6 Thirty-Five Countries

Talk about diversity!

Let's see some facts and figures.

Maps are useful to display distribution.

How would one describe the coppice situation in country X?

Time to dive into the details – how is coppice regulated in a specific country?

Finally, a few summaries.

Visit this chapter for:

Introduction to the 35 Country Reports

Albania, Austria, Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, fYR Macedonia, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom

Summary of Data from the 35 Country Reports

Introduction to the 35 Country Reports

Alicia Unrau, Peter Buckley, Dagnija Lazdiņa and Valeriu-Norocel Nicolescu

The following chapters feature elements on the past, present and future of coppice forests in 35 countries. They are a compiled of multiple, individual reports that were originally published in 2017 and have since been reviewed and updated.

The 35 countries covered in this chapter

The countries featured here were members of COST Action FP1301 EuroCoppice: Albania, Austria, Belgium, Bosnia & Herzegovina, Bulgaria, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, fYR Macedonia, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Turkey, Ukraine and the United Kingdom (Figure 1). Many key countries for coppice were involved from the beginning, while others joined later, when national experts became interested in the Action. Any country showing interest in the Action was encouraged to participate.

Of the 35 countries, two are not within the geographical boundaries of Europe, namely Israel and South Africa, while Turkey can be considered a transition country to Asia. Compared to the countries listed in the "State of Europe's Forests (SoEF) 2015" by FOREST EUROPE (2015), this chapter encompasses all of the countries who contributed 2010 data to Table 27 on coppice statistics, with the exception of Montenegro. Other countries in Europe that could be expected to have some coppice, despite not having submitted data on that type of forest to the SoEF 2015, but are not addressed in this chapter are: the Russian Federation, Belarus, Georgia, Moldova and Luxemburg.

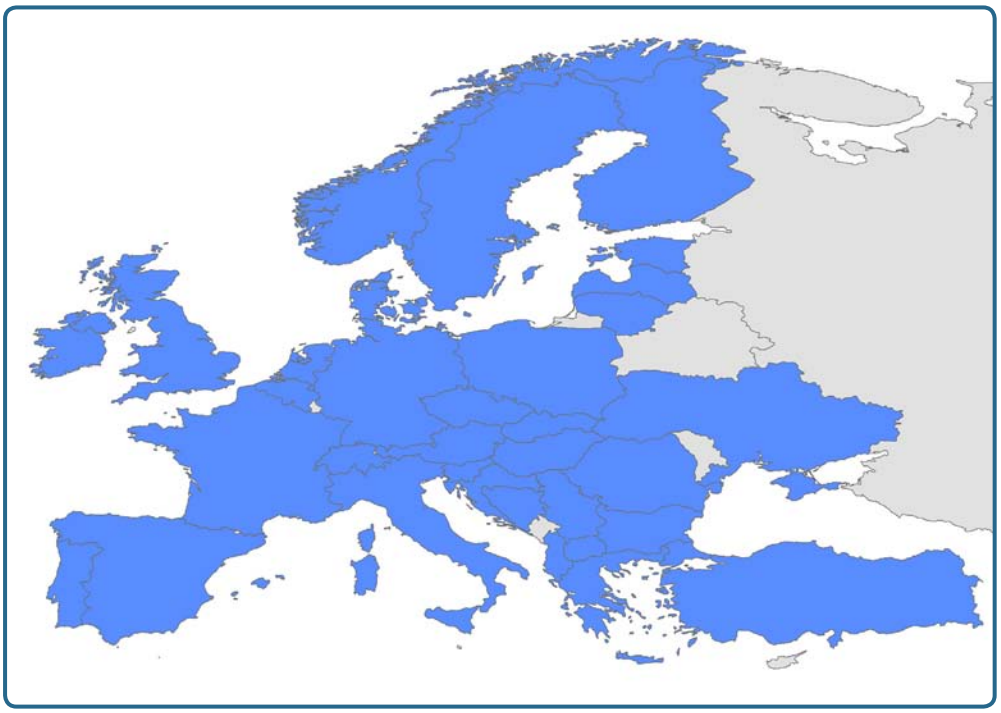

Figure 1. Map of the 33 European countries included in this chapter (in blue); it excludes two countries from outside of Europe; Israel and South Africa.

Encompassing the majority of European countries, this very broad base covers a range of coppice situations, for example: a long history of coppice, or none at all; different sizes and importance of current coppice area; active or neglected coppice; different environmental, social and economic functions; and various ways of governing coppice.

There are four sections in these country reports to which coppice forest researchers, practitioners and experts could have contributed: facts and figures, map, description and forestry regulations. Each country had different resources, expertise, and extent of coppice, so their reports vary in length and may not include all sections. The sections began as separate contributions, often by different authors - the details of this process are described in the following.

A compilation of separate reports from COST Action FP1301 EuroCoppice

In order to have a broad spectrum of information on coppice forests for the countries involved in COST Action FP1301, different themes were covered by Working Groups (WGs). Three of the five WGs independently collected information from EuroCoppice Members and/or their colleagues on most or all of the 35 EuroCoppice countries and published their results in separate booklets for each theme; they are the basis for the sections of the country reports that follow in this chapter.

Each of the original publications had its own group of editors and authors, which makes combining contributions a delicate matter. The main editors of the reports are the authors in this article, while all of the original editors are listed below. The country report authors appear under their respective section, but also as a group under the country title. The default policy was to list the authors as a group in the order of their appearance in the four sections. This policy was followed unless otherwise agreed upon by all authors. We are very thankful for the cooperation of the authors and the editors on this point.

When compiling the country reports, the contents of the original theme-related booklets were reviewed by editors and authors, proof-read and harmonised where necessary. There is still some overlap between sections within some countries, but the data or information should not be contradictory. Some of the most important aspects have been summarised in tables in the last article of this chapter.

Linking country report sections to original publications and editors

Of the four sections in the country report, three of them were originally published as individual booklets. To understand which sections were linked to which specific booklet, the original names and editors of the booklets are given here, along with some background information on each.

Section: Facts and Figures

Original title: National Factsheets on Coppice Forests
Original editors: Dagnija Lazdina and Santa Celma
Main Working Group: WG1 Definitions, History and Typology
Working Group Leader: Dagnija Lazdina, dagnija.lazdina@silava.lv

The authors were originally asked to fill in fields in an excel sheet, which was later compiled into a document by the editors. The responses in this section are, thus, often bulleted and brief, rather than descriptive. It is important to keep in mind that statistics on forest are difficult to compose in the first place, particularly so in the case of coppice. Many of the national forest inventories do not even collect data on coppice or hold relevant records. Furthermore, the definition of coppice greatly influences any data to be collected and/or interpreted.

Section: Map

This section was added after the end of the Action; all country report authors were offered the opportunity to submit a map for the updated country reports. Most countries do not have an official map of coppice, in some cases there simply is no data, so the maps included here are unique to each country and do not necessarily show coppice per se. Sometimes, for example, a map will illustrate the distribution of tree species that have the potential to be coppiced, such as in the Latvian report.

Section: Description

Original title: National Perspectives on Coppice from 35 EuroCoppice Member Countries
Original editors: Valeriu-Norocel Nicolescu, Debbie Bartlett, Peter Buckley, David Rossney, Patrick Pyttel and Alicia Unrau
Main Working Group: WG2 Ecology and silvicultural management
Working Group Leader: Valeriu-Norocel Nicolescu, nvnicolescu@unitbv.ro

The authors of this section were given a great amount of freedom concerning the contents of their texts. This way they were flexible to choose topics that are important in their respective region. While describing coppice in their country, they were requested to keep to a limit of up to ca. two pages. Any overlap between this section and the first, Facts and Figures, was shortened if the repetition is quite lengthy, but was otherwise left in.

Section: Forestry Regulations

Original title: National Forestry Regulations Affecting Coppice Management in 27 EuroCoppice Member Countries
Original editors: Jenny Mills and Peter Buckley
Main Working Group: WG4 Services, protection and nature conservation
Working Group Leader: Peter Buckley, peterbuckleyassociates@gmail.com

This section is a compilation and evaluation of legal documents relating to the specific rules and legislation affecting coppice forests, including conservation and biodiversity issues. The text is frequently quite technical because of the content involved. In some cases, there is a little overlap with other sections, but these are typically only a few sentences in the introduction of the section.

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Mills, J., Buckley, P. (Eds.) (2017). *National Regulations Affecting Coppice Management in 27 Euro-Coppice Member Countries*. COST Action FP1301 Reports. Freiburg, Germany: Albert Ludwig University of Freiburg.

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Albania

Abdulla Diku, Vasillaq Mine, Elvin Toromani and Luljeta Mine

Facts and Figures

Abdulla Diku, Vasillaq Mine and Elvin Toromani

Definitions

Coppice forests originate from sprouts and are governed by a short production cycle (rotation).

Coppice - a forest that has a sprout origin/background and that is destined to be regenerated by new sprouts, from which is derived wood material of small and medium sizes.

Pyjet cungishte e kane origjinen nga lastaret dhe qeverisen me cikel te shkurter prodhimi.

Cungishte (Korie, Zabel) - eshte nje pyll qe ka prejardhje lastarore dhe qe eshte paracaktuar te riperterihet po me lastar, nga i cili perfitohet material drusor me permasa te vogla dhe te mesme.

Legal Framework

Forest - an area of land with a dense group of forest trees greater than 0.1 ha, with a canopy coverage of not less than 30% of the area and with the potential to reach a height greater than 3 m, when forest has reached maturity.

Forest lands - areas with trees, shrubs, or other non-forest vegetation covering from 5 - 30%; bare surface; eroded and non-productive lands; sandy lands; forest roads that have not entered the register of the land property of agriculture lands that are ecologically linked and functionally related to the national forest fund.

Statistics

The total forest area in Albania is 1,052,237 ha, while the coppice forest area accounts for 295,440 ha (28% of total forest area) and has a standing volume of 5.3 million m^3 (Institute of Statistics, 2016; www.instat.gov.al/en/). Young coppice forests up to 20 years old cover approximately 73% of the entire coppice forest area and are widely spread in Albania. They mainly have a production function (about 273,045 ha) and are the main source of firewood supply for local communities in rural area.

Typology

Simple coppice	*Populus* spp., *Salix* spp., *Quercus* spp., *Alnus* spp., *Robinia* spp.
Coppice with standards	*Populus* spp., *Salix* spp., *Quercus* spp., *Alnus* spp., *Robinia* spp.
Pollarding	Not practised
Short rotation coppice	Mainly *Populus* spp.; there are efforts to cultivate *Paulownia*
Other types	A few cases aim at the conversion of oak coppice to high forests. This is considered a challenge. The normal coppice rotation age in Albania is up to 60 years old. The conversion is done through clearcutting in the entire forested area, leaving about 100-150 trees for seeds production. A few cases of mixed forest management forms (coppice with high forests) exist in Albania.

Map

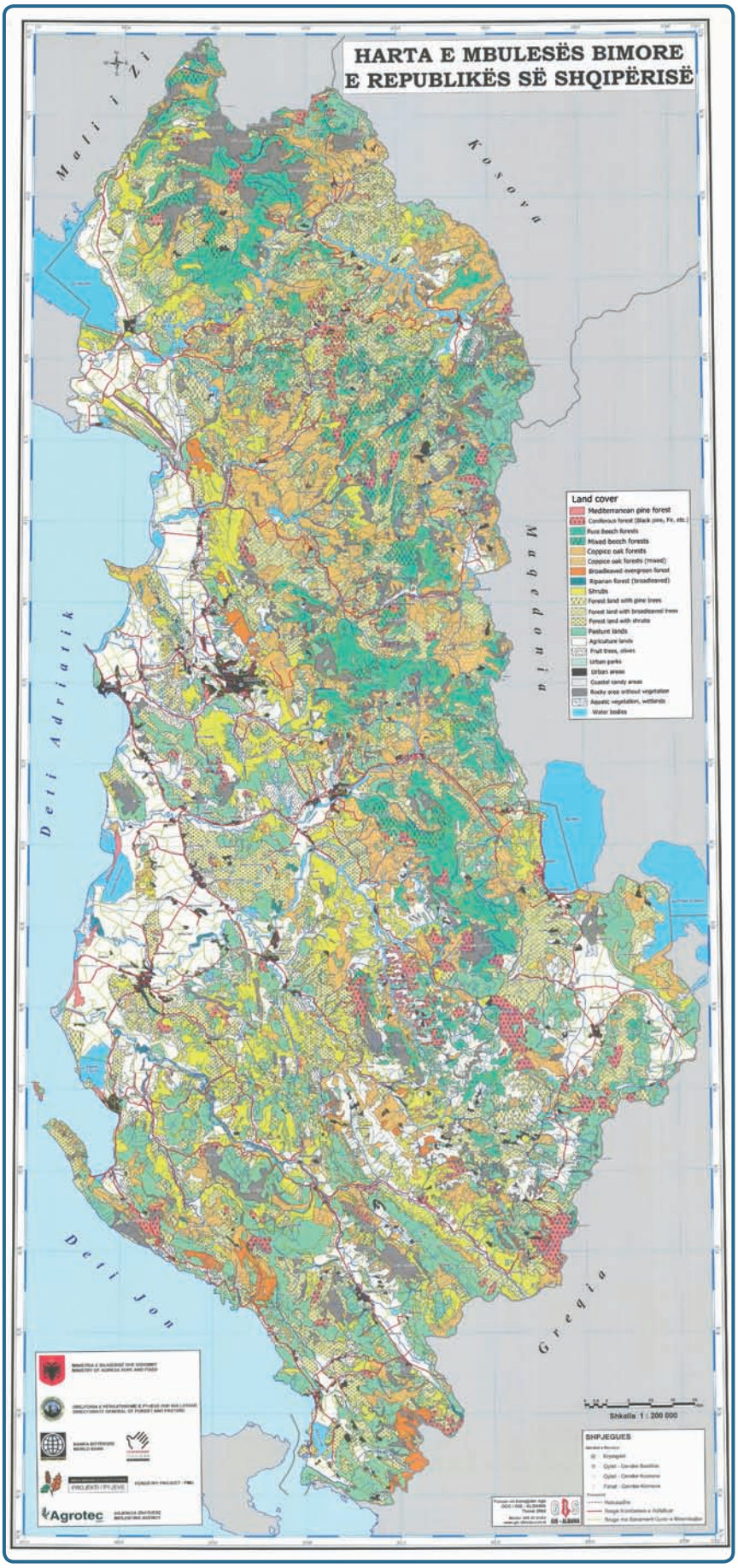
Abdulla Diku

Map of land use in Albania:

Oak coppice forests are displayed in light orange ( )

Mixed oak coppice forests are displayed in light orange with white tree-images ( )

Source: Albania National Forest Inventory



Images

Description

Abdulla Diku and Vasillaq Mine

As in all other countries, coppice forests in Albania represent a traditional system of forest management. For centuries, and until the present time, coppice forests have been the model of "coexistence" of forests with local communities. These forests have usually had the same purpose; providing firewood for heating and cooking, supplying materials for construction purposes, agriculture and industry, as well as livestock grazing, for example.

Figure 1. Oak coppice forest in Drini valley

Prior to 1944, Albania had a forest area of about 1,379,000 ha; of which ca. 300,000 ha were deforested for agriculture during the socialist period. The quantity and quality of coppice forest in Albania is variable. Most of the coppice forest is oak (Figure 1), but shrub species are also managed as coppice across the country. Generally, coppice forests are located in close proximity to residential areas. Most coppice forests in Albania are irregularly structured due to their disorganized management. In the past 10 years there has been a slight increase in the area of coppice forests, with coppiced oaks now extending to 32.5% of the Albanian forest area and comprising 17% of the total volume. The low percentage volume compared to the surface area is attributed to the low quality of these forests and poor management. The average volume per hectare of oak coppice forest is approximately 32 m^3 ha^{-1}. There is evidence of an increase in volume per hectare of coppice forests in the country, attributed to the use of alternative sources of energy for heating and cooking (electricity). The distribution of coppice forests by age classes is shown in Figure 2.

The chart shows that 70% of coppice is 0-20 years old. Based on an analysis of ANFI data, the average annual growth of coppice forests in Albania is estimated at ca. 2.1 m^3 ha^{-1} yr^{-1}.

Even shrub species are historically treated as coppice forest, with this type comprising about 23% of the forest area of the country. In terms of volume they represent about 10%, with the average volume about 20 m^3 ha^{-1}, again demonstrating the very low quality of these forests.

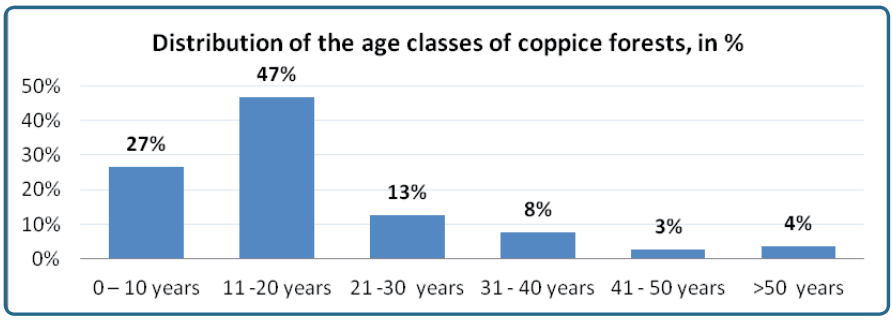


Figure 2. Distribution of the age classes of coppice forests in percent
Source: National Forest Inventory of Albania (2004)

The main problems of coppice forests in Albania are as follows:

- High demand for wood products
- Lack of sustainable management that is based on scientific criteria
- Frequent damage due to cutting and fires
- Livestock grazing in the early stages of coppice forests
- Poor quality (low volume/ha)
- Over- and ineffective use (short cutting cycles, breach of technical criteria...)
- Unfavourable national energy policy (at the expense of forests)
- Various diseases, pests and harmful agents
- Incorrect data in forest cadastres on area surface and volume

Forestry Regulations

Abdulla Diku, Luljeta Mine and Vasillaq Mine

Albania has limited forestry resources due to extended periods of overuse, damage caused by fires and illegal cutting. According to the European Environmental Agency, losses of forestry stock volume in Albania during the period 1990-2010 were 2-5 times higher than the natural growth of forests.

The forest area in Albania is 1.05 million hectares, comprising 55.25 million cubic meters. Forests cover 37% of the country's territory. Forest areas consist of: (i) 36% high forests, (ii) 28% coppice forests and (iii) 36% shrubs.

We would like to highlight the fact that the majority of shrubs in Albania are managed as coppice forests. Considering this fact, coppice forests in Albania account for over 60% of the national forest area. In terms of forest volume, high forests represent 78% of the stock, coppice forests 15% and shrubs 7%. If we analyse the volume per hectare according to forest management forms, the situation is as follows: high forests have 114 m^3/ha, coppice forests 28 m^3/ha and shrubs 9 m^3/ha. Over the period 1961-2015, the national forestry area was reduced by 300,000 hectares, or approximately 25% of the total.

The Code / Kanun (XV-XX centuries)

This represents the oldest "law" in the country, which was applied in the central and northern part of the country during that period. It constituted the main legal basis for various issues of the communities' social and economic life. The Code states that "Every house with a smoking chimney shall have its own property". With regard to forests, there was a forest area known as "*kujrija*" that either surrounded the village or was located in the vicinity. While private forests or property were divided by boundaries, "*kujrija*" was not divided and all the households of the village were equally entitled to use it. "*Kujrija*" was mainly used for firewood production, building materials, livestock fodder, grazing and hunting and each village had its own forests ("*kujri*"). They were irregular coppice forests, mainly consisting of oak and hornbeam. In addition to "*kujrija*", the village had access to its own mountain and pastures. The mountain was composed of forests located further away from the village, in its most mountainous part, and were mainly high forests that were used for timber.

Law on "Forests and pastures" (1923)

Three major forms of forestry ownership were acknowledged: (i) State-owned, (ii) Communal and (iii) Private.

This Law provided a complete framework for the organisation and management of the forestry and pasture sector management in the country, placing the emphasis on their sustainable use.

An important element of this law was the care that should be taken with coppice forests used to produce charcoal or firewood, particularly with regard to their natural regeneration. After cutting for firewood and charcoal, livestock was prohibited from entering the area for ten years and grazing outside the defined area required an official permit. This allowed the forest the necessary time to regenerate. Firewood collection, logging and grazing took place in the coppice forests (oak trees, hornbeam trees, shrubs, etc.) located close to the village. In high forests located further away from the village, only the cutting of trees for building materials was allowed. Deforestation for the purposes of opening land for agriculture or pastures was not allowed. The law also prohibited pruning trees for the purpose of providing fodder for livestock. The law also stated that "…in the case of coppice forest composed with rare trees, or in slopes, the cutting of trees is not allowed", since these trees should be given the necessary time to produce seeds, in order to guarantee the forest's regeneration.

Law no. 3349 "On forests protection" (1961)

This law was aimed at converting coppice forests into high forests. Coppice forests could be maintained only to meet the needs of the rural population. Coppice forests could also be kept under certain ecological conditions. The exploitation of coppice forests under the age of 10 was prohibited. Cutting could only take place between October 1 and March 31. Grazing of livestock was prohibited until the naturally regenerated saplings reached a height of 1.5 m from the ground, while grazing by goats was prohibited.

Law no. 4407 "On forests" (1968)

This law underlined the major role of forests in providing firewood for the development of industry, for the construction of the country, and for their paramount role in moderating climate and protecting the land from the erosion. Pruning of forest trees was allowed only in certain areas, which were defined in advance. Agricultural cooperatives were allowed to exploit coppice forests to meet their own needs for firewood and building materials. Due to the low level of industrialisation in Albania over the period 1960-1990, approximately 300,000 ha of forests in the country were converted to open agricultural land. These were coppice forests (oak trees, hornbeam trees and shrubs) near and surrounding villages. In addition, since firewood was the only source of energy available to Albanian households for heating and cooking, forests were cut faster than their natural rate of growth.

Law no. 7623 on Forests and Forest Service Police (13.10.1992)

The law envisages:

(i) the overall preservation of forestry stock for its economic function and its special value in environmental protection, water reserves, cleaning of the atmosphere, land fertility, landscape, agro-tourism and infrastructure;

(ii) control over the cutting of timber, to keep it at a sustainable level that balances the natural growth of forests, defined through growth projects drawn up in compliance with this law;

(iii) control over the development of the entire forestry sector; and

(iv) ensuring the balance between society's interests as a whole and the interests of people with legal entitlement.

To increase the forest stock and its production capacities, the forest service is obliged to undertake afforestation. In such cases, fast-growing and highly economic varieties/strains have to be used. The law highlights that "it is prohibited to cut down or uproot trees in very steep places, in a strip of land 100 m wide at the upper boundary of vegetation; it is prohibited to cut down and uproot rare varieties of trees

and shrubs, as well as the trees on both sides of national roads with an inclination over 30% and on strips of land of 20 m above and below roads, as well as in forests that have a protective and special function".

Grazing is prohibited in new forests, forests during their regeneration and in coppice forests under regeneration....

Law no. 9385 on "Forests and Forestry Service" (2005)

Pursuant to this law, the management of the national forestry stock is based on the principles of sustainable and multifunctional use of forests. This law classifies the ownership of forests as: (i) public or (ii) private.

Rehabilitation and use of national forestry stock requires protection and regeneration works to prevent or restrict harmful exploitation. Increases in the productivity of the national forestry stock should be accomplished through regeneration of exploited forests and improvement of existing forests by taking silvicultural measures. Furthermore, the afforestation of abandoned lands, barren and eroded plots is the duty of the administrators and users of these lands. Pursuant to this law, grazing and the transfer of livestock to public forests, newly afforested lands, exploited forest plots, those under regeneration and newly coppiced forests, etc., is only allowed in compliance with defined rules. As the previous law, this law also stipulates that: "it is prohibited to cut down or uproot trees and shrubs in very steep places...", due to their protective role.

Strategy for the development of forestry and pasture sector in Albania (2004)

The Strategy aims to ensure the sustainable and multifunctional development of forestry and pasturage resources. One of the objectives of the strategy is: "…the establishment of several forestry entities with regular oak coppice forests and their scientific growth as a basis for the conservation and preservation of valuable species of oak trees and their conversion into high forests…" The actions required to accomplish this objective are:

- Selection of areas with oak trees (irregular coppice forest) with the proper size and species contents, suitable for their conversion into regular coppice forest.
- Drawing up technical projects for these forestry entities and for the commencement of their implementation.
- Calculation of current and future annual productivity (when the entities will consist entirely of regular coppice trees) and conducting a study for the conversion of these entities into high forests.

To meet the needs of rural population for firewood and building materials, the strategy envisages: "The establishment of regular coppice trees within the territories of communal forests with sufficient area in order to meet the needs of communes for firewood and building materials and their unification into regular coppice forests entities for purposes of growth with short rotations." Also, another important activity to be undertaken is "the definition and separation of forests for producing firewood and building materials (from the regular coppice forests)."

Cross-cutting Environmental Strategy (2015-2020)

Its strategic objectives are:

(i) approximation and implementation of acquis communautaire in the field of forests and pastures;

(ii) increase of communal forest management capacities;

(iii) improvement of forestry information systems and databases;

(iv) strengthening forest-related research systems, technological development and innovation;

(vi) improvement of regional relations and unification of technologies and methodologies;

(vii) applications to ensure support for the development of forestry in the country;

(viii) inclusion of various climate issues in forestry stock management aspects.

The strategy also aims:

- To achieve the full transposition of acquis communautaire in forests by 2020
- To adopt a new law on forests
- To develop a national program for forests' revitalization
- To increase economic effectiveness and energy efficiency through the sustainable use of forests
- To afforest with short-rotation species to produce biomass and reduce the adverse effects of extreme natural events (floods, etc.) in pilot areas.

National strategy for development and integration (2015-2020)

As a forest-related strategic objective, the strategy values the strengthening of management and preservation of forest and pasture resources through:

- Reduction of illegal cutting by 2020;
- Developing growth plans for all forestry entities in the country;
- Rehabilitation of degraded areas.

Forestry literature regarding coppice forests

In Albania, Silviculture and Forest Mensuration are the main subjects taught at university that deal with coppice forests. Meanwhile there are various studies and monographies prepared by native authors for oak species features, silviculture treatment and their management. *Forest Growth and Silviculture* (Muharremi et al. 1990) is the main resource on forest management and handling. They provide major alternative management option for all forest types, including coppice. They mention that clear cutting should be restricted in coppice forests that have a density below 70% and on slopes, and that their conversion to high forests is desirable from a silvicultural point of view.

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Austria

Martin Kühmaier, Eduard Hochbichler, Karl Stampfer, Jenny Mills and Peter Buckley

Facts and Figures

Martin Kühmaier

Definitions

Coppice: even-aged stands consisting of trees and shrubs that regenerate wholly or mainly vegetatively (sprout or root shoot).

Niederwald: Gleichaltriger Bestand aus Bäumen und Sträuchern, die sich ganz oder überwiegend vegetativ (Stockausschlag, Wurzelbrut) verjüngen.

Short rotation coppice: Plantation of fast-growing trees or shrubs, with the aim to produce wood as a renewable resource in a short rotation period.

Kurzumtriebsfläche: Anpflanzung schnell wachsender Bäume oder Sträucher mit dem Ziel, innerhalb kurzer Umtriebszeiten Holz als nachwachsenden Rohstoff zu produzieren.

Legal Framework

1. There is no specific legal framework for coppice forests in Austria.

2. Short rotation coppices (SRCs) with a rotation period of up to 30 years are not classified as forests (Austrian Forest Act 1975 in the amendment of 2002 § 1a. (5)).

3. Dibbling of forest plants and cuttings on previously agricultural land is not considered afforestation if the owner reports within one year after planting to the district administrative authority that these forest plants will be used in the short term with a rotation period of up to 30 years (Austrian Forest Act 1975 in the amendment of 2002 § 1a. (5)).

Statistics

Coppice forests	93,000 ha	2.3 % of forest area in Austria
Short rotation coppice*	2,236 ha	On agricultural land
	Sources: BFW Waldinventur 2009, Agrarstrukturerhebung 2013	

* SRCs are grown following the quantitative order: *Populus, Salix, Robinia* (Jürgen Kern)

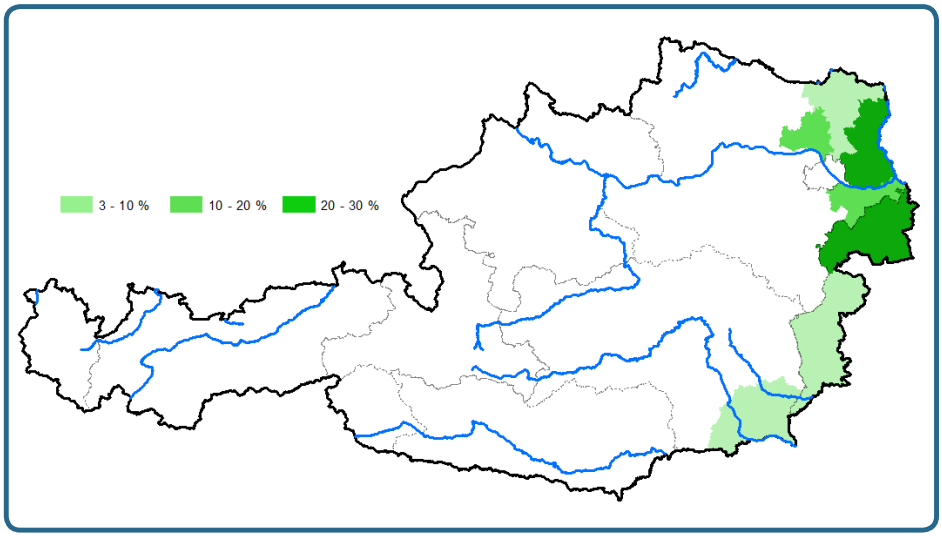
Typology

Simple coppice	Traditional natural forest regeneration method still practised in the Eastern part of Austria. Large parts have been transformed into high forests in the past decades.
Coppice with standards	Same as above
Pollarding	Practised in historic wood pastures until the beginning of the 20th century as cattle fodder, especially *Fraxinus excelsior.*
Short rotation coppice	Practised as an agricultural alternative, using *Populus* and *Salix*.

Images

Map

Martin Kühmaier



Map with the distribution of the most relevant coppice areas in Austria, shown as a percentage of the total coppice area
(Data source: BFW Waldinventur 2009)

Description

Eduard Hochbichler and Karl Stampfer

In Austria, coppice forests presently cover an area of about 100,000 ha or 2.3% of the total forested area. Approximately 75,000 ha belong to the “land-coppice system” and 25,000 ha are part of coppice forests in the alluvial plains.

Approximately 90% of coppice forests are concentrated in the eastern part of Austria, in the regions of Burgenland and Lower Austria (main growth zone ”Sommerwarmer Osten“; oak-hornbeam forest type; average rainfall 450 to 600 mm with dryer periods in spring and autumn; average annual temperature is 9.3 C (Killian et al., 1994). In this region the trees have a high potential for sprouting (Krapfenbauer, 1983).

According to the site conditions, coppice (15–30 year rotation); coppice with reserves (underwood 20-30 year rotation; reserves 40-60 years) and coppice-with-standards management (underwood 20-30 years; overwood 100-120 years) have been a widespread silvicultural practice in the eastern part

of Austria for centuries. Oak and valuable broadleaved trees were/are favoured in overwood. Periodic changes of forest management objectives, influenced by the purpose of optimisation and performance of forestry systems (coppice system vs. high forest system) and decreasing demand for firewood and/or catastrophic events, such as the colonisation of the parasitic mistletoe *Loranthus europaeus*, have led to different structured stands in the forest enterprises over the last 40 years (Krissl and Müller 1989; Tiefenbacher 1996; Hochbichler 1997; Hagen 2005).

These trends have decreased the relevance of coppice and coppice-with-standards and fostered the promotion of valuable broadleaved trees other than oak. However, demand for valuable hardwood and biomass (energy wood) has increased interest in these silvicultural systems once again. Restoration, conversion and transformation strategies are discussed, in order to improve the natural and economic performance (Hochbichler 1993).

For vigorous coppice sites (top height >24m) a "high forest character" system is now recommended, while for moderate sites (top height 18-24 m) a coppice with reserves and/or coppice-with-standards system is advised. For drier, less vigorous sites a simple coppice system is suggested. Silvicultural recommendations for coppice forest management, based on ecological and economic aspects, were developed for various silvicultural strategies (coppice, coppice-with-standards with different percentage canopy cover of the overwood and high forest) and operations (Hochbichler 2008; Hochbichler et al. 2013).

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Forestry Regulations

Jenny Mills and Peter Buckley

Austria's first comprehensive forest law in 1852 introduced the obligation to manage forests sustainably. The 1975 **Forest Act**, amended in 2002, includes general rules for sustainable forest management applying to publicly- and privately-owned forest and gives executive directives for the nine Austrian provinces.

