Chapter 1 Introduction

One of the main forest land use around the world is forest plantation. Typical example of the forest plantation stand is an artificially planted stand with seedlings of the same age of one fast-growing tree species. The main aim of forest plantations is to get the high-quality timber in target dimension for the lumbermill. Of course, this situation could differ around the world. However, above mentioned situation often leads to the low stability of this 3D ecosystem that is highly influenced by a man (Fig. 1). The reaching point of the main aim of plantations together with their stability (ecological or static) is influenced by the incidence and frequency of the abiotic disturbances and abundance of pests. This all lead for the need for forest protection.

Forest protection is one of the traditional disciplines of forestry. In the strict sense of this book, the focus is on the biotic and abiotic factors that are not crime related (i.e., illegal logging) and urban impacts, such as urban sprawl are excluded. It is hard to say precisely when forest protection was established or became independent discipline of forestry – as it was mainly continuous process that went hand in hand with silviculture and forest science. High quality literature sources, that are in many cases still actual, come from the middle of the 19th century.

Although sustainable forestry managements are increasing, it most probably will not replace the economic value of forest plantation concepts which cover the high demand for timber. Ongoing climate and land use changes together with focus on ecosystem functioning would not let this discipline disappear.

Forest protection uses disparate methods of protection against abiotic and biotical threats. Forest protection appears to be one of the most complex disciplines in forestry. It combines knowledge from various disciplines across forest ecology, silviculture, entomology, botany, mycology, vertebratology, genetics, chemistry, physiology and others derived from such disciplines like game management or phytopathology, including human dimension.

Many biotic and abiotic factors and their interactions that can change forests are studied (e.g. causes and consequences of windstorms) in forest protection. Some of them are in the focus of forest protection not so often (e.g. pathogens) and some are rather neglected (e.g.

urban sprawl). In some parts of the world, some threat could be continuously vanishing and have no influence – for example, damages by domestic animals and illegal logging in Europe and North America, which are, on the other hand, still critical important in Africa and South America. Some disciplines that are important part of forest protection are more studied in different or independent disciplines – this is the case of forest weeds that are mainly in the focus of plant science. Aliens (i.e. invasive organisms) are one of the hottest topics of present scientific agenda.

Regarding the forest protection, one of the first question that come to mind may be: Is it necessary to protect the forest? If we focus on plantation forests, the answer is clear: Yes. Nevertheless, there are many factors that influence forest, but human is (directly or indirectly) one of the important causes of many threats. People affect forest from the very beginning of humankind – except of hunting and picking, slash-and-burn and wood pasture is applied in forests for thousands of years. Furthermore, forest protection faced the biggest challenges particularly since the beginning of the Industrial Revolution. Even though, substantial human influence on stability of forest occurred much earlier. For example, due to the logging for metal production in medieval times.

If we focus on commercial forest plantations, there can be identified some leading factors important from the point of view of forest protection – (i) change in tree species composition, (ii) length of rotation period and (iii) temporal changes in forest cover.

Fig 1 Norway spruce (*Picea abies*) is together with pines and eucalypts one of the most important target trees planted in commercial forest plantations. This species with it shallow roots is highly susceptible to the wind, drought and monophagous spruce bark beetles.

1.1 Temporal change of tree species composition

The first factor important for forest protection is a significant change in the composition and distribution of the tree species in forests (Fig. 1.1). Change in species composition directly affects organisms linked to the forest ecosystem. Each tree species historically occupied specific niche, which was bounded by a number of other organisms. An example is the Scots pine (*Pinus sylvestris*) that forms naturally sparse forest on nutrient-poor soil substrates. Replacement of native oak (*Quercus* spp.) dominated forests by pine plantations would change trophic

interactions – such as depletion of soil for soil-dwelling biota and reduction of food for vertebrates. For example, vertebrates could seek for supplementary sources of food and, therefore, can cause damage to the target trees (e.g. bark browsing). High nutrient substrates could also increase the risk of pathogen attack (e.g. by *Heterobasidion* fungus).

