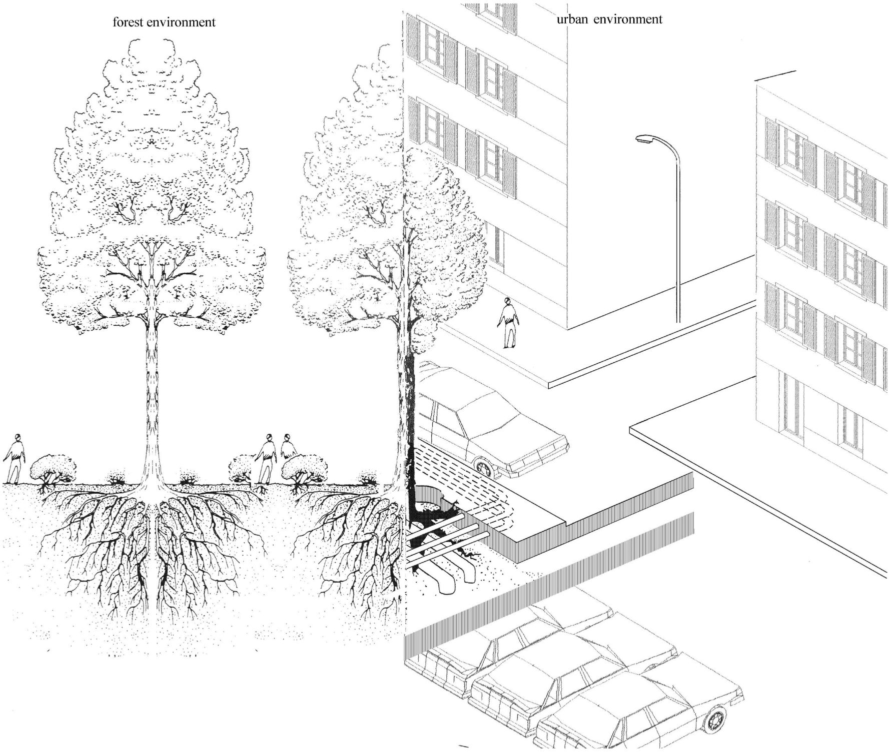

Fig. 1.1. Trees in natural and urban environments

name (species), e.g.: *Abies alba*. The specific name can be traced to several origins: Latin, Celtic, Greek, etc. (so *alba* from Latin = white; Aymonin 1986). The common name for *Abies alba* is fir, which is generally used and has been handed down from generation to generation. In this book, both scientific and common names will be used.

Considerable ecological and silvicultural information has been developed in reference books and manuals in the past century for judging how a tree or a stand should be managed. Specific features for individual trees and stands must be considered. The main criteria to select trees for urban and suburban areas are related to the growth and silvicultural requirements of each species. Following the position of a tree in a stand, trees can be classified as:

- dominant trees, with well formed crowns, receiving sunlight uniformly
- co-dominant trees, in the high canopy
- intermediate trees with crowns in the lower part of the canopy, shaded by the surroundings
- suppressed trees, with crowns below the main level of the canopy.

Fig. 1.2. Silhouettes of trees (from Hosie 1969; reproduced by permission of Natural Resources Canada, Canadian Forest Service, copyright 2005)

For each tree, the morphological and physical characteristics which must be considered are the following: height, diameter at breast height, growth ratio (radial increment rate), live crown ratio (height of crown divided by total tree height), density expressed as number of stems per hectare and general health aspect – the vigorous aspect of the tree, without insect damage or disease.

Remarkable studies by Zimmermann and Brown (1980), Wilson (1984) and Mattheck (1996, 1998) enable the reader to increase his questions and answers related to the biological and mechanical functions of trees.

Identification of native trees and plants is essential for the prediction of better growth conditions of trees in a specific site. The introduction of species like ornamental apples and cherries is used to develop the existing vegetation quickly and to satisfy the socio-economic requirements of the residents.

The street tree population is very variable and is composed of hardwoods and mixed softwoods/hardwoods, having a density of 100 trees/km of street and a diameter ranging from 10 cm to 60 cm. Deciduous trees ensure greater water evaporation and consequent cooling of the street, while mixed trees ensure a higher noise attenuation efficiency because of the evergreen species used. The diversity of urban morphology determines the structure of street tree patterns, related to the natural environment and the management policies of cities and adjacent residential or suburban zones. Table 1.1 gives some dendrometric characteristics of different species from the temperate zone.

Rapid urbanization after the First and Second World Wars altered the microclimate in urban areas, through a gradual replacement of original forest by man-made buildings and structures which increased the heat-storage capacity of cities. Street trees, as well as parks, gardens and green spaces, are natural air

Table 1.1. Some dendrological characteristics of several species growing in a forest environment (data from Hora 1981; Aymonin 1986)

Species		Height	Age (years)	
Scientific name	Common name	(m)	Maturity	Longevity
	Deciduous species			
Acer pseudoplatanus	Sycamore	30	25	200–500
Aesculus hypocastanum	Horse chestnut	25	24	200
Fagus silvatica	Common beech	45	30	300
Liriodendron tulipifera	Tulip tree	60	30	500
Quercus robur	Oak	25	45	2,000
Betula pendula	Birch	15	10	100
Populus alba	White poplar	10	5	50
Tillia cordata	Lime	35	20	500
	Coniferous species			
Picea abies	Spruce	50	50	400
Abies alba	Fir	50	15	200
Pinus strobus	Eastern white pine	80	50	200
Pinus contorta	Lodgepole pine	33	Unknown	150
Thuja plicata	Arbor vitae	60	Unknown	400
Larix decidua	Larch	35	Unknown	600
Chamaecyparis lawsoniana	False cypress	50	Unknown	400
Sequoia sempervirens	Redwood	120	Unknown	2,000

Table 1.2. Noise reduction with different patterns of street trees in Nanjing, China (data from Mao et al. 1993). The tree species are: *P.a.* = *Platanus acerifolia*; *M.g.* = *Metasequoia glyptostroboides*; *S.c.* = *Sabina chinesis; P.t.* = *Pittosporum tobira*; *C.i.* = *Carya illinoensis*; *C.d.* = *Cedrus deodara*; *E.j.* = *Euonymus japonica*

Parameters	Streets			
	No 1	No 2	No 3	No 4
Street width (m)	40	42	28	30
Tree pattern	Deciduous	Mixed	Deciduous	Mixed
Number of tree rows	6	4	2	4
Width of green belt (m)	35	35	2	4
Canopy height (m)	4–25	4–22	4–25	4–20
Crown projection (%)	80–85	80–85	85–90	80–85
Tree species	*P.a*	*M.g.*; *S.c.*; *P.t.*; *C.i.*; *E.j.*	*P.a.*	*M.g.*; *C.d.*; *C.i*
Noise attenuation (dB)	6	4	1	8
Efficiency (dB/m)	0.24	0.31	0.10	0.36

conditioners and, within a limited range, noise attenuators. Mecklenberk et al. (1972) noted that the noise attenuation capacity of trees is directly related to the density and width of planting zones. The efficiency of noise attenuation, as expressed in Table 1.2, is 0.36 dB/m for mixed zones and only 0.17 dB/m for zones planted with only one species.

The existing information in the literature on noise reduction in urban environment is quite abundantly disseminated in publications related to forest and agricultural studies during the period 1970–1990 and is very scarce later; and, in contrast, publications related to acoustic studies during the past 20 years stress the development of modeling techniques. The aim of this book is to show the necessity of understanding both aspects.

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