Clearcuts of more than 2 ha are not permitted except under certain circumstances. In protection forests the maximum clearcut area permitted is 0.2 ha. Final cuts of immature trees of less than 60 years are forbidden, although a lower limit may be given for fast-growing trees. All clearcuts of more than 0.5 ha must be approved by the Forest Authority regardless of forest type, to limit detrimental effects on the soil and adjacent forest stands. Reforestation through natural regeneration should take place within 10 years, but can be extended in adverse conditions.

In addition to the Forest Act, some Federal Provinces have **forest ordinances**, which include regulations for timber production. There is **no national act on the protection of nature**, which is regulated through separate Acts for each of the nine provinces.

National Park Laws and **Hunting and Fishery Laws**, and the **Environmental Liability Law** also impact on forestry and biodiversity.

Austria's **Forest Development Plan (FDP)** covers all the country's forests and is used to assess forest functions in the public interest in terms of its key functions: economic, protective, beneficial, and recreational. The Plan is revised every 10 years by the forest authority and includes requirements for the treatment of forests during that period.

There is no general obligation for public or private forest owners to prepare a **Forest Management Plan (FMP)**, but most publicly-owned forests are likely to have one. All forest enterprises of over 1,000 ha need to submit an FMP if they want a subsidy from the rural development programme. FMPs are also required for public and private areas with special protection such as Natura 2000 sites, national parks and conservation areas. About 43 % of the Austria's **Natura 2000 sites** are in forest areas.

Both **FSC and PEFC certification systems** operate in Austria, but by far the largest area is certified under the PEFC scheme.

The Alps cover about three-quarters of Austria's total area. The Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management (Bundesministerium für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, BMLFUW) estimates that 19.3 % of Austrian forests serve a protection role.

Protection against torrents and avalanches is included in the Austrian Constitution as a responsibility of the Federal Government. The Forest Act ensures that this task is dealt with by the **Forest Engineering Service in Torrent and Avalanche Control** (Forsttechnischen Dienstes für Wildbach- und Lawinenverbauung, WLV, also known as die.wildbach), an office of BMLFUW, which analyses and assesses hazards and risks, plans and conducts preventive and protective measures.

A **Protection Forest Strategy** was adopted in 2002. The 'Protection through Forests Initiative' (Initiative Schutz durch Wald – ISDW) began in 2007. Tasks required by the Forest Act include the preparation of hazard zone plans, which

describe the intensity and extent of all hazards due to torrents and avalanches as a basis for control measures. Engineering techniques are only used if necessary to ensure the success of the silvicultural methods adopted.

The 2002 amendments to the Forest Act redefined the term **'schutzwälder' (protection forest)** into two types:

'Standortschutzwalder', which protect the location on which they stand from erosion by wind, water or gravity and therefore require special treatment to protect the soil and vegetation and to ensure reforestation. These areas include forests on shifting sand and karst, sites liable to serious erosion or landslides, and forests on rocky ground or shallow soils where tree regeneration may be difficult.

'Objektschutzwalder' are forests that protect people, human settlements, infrastructure or agricultural land against natural hazards, such as avalanches, rocks, stones, landslides, or damaging environmental influences, and which require special treatment in order to achieve and secure their protective effect.

The owners of 'standortschutzwalder' must manage them in accordance with local conditions so that their preservation and stability is ensured. This can be financed by timber production, whereas the cost of the necessary management measures in 'objektschutzwalder' is financed by public funds or payments by those who benefit from the protection.

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Belgium

Kris Vandekerkhove, Stefan P. P. Vanbeveren, Reinhart Ceulemans, Hugues Lecomte, Didier Marchal, Jenny Mills and Peter Buckley

Facts and Figures

Kris Vandekerkhove

Definitions

Coppice: one-storey forest structure, consisting of resprouts on stools and/or root suckers, occasionally with some trees from seedlings.

Coppice with standards: two-storey forest containing a upper canopy consisting of tall trees originating from seeds, and a lower canopy consisting of resprouts on stools and/or root suckers.

Taillis: une structure à un seul étage constituée de rejets de souches et/ou de drageons, avec éventuellement quelques rares tiges issues de semis.

Taillis sous futaie: peuplement constitué d'un étage supérieur composé d'arbres de futaie issus de semences et d'un étage inférieur issus de rejets de souche et /ou de drageons.

Definitions from the Walloon Forest Inventory

Legal Framework

Traditional coppice and coppice-with-standards forests are considered a legal management system in broadleaved forests. Short rotation coppices, e.g. of willow and poplar, with rotation periods of <8 years are legally not considered 'forest'. They are within the legislation of (agricultural) crops. Source: Bosdecreet 1991 (for Flanders); code forestier (for Wallonia)

Rotation Period

There are no legal restrictions on the rotation period; however the rotation period should be included in the management plan and should be in accordance with silvicultural rules of good practice for the management plan to be approved.

Rotation period generally varies from 8-12 years (alder, ash, birch), in some cases up to 20 years (oak, hazel, hornbeam). Exceptionally shorter (4-6 year in oak for bark stripping used in the tanning industry) and longer rotations (up to 30 years) were used in the past.

Statistics

In Belgium there are still approximately 115,000 ha of coppice and coppice-with-standards (15-20% of the total forest area). This area consists mainly of coppice-with-standards forests with oak in the standards, and hazel, hornbeam, maple, sweet chestnut and birch in the coppice layer.

Low coppice covers about 15,000 ha and consists mainly of black alder in wetland areas and birch and oak on dryer grounds. This type used to be much more common in the past: in 1895 coppice still covered over 100,000 ha. Many were transformed into conifer plantations or high forest of broadleaved trees.

Coppice with standards still cover about 100,000 ha (over 200,000 ha in 1895), mainly in Wallonia, but most of these stands are in gradual conversion towards high forest.

Typology

Simple coppice	'taillis simple', 'hakhout' - about 15,000 ha
Coppice with standards	'taillis sous futaie', 'middelhout' - about 100,000 ha
Pollarding	'têtards', 'knotbomen' - only in the open countryside (willow, poplar, ash)
Short rotation coppice	'korte omloop hout' (KOH) - considered an agricultural crop; not under forest legislation

Images

Coppice-with-standards: oak-hornbeam forest in Cerfontaine (Namur)

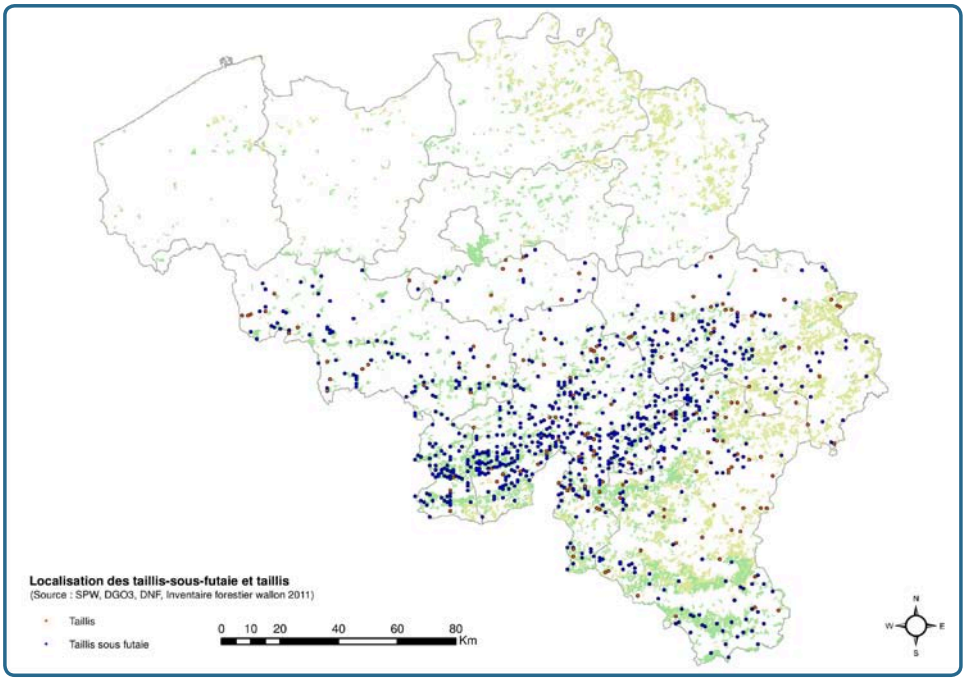
Experimental coppice-with-standards restoration in the Meerdaal Forest (south of Leuven)

Low coppice stands in Bierbeek (left) and Sinaai (right)

Photos: Kris Vandekerkhove and Peter Van de Kerckhove (right)

Map

Hugues Lecomte and Didier Marchal



Occurrence of coppice (orange dots) and coppice-with-standards (blue dots) in Belgium, based on the Walloon Forest Inventory plots (SPW, DGO3, DNF, Inventaire forestier wallon 2011). Operational coppice and coppice with standards forests in the northern part of Belgium (Flanders), are not shown in this map, but are very rare (only a few hundred ha). The background displays forest in Belgium: broadleaved in dark green, conifer in light green. Source: EFI forest map of Europe, version 2011 (Kempeneers et al. 2011; Päivinen et al. 2001; Schuck et al. 2002).

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Description

Stefan P. P. Vanbeveren and Reinhart Ceulemans

In Belgium, the distinction is made between simple coppice cultures (*hakhout*) and coppice with standards (*middelhout*). Coppice cultures have rotations of 2-30 years and were the dominant management regime from the middle ages until the beginning of the 20th century. The early and more frequent revenues, in comparison to traditional forests, were the main motives for this management regime. The main products extracted from coppice cultures are firewood, oak bark (for tanning), charcoal, pole wood and branches for brooms.

For several years, experimental, high density (up to 18,000 trees ha^{-1}), short-rotation (2-4 years) coppice cultures have been established, mainly with *Populus* (Figure 1) and *Salix* species. These short-rotation coppice cultures are currently grown on 30 ha, an area expected to expand with the predicted increase in demand for second generation biofuels.

Coppice with standards is more typical on rich soils. The coppiced trees were mainly selected for firewood (e.g. *Carpinus betulus, Corylus avellana, Fraxinus excelsior, Castanea sativa* and *Alnus*), while the uneven-aged standards were selected to produce timber (e.g. *Quercus, Populus, Fraxinus excelsior* and *Larix*). From the little information available on productivity, stem wood values have been calculated at 2 to 7 m^3 ha^{-1} yr^{-1}.

The use of coppice cultures in Belgium declined in the 20th century as a consequence of a decrease in the demand for firewood and oak bark and an increase in management costs. Most coppice cultures have been converted to oak high forest or abandoned. Conversion to oak forest involved pruning all but one shoot from each stool; this proved, however, to be an unsuccessful management strategy as it led to poor stem quality. The transformation of coppice cultures usually involved inter-planting with different species such as *Pinus sylvestris, Pseudotsuga menziesii* and/or *Larix*, although old coppice stools can still be found. Recently, coppice cultures have

Figure 1. An experimental SRC culture in Lochristi (East-Flanders, Belgium) with *Populus* (genotype Bakan, *P. trichocarpa* Torr & Gray (ex Hook) x *P. maximowiczii* Henry).

received attention for their nature, cultural and historical value. Re-coppicing old stools is not usually sufficient to re-establish coppices due to the low regeneration capacity of buds. Even if these are still capable of sprouting, stem density will be too low, as a consequence of the self-thinning process during past decades. Therefore, new planting is often necessary, which requires protection from wildlife and control of competing understorey growth.

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Forestry Regulations

Jenny Mills, Peter Buckley and Kris Vandekerkove

Flanders

1990 Forest Decree (Bosdecreet)

The law on Flemish forest management and is valid both for state and private forests.

1997 Nature Decree (Natuuurdecreet)

Aims to maintain, restore and develop the natural environment through protection and management measures.

While the forest management regulation of the Forest Decree still applies, the 1997 decree embodies principles that guide the government not to authorise or accept any management operation or plan that will degrade either the quality or quantity of the natural environment. These 'stand still' precautionary principles are embodied in the guidelines for forest management plans (bosbeheerplans) and felling permits (kapmachtiging) issued by the **Agency for Nature and Forest (Agentschap Natuur & Bos - ANB)**, which are applicable to all forests. The possible conservation impact must be assessed in all planned operations and avoidable damage must be prevented.

The Nature Decree deals with nature reserves, Natura 2000 Special Areas of Conservation, and also sets up the Flemish Ecological Network (Vlaams ecologisch netwerk; VEN) and Integral Interweaving and Supportive Network (Integraal Verwevings- en Ondersteunend Netwerk; IVON), an ecological network of linked, protected and other valuable areas to facilitate species migration. Although the main management aim is nature conservation, other activities, such as recreation, agriculture, forestry, military activities or the extraction of drinking water, are allowed in the VEN and IVON provided they do not jeopardise conservation.

In 2003 the Flemish Government established the **Criteria for Sustainable Forest Management** that include various goals and restrictions that are mandatory for all public and private forests within the VEN.

There are three levels of restrictions:

1. A basic level that applies to all forests

These restrictions are included in the directives for the evaluation of felling permit applications and management plans:

- Deforestation is forbidden (unless with special exceptional permit and procedure).
- No felling or harvest operations are allowed unless described in an approved management plan or in a felling permit authorised by the ANB. For an owner of several scattered small areas that collectively have an area exceeding

five hectares, but are each individually less than 5 ha, there is no obligation to draw up a management plan, but one can be drawn up voluntarily.

- Forest ownerships of >5 ha should have a (limited) management plan covering a 20-year period.
- Clearcutting is to be avoided. Where necessary, the maximum size of clearcuts for poplar and exotic tree species is 3 ha. For native broadleaved woodland, the maximum size is 1 ha, unless transforming homogeneous stands to more mixed stands, when the area may be enlarged to 3 ha.
- Clearcuts should be spread over the forest, at least 100 m apart.
- No felling and harvesting can take place from April 1 - June 30. (This can be extended, shortened or cancelled depending on local ecological conditions.)
- In thinning operations, maximum thinning intensities can be imposed (in % of stem number or basal area).
- Thinning that leads to degradation of the stand quality or structure (removing all quality trees) will not be allowed.
- Coppicing is allowed in appropriate stands and species, with a minimum rotation time of 8 years.
- Specific measures to prevent soil damage may be imposed if the conditions of the felling permit (e.g. fixed skidding tracks, avoiding certain areas).
- Other preconditions can be connected to the felling permit by the forest administration, e.g. pertaining to certain valuable trees or species to be spared.
- Successful regeneration must be established within 5 years after final felling. This can be by natural or artificial regeneration (to be planted within 3 years after final felling).

All regeneration and transformation should follow the 'stand-still' principle:

- Native trees cannot be replaced by exotics.
- Native broadleaved cannot be replaced by native coniferous forest (Scots pine).
- Mixed stands cannot be replaced by homogeneous stands.
- The owner is encouraged to keep and increase levels of dead wood and old trees, but there is no strict target.
- Planting subsidies are given to switch to indigenous tree species and there is a subsidy scheme for public access.
- When applying for a kapmachtiging, ANB decides if felling is permitted within sixty days of submission and under what conditions. If there is no reply within that period, the kapmachtiging is considered granted.
- In private forests, fellings can take place for urgent safety reasons without a kapmachtiging, but ANB must be notified in writing within 24 hours. If felling is necessary for sanitary reasons, a fortnight's notice should be given. Within 6 months after these types of felling, a proposal for rehabilitation measures must be submitted to ANB.

2. 'Criteria for Sustainable Forest Management'

This is compulsory for all forests (both state and private) inside the VEN. Outside VEN areas, forest owners can decide to join voluntarily, in which case they are also eligible for financial incentives and other opportunities (certification) related to CSFM.

In CSFM forests, the basic level restrictions are still in force, but some points are more stringent: it aims for 'continuous improvement' on some points, rather than 'stand-still'.

The following requirements and restrictive measures are applied:

- An extensive management plan is required, with a detailed inventory of elements valuable

for nature conservation and specific management operations to conserve them (e.g. old habitat trees, streams, archaeological sites)

- Choice of tree species: 'stand still' plus a long-term goal for conversion of exotic stands to mixed indigenous on 20% of the surface area.
- Change all homogeneous stands to mixed stands (at least 30% admixture).
- Size of clearcuts: 1 ha, unless the plan is for transformation towards more mixed stands from homogeneous exotic plantations.
- Dead wood: A clear target, 4% of total stock, plus quality requirements: all sizes, standing and lying.
- Overmature trees: a certain number of trees/ha should be selected to be left unharvested.
- 5% of the forest should consist of, or be developed towards 'key habitats'. These can be ecologically valuable open spaces and/or semi-natural stands of mixed native woodland (a selective harvest of high timber value trees not detrimental to the quality is still allowed).

These CSFM criteria are very demanding and for many owners obligatory, but they also give the owner a certain legal security and other opportunities.

The CSFM are considered to be in accordance with the requirements for Natura 2000 habitats and also with FSC and PEFC(*)-certification standards, which makes all forests managed according to CSFM automatically eligible for individual or group-certification.

Some extra financial incentives are also provided:

- The owner is excepted from certain taxes and succession rights.
- Subsidy (per ha) for key-habitats and management of valuable open spaces.
- Subsidies for the production of an extensive management plan.

(*) No official Flemish PEFC-standard exists at this moment, but the CSFM is in accordance with global PEFC-standards, and the official standards of neighbouring countries or regions, like the Netherlands and Wallonia.

3. 'Management Vision for Public Forests'

This is applied to all public forests and is compulsory for State-owned Domanial forests. It includes very high standards of forest management, particularly for nature conservation; they are comparable to CSFM but go further for some elements. In particular, there are higher targets for tree species composition.

- The basic principle is close-to-nature forestry, with small-scale interventions, selective thinnings and abandoning of final cuts. Clearcuts (1 ha or more) are only allowed in exceptional cases.
- In the long term, the majority of forest stands in public forests should consist of mixed, uneven aged, indigenous forest stands and 80% of all stands should consist of indigenous species. There should be at least a 30% admixture of indigenous species in the remaining exotic stands.
- All stands must be mixed, meaning that no species should cover over 90% of the basal area.
- New afforestations are to be of indigenous species. Poplar clones may be used as a 'pioneer' generation, at most on 50% of the area.
- Natural regeneration is used whenever possible.
- Special attention and appropriate management is given to valuable non-forest biotopes in the forest complex (heathland, ponds, etc.). These permanent open spaces, together with transient open spaces with high conservation value, should cover at least 5-15% of the total forest area.
- Special attention is also given to rare and vulnerable species (hollow trees with bat colonies, breeding areas of rare bird species, etc.).

- Special attention is also given to rare local genotypes of trees and shrubs.
- No commercial harvesting (with heavy machinery) is allowed in valuable and vulnerable riparian forests and swamp forests.
- Changes in natural hydrology should be restricted to the absolute minimum.
- Old trees: some trees are spared to become old and die naturally. They can be spread over the stand or grouped. If spread over the stand, at least 10 trees/ha are to be spared (for very large trees and low stem numbers: at least 10% of the stand basal area). If clustered, areas of at least 5% of the stand are selected and remain unharvested.
- On dead wood, the same threshold is set as in CSFM: at least 4% of the standing stock, both standing and lying, in all decay classes, and representative for the species composition and size distribution of the stand.

As public forest management is not privatised (as in other countries), the forest administration is not eligible for any subsidies. They receive a yearly budget in order to realise these and other services, such as recreational infrastructure.

Forests within the Natura 2000-network

For forests within SACs there are no clear restrictions, but from the executive orders on Natura 2000 targets, it is clear that forests that adhere to a certain habitat type should at least comply with the CSFM if they want to reach the required favourable status of conservation.

A new nature management plan (natuurbeheerplan)

The ANB is working on the integration of the Forest and Nature decrees. When this new legislation comes into force, management of different types of natural areas will be covered by a single conservation plan. Individual management plans will continue, with some revisions to thresholds, limits, etc. This will not change current rules for specific points related to coppice, so coppice can be applied in 'appropriate' stands: the evaluation of the appropriateness will be done by the local official of ANB. In practice, this means that approval will be given in cases of 'continuation' or 'restoration' of previous coppice stands, and may be approved for young stands of broadleaved forest that are able to resprout to coppice (i.e. all except for beech). For old, well-structured broadleaved high forest stands, conversion to coppice may be regarded as a degradation of present natural values and a violation of the 'stand still principle', so may be refused. If these old, mixed stands are previous coppice-with-standards stands, permission will most probably be given for restoration of this type of management, under the prerequisite that ecologically valuable standard trees are to be spared.

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Wallonia

A new **Forest Code** (Code Forestier), covering private and public forests, was adopted by the Walloon Parliament in 2008. It replaced the former Code, which dated from 1854. Some of the objectives are to: produce wood of increased quality and quantity; fight climate change; safeguard biodiversity; fight fragmentation; diversify the forests; and ensure the social, recreational and educational role of the forest. The Code encourages the use of tree species adapted to local soil conditions, genetic conservation (rare tree species and local ecotypes), natural regeneration, an uneven-aged structure, and soil and water protection (limits on clear-cutting, drainage, etc.). Inheritance tax on standing timber has been abolished to encourage planting of species such as oak or beech rather than conifers.

Some of the regulations are:

- Except in urgent, authorized cases, it is forbidden to clearfell coupes over 5 ha in forests with more than 50% conifers. For areas with more than 50% broadleaves, the maximum clearfell allowed is 3 ha. This applies to all felling, which leaves an amount of woody material less than 75m^3/ha for standards and at least 25m^3/ha for coppice-with-standards of strong shoots.
- All requests for urgent and non-urgent coupes must be submitted to a section of the Department of Nature and Forests (Département de la Nature et des Forêts).
- The use of pesticides, herbicides and fungicides are prohibited, except in certain cases specified by the Government, in order to fight specific diseases and invasive species.
- All public forests contiguously larger than 20 hectares must have a management plan.
- Management plans are optional for small private forests. A simple management plan ("document simple de gestion"), mainly describing the planned harvests for the following 20-year period can be produced but is not obligatory.
- In the absence of a management plan, all harvesting requires an explicit authorisation from the administration.
- In public forests, at least one tree of exceptional biological interest (dead or damaged trees) must be retained for each 2 ha.
- In broadleaved stands, up to 2 dead or windthrown trees per ha with a diameter of 40 cm must be retained, unless they are dangerous or of high economic value.
- In conifer stands, 2 stumps of broken or dead trees should be retained per hectare, including those in clearfell areas.

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Bosnia and Herzegovina

Ćemal Višnjić, Sead Vojniković and Besim Balić

Description

Ćemal Višnjić, Sead Vojniković and Besim Balić

Forests and forest land in Bosnia and Herzegovina (BiH) occupy an area of 3,231,500 hectares, or 63% of the total area of the country. There are 1,252,200 ha of coppice forests in BiH, of which 34.5% comprises of beech, 32.6% thermophilic oak, 22.5% sessile oak, and 10.4% other types of coppice. In terms of ownership, 53% of coppice forests are state-owned and 47% private.

The purpose of coppice forests in Bosnia and Herzegovina, can be grouped into five classes:

1. productive
2. in very poor management condition
3. special purpose
4. protective
5. inaccessible due to landmines.

Data on the area of coppice forests divided into the above listed five classes, are shown in Table 1.

Productive coppice forests (class 1) are managed for timber production, the most important function (Fig. 1). The coppice forest classes 2 - 4 have more environmental and protective funtions, while those coppices in class 5 are not subject to any kind of management activity because of the potential dangers of mines from the last war.

The stocking volumes of productive coppice forests in Bosnia and Herzegovina (class 1) by different forest communities are given in Table 2.

In the past, coppice forests in BiH were established as a result of patchy, uncontrolled and unplanned human activity in the forest. As a result, various types of coppice forests have developed, differing widely in structure, quality of stems and species composition.

Policy now aims to optimise all coppice forests in the productive (class 1) category by using management methods and silvicultural systems to improve the volume of quality stem production and sustainability.

To this end, four categories have been developed to divide coppice forests in terms of the quality of wood and site conditions.

Table 1. Areas (ha) all coppice forests in Bosnia and Herzegovina according to classes described above (FBiH- Federation of Bosnia and Herzegovina, RS Republic Srpska)

Class	FBiH			RS			BiH (FBiH & RS)		
	State	Private	Total	State	Private	Total	State	Private	Total
1	217,300	164,000	381,300	221,000	284,900	505,900	438,400	451,300	889,700
2	86,200	52,400	138,600	53,200	27,200	80,400	139,400	80,000	219,400
3	400	400	800	4,800	400	5,200	5,200	800	6,000
4	1,200	800	2,000	2,000	1200	3,200	3,200	2000	5,200
5	52,700	21,200	73,900	23,200	34,800	58,000	75,900	56,000	131,900
Total	357,800	238,800	596,600	304,200	348,500	652,700	662,100	590,100	1,252,200

These categories are as follows:

1. good quality coppice forests (class 1)
2. medium quality coppice forests
3. poor quality coppice forests
4. unknown quality of coppice forests

The Forestry Management Company in Bosnia and Herzegovina pays most attention to good quality coppice forest. These forests, especially coppice forests of beech and sessile oak are managed under the coppice selection system. The most frequent rotation is 40-60 years, with felling cycles of 10 years.

In addition to the aforementioned types of coppice forests, Bosnia and Herzegovina also have pollards, sometimes as individual trees or in groups. These are evidence of cultural heritage; pollards located near the villages were used by locals as a source of small dimension building materials and firewood (Fig. 2).

Table 2. Area and average stocking of large timber of all available coppice forests of productive character according to coeno-ecological units and entities in Bosnia and Herzegovina (FBiH-Federation of Bosnia and Herzegovina, RS-Republica Srpska)

Coeno-ecological units of coppice forests	FBiH		RS		BiH (FBiH & RS)		
	ha	(m^3/ha)	ha	(m^3/ha)	ha	(m^3/ha)	+-(%)
Beech coppice forests	163,500	142.73	189,300	148.99	352,800	146.04	6.49
Sessile oak coppice forest	69,300	77.81	160,500	98.42	230,700	92.31	9.93
Termopfilic oak forests	123,500	31.39	85,200	27.90	208,700	29.97	17.17
Other coppice forests	25,000	90.04	70,900	104.15	97,100	100.76	15.18
Total coppice forest	381,300	87.68	505,900	104.46	889,700	97.39	5.27

Figure 1. Productive, well developed coppice beech forest (central Bosnia)

Figure 2. Coppice beech forests with pollards (near Sarajevo)

Bulgaria

Ivailo Markoff, Grud Popov and Patrick Pyttel

Facts and Figures

Ivailo Markoff

Definitions

Forestry Act 2011: 88. (1) Forests are managed as high forest, conversion forest or coppice (Niederwald). (2) High forests are managed in a way to maintain their seedling origin. (3) Conversion forests are managed in a way that transforms them into high forest. (4) Niederwald is managed in a way ensuring its regeneration from re-sprouting.... (5) Not managed as forests are: ... 2. plantations of tree or shrub species for fast production of biomass;

§ 1. In the text of this Act: 54. "Niederwald" are forests of black locust (*Robinia pseudoacacia*), oriental hornbeam (*Carpinus orientalis*), manna ash (*Fraxinus ornus*) and honey locust (*Gleditsia triacanthos*) for coppice regeneration.

Forestry Act 2011, last changed in 7.08.2015

Чл. 88. (1) Горите се стопанисват като високостеблени, издънкови за превръщане в семенни и нискостеблени. (2) Високостеблените гори се стопанисват по начин, запазващ семенния им произход. (3) Издънковите за превръщане в семенни гори се стопанисват по начин, осигуряващ превръщането им в семенни. (4) Нискостеблените гори се стопанисват по начин, осигуряващ издънковото им възобновяване. (5) Не се стопанисват като гора: 2. плантации от дървесни или храстови видове, създадени с цел ускорено производство на биомаса;

§ 1. По смисъла на този закон: 54. "Нискостеблени" са акациевите, келяв габърови, мъждрянови и гледичиеви гори за издънково възобновяване. Чл. 104. (1) Забранява се: 1. провеждането на гола сеч във всички гори с изключение на тополовите, върбовите и нискостеблените гори;

Legal Framework

103. (1) ... Niederwald can be cut from Sept. 1st to Apr. 1st.

104. (1) It is prohibited: 1. to clear-cut a forest except poplar forests, willow forests and Niederwald.

Rotation Period

102. The age of regeneration cut can be not less than ... 2. 50 years for a conversion forest; 3. 15 years for a black locust forest and 20 for the other Niederwald species.

Statistics

Total forest area in Bulgaria is 3,833,640 ha. Conversion coppice takes up 1,351,815 ha, consisting mostly of oak (*Quercus* spp.; 1,025,571 ha), beech (*Fagus* spp.), hornbeam and linden (*Tilia* spp.). Conversion coppices have growing stock of 158,050,412 m^3.

Coppice forests take up 481,747 ha, mostly with oriental hornbeam (197,909 ha) and black locust (153,851 ha) and have stock of 18,665,335 m^3. Coppices mainly consist of trees older than 60 years.

Typology

Simple coppice	Only black locust plantations are still coppiced, rotation age 20 years. Oriental hornbeam can also be coppiced, but this is seldom done.
Coppice with standards	Not practised
Pollarding	Abandoned since the post-war years
Short rotation coppice	Not practised
Other types	1,351,815 ha (in 2015) of conversion coppice, of which 70% is oak and 15% beech, as well as hornbeam, linden etc. Rotation age is 60 to 100 years, aimed at seedling regeneration; most are ageing; the average age is 45 years.

Images

Oriental hornbeam coppice

Beech coppice

Oak coppice

Description

Ivailo Markoff, Grud Popov and Patrick Pyttel

Bulgarian coppice occupies 1,833,562 ha, or 48% of the country's forest area. Oaks are dominant (60% of the coppiced area), mainly sessile oak, Hungarian oak and Turkey oak (*Q. petraea, Q. frainetto* and *Q. cerris*), followed by beech (10%), black locust (9%), oriental hornbeam (8%), hornbeam (*Carpinus betulus*; 6%) and smaller areas of linden (*Tilia* spp.), aspen (*Populus* spp.), chestnut (*Castanea sativa*), pubescent oak (*Q. pubescens*), pedunculate oak (*Q. robur* L.), etc. Single trees and groves of the pedunculate oak have survived in cornfields.

Bulgarian coppices are the result of thousands of years of human pressure; uprooting for cornfields and pasture, in addition to the extraction of timber, charcoal and firewood. The number of coppicing rotations is irregular and not usually known, which makes it difficult to estimate their age and the vitality of their roots. With some species, a large spacing between the stems in a stool betrays a very old root system. Furthermore, all Bulgarian coppices have a large or small component of regeneration by seed; this improves their vitality but makes it even more difficult to evaluate their age.

Coppice is mainly found in the oak forest belt, the most densely populated part of the country. The average altitude is 450 m above sea level, rarely above 1000 m. Coppice forests are made up of 70% oak and 14% beech. One third (29%) are not owned by the state, of which half are private (14%) and the rest community owned. The average slope of the coppice sites is 19°, which is indicative of their protective function.

The average Martonne aridity index for Bulgarian coppices is about 30. By 2050 some 9–10% of them will have developed a steppe climate (aridity below 20) and will be gradually replaced by grasslands and shrubs. By 2080, depending on the climate change scenario, some 16% to 44% of them are expected to be lost in this way. Climatic change is perceived in Bulgaria as increasingly frequent snowless winters and summer droughts. Indirect evidence of this is given by the presence of exotic insects that were previously found only in the Mediterranean.

As a result of their abundance, Bulgarian coppice forests have never been subject to nature protection as such. However, in recent times over 60% of Bulgarian forests have been taken into Natura 2000 zones and habitats, including the bulk of the coppices.

Most of the coppice (74%) is in the process of conversion to high forest, with the remaining 26% maintained as simple coppice. Half of the simple forests are plantations of black locust, which are actually coppiced, the rest are natural stands of oriental hornbeam, which have been rather abandoned after decades of efforts to replace them with conifers. There are no coppice with standards areas in Bulgaria. In 1951 there were still 36,000 ha of pollarded high coppices, but since then pollarding has been abandoned. There is no short rotation coppice yet. Unlike Mediterranean countries, there is no maquis in Bulgaria. Deforested and devastated lands were afforested in the post-war years with nearly 1,000,000 ha of pine plantations, through which mountain streams and soil erosion were brought under control.

The rotation ages for the conversion forests are: 100 years for the best (site index I and II), 80 for the middle (III) and 60 for the poor (IV and V). Lower rotation ages are set for Turkey oak, with 60, 40 and 40 years, respectively. The average age of conversion forests is 45 years, i.e. they are already aging. The rotation age for black locust is 20, its average age being 16. It is difficult to set a rotation age for the oriental hornbeam, but its average age is 50 years.

There are two types of coppice conversion to high forest in Bulgaria: poor coppices are clear-cut and replaced with conifers, mainly pines, or the final cutting is postponed until the reproductive power of stools diminishes and in the meantime they are thinned for pit-poles and firewood. The replacement with conifers was, however, abandoned in 2006 because the suppression of stools is too expensive.