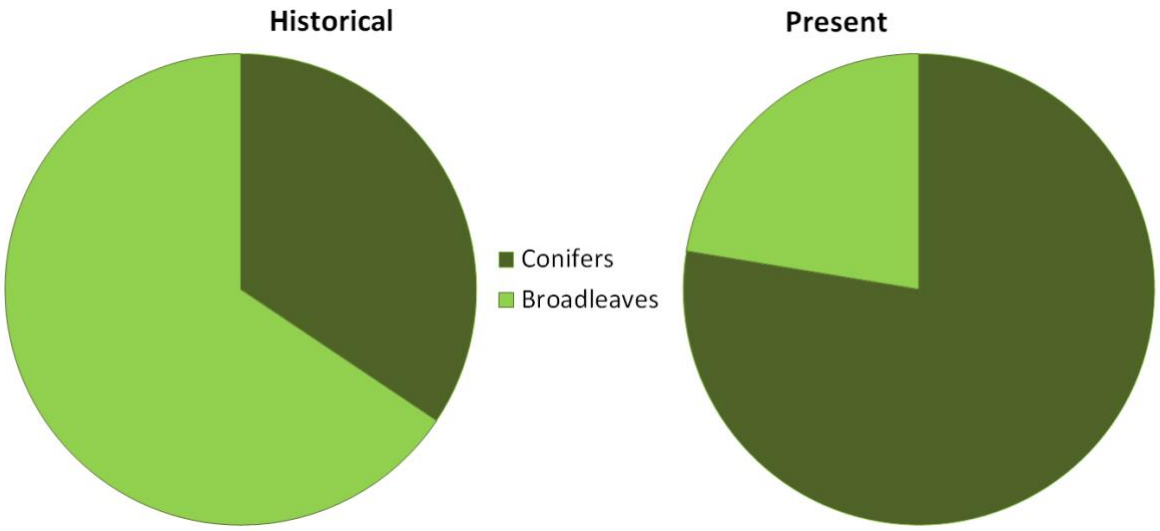

Fig 1.1 Pie diagrams illustrating the change between estimated historical (pre-human: 7 000-4 500 BP; pollen analyses based) and present composition of conifers (dark green) and broadleaves (light green) in the Czech Republic.

Neuhäuselová Z et al (2001) Map of potential natural vegetation of the Czech Republic. Academia, Praha.

Poleno Z et al (2007) Pěstování lesů II – Teoretická východiska pěstování lesů. Lesnická Práce, Kostelec nad Černými lesy.

1.2 Long rotation period

The second important factor in forest protection is the length of rotation period of forest stands. Although, commercial plantations are mainly consisted of fast-growing trees – for

example, in the Czech Republic the minimum age for harvest of coniferous stands is still not lower than 80 years and for target deciduous trees (oak or beech) often exceeds 150 years. Nevertheless, during this is long time forests may be threatened by various events (Fig. 1.2).

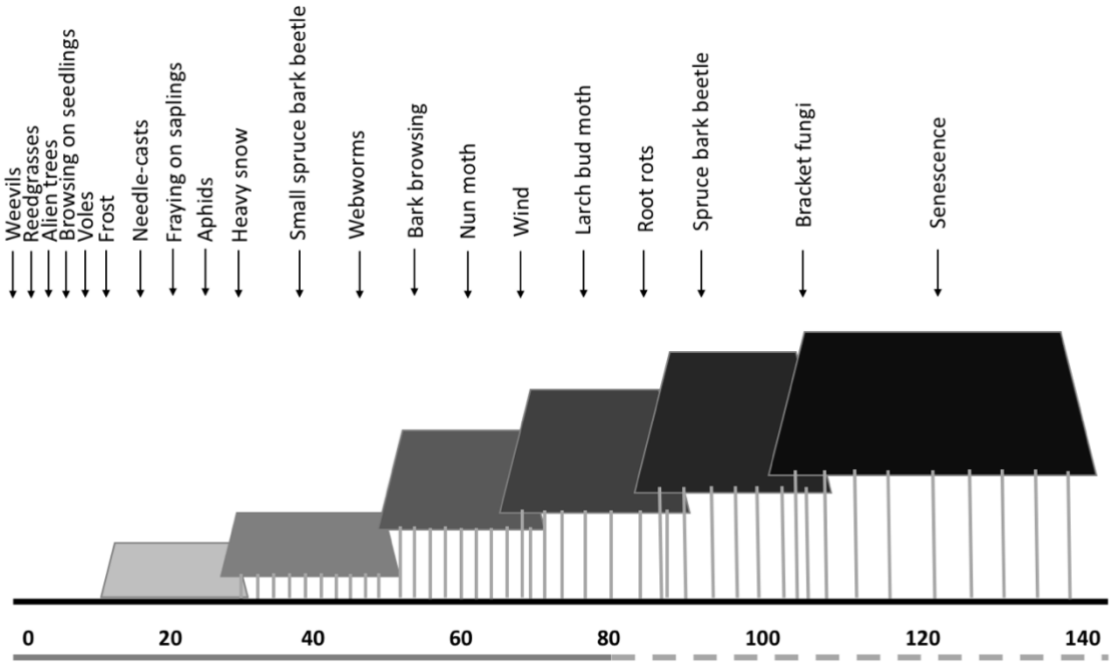

Fig 1.2 Norway spruce (*Picea abies*) forest stands as an example with its possible threats that might occur during the 80-year (solid dark grey) and longer rotation period (dashed light grey).

1.3. Change in the forest cover

The third factor, which is important for forest protection, is the change of the area of forest cover. Several parts of the world are facing up to large deforestation with forthcoming change in total environment. This is often caused by illegal or at least unsustainable logging. This is well documented from Far East or Amazonia.

Nevertheless, the forest cover could also expand. It may reach one more percent of total forest cover (e.g. nearly 800 km² in the Czech Republic) during tens of years. One of the

important reasons is actual high migration of human to cities and forthcoming abandonment of village landscape. One of the processes is the spontaneous succession toward forest – such as in former military training areas, on marginal agricultural land or in traditionally managed forests left to the wilderness. Another case is the artificial afforestation including afforestation of former productive agricultural land (grasslands, arable land, or fruit orchards).