In Bulgaria, the conversion of coppice to high forest is a policy dating back to the 1950s, but the main efforts started in the early 60s. This policy aimed to improve both productivity and quality of forests. Indeed, although coppices occupy 50% of the woodland, they produce only 39% of the harvested wood, mainly industrial wood and firewood. Sawlogs only make up 5% of the harvested wood, against 23% for the broad-leaved high forest and 36% for the conifers. Nowadays, the rising prices of energy wood gives some cause to reconsider this policy. Although the firewood prices are also rising in Bulgaria, it is nevertheless the cheapest form of energy. All rural areas in Bulgaria use firewood for heating.

If biomass production is the aim of Bulgarian coppice management, an examination of mean increment shows that the optimal rotation time is about 20 years. At that age, the stands do not produce seeds and should regenerate by re-sprouting. However, resuming coppicing will be a silvicultural challenge because of aging and problems with oak regeneration. Recently, private forest owners often clear-cut their coppice, counting on regeneration by re-sprouting, but the aged coppice re-sprout badly. In addition, Bulgarian coppice forests are dominated by oak, which has a poorer regen-

eration because it does not produce suckers (shoots from the roots), unlike beech and the other coppiced species. Another problem is the aging of the root system, which is older than the stems in a coppice. After a number of coppice rotations, the tap root of the oak begins to decay. Thus, the oak coppices become unstable, shallow-rooted forests. In the lowland, their disappearance is a question of time; a large part of the oak coppices are currently in this threatened condition, especially the Turkey oak. The sustained management of such forests requires making use of the available natural seedlings to renew the root system. Most suitable is the group shelterwood method of cutting with a regeneration period of 15 to 20 years. Where natural regeneration with seedlings is impossible, or has failed, acorns must be sown - in the autumn and after soil preparation, in order to reduce the competing vegetation. Planting of saplings should be avoided because oak develops a deep root while growing in the nursery, which is damaged by transplanting. In conclusion: although the idea to resume coppicing is very promising, it requires further investigation and experiments.

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Forestry Regulations

Ivailo Markoff

Bulgarian coppice forests cover an area of almost 2,000,000 ha, or 48% of the total forest area. There are no plans for their protection; however, an large percentage of these coppices is protected under the Natura 2000 network, a network which covers 60% of Bulgarian forests. Most coppice is state-owned (ca. 70%) or municipal (15%); privately owned coppice is characterised by very small plots belonging to millions of owners.

The main regulations affecting coppices are:

- Forestry Act + Implementation Rules
- Forest Management Ordinance
- Ordinance on Felling

They can all be downloaded from the website of the Executive Forest Agency.

Forestry Act

The act was issued in 2011 and amended many times afterwards. It has the following texts that affect coppice:

Art. 13. (1) Forest management plans shall be elaborated for state forests and municipal forests, with the exception of the territories provided for the needs of the national security and defense. … (3) Forest management plans or programs are developed for the forests owned by natural persons, legal entities and their associations. … (4) The forestry plans and programs shall determine the permitted use of the forest resources and the guidelines for achieving the management goals of the forest territories for a period of 10 years.

Art. 88. (1) The forests shall be managed as high forest, coppice for conversion into high forest or coppice (Niederwald). … (5): … 2. Plantations of wood or shrub species created for the purpose of accelerated production of biomass are not considered to be forests.

Art. 102. Final cuts shall be carried out at an age of not less than: … 2. 50 years in the coppice forests for transformation into high forest; 3. 15 years for black locust plantations and 20 years for the other coppice forests.

Art. 104. (1): 1. Clearcuts are prohibited in all forests except for poplar, willow and low-stem (coppice) forests.

Art. 124. 3. Grazing is prohibited in forest plantations, young forest stands regenerated by seed and coppice until they reach a height of 3 m;

§ 1. … 9. "Clearcut" is a final cut where, for a period of not more than one year, all the trees of the mature stand on a given territory are cut. … 54. "coppices" are forests of black locust, oriental hornbeam, manna ash and honey locust regenerated by shoots.

(Forestry Act) Implementation Rules

The Implementation Rules state the following usages:

Art. 89. … (3) The use of wood after paying the stumpage price … may be effected in: … 4. cutting of coppice forests for conversion into high forest and coppice forests maintained as coppices.

Art. 109. The number of animals grazing in forests shall be determined according to productivity and conditions of the pastures and the grass cover, in compliance with the following limitations: … 2. for coppices: up to 1 cow per hectare and up to 1 sheep or pig per 0.2 hectares.

Ordinance on Felling

The Ordinance on Felling gives many details on conversion.

Forest Management Ordinance

The Forest Management Ordinance regulates the elaboration of forest management plans and programs (a program is a simplified plan made for a small property). It provides details on rotation age in managed forests (covered by management plans), while the minimal cutting ages specified above are valid in all forests. The common rotation ages for the high forest conversions are: 100 years for the best (site index I and II), 80 for the middle (III) and 60 for the poor (IV and V). Lower rotation ages are set for Turkey oak, 60, 40 and 40 years, respectively. The rotation age for black locust is 20 years.

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Croatia

Tomislav Dubravac, Martina Đodan, Damir Barčić and Miljenko Županić

Facts and Figures

Tomislav Dubravac and Martina Đodan

Definitions

Coppice forests are the result of deliberate or undeliberate degradation of high forests and are of vegetative origin (sprouts from the stump or roots - Dubravac and Krejči, 2001). A common feature of most coppices is the absence of any silvicultural activities throughout their development (Krejči and Dubravac, 2004). Since they were left to spontaneous development, a whole spectrum of coppices formed, from those with the highest quality, a relatively high wood volume, good structure and crown coverage to those of poor quality and low wood volume. In the past, coppices resulted from the growing needs for fuelwood and the lack of proper managerial interventions. Today, they are mainly a result of the unsuccessful regeneration of high forests. Tree species forming coppices are oaks (sessile, pubescent, holm), beech, hornbeam, chestnut, alder, black locust, etc.

Panjače su šume niskog uzgojnog oblika nastale namjernim ili nenamjernim procesima degradacije sastojina visokog uzgojnog oblika. Zajedničko obilježje većine panjača je izostanak bilo kakvih uzgojnih radova u mladosti i tijekom njihova razvoja. Kako su prepuštene spontanom razvoju, formirao se čitav spektar, od onih najkvalitetnijih s relativno visokom drvnom masom dobro sklopljenih i suvislo obraslih sastojina pa do onih nekvalitetnih, razbijenog sklopa, s kržljavim i kvalitetno lošim stablima male drvne mase. U prošlosti su nastajale iz potreba za ogrjevom i nestručnim gospodarenjem, u novije vrijeme nastaju kao posljedica neuspjele obnove visokih šuma. Glavne su vrste drveća koje tvore šume niskoga uzgojnoga oblika kitnjak, medunac, cer, crnika, bukva, obični grab, kesten, joha, bagrem i dr.

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Rotation Period

Rotation is determined by legal acts (Forest Management Rulebook).

Rotation for the coppice forests by species:

1. Oaks (*Quercus pubescens* Willd., *Quercus ilex* L., *Quercus petraea* (Matt.) Liebl.) - 80 years,
2. Beech (*Fagus sylvatica* L.) - 80 years,
3. European hornbeam (*Carpinus betulus* L.) - 40 years
4. Black locust (*Robinia pseudoacacia* L.) - 30 years
5. Soft deciduous (*Populus* sp., *Salix* sp., *Alnus* sp.) - 30 years.

Statistics

The area of coppice forests in Croatia amounts to 359,610 ha (14.4 % of forests in Croatia), while 192,986 ha (53.7 %) are managed by the state-owned company „Hrvatske šume“ Ltd., 5,832 ha (1.6 %) of state-owned coppices are managed by other legal entities and 160,792 ha (44.7 %) are privately owned. The total growing stock of coppice forests is approximately 41.1 million m³, with an annual increment of 1.09 million m³ (Source: National Forest Management Plan 2016 – 2025).

Area of state owned coppices according to tree species: *Fagus sylvatica* L. (103,737 ha, 28.9 %), *Quercus pubescens* Willd. (95,640 ha, 26.7 %), *Quercus cerris* L. (41,845 ha, 11.7 %), *Carpinus betulus* L. (28,786 ha, 8.0 %), *Quercus petraea* (Matt.) Liebl. (22,959 ha, 6.4 %), *Quercus ilex* L. (21,217 ha, 5.9 %), other tree species (44,620 ha, 12.4 %).

Area of private coppices according to tree species: *Quercus ilex* L. (65,679 ha, 23.9%), *Quercus pubescens* Willd. (60,424 ha, 22.0%), *Carpinus betulus* L. (46,873 ha, 17.1 %), *Fagus sylvatica* L. (26,356 ha, 9.6%), *Quercus petraea* (Matt.) Liebl. (15,342 ha, 5.6%), other tree species (59,993 ha, 21.8%).

Typology

Simple coppice	The most common type in the country.
Coppice with standards	Ca. 15% of coppices can be regarded as coppices with standards.
Pollarding	Found in the northern part of Croatia, Istria and especially in the northern part of the island of Cres (oak and chestnut, but also suitable for: Mediterranean oaks, chestnut, mulberry, hazelnut, willows).
Short rotation coppice	*Populus* sp., *Salix* sp.

Images

Coppice forests in the northern part of Adriatic coastal area in Croatia. From left to right: holm oak coppice, pubescent oak coppice, Turkey oak coppice, holm oak coppice (photos Tomislav Dubravac)

Description

Tomislav Dubravac and Damir Barčić

The total area of coppice forest in Croatia amounts to 359,610 ha, of which 6.4% has a protective function, for example for soil and watercourses, and serves as a designated protected area (e.g. national parks) or another special purpose areas. Coppice forests in Croatia represent a significant source of wood products and provide a variety of forest services and functions. There is an almost equal distribution between private and state ownership, at 55.3 % and 44.7 % respectively.

Generally, coppice forests in Croatia can be divided into the Continental and Mediterranean parts of the country. Characteristic tree species

in the Continental part are: European beech, hornbeam, sessile oak, chestnut, alder and black locust, while in the Mediterranean area one finds holm oak, pubescent oak and hornbeam.

Coppicing is the most convenient form of management for owners of small deciduous forests as it allows them to extract firewood, poles, small-sized industrial wood and fallen leaves. It is also possible to organize grazing in these coppices.

Figure 1. View of the holm oak coppice forest on the Croatian Adriatic coast (Photo: D. Barcic).

Coppices were created by intention or accidentally, curtailing the development of a single-stemmed standard tree.

It should be mentioned that degraded coppice stands often have a high habitat value. Conversion of coppice must retain the existing soil fertility, in addition to developing native stands from seed. In accordance with the Forest Act, which applies to all regular forests, including coppice stools, the aim of regeneration must be to produce a high forest stand. Exceptions to this are alder, poplar, willow and black locust stands, which can be renewed by clear cutting, reforestation and shoots.

As with the high forests, silvicultural activities in coppice are divided into two basic groups:

1. Silvicultural activities on the clearing and thinning of coppice.
2. Silvicultural activities on the regeneration of coppice.

Coppice forests in Croatia by categories of European forest types:

4 – Acidophilous oak and oak-birch forest;
5 – Mesophytic deciduous forest;
6 – Beech forest;
7 – Mountainous beech forest;
8 – Thermophilous deciduous forest;
9 – Broadleaved evergreen forest;
12 – Floodplain forest.

See Figure 2 for the distribution of these types by area.

Coppice rotation for species according to the Forest Management Plan regulations:

Oaks.....80 years
(*Quercus pubescens, Q. ilex, Q. petraea*)

Beech.....80 years
(*Fagus sylvatica*)

European hornbeam.....40 years
(*Carpinus betulus*)

False acacia.....30 years
(*Robinia pseudoacacia*)

Soft deciduous.....30 years
(*Populus* spp., *Salix* spp., *Alnus* spp.)

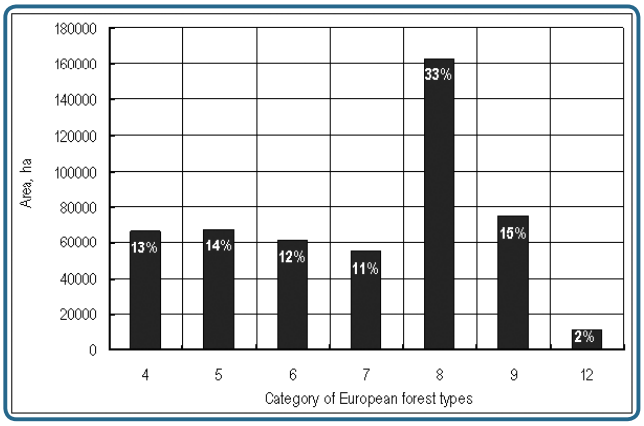

Figure 2. Area of coppice forests in Croatia by European forest types (Source: Dekanić et al, 2009)

Forestry Regulations

Miljenko Županić

The tradition of forestry and organized sustainable forest management in Croatia is more than 250-years old. Most of the forest in Croatia is in state ownership (76 %) and it has always been regulated at the national level.

At present, forest management and other forestry activities are regulated by several **laws and legal acts**, such as the:

- Law on Forests
- Forest Management Rulebook
- Laws on Physical Planning & Building
- Nature Protection
- Forest Planting Material
- Law on Fire Protection

In the actual management of state forests, the state-owned company **Croatian Forest Ltd.** (in Croatian, Hrvatske šume d.o.o.) has a key role. The company is obliged by Law to make detailed **Forest Management Plans** and to keep precise book-keeping records of growing stock for every **Forest Management Unit**.

Coppice is mentioned only in forest management plans or the management plans of protected areas.

All forest areas in Croatia are split into management units, which usually cover 2000-3000 ha and are divided according to ownership (state or private). Forest management plans are made for each unit for 10 years. State units have had these plans for 50 years, while around 70% of private units are covered in practice by the **Advisory service** (state agency) plans. This agency is also responsible for the administration of private forests. Forest management plans are made by licensed companies, during which all stakeholders are invited to share their opinions. Private owners may also have an input into management rules that form part of the plan (including coppice management), because these rules underlie applications for various projects and subsidies. Private owners who own more than 20 ha of forest can have a single ownership management plan. Each forest management plan must be approved by the Ministry, which may involve public discussion during the process of approval.

Currently, the most important policy document affecting coppice management is the **Law on Forests**, which is a national level regulation. Coppice is only mentioned as a silvicultural form in subordinate regulations – the **Forest Management Rulebook**; rotation periods are defined according to the management goals. These regulations incorporate EU timber regulations and Pan-European criteria and indicators for sustainable forest management.

According to these regulations, private owners must have permission to cut all types of forest, including coppice. Permission for cutting is given by the forest extension service on the basis that tree marking is done by a forester from a licensed company and proof of ownership is given to the court. If owners have to transport the wood products on public roads after cutting, they must obtain special delivery authorization, also issued by a licensed company, even if the owner uses the wood themself. All of these administrative procedures have some financial cost, so most new owners who don't need wood for themselves are not interested in cutting, as profits are not guaranteed.

For private forests that are included in protection areas, subsidies may be available to compensate limitations in management, but only when managed according to the protection rules included in the management plan.

The main challenges in private forests are their small scale, the heterogeneity of silvicultural forms, poor cadastre and land-registry records, indistinct parcel borders and degradation of forests (Čavlovic, 2004). However, the property rights as such remain the most important challenge, because this presents an obstacle to the consolidation of smaller properties.

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Czech Republic

Petra Štochlová and Radim Hédl

Facts and Figures

Petra Štochlová

Definitions

(1) low coppice forest - forest management system in which trees originate from sprouts

(1) nízký les (pařezina) - hospodářský tvar lesa vzniklý výmladností

(2) coppice with standards - forest management system in which trees coming from sprouting and individuals originating from seeds are combined

(2) střední (sdružený) les - hospodářský tvar lesa vzniklý jako kombinace výmladkové složky a jedinců semenného původu

(1) & (2): Decree of the Ministry of Agriculture of the Czech Republic no. 83/1996 Coll. on elaborating regional plans of forest development and on specification of economic complexes

(3) stand of fast-growing trees (short rotation coppice; SRC) - cultivated agricultural land with permanent culture that is uniformly planted with at least one thousand woody plants per ha including handling area that cannot exceed 12 m on both sides of the rows and width of inter-row along the edge rows

(3) porost rychle rostoucích dřevin (výmladková plantáž) -zemědělsky obhospodařovaná půda s trvalou kulturou, která je rovnoměrně a souvisle osázena dřevinami, a to v minimálním počtu 1000 životaschopných jedinců na 1 hektar dílu půdního bloku, do plochy této zemědělsky obhospodařované půdy se započítává související manipulační prostor, který nesmí přesahovat 12 metrů na začátku a na konci řad a šířku jednoho meziřadí, v nejvyšší započitatelné šířce 8 metrů, podél řad po obou stranách rychle rostoucích dřevin pěstovaných ve výmladkových plantážích a netvoří součást cesty

(3): Government decree no. 307/2014 on land use records keeping

Legal Framework

Act no. 289/1995 on Forests defines forest as a forest stand with its environment and land designated for the fulfillment of forest functions. It defines the minimum age of trees to be felled (80 years); earlier felling is only possible with an exemption or in a special forest management sets of stands. Management sets are mean units used to differentiate between management methods in forests set out within individual natural forest areas and based on their function, natural conditions and state of forest stand. There are 24 management sets (and 3 for protecting forests); 6 of which include coppice.

Decree of the Ministry of Agriculture of the Czech Republic no. 83/1996 on elaborating regional plans of forest development and on specification of economic complexes - defines coppice forests and 6 forest management sets of stands where coppice forests can be grown and the age when they can be harvested.

Act no. 252/1997 on agriculture - SRC is defined as one of the crops that can be grown on agricultural land.

Act no. 334/1992 on protection of agricultural land resources - restricts growing SRC on agricultural land of I. and II. protection category; defines the maximum rotation length (10 years) and maximum growing period (30 years) for SRC; the land must be used in the different way 3 years after SRC removal.

Act no. 114/1992 on the Conservation of Nature and Landscape - growing allochthonous plants (mainly hybrid poplars) is possible only with permission; they are banned in protected areas.

Rotation Period

For (1) & (2): According to Czech law Act no. 289/1995 on Forests most forests cannot be felled before the age of 80. Simple coppice management is only allowed in six forest management sets of stands. Coppice forests with a predominance of hardwood trees are definitely preferred and have a recommended rotation length of 40 years (with a range between 30-50 years, in some cases 60 years). In coppice forests with a predominance of soft wood trees, the recommended rotation length is between 20 and 30 years. The recommended rotation length for willow forest cover and locust forest cover is 40 and 70 years, respectively, in specific forest management sets of stands.

For (3): Agricultural land can be used for growing woody plants of up to 10 years. However, SRC grown on agricultural land has a maximum of 30 years with rotation periods up to 10 years.

Typology

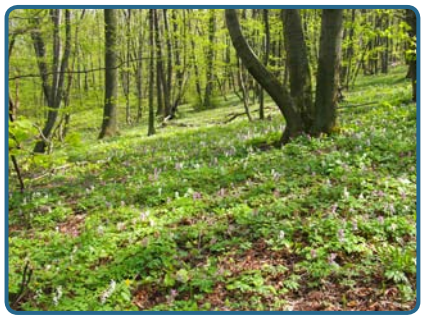
Simple coppice	Allowed in 6 forest management sets of stands. Species: alder, oak, hornbeam, maple, ash, elm, lime, poplar, willow (wild cherry tree, birch, rowan tree)
Coppice with standards	Mainly with sessile or common oak or common or narrow-leaved ash as standards
Pollarding	Not practised
Short rotation coppice	Mainly *Populus*, *Salix*, minimally *Alnus* or *Fraxinus*

Images

Simple Coppice

Coppice stools

Thinning of a coppice stand



Coppice stand vegetation
(Photos: Radim Hédl)

Short Rotation Coppice

Black poplar plantation in the first vegetation period

Black poplar plantation in the last vegetation period before 2nd harvest (6,061 plants per ha, 3 year rotation)

Sixth harvest in black poplar plantation (2,222 plants per ha, 3 year rotation)
(Photos: Petra Štochlová & Kateřina Novotná)

Map

Radim Hédl

Extent of coppicing in the Czech Republic

Currently, there are only six sites in the Czech Republic where coppicing has been restored in about the past decade (since 2007-2008). Altogether, they comprise up to 20 ha of freshly restored coppices and have only gone through one cutting (Fig. 1, black stars). Prior to that, there were no active coppices for the whole second half of the 20th century. Coppices were deliberately transformed to high forest by singling-out of coppice stools. This process was at its peak probably in the first two decades after WW II, but certainly exists at least since the 19th century. The coppicing abandonment had been an overall process started sometime between the end of the 18th to the early 19th century. Active coppices survived only locally until the 1930s–1940s (e.g. Müllerová et al. 2014).

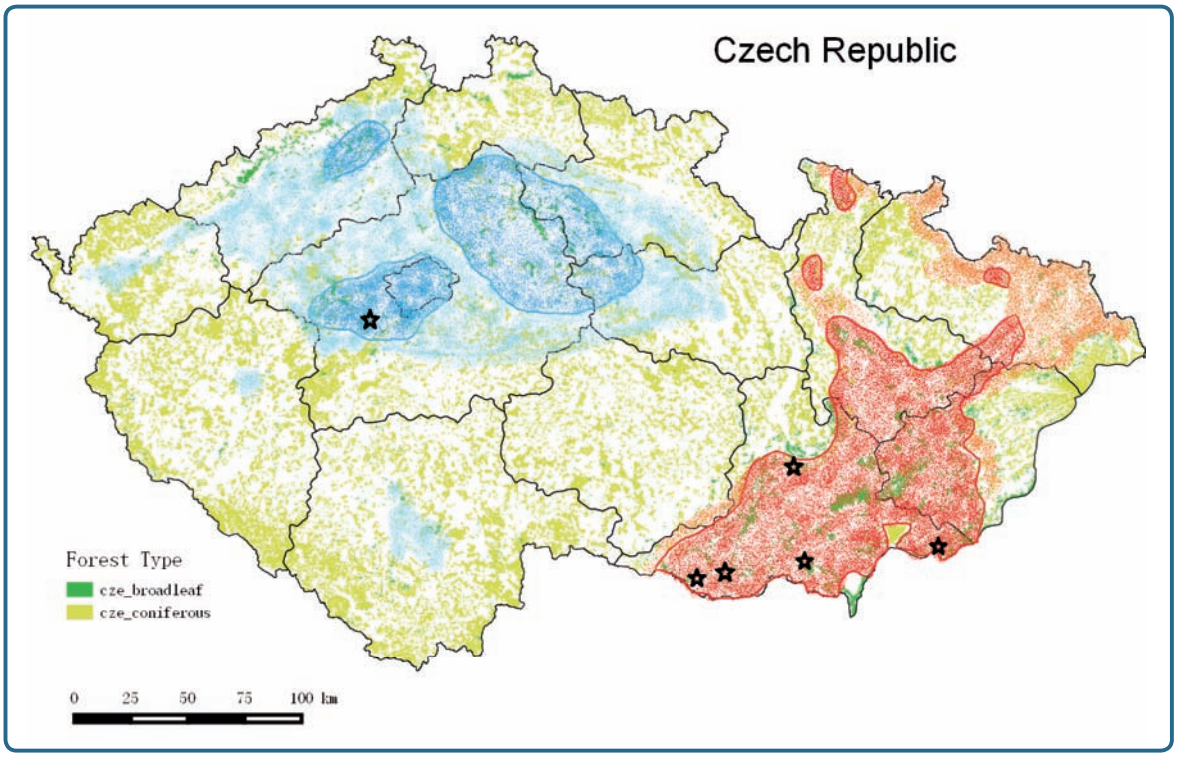


Figure 1. Extent of the historical and current coppicing in the Czech Republic. Map by R. Hédl.

Solid red boundary, red filling:
Core area of historically prevalent coppicing for Moravia and Silesia; based on an unpublished map by Szabó et al.

Orange area, no solid boundary:
Probable additional extent of the core area of historical coppicing in Moravia and Silesia; based partly on an unpublished map by Szabó et al. and my own estimate

Solid blue boundary, blue filling:
Core area of historically prevalent coppicing for Bohemia; based on a map for 1947 by Maděra et al. (2017)

Light-blue area, no solid boundary:
Estimated extent of the core historical coppicing area for Bohemia

Black star:
Sites of restored coppices in 2017; there are 6 sites altogether, some of which have 2 to 3 sub-sites; one such site has already been abandoned (not marked)

Background: Broadleaved forest in dark green, coniferous forest in light green
(Source: EFI forest map of Europe - Kempeneers et al. 2011; Päivinen et al. 2001; Schuck et al. 2002)

Coppicing can be traced back to the Middle Ages (14th century), based on the written evidence. There is, however, some dispute concerning terms and their exact meaning: "rubetum" versus "silva" (see Szabó et al. 2015). The archival data enabled modelling for the extent of coppicing in the Late Middle Ages for the whole Moravia (eastern Czech Republic; l. c.).

The area of the historical coppicing did not change much up until the 19th century. A precise reconstruction of the proportion of coppice forests at the level of cadastres (civil parishes) for the 19th century was made by Szabó et al. (unpublished map). It clearly shows an area with prevalent coppicing, however only for Moravia and small parts of historical Silesia. It is currently the best available reconstruction of the historical coppicing in the Czech Republic, because it is based directly on a large critical database of the historical archival information (www.longwood.cz).

For the western part of the Czech Republic, Bohemia, there is no such map. A predictive modelling was made for the whole country by Maděra et al. (2017), however the reliability of the historical source used for this prediction remains uncertain (digitalized descriptions for the so called Stable cadastre, available at http://archivnimapy.cuzk.cz). The same paper presents a map of the coppiced area in 1947, then already abandoned coppices. It generally conforms to the Szabó's map for the 19th century and can be used for the reconstruction of the historical coppicing in Bohemia.

To conclude, there are two "core areas" of coppicing (Fig. 1) in the Czech Republic. One in Bohemia, another in Moravia and parts of historical Silesia. They are highly correlated with lower elevations (up to 500 m a.s.l.) and high density of human inhabitation (since the Neolithic). In these areas, over 50% of all forest (often 80–90%) was regularly coppiced from at least the Middle Ages until the 19th century. Adjacent areas with less than 50% but probably no less than ca. 10% of coppicing can be estimated or predicted from the combination natural conditions, type of forest etc.

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Description

Petra Štochlová

In the past, most of the forest cover in the lowlands, the warm hilly areas and highland areas of the Czech Republic were managed as coppice forests to produce firewood. In the 19th century, the decreasing demand for firewood caused coppice forests, including those with standard trees, to begin to be transformed into high forest. The transformation was done in two ways: the direct method was to re-plant using saplings produced from seed after felling coppice; the indirect one was by the singling-out of coppice stools, finally leaving only one. Around 1900, coppices in what is now the Czech Republic covered approximately 95,000 ha, representing 4.1% of forest cover (Adamec et al. 2014). Since then, the area had been decreasing.

Recently interest in the coppice forests has been increasing in the Czech Republic in order to protect endangered species, enhance biodiversity and obtain a sustainable source of energy. In the last decade, areas of coppice forest have slowly started to increase. Approximately 9,310 ha (0.36 %) of simple coppice forest and 2,393 ha (0.09 %) of coppice with standards can now be found in the Czech Republic (ÚHUL 2014). Most of the coppice forests are situated in the south-eastern part of the Czech Republic.

According to Czech law Act no. 289/1995 on Forests, most forests cannot be felled earlier than the age of 80. Simple coppice management is only allowed in six forest management sets of stands. Coppice forests predominantly composed of hardwood trees are preferred, with a recommended rotation length of 40 years (although this can range between 30 and 50 years, and in some cases 60 years). Where softwood trees are in the majority, the recommended rotation length is between 20 and 30 years. Recommended rotation length for willow and black locust is 40 and 70 years, respectively, in specific forest management stands. Among recommended trees for coppicing in the Czech Republic are alder, oak, hornbeam, maple, ash, elm, lime, poplar and willow; in addition wild cherry, birch and rowan can be also used.

At the present time, the efforts to restore coppice management are viewed circumspectly by some foresters; more information is required in some areas. Although the systems of coppice forest management have been covered extensively in scholarly publications, less is known about the economic effectiveness of coppice forest systems. Recently some research plots were established, converting from quasi-high forest to coppice. Promising results could contribute to positive awareness of coppice forest and this, combined with liberalisation of Czech law, could help with coppice forest renewal.

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Forestry Regulations

Radim Hédl

Forests cover about 34% of the area of the Czech Republic. The long history of forest use in the Czech Lands has been paralleled by regulations applied from local to whole-country levels. Examples of popularly known historical milestones are laws imposed by the emperors Charles IV (14th century) and Maria Theresa (18th century). Countless regulations were applied historically within particular domains and properties, at least since the Middle Ages. After a long period of „traditional" forest management, the eventually prevailing trend was towards „modern" forestry has been in place since the end of 18th century. Originally from Germany, this rational concept aimed to produce the maximum yields of timber while securing the sustainable production of forest stands by applying strict measures protecting soil fertility and tree regeneration.

Consequently, all types of forest use interfering with timber-oriented forestry were suppressed and gradually replaced with highly standardized approach. This meant an end to the three formerly widespread non-timber forest uses, which were coppicing, wood-pasture and litter raking. Tree species composition shifted from mostly mixed and broadleaved stands to the currently prevailing plantations of Norway spruce (52%) and Scotch pine (17%), while broadleaved tree species make up only about 25% of forest composition in the Czech Republic.

The **Czech Act on Forests from 1995** declares its purpose as follows: „The purpose of this Act is to determine conditions for the preservation, tending and regeneration of forests as national riches forming an irreplaceable part of the environment, to enable the fulfillment of all their functions and to support sustainable forestry." An important rule is the 80-year limitation on forest stand felling: „It is prohibited to carry out planned main felling in forests under 80 years of age…" (Art. 33). However, the same article follows: „…in justified cases, during the course of approving the plan or preparing the guidelines or at the request of the forest owner, the relevant state forest administration body may grant exemptions from this rule." The exceptions from the 80-year rule are issued by the Ministry of Agriculture or Regional councils, based on the request of forest owners or on its own initiative.

The **Decree 83/1996 of the Czech Ministry of Agriculture**, provides recommendations on forest management in forest stand categories defined by dominant tree species and habitat conditions. Coppicing with a cutting period of 30 to 40 years is mentioned among recommended management types for several forest categories. Exceptions from the 80-year rule can therefore be plausibly applied in the form of coppicing. In still broader terms, **Article 8 of the Act on Forests** defines three main forest classes from the management perspective. „The class of Special Purpose Forests can be also applied to forests in relation to which a general interest in the improvement and protection of the environment or any other valid interest in the fulfillment of non-wood-producing functions of the forest is superior to the wood-producing functions." One category of **Special Purpose Forests** is defined as „forests necessary for the preservation of biological diversity", cf. letter (f) of the same article.

The Law is simple, its application difficult. Exceptions allowing shorter cutting periods required for active coppicing are granted on stands of fast-growing trees, such as willows, poplars or non-native black locust. In case of slow-growing species such as oaks, exceptions

are given very reluctantly. It is largely because of historically-conditioned resistance of the great majority of forestry authorities and practicing forest managers towards short-cutting systems including coppices. The reasons should be sought in the historical development of forestry in the Czech Republic.

In the lowland areas, coppicing yielded most of the wood production in the past. Coppices („low forest", adopted from German term Niederwald) and coppices-with-standards („middle forest", from German Mittelwald) were very common both in hardwood and softwood stands. Coppicing was gradually abandoned during the 19th century, partly because of shift to fossil fuels, and completely ceased after the WW II. In the 1950s, during the early communist period of the then Czechoslovakia, coppicing was considered by many influential forestry researchers a „capitalist" method, targeting at maximum wood production at the cost of depleting of soil nutrients and sustainable wood production capacity. This view basically conformed to the transformation from multiple-use towards timber-oriented forestry during the preceding century.

The second half of the 20th century witnessed a transfer of the remaining inactive coppices to high forest by the means of singling-out of the most dominant stems. This process was far from perfect, hence many today's forests still bear the original coppice structure. The area of these partially converted stands cannot be reliably established from the forestry log books, because the record on the management form is strongly biased towards high forest. Data on the current extent of coppice forests in the Czech Republic is therefore more or less a rough estimate. However, the tireless efforts of the past two hundred years have eventually led to the complete elimination of active coppices in the country.

Current revival of coppicing in the Czech Republic follows the development in western Europe. Relaxation of timber-oriented forestry and greater acknowledgement of ecological values of forests in the past two to three decades creates oppotunities for the return of traditional management forms, including coppicing. It is generally considered suitable for small- to mid-size owners, who would appreciate a regular supply of fuel wood. Another important argument for coppicing reintroduction is to provide support for biological diversity. It has been shown in many studies, both from abroad and directly from the Czech Republic, that coppicing abandonment has led to the decline of several groups of light-demanding organisms, including insects and vascular plants. Coppicing is therefore a relatively recently emerging strategy of nature conservation; it has been applied in several nature reserves. These forests are mostly protected in reserves established under the Czech law, or more recently, as a part of the EU Natura 2000 network.

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Denmark

Pieter D. Kofman, Kjell Suadicani, Jenny Mills and Peter Buckley

Facts and Figures

Pieter D. Kofman and Kjell Suadicani

Definitions

Coppice – silvicultural method where the regeneration is vegetative as the shoots come from the stumps and form the new forest. The rotation cycle is short, usually 1-40 years, which means that the trees never reach their full height. In coppice forestry tree species with good ability to stump shoot formation are used, for example, willow, oak, hazel and alder. In Denmark coppice forestry is not very widespread.

Lavskov, skovdriftsform, hvor skovforyngelsen sker ved stævning (vegetativ foryngelse), idet støddene fra de fældede træer sætter stødskud, der vokser op til ny skov. Omdriftstiden er lav, som oftest 1-40 år, hvorfor træerne aldrig når deres fulde højde. Til lavskov benyttes træarter med god evne til stødskudsdannelse, fx pil, eg, hassel og rødel. I Danmark er lavskovsdrift kun lidt udbredt. Se også skovdyrkning og stævningsskov.

Coppice forest - forest that regenerates through shoots from the stump of the felled tree. In Denmark coppice was formerly a common silvicultural system in alder, oak and ash. The system was particularly widespread in Funen and among small forest owners. The system allows for a continuous, steady production of firewood, poles, fencing and similar assortments from even a small piece of forest.

Stævningsskov, skov, der forynges gennem stødskud, dvs. skud fra stubben af det fældede træ; d.s.s. lavskov. I Danmark var stævningsskov tidligere en almindelig driftsform, bl.a. i rødel, eg og ask. Driftsformen var særlig udbredt på Fyn og blandt småskovsejere. Driftsformen giver mulighed for et løbende, jævnt udbytte af ved til brænde, pæle, hegnsmateriale og lignende småeffekter fra selv et lille stykke skov.

In Denmark coppice is now rare, but, for example, in large parts of Europe coppice is widespread. Mechanized coppice forestry has been introduced as energy forest has been established.

I Danmark er stævningsskov nu sjælden, men fx i store dele af Europa er stævningsdrift vidt udbredt. Mekaniseret stævningsdrift har fået fornyet aktualitet i form af energiskov.

Energy forests are plantations of hardwoods with rapid juvenile growth, harvested for use as wood fuel. In Denmark willows are the most used species and the rotation is commonly three years. Energy forests have mostly been planted on former agricultural land. The production is approximately 7 tonnes of dry matter per ha. In 1995 there were approx. 500 ha of energy forest in Denmark.

Energiskov, plantage af løvtræer med hurtig ungdomsvækst, som høstes til brug ved energiproduktion. I Danmark anvendes piletræer, der hugges til flis hvert tredje år, hvorpå de vokser op igen. Energiskove plantes bl.a. på braklagte jorder. Produktionen udgør årligt ca. 7 t tørstof pr. ha; i 1995 var der ca. 500 ha energiskov i Danmark.

Gyldendals large lexicon, translated:
http://www.denstoredanske.dk/Natur_og_ miljø/Skovbrug/Skovdyrkning

Legal Framework

There is a definition of short rotation coppice in the COMMISSION REGULATION (EC) No 1120/2009 of 29 October 2009 on the implementation of the single payment scheme in Title III of Council Regulation (EC) No 73 / 2009, which establishes common rules for the direct support schemes available to farmers:

"Short rotation coppice" means areas planted with those tree species of CN code 0602 90 41 that consist of woody, perennial crops, the rootstock or stools remaining in the ground after harvesting, with new shoots emerging in the following season and that are contained in a list to be drawn up by Member States from 2010 of the species which are appropriate for use as short rotation coppice and their maximum harvest cycle.

(http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:316:0001:0026:EN:PDF)

Statistics

In the Danish forest statistics, ancient management forms cover about 22,000 ha. The proportion of coppice is estimated to be about 6,000 ha of which only few hundred ha is managed the traditional way. Some plantings along roads and railroads are managed as coppice, but we don't have statistics on these areas.

Typology

Simple coppice	Limited use
Coppice with standards	Not practised
Pollarding	Limited use
Short rotation coppice	*Salix*
Other types	Narrow wind break barriers (2-4 m) that are harvested every 30-40 years

Images

Description

Kjell Suadicani and Pieter D. Kofman

Traditional coppice

As in most of Europe, systematic cutting of trees with the purpose of obtaining regrowth from the stumps has been an important part of agriculture and silviculture for thousands of years. Old murals in some Danish churches show the cutting of branches with leaves for fodder.

Coppice forestry was the common silvicultural method in the peasant's forests. The products were fencing, fodder, firewood, charcoal, hoops, shanks, clogs etc. Until wire fencing took over around the 1880s, fencing was a quite important product from coppice forestry.

It is assumed that the area of coppice forestry has declined in the period from 1600 to 1800, along with the destruction of the forests in general, but the decline was not a result of there being no need for the products from the coppice forests. That happened later on.

After the law on conservation of the forests in 1805, the land was divided into agricultural land and forests. Before that the two land uses were more mixed. In any case coppicing continued in the forests, because the peasants had the right to cut simple forest and forest in their ownership. Around 1830 the production of agricultural fodder, such as clover and turnips, reduced the need for fodder from the coppice forests, but these survived as a niche silvicultural system at least until the beginning of 1900.

Coppice forestry gradually lost economic importance as other products replaced those from the coppice forests, and many coppice forests grew up to normal high forest. Marks of the old coppice system can still be seen as stumps and crooked growth in stands of old trees.

There is a renewed interest in old silvicultural systems and among these also coppice forestry, because the old systems often create habitats for endangered species.

In the Danish Nature Forest Strategy from 1994 it was stated that the area with old silvicultural systems should be expanded to at least 4000 ha in 2000, and subsidies were introduced in order to reach this goal.

Today there is around 6,000 ha of old coppice forests, but only a few hundred ha is managed as coppice forestry. Especially in state forests, coppice has been reintroduced. Some other coppice forests are conserved by law or because of interest from the land owner.

Coppice forestry is type no. 91 in the Danish system of forest development types. These types describe the long term goal of the desired forest development.

The Danish system describes four different **coppice forest types**:

1. Oak coppice forests.
Oak, aspen, birch, rowan, hazel.

2. Hazel coppice forests.
Hazel, ash, oak, alder, maple, thorn, elder.

3. Alder coppice forests; Swamp forests
Alder, ash, birch, willow.

4. Energy forests.
Different clones of willow and poplar.

The three upper types are historic types of coppice forests, while the fourth is the modern version introduced in Denmark in the 1980s.

Short Rotation Coppice

Short Rotation Coppice (SRC) is slowly finding its way into Danish agriculture. It is believed that some 2,000 ha of mainly willow plantations exist. There is one main supplier of cuttings, planting and harvesting equipment in the North

of Jutland. This grower alone owns more than 200 ha of plantations.

The shoots are cut mechanically in the cut and chip method and the chips are delivered to nearby district heating plants. Since normal wood for energy from forests and landscape elements is becoming scarce in Denmark because of the high demand, it is likely that SRC will increase in area in the years to come.

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Forestry Regulations

Jenny Mills, Peter Buckley, Pieter D. Kofman and Kjell Suadicani

There are approximately 610,000 ha of forest in Denmark covering about 14.5% of the land area (FRA 2015). Conifers take up 50% of total forest land and deciduous species just over 46%; the remaining forest land remains bare of trees or the types of trees are unspecified. Sixty-eight percent of the forest area is privately owned and there are about 29,000 forest owners in Denmark. A survey in 2000 showed that 91 % of properties are less than 20 ha in size. Danish state forests (110,000 ha) are managed by the **Nature Agency (Naturstyrelsen)**, which is part of the Danish Ministry of Environment and Food (Miljø- og Fødevareministeriet). It also manages 90,000 ha of light, open areas such as meadows and moors. It has 18 regional offices that supervise private forests to ensure compliance with the Forest Act and to administer grant schemes.

Uncontrolled felling reduced forest cover to 2-3% in Denmark by the early 1800s. A **Forest Act** was adopted in 1805 which banned forest clearance and encouraged afforestation. A forest reserve obligation (fredskov) was introduced to secure future wood supplies. This led to the majority of private forests and all public forests in Denmark being designated as forest reserves, in total about 90% of Danish forests. These are regulated by the Forest Act under a sustainable forest management regime that pays regard to economic, ecological and social factors. The 2002 **National Forest Programme** advocated close-to-nature management and this has been the practice in all Danish state forests and many municipal ones since 2005, replacing the previous age-class forestry management method. However this type of management has not been so readily accepted in privately-owned forests. State-owned forests are **certified** according to both the FSC and PEFC standards.

In the transition to close-to-nature management, **19 'forest development types'** have been described that set objectives for the composition and structure of individual stands.

These include **4 historic types**:

- coppice forest
- forest pasture
- forest meadow and
- unmanaged forest

There is a tradition of coppicing and pollarding in eastern Denmark, particularly on Funen, Langeland, Lolland and Als where there are different types of very species-rich coppice forests. Hazel coppice occurs frequently but over 40 species of trees and shrubs can be found. In Jutland, oak scrub with some aspen has been used in the past for grazing and pollarding. Many oak forests were cut down during WW2 and no felling has since taken place although there is some scrub that is still pollarded.

The latest version of the Forest Law (Legislative Decree no. 678 of 14 June 2013, with changes imposed by § 3 of Law no. 86 of 28 January 2014) prescribes the use of forest reserve land. Guidance on the interpretation of the Law is given on Naturstyrelsen's website (https://www.retsinformation.dk/forms/r0710.aspx?id=175267). The Law does not require forest management planning at the level of individual properties, although this will, presumably, be carried out when applications are made for PEFC or FSC certification. Owners are not required to apply for logging permits or to notify the authorities before logging begins.

Some of the Forest Law provisions are:

- Areas must be stocked with trees that form, or within a reasonable period of time (up to 10 years) will form, a connected forest of standard trees. This excludes areas needed for forest management, such as roads, storage spaces, loading docks, firebreaks, forest nurseries, etc. and the other exceptions mentioned below.

- Harvesting, except thinning, may not take place before the vegetation or the individual tree has reached the age or dimension where it is mature and ready to harvest. This applies to single trees in uneven-aged forests or to stands of even-aged trees. Exceptions to this rule are mentioned below. Clear-cuts should be avoided where possible. A border of deciduous trees and shrubs on the external edges of forest reserve areas must be preserved; the width of these will vary depending on local circumstances. Safety considerations will dictate treatment of forest which also has a role as 'protection forest', e.g. for railways and roads.

- Coppicing can be carried out on up to 10% of a forest reserve without a derogation. Animal husbandry is prohibited, but forest grazing is permitted on 10% of a forest reserve provided any fencing does not prevent public access where the Nature Protection Act allows it. It is expected, although not required by the Law, that such operations are carried out where there is a historical tradition for this type of forestry or for cultural reasons. This applies to species, such as hazel, alder, ash and oak but also to other suitable species where they have been traditionally coppiced locally and also includes pollarding of willow.

The 10% is calculated from the total area of each forest reserve including any non-vegetated areas. One owner's property may contain several forest reserve areas and in such cases the 10% applies to each individual area. However, if they are physically separated from each other, the 10% areas cannot be aggregated and the coppicing or grazing carried out in only one of them.

A dispensation to allow coppicing or forest grazing on more than 10% of a forest reserve area may be given if traces of this type of management can be found on the forest reserve area. This could be the case for many properties with old coppice that dates back hundreds of years and where it is desirable for whole forest areas of, typically, 1 to 5 ha to be coppiced.

The 10% rule also applies to growing Christmas

trees and other greenery, as long as this is short-term, i.e the trees must not be grown to maturity. The area to be planted must not affect valuable or vulnerable habitats and they must be surrounded by a belt of hardwood trees.

In addition to the areas that can lawfully be without woodland, **open natural areas** can be established for up to 10% of a forest area in order to promote nature and landscape values, cultural and biological diversity. This could include forest meadows or protected natural areas, and areas under natural succession but it excludes areas planted with agricultural crops, fruit trees, berry bushes, flower production, etc. Any deforestation necessary to open a natural area may be subject to an **Environmental Impact Assessment** if it might significantly affect important habitat areas. There is an obligation to report any proposed deforestation for EIA screening, regardless of whether it is on a forest reserve or not. Other open areas may be permitted if required by the **Nature Protection Act** or the **Buildings Preservation Act**.

The Forest Law includes provisions to conserve oak scrub forest (4,725 ha), which is found especially in central and western Jutland. Alder carrs may be subject to the Nature Protection Act and designated as a priority habitat under the EU Habitats Directive. Also, lakes, bogs, heaths, salt marshes, meadows and biological commons that belong to the forest reserves and are not covered by the Nature Conservation Act must not be drained, planted or otherwise altered.

The Forest Act and Nature Protection Act require that some operations in **Natura 2000** areas, which would otherwise be allowed under the Forest Act, be notified to the relevant authorities before implementation, so that an assessment can be made as to whether they could lead to habitat deterioration or disturbance to species for which the site has been designated. This includes coppicing. If necessary, conditions will be agreed with the owner if possible or imposed if not. The obligation to notify is independent of whether there is a Natura 2000 plan or management plan. Activities that require a derogation from the Forest Act or other legislation need not be notified because an assessment in relation to Natura 2000 protection will be made when the derogation application is processed.

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Estonia

Katrin Heinsoo, Indrek Jakobson, Jenny Mills and Peter Buckley

Facts and Figures

Katrin Heinsoo and Indrek Jakobson

Definitions

Coppice forests are considered a traditional form of passive silviculture that involves:

(1) repetitive felling on the same stump

(2) the meanings of "coppice" and "short-rotation coppice" are considered to be the same.

Coppice is very common, but not undertaken as a form of silviculture.

Lühikese raieringiga metsandus

Legal Framework

Coppice forestry, as with all of other forestry, is mainly regulated by two legal acts:

1) Estonian Forestry Law

2) Estonian Forestry Development plan 2012-2000.

Typology

Simple coppice	Historically common method of forest regeneration, but losing ground
Coppice with standards	No special standards for coppice
Pollarding	Only on roadsides and on islands
Short rotation coppice	Short Rotation Coppice is managed on agricultural lands Willow, Hybird Aspen, Grey Alder
Other types	Very few stands for environmental projects and scientific purposes (Estonian University of Life Sciences) Water cleaning in Tartumaa and Lääne-Virumaa counties, Hybrid aspen etc.; plantations

Images

Description

Katrin Heinsoo

Estonia is located on the border between coniferous taiga forests and broadleaf temperate forest. Hence, there is a large number of different forest types here and many NATURA 2000 plant community types are represented (Keskkonnaministeerium, 2016). Nearly half of the land area is within the boreal zone, which, historically, has always been covered with forests (Eesti statistika, 2016); natural reforestation of agricultural fields has always been more a problem than desired by the landowners.

Coppice forest management has never been a cultural tradition in Estonia; re-sprouting of stools occured simply as a result of use. Due to the cold climate, firewood has always been needed in large quantities. Typically this was collected manually during wintertime from the low quality forest areas, mainly wet sites dominated by broadleaf trees (alders, aspens or willows) (RMK, 2016). Usually clearcuts were not performed; instead older, unhealthy, too dense or dead trees were cut (Valk and Eilart, 1974). The regeneration of trees was natural and the forests contained trees with a large age variability. Such an age distribution of trees in a particular area is also the main aim in the Estonian broadleaf forest protection goals today (Paal, 2000).

Another type of landscape in which coppiced trees can be found, is one specific type of semi-natural grasslands – wooded meadows (NATURA 2000 type 6530*). Historically, the main aim of this particular management form was to provide the cattle of the landowner with grass during grazing period or hay during wintertime (Talvi, 2010). Pruning of bushes and trees was also an option during years of poor biomass production. The main aim of the trees in this landscape was to provide the cattle with shelter, as well as increase soil fertility and moisture through the deeper root-system of the trees. The selection of tree species left to the grassland depended on the landowner's ideas but usually broadleaf trees were preferred. Sometimes these trees were coppiced, but the cutting was selective to keep the farming system going. Today the number of trees that can be grown in this type of grassland is very limited.

A little over 20 years ago we planted the first experimental Short Rotation Coppice (SRC) plots with different willow species in different parts of Estonia in order to promote the local economy and renewable energy production. Since then we have performed different studies on the usage of SRC for woodchip production (Heinsoo et al., 2002), the purification efficiency of SRC vegetation filters (Holm and Heinsoo, 2013) and other ecosystem services that can be provided by SRC (Poplars and willows, 2016). However, due to legislative limitations on the establishment of SRC, the lack of a supporting scheme for SRC management and very volatile wood residue prices, the current area of SRC in Estonia is much smaller than in neighbouring countries.

Figure 1. Examples of coppice and short rotation coppice in Estonia

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Forestry Regulations

Jenny Mills, Peter Buckley and Katrin Heinsoo

The area of Estonia is 45,227 km^2. Just over half of the country is covered with 2.2 M ha of forest of which 1.6 M ha is manageable forest. Deciduous trees account for 51% of stands; 49% are conifers. The most common tree species are Scots pine, Norway spruce, Silver and Downy birch, aspen, Black alder and Grey alder. 47% of the forest area is in private ownership, the state owns 41% and 12% is still "subject to privatization". State forests are managed and marketed by the **State Forest Management Centre** (Riigimetsa Majandamise Keskus, RMK) and overseen by the Ministry of the Environment (Keskkonnaministeerium). A forestry development plan is prepared every 10 years and approved by the Estonian Parliament (Riigikogu). The principal goals of the **'Estonian Forestry Development Program until 2020'** are to safeguard forest productivity and viability and ensure the varied and effective use of forests. At least 10% of forest land is under strict protection.

Coppice management is not practiced, except in Short Rotation Coppice willow, poplar and alder plantations, but it has been used in the past in traditional wooded meadows, which are species rich and classified as a **European priority habitat** (6530 Fennoscandian wooded meadows). As well as hay harvesting and collection of wood for fuel, branches with leaves were coppiced or pollarded and dried for winter fodder. It is estimated that wooded meadows covered nearly 19% of Estonia's surface area at the end of the 19th century, but only approximately 8400 ha now remain, of which about 2700 ha are protected.

Since the early 1990s there have been several **Forest Acts**, each with amendments. The current Act does not apply to detached plots of forest land of less than 0.5 ha, or land where the average age of trees does not exceed 10 years and is not registered as forest land - even though it may comply with other definitions of forest land (at least 0.1 ha with woody plants at least 1.3m high and with canopy density of at least 30%). Estonian forestry is supervised by the Environmental Board of the Ministry of the Environment who give consent for felling operations.

Some of the provisions of the most recent Act are:

- A forest survey is carried out to receive data on the condition of forest and the volume of growing stock, to advise forest owners and to plan long-term forest management activities. The guidelines give the requirements for forest mapping; the objectives and methods of forest inventory; requirements for planning forest management; the methods of calculating the prescribed cut; and the requirements for preparation of forest management plans. The inventory data in force is mandatory for an improvement cutting, thinning and selective cutting. A forest management plan will be prepared for a forest owner together with forest inventory, unless the forest owner does not wish it.

- The following types of cutting are permitted: regeneration cutting, including clear cutting and shelterwood cutting; improvement cutting, including cleaning in stands with the average DBH of up to 8 cm, thinning in stands with the average DBH of 8cm and larger, and sanitary cutting; track cutting, including the cutting of 'quarter' or boundary lines; the cleaning of an existing ride or road shoulder, ditch bank or ditch shoulder from trees with the average DBH of more than 8cm; formative cutting in a protected area to attain a goal complying with the protection management plan, an action plan for the protection and control of a species, or for the purpose of preservation and improvement of the status of the protected area or key habitat.

- A forest owner must replant clear-cut areas over 0.5 ha within 2 years after cutting, although this is not necessary if natural regeneration with a suitable species composition and number of plants on the whole area is sufficient.

- Regulation of the water and nutrition regime of forest soil is permitted, but fertilisation of forests, except forest nurseries, with mineral fertilisers is prohibited.

- The minister responsible will establish the rotation age at which clear cutting is permitted per tree species and quality classes, making certain that it is: 90-160 years for pine and hard broadleaved tree stands; 80-120 years for spruce; 60-80 years for birch and black alder; 30-50 years for aspen.

- When clear cutting, all trees should be cut from the cutting area within 1 year after the beginning of the cut except for: 20 to 70 pines, white birches, ashes, oaks, black alders, European white elms or Scots elms per hectare, dispersed or in small groups, which are left as seed trees, and viable undergrowth. Seed trees will not be left if there are no trees suitable or if viable undergrowth of the tree species suitable for the forest site type exists in the cutting area for reforestation and is preserved when cutting.

- Old crop trees, i.e. trees necessary to ensure biological diversity, or the preserved standing parts of such trees, should be left so there is a total volume of stem wood of at least 5 solid cubic metres per hectare, or in the case of a cutting area sized over 5 ha, at least 10 cubic metres per ha.

- Key habitats: areas up to 7 ha needing protection and where there is a high probability of finding endangered or rare species. In state forests, the state forest manager organises the protection of key habitats in accordance with a ministerial directive. Protection of a key habitat is by a contract with the owner which gives the Ministry of the Environment a right of use for 20 years which may restrict economic activities. The forest owner must ensure its preservation. About one third of forests are covered with management restrictions.

- Protective forest: In forest designated by a plan for the protection of a settlement or residential building against air pollution, noise, strong wind or snowstorm or for reducing the fire risk or prevention of the spread of forest fire, the local authority may, by agreement with the landowner, establish restrictions as to the type of cutting for regeneration cutting and to the size of the cutting area and the rotation age in the event of clear cutting.

- A cutting right (raieõigus) is necessary to prove the legality of cutting, delivery of timber, etc. The right is established by an entry in the land registry, a transfer deed for the cutting right or timber, permission from the Environmental Board or a forest notification in the state register of the forest resource and an identity document.

- A forest owner, or his representative, must submit a forest notification to the Environmental Board concerning planned cuttings, except cleaning; or serious forest damage. The Environmental Board verifies the compliance of the planned cutting with the legislative requirements, valid inventory data or data about the condition, age, basal area and forest resources if the inventory data does not reflect the actual situation. If the planned activity does not comply with the legislation, the Environmental Board has the right to ban the activity, and making recommendations for bringing the activity into compliance with the legislation.

- A forest owner may cut, without submitting a forest notification or without registering with the state register of the forest resource, up to 20 solid cubic metres of wood per 'immovable' (a particular type of property) per year.

Forest certification

Both PEFC and FSC schemes are used in Estonia. PEFC is most commonly used in private forests; about 110,000 hectares of private forests are certified. State forests are certified by both PEFC and FSC.

Natura 2000

N2000 sites in Estonia are protected under the 2004 Nature Conservation Act. Management plans are compiled and approved by the Environmental Board (Keskkonnaamet). About 18% of total forest area is covered by Natura 2000.

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Finland

Jyrki Hytönen, Jenny Mills and Peter Buckley

Facts and Figures

Jyrki Hytönen

Definitions

Woodland that has been regenerated from shoots formed at the stumps of the previous crop trees, root suckers, or both, i.e., by vegetative means. Normally grown on a short rotation for small material, but sometimes, to a substantial size.

Vesametsä. Kanto- tai juurivesoista vegetatiivisesti syntynyt metsä. Vesametsiä kasvatetaan tavallisesti lyhyellä kiertoajalla mutta joskus tavoitteena voi olla myös ainespuun tuotanto.

Typology

Simple coppice	Not practised (however, birches of stump sprout origin are accepted in regeneration areas to fill in the plantation)
Coppice with standards	Not practised
Pollarding	Only in gardens and parks
Short rotation coppice	Mainly small scale plantations with *Salix, Alnus incana, P. tremula x tremuloides, Betula pubescens*

Images

Examples of Short Rotation Coppice

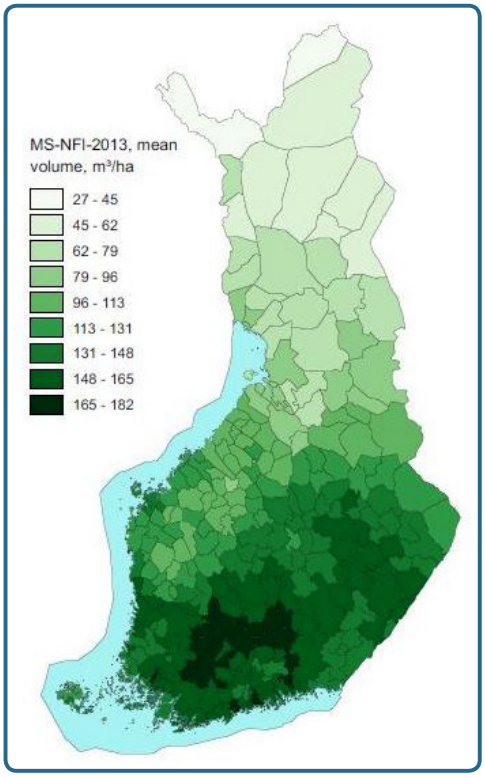
One-year-old hybrid aspen

Grey alder in Central Finland

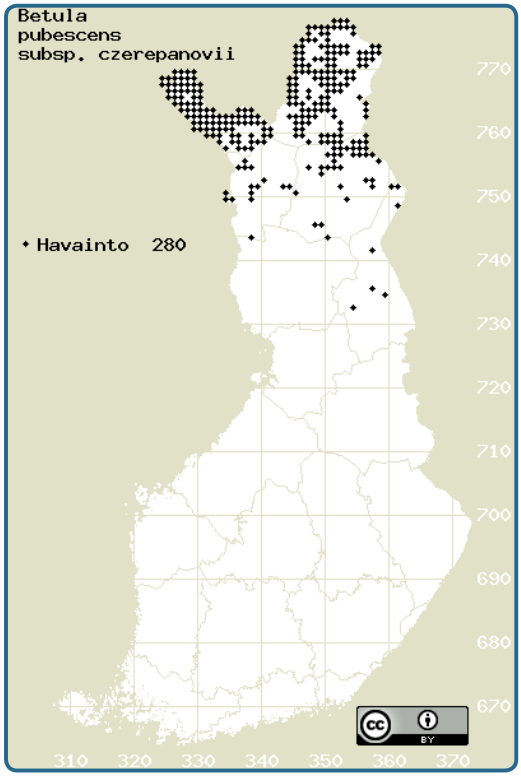
Downy birch in Lapland

Maps

Jyrki Hytönen



The mean volume of growing stock on forest and less productive forest land by municipalities in Finland (Mäkisara et al. 2016)



Mountain birch is most common in Finland's three northernmost municipalities; this species was coppiced in the past (Lampinen and Lahti 2017)

Mäkisara, K. Katila, M., Peräsaari, J. & Tomppo, E. 2016. *The Multi-Source National Forest Inventory of Finland – methods and results 2013*. Natural resources and bioeconomy studies 10/2016. http://urn.fi/URN:ISBN:978-952-326-186-0

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Description

Jyrki Hytönen

Forests are Finland

Finland is the most extensively forested country in Europe. Finland's forests are mostly northern boreal. Wooded land occupies 26 million ha or 86% of the land area of Finland. This is divided into forest (66% of the land area), scrub and waste land. Of the growing stock volume (2357 million m^3), 50% consists of Scots pine (*Pinus sylvestris*), 30% Norway spruce (*Picea abies*), 16% birch (*Betula pendula* and *B. pubescens*) and 4% other broadleaves.

Traditional coppice forests

Even though coppicing is a traditional silvicultural management system, widely used in Central and Southern Europe, its application in Finland has been very limited. Most of our native deciduous tree species are not considered very suitable for coppice management. In some special cases, such as mountain birch (*Betula pubescens* spp. *tortuosa*) stands in Lapland, there have been recommendations to coppice for firewood. Historically, hazel (*Corylus*

avellana) and linden (*Tilia cordata*) were grown as coppice for timber and other products in the south of the country. Pollarding was used in small areas to produce fodder for cattle.

Today, traditionally managed coppice forests do not exist in Finland. However, in normal forests there are trees of coppice origin, especially birches, but also other species such as rowans. Growing coppiced trees is not encouraged but they may fill up the stand.

Short rotation forests

The use of bioenergy is increasing rapidly due to the need to reduce greenhouse gas emissions. Wood-based fuels are playing a leading role in Finland in attempts to reach national and European Union targets to increase the use of renewable energy. The National Climate and Energy Strategy aims to increase annual woodchip production in Finland to 13.5 million m^3 by the year 2020. Even though woody biomass is mainly harvested from existing forests (small sized trees, slash and stumps), growing 'energy forests' may become economically viable in the future. Energy plantations based on fast growing deciduous tree species, grown in dense stands and renewed by coppicing, have been studied in Finland, with a focus on short-rotation willow. This research was begun in Finland in the late 1970s with extensive studies of cultivation methods. However, due to the combination of falling oil prices and high production costs of willow energy, this practice has not been widely adopted. Currently there are only around 200 ha of willow plantations in Finland. This may increase with the growing demand for energy and increasing prices of other fuel sources.

Due to Finland's northern location, other native deciduous tree species have been the subject of short-rotation coppice (SRC) research. The rotation for coppicing native birches, alders and aspens is between 20 and 30 years, which

Figure 1. One-year growth of energy willow in south Finland (left) and four years old downy birch coppice in northern Finland (right)

is considerably longer than for willow. Downy birch (*Betula pubescens*) growing on peatlands (of which there are 572,000 ha) is receiving increasing interest. The grey alder (*Alnus incana*) also has several good qualities, such as a capacity for binding atmospheric nitrogen, good coppicing ability and fast growth. These characteristics are appreciated as they directly affect the economics of biomass production. A further advantage of alder is that it is not susceptible to insect damage and is not as palatable to mammals (vole, moose, hare) as birches, willows, aspen and poplar. Aspen (*Populus tremula*) and hybrid aspen are also subject for research for SRC potential.

Future challenges

The future expansion of wood biomass production systems has many challenges and depends on economical, ecological and policy matters. As well as producing bioenergy cost-effectively and in an environmentally sustainable way, SRC is also expected to provide employment opportunities and support the cultural landscape. Research and development investment is needed to promote the expansion of new renewable energy systems.

Forestry Regulations

Jenny Mills, Peter Buckley and Jyrki Hytönen

About 20% of the total growing stock volume in Finland (2 357 mill. m^3) is of broadleaved species, the other 80% is composed of Norway spruce and Scots pine. Birches (silver birch and downy birch) constitute 83% of the growing stock of broadleaved species. There are no traditionally-managed coppice forests in Finland today, although coppicing was historically carried out on a very small scale in the south of the country. However, some trees of coppice origin can still be found in normal forests.

New forest legislation to ensure sustainable forestry came into force in 2014 including amendments to the 1996 **Forest Act** (metsälaki) and provisions for protected forests in the **Nature Conservation Act** (luonnonsuojelulaki). The amendments to the Forest Act aim to increase the freedom of choice of forest owners in managing their own forest property, to improve the profitability of forestry and operating conditions of the forest industry, and to enhance the biodiversity of forests. One important objective in the reform was to have less detailed regulation on the treatment of forests and to clarify the legislation. The most important changes include allowing uneven-aged forest stands, abolition of age and diameter limits in regeneration, a more diverse range of tree species, and an increase in habitats of special importance. Notification of the establishment of seedling stands is no longer required and supervision is targeted at the results of regeneration, for which new minimum limits have been specified.

The **Finnish Forest Centre** (Suomen metsäkeskus), a state-funded organisation, enforces forestry legislation. It also promotes forestry and related livelihoods, advises landowners on how to care for and benefit from their forests and ecosystems, and collects and shares data related to Finland's forests. The Finnish Forest Centre operates under the guidance of the Ministry of Agriculture and Forestry (Maa-ja metsätalousministeriö).

The Ministry of Agriculture and Forestry prepares a **National Forest Programme**, the objective of which is to promote diverse use of forests in line with the principle of sustainable development. The Forestry Centre prepares a **Regional Forest Programme** in its own territory and monitors its implementation. The programme contains objectives for sustainable forest management, objectives to be set for measures referred to in the legislation on the financing of sustainable forestry and general objectives for the development of forestry in the region. Both processes are participatory and a wide range of interest groups are involved in them.

Some regulations of the Forest Act:

- When intending to carry out felling, the landowner should send a forest use declaration (Metsänkäyttöilmoitus) to the Forestry Centre no later than 10 days, but no sooner than 3 years, prior to the date on which felling or other operations are due to start.
- A forest use declaration is not needed for subsistence felling for household use, for small-sized trees of a mean diameter of up to 13 cm or if they are in the marginal zones of power lines and railways or felling for a ditch, water pipe or sewer line, small areas of road, electricity or other similar lines, unless the fellings are in a habitat of special importance.
- There are seven types of habitats of special importance for biodiversity mentioned in the Forest Act, but which are small in area. Forests in these habitats must be managed and utilised cautiously so that the characteristic features of

the habitats are preserved or reinforced. Among others, these include habitats near streams and ponds, various mire, fen and flooded habitats, herb-rich forest patches, which include natural or semi-natural tree and shrub stands, and heath-land forest located in undrained peatlands or peatlands where the natural water economy has for the most part remained unchanged. Actions that must not be taken in habitats of special importance include regeneration felling, forest road construction, treatment of the soil surface that may damage vegetation characteristic of the site, ditch drainage, cleaning of brooks and rivulets and use of chemical pesticides.