Especially, artificially planted forests (afforested) could be at risk. The main reasons are: the use of non-indigenous trees, planting of monocultures, planting on nutrient-rich soils and roots deformed from pots. Such stands are at risk also due to drought, compaction of the lower soil layers (i.e. under the topsoil), high risk of pests and pathogens and low resistance to the wind.

Fig 1.3 An example of the forest cover expansion. Traditional agroforestry, in the form of fruit orchard, on this solitary hill in lowland was partly planted by mixture of fast-growing conifers and partly left to the spontaneous succession.

1.4 Basic discrimination of the main threats to the forests

The most often used division of potentially harmful factors in forest protection is to (i) biotic and (ii) abiotic factors. There is usually more attention given to biotic factors. The main reason is the greater possibility of prevention measures and remedies compared to abiotic threats. It depends on the place where we are, but in many places of the world insects certainly cause the most damages from all biotic threats. High numbers of game, wildlife and domestic livestock and lack of natural predators also significantly can affect forest health worldwide. The other significant biotic factors are weeds and fungi.

The importance of abiotic factors may vary greatly in different parts of the world. Even though snow damage is of lower importance in the most commercial forests, avalanches in mountainous forests acquire considerable importance. Look at it the other way around, forest fires are among the greatest threats to global forest protection but are not serious threat in Central Europe (Fig. 1.4). The other important abiotic factors are frosts, floods, or soil erosion.

As it is mentioned above, the importance of potential threats is differing around the world. There are several examples of the interconnection of biotic and abiotic threats. For example, windstorm is often accompanied by bark beetle outbreaks.

Fig 1.4 Forest fires have two faces in forest ecosystems – fire is an important factor for regeneration of forests, but in commercial forests is rather a threat.

1.5 Some specific or unique factors to the forest protection

1.5.1 Differences of protection between forest stands and nurseries

Harmful factors in commercial forestry can be divided to those causing losses in forest nurseries and those in forest stands. Forest nursery is a place, where seedlings and saplings are growth from seeds for future commercial artificial afforestation. Forest nurseries are much better accessible. Way of intervening in forest nurseries is, thus, intense and can perhaps be compared to agriculture.

Much more temporally diversified ways of damage can occur in forest stands. The number of interventions is greatly influenced by their accessibility and length of rotation period.

Fig 1.5.1 Many target tree species in forest nurseries are pre-cultivated in greenhouses. This is example of the European beech (*Fagus sylvatica*) in plastic square-tube treepots that will be placed in outdoor beds after overwintering in greenhouse.

1.5.2 Invasive organisms

Way of protecting the forest is considerably influenced by a multitude of invasive organisms like Black locust, *Robinia pseudoaccacia*, in Europe or Emerald ash borer, *Agrilus planipennis*, in North America. Invasive organisms, known as aliens, are often replacing native

species, and can become pest – especially, if they have a broad tolerance for abiotic conditions and no natural enemies.

Some species that are not true aliens might spread extra-limitally like the Norway spruce in Europe or Great spruce bark beetle, *Dendroctonus micans*, in Eurasia. This means that the organism is still mainly within its distribution areas, but it is rapidly filling the empty spaces (often formerly unsuitable). In the case of extra-limitally spreading organisms, we know usually at least something about their biology. The situation with aliens is considerably vitiated by the unavailability of information about their requirements in their former distribution area. Furthermore, there could be a shift in requirements of the alien under the conditions of the new distribution area. Therefore, requirements of alien in a new area could be different to its area of origin.

Fig 1.5.2 Some alien species are conspicuous. Many of them were formerly ornamental plants. This is the case of the poisonous weed Large-leaved lupine (*Lupinus polyphyllus*) native to the western North America. This plant can expand in clear cuts when they started to be moister due to absence of the trees.

1.5.3 The main curative methods used in forest protection

The best solution in forestry is the prevention against all threats (Fig. 1.5.3). Nevertheless, due to many reasons, the curative methods are often the only solution. Therefore, it is appropriate to mention the main curative ways to protect the forest.

These are mainly mechanical protection (e.g. mowing) and chemical protection (e.g. use of pesticides). Both approaches have advantages and disadvantages, but the main reasons for their use will be primarily their efficiency, practicability, and price. Biological control is presently mentioned as one of the most promising methods in forest protection. Nevertheless, each potential pest or pathogen is unique and therefore need a unique treatment.

Therefore, it is crucial to choose the right forest protection measures against targeted pest or pathogen to avoid collateral damages, e.g. the loss of beneficial organisms. Inappropriate measures can lead to unintentional decrease of economic value and biodiversity loss, and even worsen the situation.

Fig 1.5.3 Natural regeneration of Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*) after the clear cut is affected by the absence of protection against the forest weeds (grasses and heath) and game (Roe deer).