- In habitats of special importance, cautious fellings can take place by choosing individual trees that preserve the stand in its natural or semi-natural state so that the natural or semi-natural water economy of the habitat does not change. No wood harvesting may be done in steep bluffs and the forest lying directly underneath. In sandy soils, exposed bedrock and boulder fields, cautious fellings can take place by choosing individual trees so that old, as well as dead and decaying trees, are preserved.
- Intermediate felling for the purpose of growing the remaining tree stand or that promotes the creation of new seedling material shall be done such a way that after the intermediate felling a sufficient and evenly distributed stand with growth potential is left in the treatment area. Matters to be taken into account in assessing the sufficiency of the stand to be left include the geographical location of the treatment area, site, method of implementing the intermediate felling and dominating height, which means the arithmetic mean of the one hundred thickest trees within a hectare. Intermediate felling involves a forest regeneration obligation if the volume and status of the remaining stand is not sufficient to create a new stand.
- Regeneration felling resulting in an open area except for the retention of seed or shelter trees to produce a new tree stand, involves a forest regeneration obligation if the exposed area exceeds 0.3 hectares. In forest regeneration, a seedling stand may be established with seedlings or seed of pine, spruce, silver birch, aspen, Siberian larch, maple, common alder, oak, European white elm, Scotch elm, small-leaved linden, ash and hybrid aspen of suitable provenance. According to the Decree on Sustainable Management and Use of Forests (1234/2010), regeneration of aspen and hybrid aspen by sprouting is also allowed. A seedling stand may be established with seedlings or seed of downy birch only in peatland, paludified sections of mineral soils and compact soils dominated by clay or silt. In other sites downy birch may be used as a supplementary tree species depending on its site and the geographical location of the area.

The Forestry Act is not applicable in, among other places, protected areas established under the Nature Conservation Act, areas purchased by the State for nature protection purposes, or other State-owned areas managed in accordance with a protection decision of the state forest administration, Metsähallitus, or other authority administering State lands, or in areas referred to in the Act on Wilderness Reserves other than the seven habitats of special importance mentioned above. The majority of nature reserves are located on state-owned land and maintained by Metsähallitus.

The **Ministry of the Environment** (Ympäristöministeriö) guides and monitors nature conservation in Finland. It prepares legislation to maintain biodiversity and is responsible for the general monitoring of the implementation of this legislation. The Ministry also prepares nature conservation programmes and establishes nature reserves under these programmes.

Furthermore, it approves the management and use plans of major nature reserves. The **Finnish Environment Institute** (Suomen ympäristökeskus) researches and assesses biodiversity, serving various public bodies and agencies, businesses and communities. It assesses the endangered status of organisms and habitats, conducts research on the management and restoration of different habitats, and on the importance of ecosystem services and their interaction with biodiversity.

Centres for Economic Development, Transport and the Environment

(Elinkeino-, liikenne- ja ympäristökeskukset - ELY Centres) promote and supervise nature conservation and landscape protection in their respective regions. They safeguard biodiversity, for example, by establishing nature reserves on privately owned land, acquiring areas for the state, for the purpose of nature conservation, approving proposals for protected areas and management and use plans for these areas, safeguarding natural values in land use planning and planning the management and use of Natura 2000 areas. If a felling operation is to be carried out in a Natura 2000 site, or in its vicinity, which could significantly damage the natural value of the area, a declaration must be made to the area's ELY Centre.

About 18% of Finland's forestry land is **protected** or under restricted forestry use. The share of strictly protected forests is almost 14%. About 95% of commercial forests are PEFC **certified**.

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France

Philippe Ruch, Jenny Mills and Peter Buckley

Facts and Figures

Philippe Ruch

Definitions

Simple Coppice: forest whose trees have been regenerated at the same time, by allowing regrowth from cut stumps or root suckers. Thus, all trees are even-aged and are about the same size (diameter and height).

Compound coppice with standards system: forest stand composed of high forest (broad-leaves or coniferous, even-aged or uneven-aged) and coppice, side by side or stacked.

Taillis simple: peuplement forestier composé d'arbres issus de rejets et drageons auquel est appliqué un traitement régulier. De ce fait, il est constitué d'arbres de dimensions (diamètre, hauteur) voisines et il est équienne.

Mélange de futaie et taillis: peuplement forestier constitué d'une futaie feuillue et/ou résineuse, régulière ou irrégulière, superposée ou juxtaposée à un taillis.

Delpech R. et al., *Typologie des stations forestières – Vocabulaire*, IDF, 1993

Short Rotation Coppice (SRC): rotation from 7 to 10 years, objective is to produce small trees (diameter 15 cm, height 15-18 m).

Very Short Rotation Coppice (VSRC): rotation from 2 to 4 years, objective is to produce small shoots (diameter 3 - 5 cm, height 4-8 m).

Taillis à Courtes Rotations (TCR): rotations de 7 à 10 ans, objectif produire de petits arbres (15 cm de diamètre, hauteur 15-18 m).

Taillis à très courtes rotations (TTCR): rotations de 2 à 4 ans, objectif produire beaucoup de petits brins (3 à 5 cm de diamètre; hauteur 4 à 8 m).

Berthelot A., *Produire de la biomasse avec des taillis de peupliers*, AFOCEL, 2007

Legal Framework

Forest-related activities naturally have to comply with the National (French) Forest Policies. Logging operations, which are not planned in a approved management document, are generally subject to an application for authorisation. It varies according to the situation of the forest and the size of the clear-cut.

Statistics

Simple coppice forest structures represent 1.7 million ha (11% of the French forests) and compound coppice with standards system 4.7 million ha (30%).

Source: National Forest Inventory, 2013. Les résultats des campagnes d'inventaire 2009 à 2013.

Short-Rotation Coppice (SRC) and Very Short Rotation Coppice (VSRC) cover merely a few thousand ha in France and are therefore quite marginal.

Typology

Simple coppice	Mediterranean coppices (*Quercus ilex* and *Quercus pubescens*): 52% of the simple coppice area and *Castenea sativa*, 13% of simple coppice; more locally, there are also coppiced *Fagus sylvatica* in the mountains, *Quercus robur* and *Quercus petraea* and more marginally *Alnus glutinosa* and *Robinia pseudoacacia.*
Coppice with standards	*Carpinus betulus, Quercus robur* or *Quercus petraea* coppices and standards of common oaks on clayey loam soils in central and northeastern France. Other species such as *Betula verrucosa, Fagus sylvatica* and *Populus tremula* can also be found in such situations; Common oaks, chestnut or birch coppice and sessile oak standards on poorer siliceous soils in central and western France.
Pollarding	Only in some rural regions (*Quercus* and *Fraxinus* mostly)
Short rotation coppice	SRC: *Populus, Eucalyptus, Robinia pseudoacacia* VSRC: *Populus, Salix, Robinia pseudoacacia*

Images



Description

Philippe Ruch

Until the industrial era, coppice and coppice with standards were the dominant silvicultural systems in French hardwood forests. The main function of coppice was to supply wood fuel (as logs, bundles or charcoal) for domestic or industrial consumption (forges, glassware, etc.). In some regions, the bark from chestnut and holm oak was also an important resource for tanning. A great conversion campaign towards high forest management started in the middle of the 19th century in public forests. This was connected to the utilization of coal and the depletion of forests. This trend has continued up to the present.

Furthermore, the rural exodus of the 20th century and the attractiveness of fossil fuels have led to the abandonment of coppice management after the 2nd World War. Thus, a significant part of the coppice has been converted by planting coniferous species, which was strongly encouraged through subsidies. Nowadays, there is a renewed interest for firewood due to the rising energy costs and the development of the bioenergy economy.

Compared to the overall 15.7 million ha forest production area, simple coppice forest structures represent 1.7 million ha (11% of the forests) and coppice with standards, 4.7 million ha (30%).

France has a great diversity of forest environments and species linked to diverse geological contexts (acid soils and calcareous soils) and climates (Mediterranean, oceanic, continental

and mountain). Thus, the main types of coppice in France, also a result of human choices, are:

- Mediterranean coppices of holm oaks (*Quercus ilex*) and pubescent oaks (*Q. pubescens*), which represent 52% of the simple coppice area; coppicing is still the main silvicultural system and firewood the principal product;
- Chestnut coppice (*Castenea sativa*), 13% of simple coppice, whose main products are industrial timber, stakes and parquet. Thinning-driven conversion to high forest is sometimes undertaken by owners of land with rich soil. Conversion by plantation is an alternative option often chosen for declining stands;
- More locally, there are also coppice of beech (*Fagus sylvatica*) in the mountains. Common oaks (*Quercus robur* and *Quercus petraea*) and more marginally black alder (*Alnus glutinosa*) or black locust (*Robinia pseudoacacia*) can also be found as coppice;
- Mixed forest structures, composed of coppice with standards. Industrial wood (for the pulp and panelboard mills) and wood energy (logs and more recently wood chips) are the two main value chains for the coppice products. In these stands, forest management is mainly focused on the standards in order to produce timber, which is more valuable. Two main types are represented:
  - hornbeam (*Carpinus betulus*) or common oaks (*Quercus robur* and *Quercus petraea*) coppice and standards of common oaks on clayey loam soils in central and northeastern France. Other species such as birch (*Betula verrucosa*), beech (*Fagus sylvatica*) and aspen (*Populus tremula*) can also be found in such situations;
  - common oaks, chestnut or birch coppice and sessile oak standards on poorer siliceous soils in central and western France.

Although this diversity highlights that coppice structures are still widely present in French forests, their forest management and utilization tend to be taken for granted.

Short-Rotation Coppice (SRC) and Very Short Rotation Coppice (VSRC) cover merely a few thousand ha in France and are therefore quite marginal. The first poplars and eucalyptus SRC plantations for pulp wood purposes date back to the 1980s. More recently (2008 to 2012), an attempt has been made to introduce VSRC and SRC on agricultural land for energy purposes, mainly with black locust, poplar and willow. However, this trend has not been pursued due to low profitability. Currently, only eucalypt SCR continues to be planted in the southwest of France.

Figure 1. Hornbeam coppice with pedunculate oak standard in northeastern France (left) and chestnut coppice in western France (right)

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Forestry Regulations

Jenny Mills, Peter Buckley and Philippe Ruch

The **Code Forestier** contains the laws regulating French forests. Interpretation and implementation of the Code filters down through various levels of Government documentation including les Orientations Régionales Forestières (**ORF**), which describe the sustainable management objectives of forestry policy for regional administrative areas taking into account economic, environmental and social issues. They specify the broad guidelines to be followed by the entire forest industry and concern all public and private forests and sector participants (foresters, forestry companies, manufacturers and wood processors). The ORF sets forest policy at a regional level as well as general action programs for the **DRA** (Directive Régionale d'Aménagement des forêts domaniales), **SRA** (les Schémas Régionaux d'Aménagement des forêts communales), and, for private forests, **SRGS** (le Schéma Régional de Gestion Sylvicole).

If a forest-owner has an approved sustainable management document, then planned coupes and other management operations do not usually need separate authorisation. For public or community forests, the "aménagement" constitutes the sustainable management document.

In private forests, there are 3 principal types of sustainable management documents, depending on the size of the forest and the owner's choice:

PSG (plan simple de gestion)

Obligatory where the cumulative area of the owner's forest plots located in the same municipality is equal to or greater than 25 hectares (a continuous area or the sum of fragmented patches over 4 ha in nearby municipalities). The plan lasts for 10 - 20 years and is approved by the CRPF*. A voluntary PSG can be carried out for properties between 10 and 25 hectares.

*Centre Regional de la Propriété Forestière France is divided into 11 CRPFs, delegated from the Centre National de la Propriété Forestière, a public advisory and management service for forestry owners. They are administered by elected forest owners and run by a team of forestry engineers and technicians. They direct and promote improved management of private forests.

RTG (règlement type de gestion)

An optional management document that is intended to define management arrangements for owners of forest of between 10 and 25 ha. It is overseen by an 'organisme de gestion et d'exploitation en commun' (OGEC*) and leads to at least 10 years of commitment.

*An OGEC is an organisation of proprietors for communal forestry management and exploitation. It can be a cooperative or management syndicate or an association of forestry proprietors as defined by a specific law.

CBPS (code des bonnes pratiques sylvicoles)

An optional document for small properties, drafted by the Centre Régional de la Propriété Forestière (CRPF) and validated by the Prefect of the region, which includes the essential recommendations by type of stand consistent with sustainable management. The owners adhere to it for a period of at least 10 years.

What regulations must be followed if wood is to be harvested? In privately-owned forests, whatever the size of the property, 2 cases may apply depending on whether a management plan has been established or not.

i) If such a plan exists, its compliance with the regional directives has been approved by the authorised administration and a harvesting operation need only comply with the plan (i.e. it meets the management objectives).

ii) If there is no management plan, then the harvesting operation will fall under specific regulation. The most common situations are:

• If the size of the future operation is > 4ha† and more than half of the volume of the standing standards are to be harvested: the operation needs to be authorised by the county administration (DDT - la Direction Départementale des Territoires)

• If the operation is a final felling (or clearcut) > 1ha† in a forest larger than 4ha†: the stand must be re-established (regeneration or plantation) at the latest 5 years after harvest

• Moreover, some forests may fall under municipal jurisdiction: they are classified in EBC (Espaces boisés classés), areas that need to be preserved (clearcuts for coppice are only allowed if they are considered a "usual" harvesting operation, every operation has to be approved by the municipal council).

Independently of the existence of a management plan, the location of the forest can also be subject to specific environmental regulation according to the nature of the area (specific protection status such as, e.g. Natura 2000, water).

...

An exception is made for cuts that are for the owner's own domestic use for firewood or for his agricultural fencing requirements, but not for timber. Where the firewood is sold, or more than a third of it is given away, authorization is necessary. The relevant article in the Code Forestier (L312-10) does not indicate what quantity or diameter of wood can be cut for the owner's domestic use.

Cutting of poplar plantations is not affected by these regulations. Thinning necessary for the good management of softwood stands will be authorized.

From a general point of view, clear-cuts or stand regeneration will be allowed where the stand has reached or exceeded the minimum age of exploitability defined for that type of stand in the Scheme of Regional Woodland Management (SRGS). For younger stands, an analysis is made on a case by case basis.

Penalties

Cutting without authorisation is illegal according to articles L313-11 et L362-1 of the Code Forestier. The agent or proprietor will receive a fine of € 20,000 per hectare for the first two hectares and € 60,000 for each supplementary hectare.

Obligatory renewal after clearcutting

All stands of 1 ha† or more in one piece located in a forest larger than 4 ha†, regardless of stand type (standards, coppice-with-standards or simple coppice), belonging to one owner or tenant, must be restocked. This can be by regeneration or planting.

Zones where other legislation can apply

Some logging may also be subject to other regulations, for example, in wooded areas classified as an EBC*, and in, or near other protected environmental (including Natura 2000 sites), historical or architectural sites.

*Under Article L. 130-1 of the Town Planning Code (Code de l'urbanisme), a 'plan local d'urbanisme' (PLU) can classify a site as an 'Espace boisé classé' (EBC) in order to protect or create woods, forests, parks, individual trees, hedges and plantations. This also takes account of the 'Grenelle II' laws relating to the national commitment to the environment. Cutting

† Noted here are the most common cases; the actual figures are decided upon by the regional Prefect.

of mature coppice can be exempt from prior notification in an EBC as long as renewal is satisfactory and other restrictions on cutting of the standards observed.

Natura 2000 sites

There are no supplementary formalities for Natura 2000 sites for felling or woodland management, but these must be in accordance with existing regulations relevant to the site. Each Natura 2000 site has a 'document d'objectifs' (DOCOB), which sets out the management objectives for the site and how they are to be achieved, among other things.

A PSG or RTG cannot be approved for a Natura 2000 site if the coupes or forestry work affect the site's conservation status. The CRPF has the responsibility of assessing if the types of management proposed in the PSG or RTG are likely to have a significant effect on the Natura 2000 site. It is they who have to decide whether or not to approve the PSG or the RTG.

If the owner asks the CRPF if he can benefit from Article L.122 of the Code Forestier* and if there is no significant effect on the habitat of the Natura 2000, a PSG will be approved.

If it is judged by the CRPF that the Natura 2000 site will be significantly affected by the proposals, the CRPF will ask the owner to amend his felling and management plan, but if the owner does not want to comply with the amendments, the owner will, at his own cost, be required to carry out an environmental impact assessment. If not, the CRPF will refuse to approve the PSG.

* In the past an owner had to ask permission for every type of management that could make an environmental impact on the various types of environmental and other zoning. Articles L 122-7 and 8 of the Forestry Code now allow an exemption from this during the time a PSG is valid for all the management and coupes specified in it, providing an application requesting this is attached to the PSG application.

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Germany

Gero Becker, Alicia Unrau, Patrick Pyttel, Achim Dohrenbusch and Christian Suchomel

Facts and Figures

Gero Becker and Alicia Unrau

Definitions

(1) Coppice: Even-aged stands consisting of trees and shrubs (mainly: *Quercus* spp., *Carpinus betulus, Alnus glutinosa*, occasionally *Fagus silvatica*), which regenerate wholly or mainly by vegetative means (sprout or root shoot) and are harvested in small clearcuts (0.5-1 ha) in short rotations of 20-40 years. In some cases combined with standards, which have longer rotation periods.

(1) Niederwald (Stockausschlagwald): Gleichaltriger Bestand aus Bäumen und Sträuchern (hauptsächlich Quercus spp., Carpinus betulus, Alnus glutinosa, seltener Fagus silvatica), die sich ganz oder überwiegend vegetativ (Stockausschlag, Wurzelbrut) verjüngen und in kleinen Kahlschlägen (0.5-1 ha) und in kurzen Umtriebszeiten (20-40 Jahren) bewirtschaftet werden. In einigen Fällen kombiniert mit aus Samen entstandenen Bäumen im Oberstand ("Kernwüchsen"), die in längerer Umtriebszeit bewirtschaftet werden ("Mittelwald").

(2) Short rotation coppice (SRC): Plantation of fast-growing trees (mainly *Populus* spp., *Salix* spp., and *Robinia pseudoacacia*), with the aim to produce in several short rotation periods (5-20 years each) wood as a renewable resource, mainly for energy.

(2) Kurzumtriebsplantagen: Künstlich angelegte Monokulturen schnell wachsender Bäume (hauptsächlich Populus spp., Salix spp., und Robinia pseudoacacia) mit dem Ziel, innerhalb kurzer Umtriebszeiten (5-20 Jahre) mit mehreren Wiederholungen Holz als nachwachsenden Rohstoff zu produzieren, vor allem für energetische Zwecke.

For National Inventory purposes, the definition is: "Coppice forests originate from vegetative regeneration (stool or root sprouts) and are max. 40 years of age" (BWI3 Guidelines, page 34).

Legal Framework

In Germany, the federal forest law only gives a general framework for legislation and provides no mention of traditional coppice. Forest issues are regulated in detail by regional authorities in 14 of the 16 states. They rarely mention traditional coppice and, if so, it is often indirectly. For example, in Bavaria there is mention of high forest ("Hochwald"), which implies that other types of forest exist as well, while in Rhineland-Palatinate they are generally considered "non-productive forests" and it is thus clear to all concerned that they fall under the legal category of "other forest" ("Sonstiger Wald"); neither case, however, explicitly mentions coppice ("Niederwald", i.e. low forest). In Bavaria there is another indirect link since remaining coppice forest stands can qualify as a historical land use practice, in which case they should be protected. Short rotation coppice ("Kurzumtriebsplantagen") is mentioned in federal and regional forest laws. They state that it is only regarded as "forest" if the rotations exceed 20 years; otherwise it is regarded as an agricultural crop.

Statistics

National statistics according to the third Bundeswaldinventur (National Forest Inventory) in 2012: Simple coppice 45,766 ha (0.42% of total forest area); coppice with standards 32,354 ha (0.30% of the total forest area) (BWI3). It should be noted that the definition of "Niederwald" in the BWI is limited to stands with a max. age of 40 years. Thus, older coppice stands are automatically defined as "Hochwald".

In some regions (Rhineland-Palatinate, parts of North Rhine-Westphalia) the proportion of coppice may be as high as 5-10%. A recent study carried out in Rhineland-Palatinate shows that 20% (83,000 ha) of the state and community owned total forest area originated from and still shows signs of coppice forest (Becker et al. 2013). The proportion in private forests may even be slightly higher.

There are approximately 6,000 ha of Short Rotation Coppice in Germany; the plots are mainly experimental (Hauk et al. 2014).

Typology

Simple coppice	Small clearcuts; rotation 20-40 years
Coppice with standards	20-50 standards/ha, mostly oak, rotation >60-80 years, combined with coppice on a rotation of 20-40 years
Pollarding	Not significant
Short rotation coppice	*Populus*, in some cases *Robinia pseudoacacia* and *Salix* spp.

Images

Typical German coppice forest, Baumholder, Rhineland-Palatinate

SRC Poplar and willow, second rotation period

SRC 1 year old *Salix* and GHG measuring chamber

Photos: C. Suchomel

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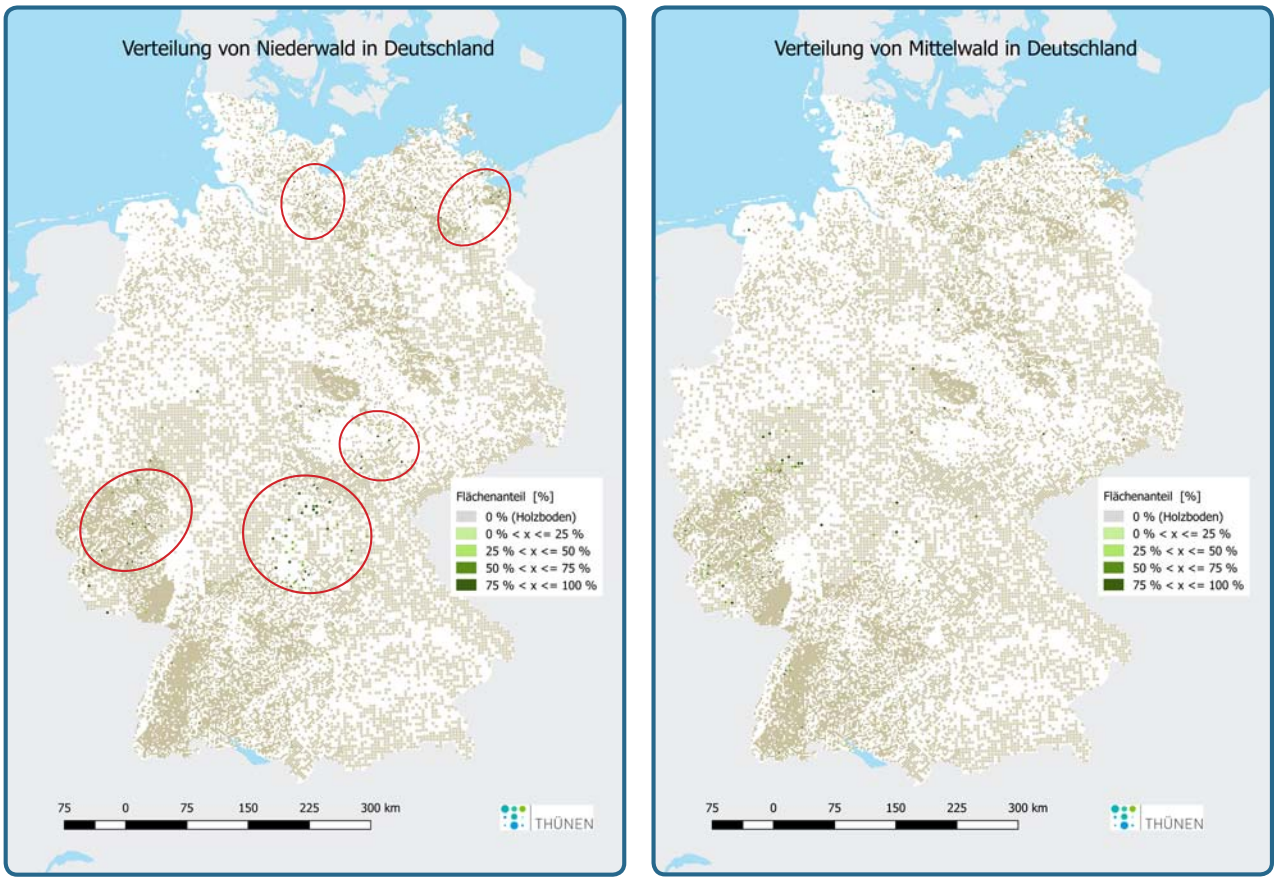
Maps

Gero Becker



Plots with active coppice (i.e. < 40 years of age) identified during the 3rd German Forest Inventory (green); Simple coppice (Niederwald) on the left and coppice with standards (Mittelwald) on the right. Circled in red on the left are the main areas of coppice, in which overaged coppice is also common (estimate). Maps: Thünen-Institut, Dritte Bundeswaldinventur.

Description

Patrick Pyttel and Achim Dohrenbusch

Coppicing is a traditional silvicultural management system applied all over the world. Until recently, coppice stands often represented important elements of the cultural landscapes in rural environments of Central Europe. These forests were traditionally used for the production of firewood and various non-timber forest products. Across Central Europe this practice was largely abandoned in the first half of the last century due to socio-economic changes and this absence of periodic coppicing led to the passive transformation of the remaining stands. In this process the stands lose their typical coppice characteristics and increasingly resemble high forest. Subsequently the specific ecological values of coppice forests decreases and this important element of the cultural landscape gradually disappears.

Today, managed coppiced forests (i.e. younger than 40 years) only cover ca. 75,000 ha of Germany, which represents 0.7% of the total forest area (BWI3, 2012), while the forest assessment of 1961 reported 3.5% of German forests as coppice. One way of preserving the ecological, cultural and historical value of coppice forests would be to resume coppicing in overaged,

formerly coppiced forests with the additional benefits of promoting light and warmth demanding species. This could also increase biodiversity.

Ongoing initiatives by the European Union (EU) call for a substantial increase in the use of renewable energy sources. The objective is to provide one fifth of European energy consumption from renewable sources by 2020. Currently 47% of the renewable energy consumed in the EU is generated from forest biomass (i.e. wood and wood waste). This demand for biomass as an energy source has stimulated interest in resuming coppicing of forests that had undergone this management in the past.

Coppice forests are now regarded as cultural heritage features, as being a potential source of fuel wood and are recognised as valuable habitat for many plant and animal species. Despite this restoration by coppicing, particularly of aged, overstood coppice forests, it has proceeded slowly for various reasons. There are broad public concerns over the ecological sustainability, fostered by the media's focus on perceived environmental damage through clear felling. The fact that remnant coppice forests are often found on sites with low growth potential, such as steep slopes, makes economic justification difficult. The potential to convert overstood coppice stands into high forest has contributed to the current situation. One obstacle to resuming coppicing is the belief, held by some forest managers, that overstood oak coppice will not re-sprout vigorously enough from the stump to ensure successful regeneration, combined with the view that coppicing causes a reduction in soil fertility.

Although most of these assumptions lack scientific evidence, some doubts are certainly justified. However, the fact that coppicing is the oldest type of regulated forest management can be considered as a clear indicator of its environmental sustainability. Recent research has shown that aged, overstood coppice forest can generally be managed in accordance with the pan-European criteria for sustainable forest management and that careful coppice management can preserve valuable and rare tree species such as *Sorbus torminalis* and *Sorbus domestica*. All forest managers should identify the basic situation, from stand to landscape level, at which coppicing is economically justified and needed in order to meet nature conservation objectives. It is important to conserve the remaining coppice forests and to continue their sustainable use and management.

Figure 1. Overaged coppice forests still dominate the landscape along the large Rhine and Moselle waterways

Forestry Regulations

Christian Suchomel and Patrick Pyttel

German forest law gives the framework for forest management in Germany. More specific laws are given by the federal states. Historic management forms are mentioned in the context of the national forest law, where it is stated that cultural heritage and heritage conservation should be taken into account (Bundesministeriums der Justiz und für Verbraucherschutz 1975).

In the **German National Strategy of Biodiversity**, which is a declared intention and not legally binding, historic management systems

such as coppice, coppice-with-standards and forest pastures are explicitly mentioned for their high value in conservation and recreation. The aim of the strategy is to continue to manage in this way and expand if possible. Historic relicts of forest management (for instance coppice) are intended to be preserved (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit 2007). Another strategy at national level is the **German Forest Strategy 2020**. Here, unique historical management systems such as coppice, coppice-with-standards and wood pastures are again confirmed as important habitats for flora and fauna, which rely on their traditional and particular management. The strategy places a high emphasis on conservation (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz 2011).

The **state forest laws** regulate clearcuts and the rules for their reforestation. All but three states specify the maximum size of a clearcut, ranging from 0,3 to 2,0 ha. Since periodic clearcuts are a genuine traditional forest management practice, the application of clearcut rules to coppice is under debate. Recently, it has been discussed whether coppice forests violate the prescription in Natura 2000 areas that forbids a deterioration of the current ecological situation.

To elaborate on the rules and regulations of the federal states related to coppice forests and their management, we selected the six federal states (out of 16) that have the highest percentage of the total recorded coppice and coppice-with-standards in Germany: Bavaria (37%), Rhineland-Palatinate (17%), Mecklenburg-Western Pomerania (9%), North Rhine-Westphalia (8%), Thuringia (8%) and Hesse (5%) (Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz 2005).

Neither German nor state laws contain specific guidelines concerning felling heights, maximum size of coppice areas or the number of standards.

Select Federal States

Bavaria

In the Bavarian forest law, coppicing or other historical forms of forest management are not specifically mentioned. The state strategy for the conservation of biodiversity only refers to regulations concerning voluntary contractual nature conservation measures (Bayerisches Staatsministerium für Umwelt und Gesundheit 2009). Here the establishment and maintenance of coppice and coppice-with-standards forests, as well as the resumption of coppicing, is permitted as a so-called compensatory measure. The same strategy refers to the need for action in forests. In the relevant paragraph, coppice and coppice-with-standards are mentioned as examples of forms of forest management which should be facilitated due to their special importance for biodiversity.

Rhineland-Palatinate

Rhineland-Palatinate is the federal state with the highest share of forest area. It is especially in this part of Germany that aged oak coppice forests are a substantial and omnipresent in many forest landscapes. Inventories in public forests, together with estimations in private forests, show that more than 160,000 ha are still covered by overaged coppice forests (these are not counted as coppice in the national forest inventory (BWI3) because they are over 40 years age). It is thus all the more surprising that neither historical forms of forest management, coppice nor coppice-with-standards forests, are considered in the state forest law. The law only indirectly mentions coppice, when it refers to non-productive forests, where special administrative regulations apply. However, coppice forests are explicitly mentioned in the state Strategy for the Conservation of Biodiversity (Ministerium für Umwelt, Landwirtschaft, Ernährung, Weinbau und Forsten Rheinland-Pfalz 2015). In this strategy, coppice forests are

considered special habitats; their high nature conservation value should be given special consideration in the context of management.

Mecklenburg-Western Pomerania

The north eastern part of Germany belongs to the federal state of Mecklenburg-Western Pomerania. In the forest law of this federal state, coppice forests are only mentioned indirectly in the context of the so-called protection forests. Forests can be designated as protection forests if they are of importance for research, conservation of genetic diversity or the conservation of meaningful historical forms of forest management (Ministerium für Landwirtschaft, Umwelt und Verbraucherschutz Mecklenburg-Vorpommern 2011). Hence, coppice and coppice-with-standards could potentially gain specific protection status, but the selection criteria for these forests are not specified. The state forest law is supported by a governmental program for the conservation and development of biological diversity, where specific attention to historical forms of forest management is expressly requested until the year 2020 (Ministerium für Landwirtschaft, Umwelt und Verbraucherschutz Mecklenburg-Vorpommern 2012). In the relevant paragraph, coppice and coppice-with-standards forests are specifically mentioned in parenthesis. Both political instruments (Ministerium für Landwirtschaft, Umwelt und Verbraucherschutz Mecklenburg-Vorpommern 2011 and 2012) are presumably influenced by the state Forest Development Program, published by the Ministry for Agriculture, Food and Forestry in the year 2002. This program requires the promotion of historical forms of forest management, along with the conservation of native tree species and rare plants (Ministerium für Ernährung, Landwirtschaft, Forsten und Fischerei Mecklenburg-Vorpommern 2002).

North Rhine-Westphalia

In North Rhine-Westphalia, which is in north-west Germany, 6,000 ha of historical forests (coppice and wood pastures) are still actively managed. In the Biodiversity Strategy it is mentioned that these forests contribute in an important way to the preservation of biodiversity. One aim is to develop an immediate concept for the coppice area and a concept for forest edges to be managed as coppice-with-standards, so as to support light- and warmth-demanding species (Ministerium für Klimaschutz, Umwelt, Landwirtschaft, Natur- und Verbraucherschutz des Landes Nordrhein-Westfalen 2015). Coppice regeneration can be allowed by the administrators as a method by the forest law of North Rhine-Westphalia. Other clear cuts (max. 2 ha) must be reforested within 2 years (Ministerium für Ernährung, Landwirtschaft und Forsten des Landes Nordrhein-Westfalen 1980).

Thuringia

The Free State of Thuringia is located in central Germany. The forest law of this state explicitly mentions coppicing. Firstly, in the context of clear cutting, the relevant article allows clear cuts in coppice and aged coppice forests, independent of their age. In all other broadleaved forests, clear cuts are not allowed until the age of 80 years. Secondly, in the context of the fee-based management services of governmental employees in private and community owned forest, the article states that fees for the management of coppice forest (excluding aged coppice and coppice-with-standards forests) are reduced by two thirds (Thüringen Forst 2015). These articles are supplemented by the state Strategy for the Conservation of Biodiversity (Thüringer Ministerium für Landwirtschaft, Forsten Umwelt und Naturschutz 2012). The strategy proposes the conservation of historical forest management types to reinforce specific forest structures and compositions.

Hesse

Hesse is in the centre of Germany. The Hessian Biodiversity Strategy does not mention coppice, coppice-with-standards or any other historical management systems (Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz 2015). The state's forest law allows a maximum clear cut size of 1 ha. Coppicing is explicitly mentioned in the context of clear cutting. The relevant article allows clear cuts in coppice and aged coppice forests, regardless of their age. In all other broadleaved forests, clear cuts are not allowed until the age of 80 years (Hessisches Ministerium für Umwelt, Energie, Landwirtschaft und Verbraucherschutz 2013).

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Maps of German States (in green): By David Liuzzo [CC BY-SA 2.0 de (https://creativecommons.org/licenses/by-sa/2.0/de/deed.en)], via Wikimedia Commons

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Greece

Giorgos Mallinis, Ioannis Mitsopoulos, Petros Tsioras, Thomas Papachristou and Gavriil Spyroglou

Facts and Figures

Giorgos Mallinis, Ioannis Mitsopoulos, Petros Tsioras, Thomas Papachristou and Gavriil Spyroglou

Definitions

Forests that resprout after felling - Papachristou	*πρεμνοφυή δάση (premnofie dasi)*
Coppice forest, or paravlastogenes forest, is forest where regeneration is done by sprouts. - Mallinis	*Πρεμνοφυές ή παραβλαστογενές δάσος είναι το δάσος στο οποίο η αναγέννηση γίνεται με παραβλαστήματα.*

Legal Framework

Presidential Decree. 19-11-1928, 28-29.
Restrictions and guidelines regarding coppice forest harvesting.

Statistics

Coppice forests cover an area of approximately 1,930,000 ha (12% of the total country's area). The main species managed as coppice are broad-leaved oaks (1,105,339 ha), beech (337,000 ha), chestnut (33,000 ha) and other broadleaved species (88,000 ha). The management of these coppice forests is intensive, with a clear cutting cycle ranging from 20 to 30 years.

1.1. Area of forest and other wooded land and its changes

	1964		1992	
	Area (1000 ha)	Percentage (%)	Area (1000 ha)	Percentage (%)
Forest *	2 512	19.0%	3 359	25.5%
Other wooded land *	3 960	30.0%	3 154	23.9%
Forest and other wooded land	6 472	49.0%	6 513	49.4%
Other land uses	6 724	51.0%	6 683	50.6%
Total area	***13 196***	***100.0%***	***13 196***	***100.0%***

* Definitions are quoted in the Appendix I

1.1.1. Area of forest according to management type and its changes

	1964		1992	
Management type	Area (1000 ha)	Percentage (%)	Area (1000 ha)	Percentage (%)
High forest	872	34.7%	1 166	34.7%
Coppice forest	1 206	48.0%	1 612	48.0%
Coppice forest with standards	434	17.3%	581	17.3%
Total	***2 512***	***100.0%***	***3 359***	***100.0%***

Source: a) Distribution of Forests in Greece 1964, General Secretariat of Forests and Natural Environment (GSF&NE), Ministry of Agriculture
b) First National Inventory of Forests 1992, GSF&NE, Ministry of Agriculture

Images

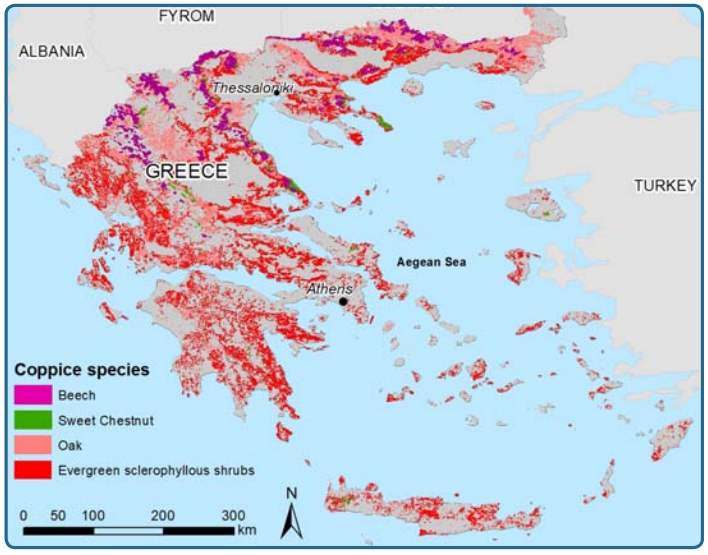
Coppice Oak forest in Northern Greece

Typology

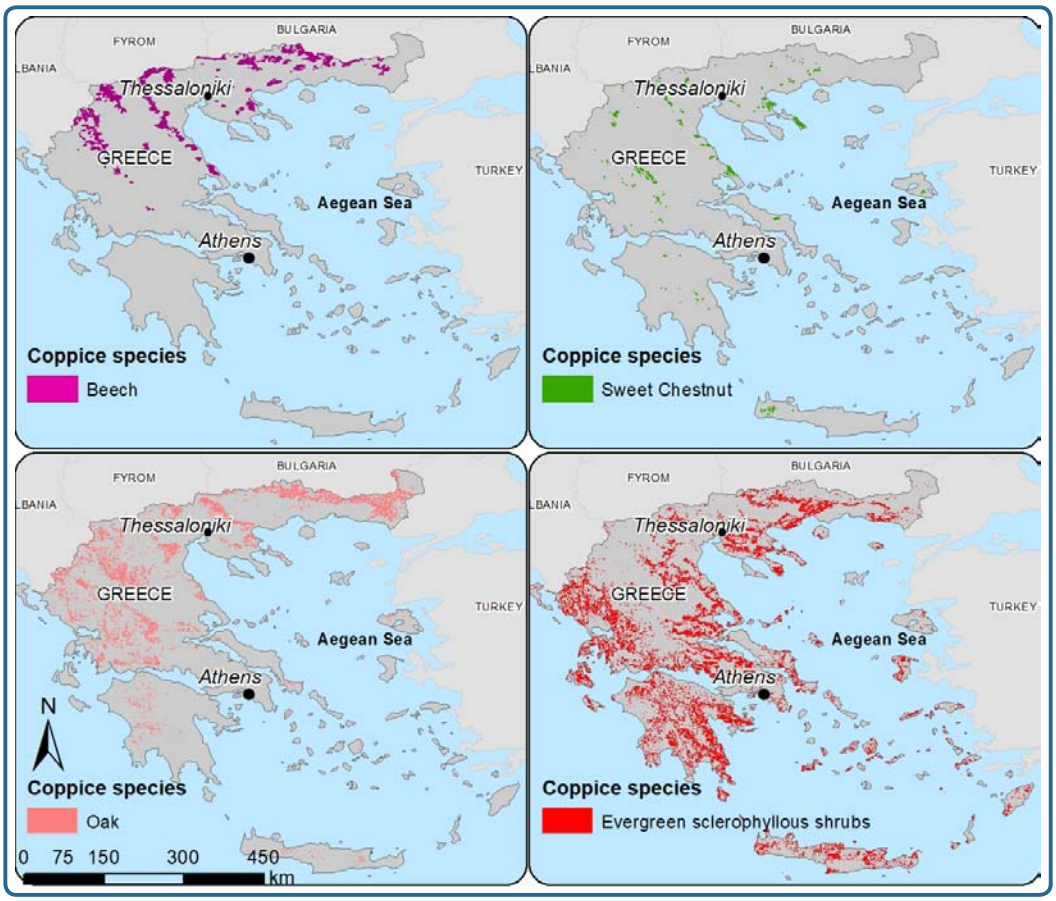
Simple coppice	Used to be applied to all broadleaved species in the past. Today almost all of the beech has been converted and much of the oak coppice forests are being converted into high forests by extending the rotation and altering the method of stand tending. All evergreen broadleaved species forests (maquis) are managed as simple coppice.
Coppice with standards	Used to be applied traditionally in oak and chestnut coppice forests but in the nineties and after the chestnut blight infestation it was prohibited to manage chestnut coppice forests with standards in order to prevent the expansion of the disease. As an alternative it was suggested to extend the rotation time or to leave standards in groups, not individual trees. Coppice with standards management is applied regularly in all oak coppice forests of the country.
Pollarding	Practised locally in rather limited cases; not practised systematically. One exception is the pollarding of white mulberry trees for feeding the silkmoth in sericulture or silk farming, but only on privately-owned mulberry plantations. Some livestock growers in rural Greece also occasionally use tree pollarding for animal fodder, but it is rather extensive and cannot be considered typical.
Short rotation coppice	Short rotation coppice is not officially applied in Greece. There is no law or other legal document for this particular management method specifically for energy purposes. One small exception of short rotation coppice concerns the basket willow (*Salix viminalis*), which was the raw material for the traditional basket making but today it is limited in very few places and the production is very small.
Other types	Coppice conversion into high forests: (1) coppice with standards can sometimes be implemented as an indirect method of conversion where a number of standard trees are retained individually or in groups at each rotation time and after several rotations the forest becomes uneven-aged and can be regenerated by seeds; (2) the extension of rotation time and stand tending by thinning is another indirect method of conversion.

Maps

Giorgos Mallinis and Gavriil Spyroglou



Overlaid map - range of the four main species that are coppiced in Greece (beech, sweet chestnut, oak and evergreen sclerophyllous shrubs)



Single maps - range of the four main species that are coppiced in Greece (beech, sweet chestnut, oak and evergreen sclerophyllous shrubs)

Data source: First National Inventory of Forests in Greece, 1992. GSF&NE, Ministry of Agriculture

Description

Gavriil Spyroglou

Coppice forests in Greece make up 65% of the forested area and 12% of the entire country (Ministry of Agriculture 1992). The main species are oaks (*Quercus* spp.) followed by chestnut (*Castanea sativa*), beech (*Fagus* spp.) and the evergreen broadleaves that make up the maquis. Other than chestnut, which can produce good quality wood in coppice rotations, the coppiced forests are characterized by very low growth rates, producing very low-value products such as firewood and charcoal. Most are grazed, either legally or illegally, and trees are still being pollarded by farmers and residents who keep a few domestic livestock animals. The aesthetic value is small because of the large clear cut areas created by this management. As a result, many of these forests are not serving their required purpose, i.e. to provide an economic use (wood production), a protective function against soil erosion and aesthetic benefits. However, the great contribution of these forests is in mitigating climate change (Chatziphilippidis and Spyroglou 2004).

Coppice silviculture is a purely man-made management system that has been implemented in Europe since Roman times, based on the re-sprouting ability of broadleaf tree species. In the past, coppice management was the "child of necessity" and an easy management solution, but today it presents numerous ecological

and environmental problems which, in the context of sustainable, multifunctional, forest management should be directly addressed by a wide program of conversion to high forest. In Mediterranean environments, coppicing remains important because, despite the exhaustive logging, uncontrolled grazing and fires, intact ecosystems have been preserved in the coppice forests. Where forests are degraded, this is not necessarily linked to coppice management and the practice can contribute to improving both habitats and biodiversity with appropriate management. Other species, such as conifers or fast growing species, can co-exist in coppices, combining trees that regenerate from seed and those sprouting from coppice stools.

Conversion of coppice into high forests represents a change in management and can be achieved in two ways (Dafis 1966; Stamou 1981). Indirectly, by extending the rotation time so it equates to that of a high forest and managing the coppice stand as if it was of seedling origin. Alternatively, it can be achieved directly by changing the species, which usually takes place on very degraded sites and is achieved by planting conifers (pines). Coppice conversion in Greece has been going on for more than 90 years, with many fluctuations. The current coppice regime is based on the

Figure 1. Typical coppice forest in Taxiarchis, Chalkidiki

views of the 1950s and earlier. It is therefore appropriate to reconsider it under the current legislative framework and to develop a new strategic plan for a modern holistic approach that will meet today's challenges.

Mediterranean ecosystems in general, and coppice forests in particular, have been used over time for resources other than woody products. Non-timber forest products such as bark, forage, soil protection, mushrooms, fruits, honey and recreation are important. A critical evaluation of the whole spectrum of uses gives the real value of coppice forests. In this context, the Mediterranean coppice forests contribute to rural development, maintaining biodiversity and its associated economic values, ecosystem functions and services and last – but not least – are of considerable cultural importance.

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Hungary

Norbert Frank

Facts and Figures

Definition

Coppice forest is a forest (woodland) regenerated by vegetative shoots (stump or roots), depending on the species.

Coppice forest = Sarjerdő

Legal Framework

Stands can be regenerated by coppice – in the absence of a different decision by the forest authority, on forests with the primary function of the soil protection, shelterbelt, the river bank protection, as well as forests with low canopy closure – in the case of alder, black locust, native poplar, as well as willow.

Black locust and native poplar can be regenerated by coppice through root shoots – with the exception of 100% state-owned forests and in the absence of the different decision of the forest authority.

The conditions of the declaration of the forest regeneration for established forest must be insured in the case of regeneration by coppice within 5 years after the obligation to regenerate the forest was formed.

Sources:

Act No. XXXVII of 2009 on forests; the protection and management of forests
Regulation 61/2017 on forests; the protection and management of forests

Description

Hungary is situated in the middle of Europe, at the central and western parts of the Carpathian Basin. Due to the characteristics of the Basin, the majority of the area of the country is flat; only one third exceeds 200 m elevation, with merely 2 % above 400 m sea-level. The extensive lower parts are characterized by small amounts of precipitation and extreme temperature changes. The naturally forest-covered areas are the western part of the Trans-Danubian region and the mountains – generally higher than 400m above sea level. Here the annual precipitation generally exceeds the 600 mm required for the maintenance of forests. In the lower regions, forests can only develop where the water level is not too high, but within reach of the tree roots, or on flood plains.

In 1920, on account of the Treaty of Trianon, the forested area fell from 7.4 million hectares to 1.2 million hectares. This radical reduction was accompanied by the fact that predominantly low productivity areas remained within the new borders. They provided fuelwood for local inhabitants – most of these forests were coppice forests.

After the Second World War, natural regeneration by coppicing was mostly from stumps with coppice shoots (alder, willow), and to a lesser degree with root suckers (black locust, native poplar).

The new forest act – Act 2009 XXXVII on the protection and management of forests – enables coppicing of alder, native poplar, willow (stumps coppice) and black locust (root suckers).

As black locust is one of the most important species in Hungary, we will briefly summarize the most important knowledge about its regeneration by coppicing.

Black locust was introduced in Hungary between 1710 and 1720. The first large black locust forests were established at the beginning of the 19th century on the Great Hungarian Plain, stabilizing the wind-blown, sandy soil. Black locust occupied 37,000 ha in 1885, 109,000 ha in 1911, 186,000 ha in 1938 and 4,000,000 ha in 2005. At present, it is the most widely planted species in Hungary, covering 24% of the country's total forest area. One-third of these stands are high forests and two-thirds are of coppice origin. In the 1960s, Hungary had more black locust forests than the rest of Europe put together. Black locust afforestation and artificial regeneration may utilize seedlings. The average per hectare volume in all black locust forests is 125 m^3 ha^{-1}, the average volume at harvest is 190 m^3 ha^{-1} and the average harvest age is 31 years. Black locust forests in Hungary have been established on a range of sites; however, only sites with an adequate moisture supply, well-aerated and loose-structured soil that is rich in nutrients and humus can produce good quality timber. Black locust stands are often regenerated by coppice (from root suckers). In young stands of coppice origin, a cleaning operation should be carried out to adjust spacing when the stands are 3-6 years old and should reduce stocking to less than 5000 stems ha^{-1}.

Figure 1. Hornbeam (*Carpinus betulus*) middle aged forest of coppice origin

Black locust are not only regenerated naturally from root suckers, but also artificially, i.e., with seedlings. The latter is also used for the establishment of new black locust plantations (stands). There are some favorable plant characteristics of black locust which make both regeneration methods possible. For seedlings, growing seeds are produced in a wide range of conditions, germinate rapidly, and preserve their germination capacity for a long time. Black locust cannot be regenerated easily by seed in a natural way due to its very hard seed-coat. On the other hand, the root system is very plastic, its vegetative growth from fragments is intensive and it is difficult to uproot (Führer and Rédei, 2003).

Table 1. Comprehensive facts on forests in Hungary

Registered forest management area	1,000 ha	2,060.8
Area of forest sub-compartments	1,000 ha	1,940.7
Forest share based on forest management area	%	22.2
Growing stock	million m^3	378.5
Gross annual increment	million m^3 yr^{-1}	13.0
Total felling	million m^3	7.4
Final cuts	million m^3	5.0
Regeneration per year	1,000 ha	17.0
Afforestation per year	1,000 ha	0.3

Table 2. Coppice in Hungary by ownership (in ha)

State ownership	root coppice	102,775.63
	stump coppice	184,988.49
Public ownership	root coppice	3,056.65
	stump coppice	2,917.50
Private ownership	root coppice	165,609.18
	stump coppice	112,835.70
Mixed ownership	root coppice	5,229.82
	stump coppice	4,006.69

When attempting semi-natural or man-made afforestation, or reforestation with black locust, the following basic technologies and operation groups are applied:

- Black locust afforestation *with deep loosening*: soil preparation (without trenching) by deep loosening of soil, planting by planting-machine or a tractor-drawn pit-drilling machine, manual soil cultivation in the rows, in inter-rows by machine.
- Black locust afforestation *with trenching or deep ploughing*: planting by planting machine or a tractor-drawn pit-drilling machine, manual soil cultivation in the rows, in the inter-rows by machine.
- *Semi-natural reforestation by root-suckers*: slash removal from the cut-area, bush-cutting, root-ripping, knocking down of coppice shoots, singling of clumps of shoots.
- *Man-made reforestation* of black locust stand *by deep loosening*: slash removal, bush cutting, chemical treatment against sprouting, deep loosening, planting by machine or tractor drawn pit-borer, knocking down of coppice shoots, manual soil cultivation in the row and mechanized in the inter-row.
- *Man-made reforestation* of black locust stands *by complete soil preparation*: slash removal, bush cutting, stump removal (stump-lifting, removal and terrain leveling), trenching, planting by machine or tractor-mounted pit-borer, manual soil cultivation in the rows and mechanized in the inter-row.

The best time for planting is in the spring. The most popular spacing for planting is 2.4 m between rows and 0.8-1.0 m within rows (4,000-5,000 seedlings ha^{-1}). Age of planting stock: 1 year, of seedbed quality. Planting may be by machine into a slit, in a pit manually prepared, or by tractor-mounted borer. Coppicing by root ripping provides abundant root suckers due to the root wounds. This operation is made with a winged deep-loosening machine working at a depth of 35-40 cm.

Criteria for successful afforestation: at least 3,500 viable plants ha^{-1} when planting with seedlings; in young coppiced stands at least 5,000 suckers ha^{-1}, which must be at least 3 m in height and consist of non-forked healthy trees, regularly distributed (Führer and Rédei, 2003).

Figure 2. Black locust (*Robinia pseudoacacia*) mixed stand (coppice and high forest)

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Ireland

Ian Short

Facts and Figures

Definitions

> "Coppice" means a forest crop raised from shoots produced from the cut stumps of the previous crop.
> Forestry Act 2014

Legal Framework

Forestry Act 2014 (http://www.irishstatutebook.ie/eli/2014/act/31/enacted/en/pdf)

The felling of trees in Ireland is regulated under the Forestry Act 2014. Most trees that are felled require a Felling License. There are some exemptions. Short rotation coppice of willow or poplar species and maintained solely for fuel is exempt.

The felling of coppice requires a felling license unless it is on an agricultural holding, is being removed for use on that holding, and that the total volume felled does not exceed 15 cubic meters in any period of 12 months.

Rotation Period

There is very little coppicing done in Ireland. Therefore there are no standard rotation periods. Short rotation coppice of willow or poplar species (predominantly willow) is on a 2 or 3 year rotation.

Typology

Simple coppice	Very little in Ireland; some for conservation/habitat and a little for craft
Coppice with standards	Not practised
Pollarding	Only in gardens, roadsides and urban streets
Short rotation coppice	Willow for biomass

Description

This report is regarding coppicing in Ireland and excludes short-rotation coppice of willow (*Salix* spp.) for biomass.

It is unclear whether coppicing and coppice-with-standards were historically important in Ireland. All the known ironmasters in Ireland were Englishmen and were likely familiar with coppicing, which was practised to ensure a continuous supply of the best charcoal (Neeson, 1991), derived from twenty-five-year-old oak coppice. McCracken (1971) argues that, except in Wicklow County, no such management was carried out in Ireland and that, if it had, the woods could have been preserved. This resulted in ironworks moving from place to place as local fuel supplies became exhausted. However,

Rackham (2010) posits that coppice woods could have been present in a large scale at one time because Viking buildings in Dublin were made extensively of wattle and daub. House walls, wooden pathways and property fences would all have been made of woven hurdle panels and would have required vast quantities of long, straight hazel (*Corylus avellana* L.), willow (*Salix* spp.) and ash (*Fraxinus excelsior* L.) rods or underwood (O'Sullivan, 1994). The Civil Survey (1654-6) records "underwood" and "copps" (Tomlinson, 1997), indicating that some form of coppice management was being carried out. The earliest record of coppice management (i.e. rotational felling of underwood in fenced woods) from the Watson-Wentworth estate in County Wicklow was 1698 (Jones, 1986). Young (1780) also mentions coppicing in the accounts of his travels around Ireland in the 18th century, some with forty-year rotations. The coppice-with-standards system was also being employed on some Kilkenny estates early in the 19th century (Tighe, 1802), though this appeared to have decreased in popularity, with some former coppices having been abandoned or neglected by this stage. A survey of County Wicklow woodlands in 1903 demonstrated that the system was still popular there, with almost 60% still being managed as coppice-with-standards (Nisbet, 1904). Attentive landlords would fence copses to protect the regrowth from grazing animals. One of the first laws enacted on forest management was in the 16th century, which required enclosure for four years following coppicing (Bosbeer et al., 2008).

Figure 1. Rehabilitative silviculture coppicing pilot study in pole-stage sycamore (*Acer pseudoplatanus*). The coppice is in its fifth growing season and was initiated when the trees were 15 years old.

Today there is little coppicing being practised in Ireland. Anecdotally there are a few owners that have small areas of coppice for household fuelwood production or for producing raw material for crafts and minor products. Some coppicing is also being practised with biodiversity and conservation objectives in mind. In a survey of native woodlands conducted during the period 2003 - 2008, 18 % of the sites surveyed had mature coppice whilst only 1% had recently cut coppice (Cross, 2012). Coppicing is not recorded by the National Forest Inventory (Government of Ireland, 2013).

Coppicing is being investigated by the B-SilvRD project (Broadleaf Silviculture Research and Development project, www.teagasc.ie/forestry/research/B-SilvRD/) as a means to bring poorly-performing pole-stage broadleaf stands into productive use. Coppice-with-standards may also have renewed potential in the current economic climate with high oil prices and increasing demand for fuelwood (Short and Hawe, 2012).

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Forestry Regulations

The **Forestry Act 2014**, administered by the Forest Service (Department of Agriculture, Food and the Marine), outlines the legislative requirements for tree felling in Ireland. The provisions of the Act and the regulations (SI No 191 of 2017) came into force from 24th May 2017. A **felling licence** granted by the Minister for Agriculture, Food and the Marine provides authority under the Forestry Act 2014 to fell or otherwise remove a tree or trees and to thin a forest for management reasons. The Forestry Act 2014 provides for a single licence process for tree felling. Felling licences can be valid for up to 10 years in duration, which may be extended for one or more further periods, up to a total of 5 years.

However, trees outside of the forest can be felled without a tree felling licence in certain circumstances.

For example, **a felling licence is not required for**:

- A tree in an urban area
- A tree within 30 metres of a building (other than a wall or temporary structure), but excluding any building built after the trees were planted.
- A tree less than 5 years of age that came about through natural regeneration and removed from a field as part of the normal maintenance of agricultural land (but not where the tree is standing in a hedgerow).
- A tree of the willow or poplar species planted and maintained solely for fuel under a short rotation coppice.
- Tree outside a forest — within 10 metres of a public road and which, in the opinion of the owner (being an opinion formed on reasonable grounds), is dangerous to

persons using the public road on account of its age or condition.

- Tree outside a forest — on an agricultural holding and removed by the owner for use on that holding, provided —

  — it does not form part of a decorative avenue or ring of trees,

  — its volume does not exceed 3 cubic metres, and

  — the removal of it, by the owner for the foregoing purpose, when taken together with the removal of other such trees by the owner for that purpose, would not result in the total volume of trees, on that holding and removed by the owner for that purpose, exceeding 15 cubic metres in any period of 12 months.

  Note: Under sub-section 2 of Section 19 this exemption does not apply in certain cases.

- Tree outside a forest — of the hawthorn or blackthorn species.
- Tree outside a forest — in a hedgerow and felled for the purposes of its trimming, provided that the tree does not exceed 20 centimetres in diameter when measured 1.3 metres from the ground.

Penalties for illegal felling can be severe, on summary conviction ranging from fines of up to a maximum of €200 per tree (total penalty not to exceed €5,000) and/or imprisonment for up to 6 months to, on conviction on indictment, a fine up to €1,000,000 and/or imprisonment for up to 5 years.

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Israel

Orna Reisman-Berman

Description

Israel is characterized by a steep precipitation gradient from North, 1200 mm rainfall, to South, less than 60 mm rainfall, along only 600 km. It is an intersect of three main climatic and three phyto-geographic zones, i.e. the Mediterranean, the Saharo-Arabian and the Irano-Turanic provinces. The vegetation changes dramatically from North to South; from a typical Mediterranean chaparral and some forest patches in the Mediterranean zone, through a shrubland in the semi-arid zone (which is the transition between the Mediterranean and the arid zone), and a very sparse steppe type shrubland in the desert. In the extreme desert, vegetation is distributed only in the dry riverbeds that flood one to several times in winter – only in rainy winters.

Those climatic conditions are not suitable for traditional coppice. Indeed, traditionally there was no coppice in this zone. However, some main traditional practices are small scale coppice. Several examples are:

The species *Ficus sycomorus* was first brought to Israel by man during the dawn of history, 6,500 years ago, perhaps even 10,000 years ago. It re-sprouts and the trunk elongates and thickens very quickly. The wood was used for construction (mainly roofs) and for heating. In ancient Egypt the wood was also used for coffins. In Israel, doors of an ancient synagogue were found that were made from *Ficus sycomorus* wood. About a tenth of all wood pieces that were found at Masada from the Roman period were made of *Ficus sycomorus* wood. Its widespread use led to re-sprouting and its management as coppice. The species is found in the coastal plans, on sand dunes above aquifers.

Similarly, *Tamarix* spp. is a native species that was used and probably planted, cut and re-cut since ancient times. Remains of *Tamarix* were found in archeological excavations as building material and firewood beginning from the Upper Paleolithic Period, 25,000 years ago, until today. The Romans used the timber of this species in the construction of a giant siege tower with a battering ram, built for their assault on the fortification of Masada in 73 CE.

A third example is the *Faidherbia albida*, originating in the sub-tropical savannas, but found in Israel in fragmented distributions along the southern shore and ephemeral rivers. Its introduction by man in ancient times and its growing in vicinity of agricultural fields cannot be ruled out. In Israel, the species propagates only by clonal means and re-sprouting is vigorous, which makes the species an excellent coppice.

In general, resprouting characterizes all woody species in the Mediterranean zone of Israel – except for *Pinus halepensis*. This trait allowed traditional practices such as small scale clear-cutting, grazing and the use of fire to encourage herbaceous species growth. Small scale clear

Figure 1. Resprouting that allowed the production of beams; *Quercus ithaburensis* (Photo: Orna Reisman-Berman)

cutting was in a sense similar to traditional coppicing – where clear-cut is selective and is conducted locally. At the time of the Ottoman Empire, a massive clear-cut of oak forests was conducted, mainly the forests of *Quercus itaburensis*.

In the modern era, starting around 1950, traditional practices such as small scale clear-cutting were excluded, whereas the chaparral expanded, becoming a dense thicket.

A large scale experiment was conducted along the gradient in Long-Term Ecological Research (LTER) stations on the effect of clear-cutting on ecosystem biodiversity. The results demonstrated that patchiness of herbaceous and woody species is of importance, and that both small scale clearcutting and grazing help to maintain the ecosystem biodiversity. This implies that the small scale clear-cutting, a form of coppicing, should be integrated in this ecosystem.

As of today it has became clear that traditional practices have a role in shaping an open vegetation form that allows the growth of herbaceous species, increasing the biodiversity and productivity of those systems. This can mean that re-introducing small scale clear-cutting or a form of coppicing can be an appropriate management tool to the Mediterranean chaparral ecosystem in Israel.

There were some trails of true coppicing in Israel with alien species. In the 60s very few plantations of *Populus nigra* were planted for the production of matches. However, in spite of the extensive irrigation and fertilization that the saplings received in agricultural soil, they did not yield even one quarter of the expected production. At the beginning of the 21st century, there was a nationwide trail of introducing the *Paulownia* as a logging-coppicing tree species. The *Paulownia* was considered attractive due to its high resistance to drought and its modest living requirements. However, the trial failed and did not reach an industrial capacity.

Figure 2. Resprouting that allowed the production of beams; *Ficus sycomorus* (Photo: Neot Kdumin archive)

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Italy

Paola Mairota, Francesco Neri, Davide Travaglini, Rodolfo Picchio,
Pier Giorgio Terzuolo, Pietro Piussi and Enrico Marchi

Facts and Figures

Enrico Marchi and Davide Travaglini

Definitions

General definitions

(1) Simple coppice without standards ("simple coppice" hereafter): At each rotation (approx. 8-10 years), all shoots are removed by clear cut. This kind of coppice system is in general permitted for certain species (e.g. black locust, poplar, willow, common hazel) depending on local (regional) forest law. Short rotation coppice theoretically fall under this definition, even though these are no longer considered (Ordinance (D.lgs.) n. 34/2018) under forestry.

(2) Simple coppice with strandards ("coppice with standards" hereafter): When coppice is felled a minimum number of standards per hectare is left depending on local forest law (e.g. 60 standards/ha in case of oak and beech coppice; 30 standards/ha in case of chestnut coppice).

(3) Uneven-aged coppice: coppice with shoots of different ages on the same stump (usually three age classes). Based on coppice selection system; the oldest (i.e. the biggest) shoots are cut every 6-8 years and a light thinning of the smaller shoots is also done.

(4) Compound coppice: forest managed with the aim to obtain a stand formed by a coppice and a high forest. It is characterised by the coexistence on the same area of a coppice, managed with clear cut, and a high forest managed with a selection system and therefore formed by trees of different age classes, that is approximately 2, 3 and 4 times (rarely more) the coppice rotation age.

(5) Mixed management system: This category brings together very heterogeneous and widespread situations, originating from the historic compound coppice system (more precisely called as a high forest above coppice or coppice below high forest, according to the prevailing layer, or by silvicultural interventions varied over time). Mixed management stands are those stands made up of shoots (of vegetative origin) and a variable number of standards (of generative origin), generally of species different from those of the coppice. The latter, which are "older" than the shoots and are distributed in at least 2 diameter classes, must provide for 25% of the crown cover. Below this threshold the stand is classified as simple coppice with standards. If the standards cover exceeds 75%, the stand is then classified as high forest. Operationally, 40% standards' cover is pursued. In addition, if standards belong to just one diameter class or their number per hectare is less than 30, the stands has to be considered as a simple coppice with standards. On the contrary if standards' density is above 300 n/ha, the stand has to be considered as a coppice undergoing conversion to high forest. Finally, also those stands where standards consist of native conifer species are assimilated to mixed management system.

(1) Ceduo semplice senza matricine: Ad ogni rotazione (circa 8-10 anni) tutti i polloni sono rimossi con un taglio raso. Questo tipo di ceduo è consentito solo per alcune specie (a esempio, robinia, pioppo, salice, nocciolo) a seconda dei regolamenti forestali regionali". In questa definizione sono teoricamente compresi i cedui a turno breve (SRC), che il D.lgs. n. 34/2018) non considera una forma di selvicoltura.

(2) Ceduo semplice matricinato: Ad ogni rotazione il ceduo è tagliato a raso lasciando un numero minimo di matricine per ettaro a seconda dei regolamenti forestali regionali (a esempio, 60 matricine per cedui di quercia e faggio, 30 matricine per cedui di castagno).

(3) Ceduo a sterzo: cedui con polloni di età diversa sulla stessa ceppaia (solitamente di tre classi di età). Si basa sul sistema di selezione dei polloni, vale a dire che ogni 6-8 anni i polloni più grandi e di maggiore età vengono tagliati con un contemporaneo leggero diradamento dei polloni più piccoli.

(4) Ceduo composto: Il ceduo composto è una forma di governo rivolta a creare o a gestire soprassuoli formati da un ceduo ed una fustaia, in cui le due componenti si combinano sullo stesso tratto di terreno boscato. La componente a fustaia di solito è formata da matricine di età pari a 2, 3 e 4 volte (raramente di di più) la durata del turno del ceduo.

(5) Governo misto: questa categoria raggruppa situazioni assai eterogenee e diffuse, originate dallo storico governo a ceduo composto, più precisamente denominato come fustaia sopra ceduo o ceduo sotto fustaia, a seconda dello strato prevalente, o da interventi selvicolturali variati nel tempo. Si definiscono boschi a governo misto i soprassuoli costituiti da polloni (rinnovazione di origine agamica) e da un numero variabile di riserve (di origine gamica), generalmente di specie diverse da quelle del ceduo, in cui la copertura dei soggetti affrancati, di età (in pratica diametro) superiore a quella del ceduo e appartenenti ad almeno 2 classi di diametro, è compresa tra il 25% (al di sotto si ricade nel ceduo semplice matricinato) e il 75% (al di sopra si ricade nella fustaia) del totale. Nella pratica si consiglia il 40% di copertura dei soggetti affrancati. Se la classe di diametro delle riserve è una sola o se queste sono presenti in numero inferiore a 30 per ettaro di superficie, il soprassuolo viene considerato a ceduo semplice matricinato; se le riserve sono più di 300 per ettaro, si ricade nella forma del ceduo in conversione. I boschi cedui con presenza di conifere di specie autoctone sono assimilati ai boschi a governo misto.

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Definitions according to the 2nd Italian National Forest Inventory (2005)

(1) Coppice (simple coppice or coppice without standards): forest stand completely composed of shoots, or dominated by shoots, as opposed to trees originating by seed (less than 20 standards per ha).

(1) Ceduo (senza matricine): soprassuolo totalmente edificato da polloni o prevalenza di questi ultimi rispetto ai soggetti arborei di origine gamica (meno di 20 matricine/ettaro).

(2) Coppice with standards: forest stand composed of shoots and standards (the latter between 20 and 120 per ha; the age of the standards is equal to 1 or 2 times the coppice rotation age).

(2) Ceduo matricinato: soprassuolo costituito da polloni e matricine (queste in numero compreso tra 20 e 120 ad ettaro, ed età pari a 1 o 2 volte il turno).

(3) Compound coppice: forest stands composed of shoots and standards (the latter > 120 per ha; the age of the standards is not uniform, and can be greater than 3 times the coppice rotation age).

(3) Ceduo composto: soprassuolo costituito da polloni e matricine (queste in numero superiore a 120 ad ettaro e di diverse classi di età, anche superiore a 3 volte il turno.

(4) Coppice in conversion to high forest (in Italian forestry literature and jargon is called "transitory high forest"): forest stand completely composed of shoots, or dominated by shoots, as opposed to trees originating by seed; the signs of thinnings carried out to prepare the stand to regenerate from seeds are clearly evident).

(4) Fustaia transitoria: soprassuolo totalmente edificato da polloni o prevalenza di questi ultimi rispetto ai soggetti arborei di origine gamica; riconoscibili segni evidenti di taglio di conversione.

...where coppice is further divided into:

(1) Young coppice: the age of shoots is less than half of the customary coppice rotation age.

(1) Ceduo giovane: con riferimento al turno consuetudinario praticato localmente o in aree limitrofe ai cedui semplici o matricinati di quel tipo forestale, fase in cui l'età dei polloni non supera la metà del turno.

(2) Adult coppice: the age of shoots is close to the customary coppice rotation age.

(2) Ceduo adulto: fase in cui l'età dei polloni è prossima al turno.

(3) Old coppice: the age of shoots is clearly greater than the customary coppice rotation age.

(3) Ceduo invecchiato: l'età dei polloni è chiaramente superiore a quella del turno consuetudinario.

(4) Coppice in the regeneration phase: forest stand after the final cut; the cut was carried out in the current year or the year before; the shoots reach the height of 1.3 m.

(4) Ceduo in rinnovazione: stadio immediatamente successivo ad un intervento di taglio eseguito nell'anno in corso o in quello precedente; i ricacci, se presenti, raggiungono 1,3 m di altezza.

(5) Uneven-aged coppices: presence of shoots of different stem sizes (age) on the same stump.

(5) Ceduo a sterzo: compresenza di polloni di dimensioni (età) differenziate sulla stessa ceppaia.

Gasparini P., Di Cosmo L., Floris A., Notarangelo G., Rizzo M., 2016 – Guida per i rilievi in campo. *INFC2015 – Terzo inventario forestale nazionale*. Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria, Unità di Ricerca per il Monitoraggio e la Pianificazione Forestale (CREA-MPF); Corpo Forestale dello Stato, Ministero per le Politiche Agricole, Alimentari e Forestali. 341 pp. https://www.inventarioforestale.org/it/node/72. Last accessed on June 4th, 2018.

Legal Framework

There are several definitions of Forest, depending on local (regional) forest law. For instance:

- The National Forest Inventory has adopted the FAO-FRA definition of forest: Land spanning more than 0.5 ha with trees higher than 5 m and a canopy cover of more than 10%, or trees able to reach these thresholds in situ.
- In Italy (D.lgs. 34/2018) forest is defined as: land spanning more than 0.2 ha with a tree canopy cover of more than 20%.

Restrictions for coppice forests are mainly based on: size of cutting area; rotation period; number of standards. These restrictions can vary in the different administrative regions, depending on local forest regulations. For instance, in the Tuscany region the following restrictions are provided:

- maximum cutting area = 20 ha;
- minimum rotation period: 8 years for chestnut, black locust, poplar, willow, alder, common hazel; 24 years for beech; 18 years for oak and other species;
- maximum rotation period: coppice forests older than 50 years must be converted to high forest;
- number of standards: in the case of coppice with standards, a minimum of 60 standards/ha must be left in the forest (a minimum of 30 standards can be left in case of chestnut forest); in the case of compound coppice, a minimum of 150 standards/ha must be left in the forest, with at least 75 standards older than twice the rotation period.

Although there are differences among the 21 administrative regions/autonomous provinces, simple coppice (coppice without standards) can only be applied to certain species, such as *Salix* spp., *Robinia pseudoacacia* (L.), *Populus* spp., *Alnus* spp., *Corylus avellana* and *Castanea sativa*. In addition, some restrictions refer to the size of the maximum cutting area, which is usually equal to 20 ha, as in the Tuscany region.

Rotation Period

The rotation period varies depending on forest species and administrative region. However, the most common minimum rotation periods are the same as in Tuscany (see above). In most regions, when the coppice is not cut for 40 years it takes the legal status of high forest.

Typology

Simple coppice	Traditional natural forest regeneration method
Coppice with standards	*Fagus sylvatica, Quercus petraea, Q. pubescens, Q. robur, Q. cerris, Q. frainetto, Q. trojana, Q. ithaburensis* subsp. *Macrolepis, Castanea sativa, Ostrya, Carpinus, Q. ilex, Q. suber*, Hygrophilous forest, other (evergreen-) deciduous forest
Pollarding	No longer used
Short rotation coppice	*Populus* spp., *Salix* spp., *Robinia pseudoacacia*, *Eucalyptus* spp., *Alnus glutinosa, Platanus, Ulmus* spp., *Castanea sativa*
Other types	Compound coppice; Coppice in conversion to high forest (esp. *Fagus sylvatica*); Uneven-aged coppice (limited to *F. sylvatica* and *Q. ilex*)

Images

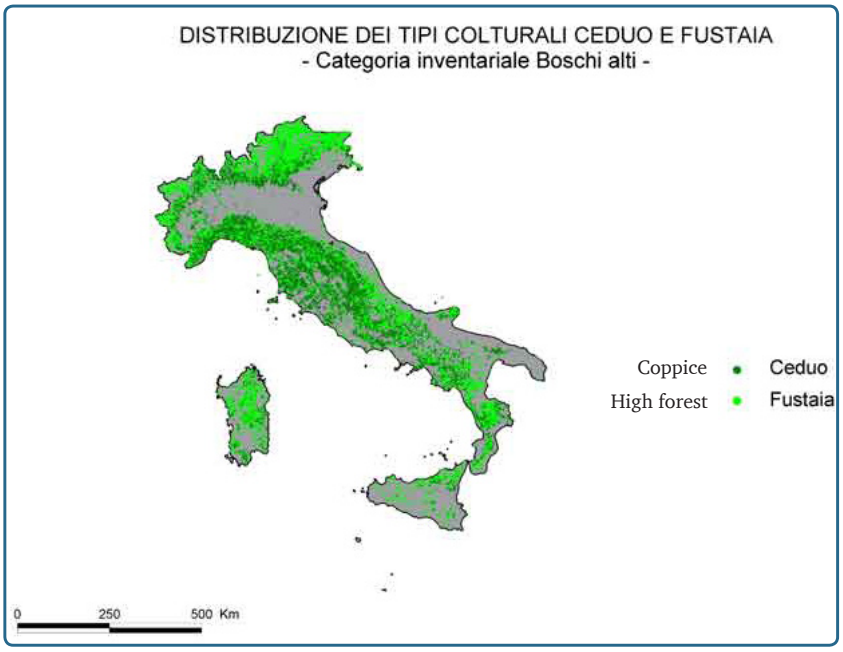
Uneven aged coppice; beech (both of above)

Coppice with standards: chestnut (upper left), downy oak (upper right), holm oak (lower left), turkey oak (lower right)

Mixed management systems

Coppice conversion to high forest; beech (left), oak (right)

Map



Map of coppice in Italy (dark green). Source: INFC (2005)

Reference

INFC (2005) Ministero delle Politiche Agricole Alimentari e Forestali - Corpo Forestale dello Stato Consiglio per la Ricerca e la Sperimentazione in Agricoltura (CRA-MPF) http://www.sian.it/inventarioforestale/img/cartogrammi/ceduo_fustaia.jpg

Description

Paola Mairota, Rodolfo Picchio, Francesco Neri, Pier Giorgio Terzuolo and Pietro Piussi

Coppice management is the most common silvicultural system in Italy. Within the approximately 8,500,000 ha of Italian forests, the forest land classified as coppice currently includes almost 35% of the national forest cover (approximately 3,666,310 ha) (INFC 2007), yet its distribution varies between administrative units (INFC 2007). This amount has been almost stable since the 1960s (La Marca & Bernetti 2011). Some stands, still regularly coppiced, have been managed this way for several centuries (Piussi 1979, Amorini & Fabbio 2009, Piussi & Redon 2001). However, some stands are relatively recent, such as those (a) derived from oak high forests exploited during the second half of the XIXth century to provide railroad sleepers, (b) resulting from salvage operations in sweet chestnut orchards destroyed by chestnut blight (*Cryphonectria parasitica* [Murr.] Barr.) in the 1940s and 1950s, and (c) derived from woodlands spontaneously or purposely established on abandoned farmland for fuelwood production during recent decades (Del Favero 2000).

The most important species traditionally managed as coppice are deciduous oaks (*Quercus* spp., 33%), European hop hornbeam (*Ostrya carpinifolia* Scop., 17%), beech (*Fagus sylvatica* L., 13%), sweet chestnut (*Castanea sativa* Miller, 16%), which are usually grown as pure stands, and the evergreen holly oak (*Quercus ilex* L., 10%), which frequently grows in mixed stands. As with most (63.5%) of the forest cover in Italy, coppice woodlands are mainly under private ownership. Nowadays, this silvicultural category is based on stools. Among the coded coppice silvicultural systems (i.e., simple coppice, coppice with standards – Matthews 1989, Nyland 2002, and compound coppice – Nyland 2002), coppice with standards is typically applied (76% of coppice woodlands - INFC 2007), while simple and compound coppices account for 24% and 16%, respectively. Other forms of coppice, e.g. shredded trees and pollards, can be currently found only as relicts and/or in agricultural landscapes.

Italian coppices account for approximately 19% of coppice in the EU28, which in turn represents 83% and 52% of coppice in Europe and at a global level, respectively (UN-ECE/FAO 2000).

Negative environmental impacts of coppice are mainly due to how this system was implemented in the past social, technical and economic context. Historically, coppice represents an important source of firewood and, until some 50 years ago, management criteria were based on short rotations (8-12 years), removal of all biomass, including deadwood and litter, and the occasional introduction of agricultural crops following coppice harvesting and grazing (Piussi et al. 2006). Nutrient losses were quite high and erosion was unavoidable, often resulting in forest degradation. These adverse effects are not necessarily the result of coppicing as such, but mainly of poor management practices, including grazing, litter collection and tillage for food crops during the 2-3 years after final harvesting, dictated by need and various physiographic, economic and social constraints (Fabbio 2010). Over time, regulations have been issued to limit activities and disturbances, without which the benefits derived from the coppice system hindered what has been conceived of, and empirically demonstrated through the centuries, as a sustainable wood production system (Mairota et al. 2016a). This more conservative use of coppice woodlands is considered effective in reducing impacts on ecosystem characteristics

and processes such as the water cycle, humus loss and nutrient removal (Piussi & Alberti 2015), particularly when carried out within the limits of the optimal ecological conditions of the dominant tree species (Del Favero 2000) and coupled with planning and implementation of appropriate harvesting systems and sustainable mechanisation levels (Pentek et al. 2008; Marchi et al. 2016; Venanzi et al. 2016). In both coppice and coppice thinned during conversion to high forests, the main harvesting methods for wood extraction (Cut-To-Length, C.T.L. or Tree-Length-System, T.L.S.) use tractors with winches (winching and skidding), tractors and trailers or tractors with bins (Picchio et al. 2009, Laschi et al. 2016). Mules and chutes are used in particular contexts (e.g. protected areas, steep terrain). Firewood bundling machines are considered in flat areas to improve safety during loading operations onto trucks before transportation. The main wood products from coppice are: firewood and poles, as well as in some cases sawlogs (chestnut and black locust) and woodchips (also produced from logging residues).

However, a negative attitude (mainly on the part of academics, controlling authorities and conservationists) towards coppice still persists both in the criteria applied to current coppices and in the recommendations for protected area management (Mairota et al. 2016b), as well as in guidelines for the monitoring of Natura 2000 habitats and species (cf. Angelini et al. 2016). Criteria for current coppice includes a higher density of standards than was traditionally used, which has crept into regulations at different administrative levels without precise scientific support (cf. Zanzi Sulli 1995, Fiorucci 2009, Mairota et al. 2016a). Their implementation has resulted in the transformation of many original Italian coppice with standards into stands with a high density of overstood coppice and declining populations of stools (Becchetti & Giovannini 1998, Del Favero 2000, Piussi 2007).

Other management options frequently applied to coppice woodlands, particularly in marginal or protected areas, are non-intervention and conversion to high forest.

The abandonment of coppice silviculture, however, is likely to hamper the ecological functionality of woodlands, dampen tree species diversity at the patch level in mixed woodlands and in beech woodlands (Garadnai et al. 2010) (Figure 1), disrupt hydrological regimes and increase wildfire risks at the landscape level (Conedera et al. 2010, Piussi & Puglisi 2013). For most species, it is also likely to thwart the eventual reinstatement of the coppice silvicultural system as shading depresses the vigour of stools (e.g. oaks – Bianchi & Giovannini 2006, beech – Terzuolo et al. 2012). Yet, the demise of silvicultural interventions may be a necessary choice for sites of low fertility in economically marginal areas or stands degraded by fire, grazing or other disturbances.

In a similar way, the conversion from coppice to high forest is not always feasible, but rather contingent on species composition and site fertility, and might pose future regeneration problems. It may also cause biotic homogenization at the stand level (Van Calster et al.

Figure 1. Over-aged beech coppice in Pollino national Park, Southern Italy (Photos: P. Mairota)

2007). Conversion to high forest is often a long-term process requiring relatively intensive interventions and may not always be economically sustainable for the owner (Motta et al. 2015). Yet, conversion to high forest, where the ecological, technical (e.g. gentle terrains and accessibility) and socio-economic conditions allow, might trigger functional and structural complexity. It would also add value to timber products in certain forest types (e.g. sweet chestnut coppice), which are currently not fully exploited.

A range of modern approaches to coppice silviculture have been tested in Italy for more than a decade within the framework of several EU- and nationally/regionally-funded pilot projects (e.g. CHESUD, TraSFoRM, SUMMACOP, RECOFORME, ForClimadapt, SELVARBO and PProSpoT, Motta et al. 2015). Most of these approaches are related to the modes of standard selection (Mairota et al. 2016a), with reference to the number of trees selected as standards, the density and the spatial arrangement as well as the age/size distribution of standards within the stand, guided by informed silvicultural choices (Bastien & Wilhelm 2000, Sansone et al. 2012, Manetti et al. 2014, Motta et al. 2015, Manetti et al. 2016). All of these approaches, capable of enhancing stand stability, soil protection and biodiversity, can be combined at the landscape level, thus introducing a wider space-time perspective into this silvicultural system and ultimately contributing to the improvement of the rural economy while reducing the ecological costs of timber importation (Manetti et al. 2006).

Although coppicing promotes simplified compositions and structures, and vegetative propagation causes a 'genetic stagnation' in the tree component of the stands (Piussi 2006), a number of studies now indicate that active coppice management can improve forest biodiversity at both local and landscape levels and that it does not negatively affect decomposition rate and the transport of nutrients (Holscher et al. 2001, Bruckman et al. 2011).

In addition, woodlands managed as coppice over the centuries show a high level of resilience (Piussi & Redon 2001, Mei 2015), owing to the capacity of the stumps of various species (particularly oaks and sweet chestnut) to expand radially, forming new stumps from shoots that develop an independent root system (cf. Piussi & Alberti 2015, Vrska et al. 2016). This should not be overlooked when compared to the uncertainties in the response of reproductive regeneration of tree species comprising current stands under changing climate conditions and the forecasted increase of disturbances (e.g. wild fires, heat or frost waves, grazing by sheep, goats and wildlife, pest outbreaks), suggesting that coppice silviculture should be reconsidered (cf. Zanzi Sulli, 1995) within the framework of balanced forest management strategies.

Such strategies should combine traditional (e.g. coppice selection system in beech forests, Coppini & Hermanin 2007) modern approaches to coppice, conversion to high forest and non-intervention, as most appropriate to specific forest habitats and site conditions at the stand/landscape level and be based on appropriate exploitation criteria. In such a way, they would most likely revitalise local economies and cultural landscapes, while being compliant with the Framework Program for the Forestry Sector – Horizon 2020, the EU 995/2010 Timber Regulation and the Habitats Directive.

Moreover, as standard trees in coppice woodlands can nowadays provide new services related to biodiversity maintenance and aesthetics, the mode of standard selection still represents a distinctive (indeed crucial and challenging) issue for coppice silviculture in Italy. This not only refers to the number of trees selected as standards, but also concerns the density and the spatial arrangement, as well as the age/

size distribution of standards within the stand, which should be guided by informed silvicultural choices. Particularly the ecological and hydrological effects of the spatial arrangement of standards within the stand (i.e. uniform vs group distribution; both envisaged in the technical prescriptions of the majority of regions, i.e. the Prescrizioni di Massima e Polizia Forestale, Annex on Legislation framework) deserves further investigation, even if it has been considered in European forestry literature (e.g. Perona 1891, Huffel 1927, Perrin 1954, Cantiani et al. 2006, Fiorucci 2009, Piussi & Alberti 2015).

Finally, the great heterogeneity of prescriptions across species and forest types in Italy (see Annex on Legislation framework), in some cases further exacerbated by prescriptions for coppicing in Natura 2000 sites, has led to a great variety of woodland structural types, most of which do not correspond to any of the coded coppice silvicultural systems (i.e. simple coppice and coppice with standards – Matthews 1989, Nyland 2002, compound coppice – Nyland 2002) nor to high forest. This calls for an effort coordinated at the national level to define ecologically and socially sound (a) criteria to reduce discrepancies and (b) principles to harmonise prescriptions concerning the same habitat types of the Habitats Directive in Natura 2000 sites in different (often neighbouring) regions.

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Forestry Regulations

Paola Mairota, Rodolfo Picchio, Francesco Neri, Pier Giorgio Terzuolo and Pietro Piussi

In Italy, from the 1970s onwards (Law n. 382 of 1975 and subsequent modifications), responsibilities for forest regulation are transferred to 19 administrative regions (NUTS2) and 2 autonomous provinces (NUTS3) (regions hereafter) in the case of organisation and management matters and delegated to these concerning landscape and environmental matters. National forest guidelines indicate important goals for the regions to consider in order to develop sustainable, multifunctional forestry, which include environmental protection, conserving and enhancing biodiversity and the forest's protective function, while promoting productivity and improving socio-economic and educational aspects of forestry. To achieve these goals, forest and land use planning is required at the regional, provincial and municipal levels.

The national legal framework relating to forestry consists of **Law n. 3267 of 1923, 'Reordering and reform of legislation on forests and mountainous terrain'** (Riordinamento e riforma della legislazione in materia di boschi e di terreni montani), and its **related Ordinance (Regio Decreto) n.1126 of 1926**, which were enacted for hydrological and soil-protection reasons. By this framework, **forest management plans** ('Piani economici dei beni silvo-pastorali') became mandatory for public estates. **Law n. 431 of 1985, the so-called 'Galasso law'** (later integrated within, and somewhat altered by Ordinance (D.lgs.) n. 490/1999), imposed constraints on various, larger areas for landscape and environmental reasons and *ope legis* included land covered by forests and woods. These two sets of norms greatly differ in the way forests and silviculture are considered (Abrami 2009). In L. 3267/1923, forests are considered in relation to their crucial role in soil-protection and watershed stability (and therefore forest activities need to be regulated). L. 431/1985 bears the legacy of a previous Law n. 1497 of 1939, which aimed to protect natural beauty and landscape from an aesthetic point of view, and considered forests as "good" *per se*. That is, forests (and indeed large chunks of the country's territory, of relevance for their environmental features) are worth protection in the light of the services (*sensu lato*) they can provide to human communities. Despite this stronger and wider "environmentalist" rationale, it has been recognized that this regulation is not actually intended to impede or prohibit silviculture (Abrami 2009).

Further national level rules are provided by **Ordinance (D.lgs.) n 34/2018 'Consolidated ordinance on forestry'** ('Testo unico in materia forestale'). This act was enforced to substitute and integrate **Ordinance (D.lgs.) n. 227 of 2001 'Orientation and modernization of the forestry sector'** ('Orientamento e modernizzazione del settore forestale') and will become effective as soon as implemented within regional regulations. It is compliant with international and EU conventions and recognizes the need for sustainable forestry management, reaffirms the definition of "bosco" (woodland-forest) where the terms woodland and forests are made equal (similar to the French Code Forestier). It also fosters forest strategic and tactical planning on the part of the regions according to the national and **EU (COM (2013 n. 659/2013) forest strategies**.

Finally, the **Ministry of the Environment's Ordinance DM of 16-06-2005** ('Linee guida di programmazione forestale') stipulates guidelines meant to assess the conservation status of forests with regard to biodiversity, delin-

eating forest planning strategies and criteria to be implemented by the NUTS2 and the NUTS3 regions in charge at different scales (e.g. regional, territorial, local-estate).

Analysis of the laws and regulations issued by the individual regions in compliance with national rules reveals considerable differences. Some regions have no legislation at all with regard to forests and forestry (e.g. Valle d'Aosta, although this autonomous region has a primary authority on these matters), others have enacted framework rules and others partial rules.

Even in the deficiency or absence of regional rules, planning has been developed by most of the regions on the basis of national standards, sometimes supplemented by regional guidelines, issued without the support of a forestry law or drafted for specific public funding schemes.

Forest plans at the regional scale are in fact just broad programming tools that describe forests, strong and weak points, objectives and, in part, resources available for the advancement of the sector. Some regions also have a separate document on the state of forests, updated periodically. This planning level is prescribed by 17 NUTS2 regions. Almost all of these have actually developed such a plan, many have approved it and some have already revised it after its natural expiration. The duration of the regional forest plan varies from 3 to 15 years, and in some cases it coincides with the duration of the regional legislature (5 years).

The second level of territorial planning, developed for **sub-regional homogeneous areas** (e.g. mountain valleys, sub-provincial areas), includes a discussion on forests and their functions, regardless of ownership. It is provided for by 8 regions, which have implemented it on part of the territory, rarely (Piemonte) on an experimental basis and sometimes enforcing it as binding instrument.

Forest planning at the **estate level, individual or associated**, is provided by all the regions that have legislated on these matters, and also has been at least partially developed by the others. This is called a forest management plan, business plan, forestry-pastoral plan, forest estate plan etc., terms that can be more or less considered synonymous.

For some of the regions/provinces, namely Valle d'Aosta, the Provinces of Trento and Bolzano, Veneto, and Friuli Venezia Giulia, forest planning instruments also cover all or most of the c**ommunal or collective estates**, or at least significant portions of the territory. These instruments are devoted to large public (seldom private) estates or, more recently, to those pertaining to associated parties favoured by rural development programs (RDP).

Forest planning in **protected areas** (nature parks and reserves) and in the **Natura 2000** sites is a complex issue, often not addressed at the legislative level, neither as part of the forest framework law, nor as regulations for the conservation of biodiversity. The latter, if enacted, sometimes explicitly provide for a Site Management Plan (PDG) (e.g. Piemonte provides it for all sites), in compliance with the Habitats Directive and the national implementing rules. Some regions/provinces have drawn up the local equivalent for many or all of the sites, in some cases already approved, while others have prepared them either for some sites, or approve site-specific Conservation Measures ('Misure di conservazione' MdC). This regulatory process should have been completed by 2016, at least at the level of site-specific conservation measures.

In any case, the forest management plans involving Natura 2000 sites must comply with such conservation measures and, according to article 6 of the Habitats Directive, must undergo Appropriate Assessment (AA) procedures.

Technical prescriptions

With regard to silviculture (including coppice silviculture), enacted regional regulations either directly provide technical prescriptions or refer to province (NUTS 3) level regulations 'Prescrizioni di Massima e Polizia Forestale' (PMPF). These have been issued for all the provinces under the national framework law (Law n. 3267 of 1923) according to national level guidelines originally (1927) defined by the Ministry of Economy (then Ministry of National Economy), revised in 1957 and again in 1963 by a panel of technicians and jurists (cf. Fiorucci, 2009). Such technical prescriptions for coppice silviculture mainly concern the number of standards to be released in coppice with standards and in compound coppice. It is interesting to note (cf. Zanzi Sulli 1995) that the rationale for the definition of the number and the age distribution of standards differs greatly between the earlier (1927) and later version (1963) of the national guidelines for PMPF, reflecting motivation for the release of standards (animal raising/timber production vs dead stool replacement, respectively). This in turn was mostly due to the need to improve the state of coppice woodlands by preventing traditional side-practices (e.g. grazing, litter collection) as well as the need to define strictly coded systems (i.e. coppice with standards vs compound coppice).

The technical prescriptions in force with respect to coppice silviculture as implemented through either regional or province level (NUTS 3, PMPF) regulations greatly differ across the country and, in particular, for what concerns:

- Possibility of avoiding standard release for some forest types (simple coppice);
- Minimum and maximum number of standards (coppice with standards);
- Minimum and maximum length of rotation;
- Prescriptions for biodiversity in coppice and/or in Natura 2000 sites.

Most regions allow simple coppice for *Alnus, Robinia, Corylus, Populus, Salix, Genista, Eucalyptus* (as well as others) and allochthonous/invasive forest types, with the exception of Valle d'Aosta, Piemonte, Emilia Romagna, Marche, Umbria and Basilicata.

With regard to the **minimum and maximum number of standards**, regions can be arranged in four groups:

1) Regions in which a PMPF derived from the 1957-1963 scheme are still in force (Valle d'Aosta, Molise, Puglia and Sicilia). In these regions, the average minimum number of standards to be released per ha^{-1} is 60 and the maximum is 120 (median values) for most forest types. These average values are close to the reference values provided in the scheme (50-140 ha^{-1}, as reported by Zanzi Sulli (1995)), where the maximum values are the threshold representing one of the attributes discriminating between the coppice with standards system and the compound coppice system, the latter having up to three standard tree age classes.

2) Regions in which PMPF have been revised between 1980 and 2003 (Veneto, Emilia Romagna and Campania) and in which, on average, a minimum of 70 and a maximum of 140 standards ha^{-1} have to be released for most forest types. The minimum is 40% higher than the 1957-1963 reference value for the PMPF scheme, as reported by Zanzi Sulli (1995).

3) Regions in which prescriptions are dictated by regional regulations (Friuli Venezia Giulia, Liguria, Toscana, Umbria, Lazio, Abruzzo and Calabria) in which, on average, a minimum of 60 and a maximum of 140 standards ha^{-1} have to be released for most forest types; the minimum is 20% higher than the reference.

4) Regions in which prescriptions are dictated by regional regulations (Lombardia, Trentino, Marche, Basilicata and Sardegna) where, on average, a minimum of 100 and a maximum of

200 standards ha^{-1} have to be released for most forest types, with the minimum and maximum exceeding the reference values by 100% and 43% respectively.

The sole exceptions are Alto Adige and Piemonte. In the first, no prescriptions are in force for coppices due to the very small share of forest cover under coppice (less than 3.5%). Piemonte's recent regulations have introduced the criterion of minimum forest cover provided by standards, instead of their number, to define standard density. This is deemed more effective for the purpose of a variety of ecosystem services (cf. also Fiorucci 2009).

For the particular forest types of sweet chestnut and beech, all regions, on average, prescribe the release of a minimum of 40 and 100 standards ha^{-1}, respectively. In addition, Friuli Venezia Giulia prescribes a minimum of 120 standards ha^{-1} for *Carpinus* forest types, while Umbria perscribes a minimum of 100 standards ha^{-1} for *Quercus ilex* forest types.

The situation is even more varied concerning the **minimum and maximum length for a coppice rotation**, which differs across regions and forest types. For beech, deciduous oaks and sweet chestnut, for example, their respective average values are: min 24±3, max 40±7 years; min 18±3, max 36±7 years; and min 12±2, max 33±13 years, which are well above the very low values of the past (8-12 years), thus overcoming one of the main drawbacks of the coppice system, i.e. the over-exploitation of soil and stools due to the high frequency of the rotations. Maximum values are more sensible nowadays: most regions discriminate by law between coppice and high forest systems and once the maximum rotation length threshold is exceeded, regulations prohibit the maintenance of coppice management and force the stand to be managed as a high forest - that is to resort, at the right time, to reproductive regeneration.

Finally, in the majority of regions ad hoc regulations concerning **nature conservation** dictate additional, yet varied, prescriptions (e.g. coupe size and spatial arrangement, dead wood and ageing trees retention). For example, the Natura 2000 sites in Puglia (DGR 2250/2010) allow silvicultural operations between October 1st and March 15th to avoid impacts on nesting habitats of protected bird species; the cumulative size of three consecutive years coupes must not exceed 10 ha; 120 standards ha^{-1} must be released in all forest types; and sporadic tree species (less than 10%) must be preserved. In another example, in the Natura 2000 sites of Lazio (Regulation 1/10, modification to article 53 of the Regulation 07/05), the appropriate assessment (AA) of plans and projects significantly affecting Natura 2000 sites, is explicitly prescribed in the absence of approved management plans, regardless of ownership type (i.e. public or private). This is mandatory for old coppices, as well as when the coupe size of regular coppice exceeds 10 ha (20 ha for sweet chestnut) or 0.4 ha in the case of forest habitat types 9180, 9210, 9220, 9340 of the Habitats Directive.

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Latvia

Dagnija Lazdiņa, Santa Celma and Kristīne Štikāne

Facts and Figures

Dagnija Lazdiņa and Santa Celma

Definitions

Coppice – deciduous tree stand that develops from shoots. Development of coppice depends on shoot production and regeneration ability. Trees that can regenerate with shoots multiple times include grey alder, black alder, birch, aspen, ash, oak and willow. Shoot sprouting activity gradually increases with tree age until it reaches physical maturity. At this point tree has the highest ability to sprout and grow shoots. Therefore, it is important to set an appropriate felling age to fit trees maturity (40-60 years). Felling time influences natural regeneration as well. The second half of winter is considered the most appropriate time for felling, since tree stumps sprout productively in the next spring and they have enough time to mature before autumn frosts start.

Atvasājs — lapkoku audze, kas izveidojusies no atvasēm. Atvasāja veidošanās atkarīga no koku atvašu dzīšanas spējas. Vairākkārt un ilgstoši atjaunoties ar atvasēm spēj baltalksnis, melnalksnis, bērzs, apse, osis, ozols un vītols. Pieaugot koka vecumam, pieaug arī atvašu dzīšanas spējas, līdz koks sasniedz fiziskās gatavības vecumu. Tad kokam ir visaugstākā atvašu dzīšanas spēja. Tādēļ, lai pēc mātesaudzes nociršanas panāktu sekmīgu izcirtuma apmežošanos ar atvasēm, jānoteic koku fiz. gatavības laikam (parasti 40—60 g.) pieskaņots cirtmets. Dabiskā atjaunošanās atkarīga arī no koku ciršanas laika. Par izdevīgāko uzskata ziemas otro pusi, jo tad pavasarī celmi bagātīgi dod atvases un tās līdz rudens salnām paspēj nobriest.

J. Bisenieks
Meža enciklopēdija, Apgāds "Zelta grauds", 2005

Legal Framework

1. Short rotation coppice - as agricultural land if planted with *Salix* spp., *Populus* spp., *Alnus incana*, on rotations of no more than 5 years. No restriction for density.

2. Forest land - more than 20% cover and over 5 m height.

2.1. Plantation forests - no restriction for felling age.
Pine at least 1,000 plants/ha initially; oak - 800/ha; ash - 500/ha.

2.2. Forest - defined felling by age or dimensions, initial density 3,000/ha pine, other species 2,000. (www.likumi.lv). NB: "Natural regeneration" means that <50% of trees were planted/seeded.

Statistics

There are no official statistics for coppice. Species that can regenerate as coppice in Latvian forests (total area 2,903,413 ha) are: birch (1,001,737 ha), aspen (151,855 ha), black alder (121,770 ha), grey alder (32,502 ha), ash (18,529 ha), oak (8,846 ha), linden (1,982 ha) and beech (119 ha). Species managed as agricultural crops that were declared for common agriculture payments in 2016 are: willow (516 ha), aspens (174 ha) and grey alder (14 ha).

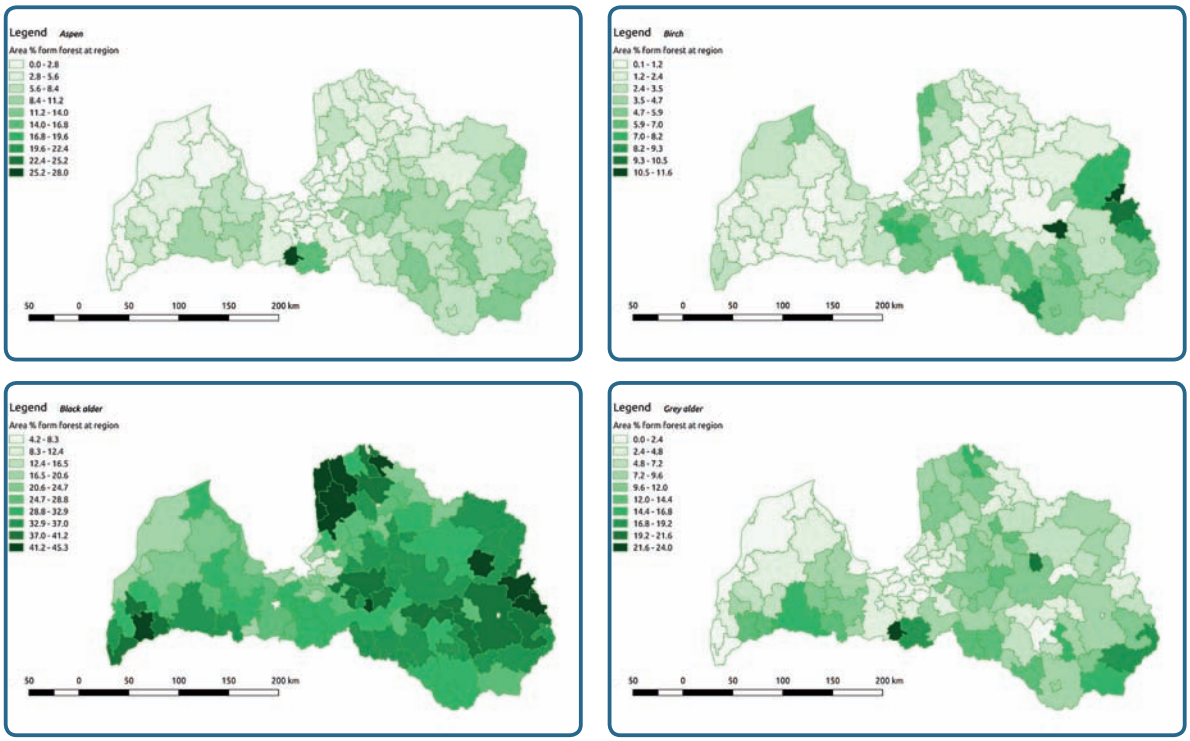
Typology

Simple coppice	Traditional natural forest regeneration method
Coppice with standards	Uncommon; *Populus, Alnus, Betula,* seldom *Salix*
Pollarding	Only on roadsides and in gardens
Short rotation coppice	*Populus, Alnus incana, Salix*
Other types	Few stands regenerated with poles or stakes (1.5 - 2 m)

Images

Maps

Dagnija Lazdiņa



Distribution of four tree species sometimes used for coppice in Latvia (species as % of forest in region): Aspen (upper left), birch (upper right), black alder (lower left) and grey alder (lower right).
Data source: Latvia State Forest Service Statistic CD 2016

Description

Dagnija Lazdiņa

Coppice as a forest management system is not separated from forestry in general. However, short rotation coppice (SRC) is separately defined as "areas planted with certain tree species, where the tree roots and stumps are left in the soil after harvesting and in the next vegetation season gives new shoots". The rotation period of SRC is normally five years, in order to receive common agriculture payments. However, it is allowed to keep up to 15 year rotation periods for poplars, willows and grey alder and still be considered an agricultural crop. In 2016, 516 ha of willows, 174 ha of aspens and 14 ha of grey alder received common agriculture payments.

Figure 1. Coppice in Latvia landscape and forests; willow on roadside (left), hybrid aspen stands (middle), black alder wetlands (right)

No statistics on coppice forests in Latvia are available. However, it is estimated that aspen, birch, alder, willow and osier are common coppice species in naturally regenerated and planted forest areas, where they have naturally sprouted from former forest stand tree stumps or root suckers (Fig. 1). Hazel, linden and ash are also at times naturally regenerated as coppice in some old wetlands. Coppice is more common in privately owned forests, which have a greater proportion of broadleaves than the state forests (Fig. 2). The proportion of private and state forests is close to 50:50.

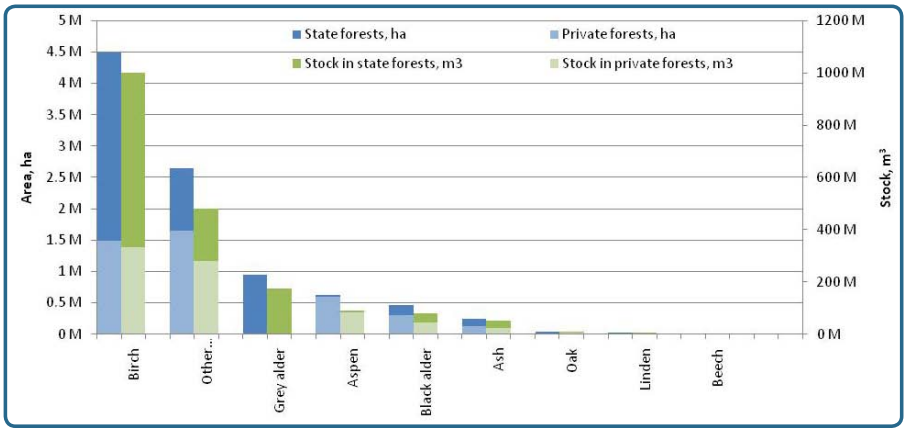


Figure 2. Growing stock (in millions – M) of traditional coppice forest species and area in Latvia forests (Source: VMD CD2016)

Both grey and black alder are widely spread in the Latvian landscape. Grey alder is a pioneer species on abandoned former agriculture land, but black alder contributes to the biodiversity of old forests in wetlands providing habitat for living organisms. Black alder also grows on the banks of small forest rivers and ditches.

Willows are mainly distributed near water reservoir banks, protected wetlands and "poorly managed" forest properties. In addition to their use in short rotation coppice, willows, including decorative varieties, are also used in flower gardens and industrial parks. Coppice forest products are becoming fashionable as interest increases in the centuries-old traditions of using willows and osiers materials for different craft work, fences and apiculture as early flowering trees.

Poplars are still used as windbreaks, shelterbelts and fast growing landscaping trees; they are commonly planted along roads and on borders between properties.

Forestry Regulations

Kristīne Štikane and Dagnija Lazdiņa

Latvia is situated in the boreo-nemoral zone, a transition between the temperate and boreal forest zones where mixed forests of broadleaves and conifers are common. Forests cover about 50% of the area of Latvia.

Basically, the three dominant tree species in the forests of Latvia are pine (*Pinus sylvestris*), spruce (*Picea abies*) and birch (*Betula pendula*). According to the 2010 National Forest Inventory (NFI) data, potential coppice species making up of the forest area of Latvia include birch (27.9%), grey alder (*Alnus incana* 9.8%), aspen (*Populus tremula* 7.7%), black alder (*Alnus glutinosa* 5.1%), ash (*Fraxinus excelsior* 0.8%) and oak (*Quercus* spp. 0.7%). There is no data available for willow (*Salix* spp.) because it is not widely planted as a main species in the forest.

After the restoration of Latvia's independence in 1990, the forestry sector has become one of the most important sectors in the country's economy. Since then, the forest area in the country has increased by around 60,000 hectares per year. That was the first time when representatives of the timber industry began to gather together in associations, so as to be able to defend their interests more successfully; not only in Latvia, but also in export markets. Exports of forestry products are more than 70 times higher than they were 20 years ago. Meanwhile, a list of specially protected environmental territories (IADT) was established in 1993.

On April 28, 1998, the government of Latvia adopted the **Forest Policy**, which has been developed to reach a compromise among all stakeholders interested in forestry. Prerequisites of a sustainable forest management are the targets defined and principles established in Latvia's Forest Policy. In 2000, the **Latvian Forest Industry Federation** was established to assist in the development and coordination of the activities of the various associations, in order to agree on fundamental principles aimed at preserving the national forest for future generations, as well as representing the interests of the timber industries at the international level. Since 2000, the **Ministry of Agriculture** performs the regulatory function laid down in the Forest Policy while the monitoring function is done by the **State Forest Service**.

In Latvia, considerable emphasis is placed on "planted forests", in which over 50% of trees were planted or sown, as opposed to having regenerated naturally, and this is reflected in the national regulations and definitions. The rationale is that improved planting material from tree breeding leads to a higher forest productivity and it is, thus, good practice to ensure as many trees as possible originate from such a source. It results in particular consequences for coppice, since for each shoot of stump or root origin, at least one additional tree should be planted or sown for the stand to achieve the desirable "planted forest" status.

The major part of the forest area possessed by the state is managed by the state-owned business operator; the **joint-stock company "Latvijas valsts mezi"** (Latvian State Forests) manages and administers 1.63 million ha of land, including 1.60 million ha of forest land, which incorporates 1.41 million ha of forest.

In 2004, when Latvia joined the European Union, it automatically became part of the unified **Natura 2000** network of protected territories in the EU. Among the species and biotopes that are listed in the EU's bird and biotope directives, Latvia protects 60 types of

biotopes. There are several protected forest biotopes in Latvia which are listed in the relevant EU directive – boreal forests, primary forests along meandering rivers, certain coniferous forests, stands of oaks, forests on hillsides and in valleys, swampy forests, wet broadleaf forests, forests on river banks with oak and elm trees, dry fields of heather along seashore lowlands and other areas, wet fields of heather with crossleaved heath (*Erica tetralix*), as well as stands of juniper in calcified meadows.

There are many **forest habitats in Latvia protected by the EU directive**, which includes territories in which coppice tree species are common:

9010* Western taiga, which is typically dominated by pine, spruce, aspen and birch, or their combination.

9020* Fennoscandian hemiboreal communities of natural, old broad-leaved deciduous forests (of *Quercus, Tilia, Acer, Fraxinus* or *Ulmus*); rich in epiphytes. The tree layer typically is dominated by an admixture of ash, elm (*Ulmus* spp.), willow, lime (*Tilia* spp.), oak and aspen in different combinations, but with none of them dominant. A minor admixture of spruce, birch and pine is possible.

9080* Fennoscandian deciduous swamp forests are typically dominated by alder, ash, birch, or in admixture.

9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli community, typically dominated by oak, hornbeam and lime, or in admixture.

9180* Tilio-Acerion forests of slopes, screes and ravines where the tree layer is dominated by lime, ash, oak, elm, willow and maple (*Acer* spp.), or in admixture.

91D0* Bog woodlands are typically dominated by one or more species of pine, spruce and birch; occasionally aspen or alder are found in admixture, but these rarely dominate.

91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-padion, Alnion incanae, Salicion albae*) are protected under the EU habitat directive where the main species are ash, alder, elm (*Ulmus* spp.), willow, grey alder and bird cherry (*Prunus padus*). These are distinguished by an underlayer of brush and other various trees in admixture with a canopy dominated by aspen or birch.

91F0 Riparian mixed forests of *Quercus robur, Ulmus laevis* and *Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*) typically dominated by oak, elm, willow, or ash, or in different combinations of these species.

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Lithuania

Marius Aleinikovas, Mindaugas Škema and Julija Konstantinavičienė

Facts and Figures

Marius Aleinikovas

Typology

Simple coppice	Small amount, only in private forests
Coppice with standards	Ash, birch, grey alder
Pollarding	Only on seedling plantation
Short rotation coppice	Willow, aspen, grey alder

Image

Description

Mindaugas Škema, Marius Aleinikovas and Julija Konstantinavičienė

In Lithuania, coppice and coppice with standards are very rare and the national forest inventory authority of Lithuania (State Forest Service) does not even register these types of forest. Short rotation coppice system research in Lithuania was established 20 years ago.

The most common coppice is a willow (*Salix* sp.) short rotation coppice system, used to produce biomass for energy. In Lithuania, the short rotation woody crop area is 3,027 ha, with an additional willow plantation area of 2,477 ha (NMA, 2014). Compared with some other countries, in terms of the country's area, Lithuania has a relatively large area of woody energy plantations. However, as of 2015, 66% of willow plantation owners had not harvested their first rotation crop (Konstantinavičienė and Stakėnas, 2015).

The first commercial short rotation energy plantations (SREP) were planted in 2003 in Lithuania, however statistical data could be found only from 2007 (see Table 1),with later yearly increases of 13-60% (NMA, 2114).

A mathematical model for the determination of the dry above-ground biomass of energy willow plantations grown in Lithuania using a non-destructive method has been prepared (Konstantinavičienė et al., 2014).

Another coppice culture in Lithuania is hybrid aspen. Breeding and selection work on hybrid aspen started in 1965. It was reactivated in 1982 and again in 2007 (A. Pliūra, personal communication). Until 2007, approximately

Table 1. Statistics on short rotation energy plantations (SREP) and willow energy plantations (WEP)

Year	SREP total area (ha)	SREP increase (%)	WEP total area (ha)	WEP increase (%)
2007	260	–	–	–
2008	375	44	–	–
2009	492	31	–	–
2010	556	13	–	–
2011	891	60	109	–
2012	1106	24	252	131
2013	1768	60	1196	375
2014	2493	41	1823	52
2015	3027	21	2477	36

50 ha were cultivated both on forest and abandoned agricultural lands.

During the past decade, up to 400 ha of hybrid aspen short rotation plantations have been planted annually in Lithuania (Fig. 1) (Tullus et al., 2011; A. Pliūra, personal communication).

Breeding of hybrid poplars has also been started and the clones best adapted to Lithuanian climatic conditions will be used to establish short rotation plantations, a portion of which will also be managed as coppice forest without replanting after the first and second rotations (Pliūra et al., 2014).

Figure 1. Short rotation plantation of hybrid aspen in Dubrava Forest Enterprise, Lithuania; it will become coppice forest in one rotation (after a clear cut at 20 years of age) (Photo: V. Suchockas and A. Pliura)

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Forestry Regulations

Marius Aleinikovas and Mindaugas Škema

Lithuanian forests are a natural element of the Lithuanian landscape. They offer biodiversity, productivity and sustainability, and provide timber, green energy, food products and opportunities for healthy recreation of the urban and rural people. According to data from the Lithuanian Statistical Yearbook of Forestry (2016), the total forest land area is 2,186,000 ha, which is 33.5 % of the country's territory. The total growing stock volume is 537 million m^3, while the gross annual increment is 19.3 million m^3. Deciduous trees account for 56% of stands; 44% are conifers. The most common tree species are Scots pine (*Pinus sylvestris*), silver and downy birch (*Betula pendula* and *B. pubescens*), Norway spruce (*Picea abies*), black and grey alder (*Alnus glutinosa* and *A. incana*), aspen (*Populus tremula*) and oak (*Quercus* spp).

After the restoration of Independence in Lithuania, forest property rights were restored. The structure of **forest ownership** has changed due to an ongoing land reform process. All forestland was first transferred to the countrywide network of 43 state forest enterprises under the Ministry of Forestry. Currently, the private forest sector consists of 249,000 private forest owners, managing a total of 873,000 ha (LSYF, 2016), which is 39.9% of the total forest

area. Forests belonging to the state cover 49.8 % and forest areas reserved for restitution amount to 10.3%.

State forest managers and private forest owners are obliged to manage and use their forests according to the **Forest Law** describing regulations on the management and use of forests, as well as other legal acts related to forest management, e.g.:

- Regulations for Forest Regeneration and Establishment (2008)
- Rules for Forest Sanitary Protection (2007)
- Rules for Forest Felling (2015)
- Rules for Forest Improvement Cuttings (2002), etc.

Forest management, reforestation and use are regulated in more detail in legal acts approved by the Minister of Environment. The main legal act is the **Law on Forests**, adopted in 1994. It regulates reforestation, protection and use of forests and specifies the legal preconditions for managing all forest ownership types upon equal sustainable forestry principles. According to the Law on Forests, the state forestry policy trends are defined by **Seimas** (Parliament of the Republic of Lithuania) by adopting appropriate laws. The state forestry strategy and state forestry programmes are prepared by the Ministry of Environment.

Forest sector development targets are guided through the **National Forestry Sector Development Programme for 2012–2020**, which was approved by the government in 2012. The document describes development trends and targets for the forestry sector. The major ones are to preserve Lithuanian forests and increase their area and resources, as well as to preserve the efficiency and sustainability of forest ecosystems, taking account of their ecological and social role and the impact of climate change.

At the beginning of 2016, the distribution of forests by functional groups was as follows.

- Group I (strict nature reserves): 26,500 ha (1.2%);
- Group II (ecosystem protection and recreational): 266,500 ha (12.2%);
- Group III (having protection status with regard to geology, geomorphology, hydrological and cultural merit): 333,400 ha (15.2%);
- Group IV (commercial): 1,560,300 ha (71.4%).

The Group IV commercial forests are split into:

a) commercial forests of normal cutting age, encompassing productive forest stands that continuously supply wood, following the requirements of environmental protection; and

b) forest plantations, where the objective is to grow as much wood as possible in the shortest period of time.

The latter are forests that consist of stands of fast-growing tree species with a cutting age of at least 15 years. Only stands with the same age class can be attributed to forest plantations. It is prohibited to plant forest plantations in non-plantation forest cutting areas. Coppice management is rarely practiced, except in short-rotation plantations of willow or poplar.

According to the Forest Law, forest managers and owners are obliged to follow certain mandatory parts of a **forest management plan** (i.e. the amount of wood allowed to be cut over a period of 10 years and reforestation within prescribed environmental protection requirements). Internal forest management projects for private forest holdings of less than 10 ha may be prepared for 20 years. If, over 10 years, the private forest owner does not cut all the permitted quantity of wood, the validity of the project can be extended for a further 5 years.

The preparation of an internal forest management project is not obligatory in the following cases:

1) final felling of grey alder, aspen and other low value stands;

2) private forest holdings of less than 3 ha.

Lithuanian Law states the mandatory reforestation of clear-cuts and the expansion of the forest area through afforestation of abandoned lands. Clear-cut areas should be reforested within 3 years after cutting. Unsuccessful natural and artificial regeneration should be reforested within 2 years. During the past 10 years, natural forests have expanded rapidly, by about 65,000 ha of new forest, as a result of both natural growth and planting on abandoned agricultural land. Furthermore, since Lithuania joined the EU, afforestation of agricultural land has been introduced using support from EU rural development funds and national funds.

The rotation age at which clear cutting is permitted is established in the **Rules of Felling**. For group IV in state forests it is:

- 121 years: oak
- 101 years: pine, larch, ash, maple, beech, elm
- 71 years: spruce
- 61 years: birch, black alder, lime, hornbeam
- 41 years: aspen
- 31 years: grey alder, sallow and willow

In private forests, for grey alder, aspen, willow and sallow the age of felling in group IV forests is not prescribed. Within forest groups II-IVa, at least 7 live trees/ha (of which at least 3 must be older or thicker than average trees in the forest) and at least 3 dead trees must be left, with a thickness of more than 20 cm in diameter at 1.3 m above ground, to ensure biological diversity.

Certification Schemes for forest products in State Forest Enterprises are certified under the rules of the Forest Stewardship Council (FSC) forest management and chain of custody. According to the United Nations Economic Commission for Europe (UNECE), State Forest Enterprises produce about 3.8 million m^3 of FSC certified round wood, 50 % of all the round wood volume produced in Lithuania. Lithuania has its very own system of protected areas, and long-standing traditions for the protection of natural and cultural heritage. Protected areas are established not only for the protection of natural and cultural values, but also for their adaptation to allow public use and access, be it for educational, recreational or other purposes. The Natura 2000 network covers about 13% of the total country territory.

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fYR of Macedonia

Pande Trajkov and Ljupco Nestorovski

Facts and Figures

Pande Trajkov

Definitions

Coppice forest – a forest originating by vegetative means, i.e. by basal shoots, root suckers or both.	*Нискостеблена шума – е шума настаната по вегетативен пат односно изданци од пенушки, ибојци од корења или на двата начини.*

Legal Framework

1. Forest land with more than 20% cover and
2. Volume density of more than 0,3 (30% of "normal" stands)

Regulation for Forest Management Plans (http://www.mzsv.gov.mk).

Statistics

Total forest area in 2012: 989,000 ha

Managed forest: 902,000 ha

High forest: 276,000 ha

Coppice forest: 561,000 ha

Coppice with standards: 3,000 ha

Shrubs, maquis, etc.: 54,000 ha

Artificial forest (up to 20 years): 8,000 ha

Unmanaged forest: 87,000 ha

Main species: *Fagus moesiaca, Quercus petraea, Q. conferta, Q. cerris, Q. trojana, Q. pubescens* and *Q. coccifera.*

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Typology

Simple coppice	Traditional, clearcuts, rotation 40-50 years
Coppice with standards	Very rare
Pollarding	Practised in the past; very rare today
Short rotation coppice	Not practised
Other types	Coppice in conversion process (oak and beech) with natural regeneration (seeds) or introduction of conifers (*Pinus, Abies, Picea*)

Images

Overaged oak stand with natural seeds regeneration (Goten Mountain)

Harvested oak plantation

Successfully regenerated sessile oak coppice stand (Bushava Mountain)

Beech coppice stand (Bistra Mountain)

Description

Pande Trajkov

Due to a combination of traditional forest management, extensive cattle breeding that was practiced until the middle of the 20th century and cruel environmental and climatic conditions, large areas of the forests in the Republic of Macedonia are coppiced and degraded. In previous times, the landscape in the lower and middle parts of the mountains mainly comprised coppiced forests. In order to improve their condition and prevent further degradation of forests, an Act was introduced in 1948 to prohibit the breeding of goats (Nikolovski, 1955). The result was a rapid reduction in the goat population. During the second half of the 20th century the recommendation was for coppice to be transformed into high forest (Nikolovski, 1955, 1958, 1960, 1964, 1966; Mircevski, 1977, 1989). Direct conversion, combined with replacement of tree species, was recommended for degraded coppice forests, while the preserved stands were subjected to indirect conversion. The most common species used for re-forestation was black pine, which has a low growth rate on poor sites and suffers damage from frequently occurring forest fires and pests (Trajkov, 2007). This history, along with a lack of knowledge on the growth of other species, has meant that only few coppice forests have actually been converted in recent decades.

Today the total area of managed coppice forests is about 618,000 hectares, or about 68.5% of the total managed forest. 54,000 hectares of these are shrubs and pseudo-maquis. The coppice forests consist mainly of beech (*Fagus moesiaca*) and several species of oak: sessile (*Quercus petraea*), Hungarian (*Q. conferta*), Turkey (*Q. cerris*), Macedonian (*Q. trojana*), downy (*Q. pubescens*) and kermes (*Q. coccifera*). There are also several types of hornbeam: the European (*Carpinus betulus*), Oriental (*C. orientalis*) and hop hornbeam (*Ostrya carpinifolia*), as well as maples (*Acer campestre, A. monspessulanum, A. obtusatum*), manna ash (*Fraxinus ornus*) and aspen (*Populus tremula*).

Oak coppice forests (Figure 1) cover a wide range across the vertical distribution of vegetation. As a result of human influence, almost all the oak forests occurring up to an altitude of 1100 meters are coppiced, except for small areas around religious objects or deep in the mountains, far from human settlements. Both beech and oak stands re-spout well from coppiced stools until they are very old; these are managed on a rotation of 50 years. The wood from the coppice forests is mainly used as firewood.

As a result of the large coppice resource and despite the continuation of coppicing, there

are now over-aged stands, older than 50 years, whose regeneration is debatable. In privately owned coppiced oak forests, thinning has been practised in order to provide continuous annual yield. This approach has led to a reduction in the canopy and the emergence of a vigorous understorey that now obstructs its transformation to high forest. On the other hand, the reduced number of stools in these stands means that the classic coppice system cannot be applied and economics prevents owners from performing direct transformation. Thus, oak coppice stands are being quietly transformed into hornbeam and ash stands.

Environmental and political development in the country is increasingly threatening the existence of the coppice system. The public comments negatively on large areas of clear cut near settlements, close to recreation centers or along roads.

Figure 1. Oak coppice stands in the regeneration stage

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Forestry Regulations

Ljupco Nestorovski

In the Republic of Macedonia, the **Law on Forest** (Official Gazette no. 64/09, and subsequent modifications from 24/11, 53/11, 25/13, 79/13, 147/13 and 43/14) gives instructions and specifies the responsibilities of stakeholders for the management of forests. These guidelines cover the most important goals for state and privately owned forest in order to preserve and further develop sustainable, multifunctional forestry, as well as the socio-economic welfare of stakeholders. Environmental protection and the promotion of other forest functions and values are partly covered within the same Law, and partly in the **Law on Nature Protection** (Official gazette no.53/05 and its modifications). Both Laws have provisions that concern topics such as forest management, forest planning, protection and silviculture.

Following a chain of historical, economic and political events, organised forest management and planning systems for forests in the Republic of Macedonia began after the Second World War. The first Law on Forests was adopted in former Yugoslavia in 1949 and it was subsequently revised several times (1956, 1974, 1986). After independence in 1991, the new Law on Forests was adopted in 1997 and became operational in 1999.

There are no special issues in this Law that treat coppice separate from high forest. Coppicing is considered a regular way of managing forests. The rotation depends on tree species (mostly different types of oak, ash, beech and hornbeam), and is usually done every 30-50 years. The most common treatment is traditional coppicing. To date there is no national inventory, but forest management plans are made for every unit (limited to a maximum of 5,000 ha). There are no differences in the treatment of private and state-owned forests. Private owners with an area of forest greater than 100 ha are obliged to make a **Forest Management Plan** (FMP) that must be approved by the Ministry of Agriculture, Forestry and Water Economy. This also applies to the Public enterprise "Makedonski sumi" that manages state-owned forests, in accordance with the provisions in FMP of the surrounding forests. The **Ministry of Agriculture, Forestry and Water Economy** is also responsible for licensing forest engineers to be able to plan activities in private owned forests.

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Netherlands

Patrick Jansen, Jenny Mills and Peter Buckley

Facts and Figures

Patrick Jansen

Definitions

Closed forest with vegetative regeneration by regrowth of the stools of deciduous species (not willow) with good regrowth capacity.	*Gesloten bos met vegetatieve verjonging door stronkopslag van loofboomsoorten (m.u.v. wilg) met een goed uitstoelingsvermogen.*

Legal Framework

Traditional coppice is considered forest in the Dutch Nature Conservation Act. The criteria are a minimum area of 0.1 hectare and a canopy cover of at least 60%.

Short rotation coppice is considered agriculture in the new Nature Conservation Act. It is defined as: plantation of willow, poplar, ash or alder with the aim to produce woody biomass. It is harvested at least every 10 years and contains at least 10,000 stools per hectare per unit. The short rotation coppice must have been established after January 1st, 2013.

Statistics

Forests in the Netherlands consisted mainly of coppice woodlands until approximately the end of the 19th century. Since then, most coppice woodlands have been converted to high forest through replanting, abandonment and singling. Approximately 1,500 hectares is still coppiced today.

Typology

Simple coppice	As forests and small plantings in open, agricultural area.
Coppice with standards	Currently not practised
Pollarding	On roadsides, waterways and as forests along rivers
Short rotation coppice	Mainly *Salix* (limited area)

Description

Patrick Jansen

Large parts of the Dutch forests, approximately 57%, were coppice woodlands until around 1850. Oak coppice was dominant due to the use of its bark for leather production. The most common production cycle was 8-10 years for bark production. Longer production cycles were used for fuelwood, up to 25 years. Coppice with standards was rather rare in the Netherlands.

Some beech and birch coppice existed on the drier lands and ash and alder coppice (Figure 1) in wetter conditions. Due to the rise of cheaper tanning and fuel products and rising labour

Figure 1. Coppice management in alder coppice in The Netherlands (Photo: P. Jansen)

costs, the management of coppice woodlands declined in the second half of the 19th century. Thereafter, only a small proportion of the coppice woodlands were managed in the traditional way. During the two World Wars, some coppice woodlands were harvested for fuel wood, and in many cases this was the last time they were coppiced. Coppice woodland on the more fertile soils was converted to agricultural land. In drier, not so fertile grounds the coppice woodlands were converted to high forest. Between 1955 and 1965 there was even a subsidy scheme available for this aim. High forests were seen as a better economic alternative. Stools were cut down and species such as Douglas-fir or spruce were planted, but many oak coppice woodlands were also 'singled'. In this strategy only one sprout was saved on every stool. These shoots formed the basis of a new high forest of oak.

Already in 1964 two prominent ecologists published an article on the nature conservation values of traditional coppice woodlands. Some nature conservation organisations saved a small area of coppice woodlands for this reason, but most was converted to high forest or agricultural land or simply abandoned.

Currently only approximately 1,500 ha of actively managed coppice woodlands remain managed mainly for biodiversity and cultural heritage. Old stools form an interesting habitat for certain species, for example some rare mosses. Coppice woodlands are also a suitable habitat for a large number of species because of the quick shift between sunny and shaded conditions. Both light demanding and shade tolerant species can find a suitable habitat in actively managed and therefore ever-changing coppice woodlands.

One of the main challenges in restoring coppice woodlands is to rejuvenate old stools. Many old stools died back after coppicing. This is also due to the large number of deer, but research has shown that the main reason is the time that has passed since the last coppicing. Even if the old stools resprout successfully, the number of stools is very low compared to historic densities. The low number of stools in old coppice woodlands is due to self thinning in the last decades. Restoring coppice woodlands therefore also involves planting new trees with the aim of forming new stools.

The wood from these coppice woodlands is mainly used as industrial biomass chips or domestic fire wood. The rise of the biomass market has had some positive impacts on the management of coppice woodlands, but the cost of coppicing and restoring coppice woodlands is still much higher than the income from the wood and biomass sales. Coppice woodlands are also subsidised. For coppice woodlands on wet soils the management subsidy is currently 2,563 euro per hectare per year. On dry lands it is 394 euro per hectare per year. These subsidies have been crucial in protecting the small remaining area of coppice woodlands in The Netherlands.

Since the nineties, high density short rotation coppice with poplar and willow has been promoted, but due to the high prices for land it has only been a success in areas where dual goals could be achieved. A good example is the establishment of short rotation coppice on biological chicken farms. The chickens use the available land better through the short rotation coppice and the farmer has biomass to sell.

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Forestry Regulations

Jenny Mills, Peter Buckley and Patrick Jansen

Some 10% (360,000 hectares) of the Netherlands consists of woodland, which is protected under the 1961 **Forestry Act** (the Boswet).

The legislation in the Act applies to planting areas greater than 1000 m^2, or when there are more than 20 trees in a row. Trees in urban areas are excluded; these are regulated under municipal law.

One month before felling is due to take place it must be reported, either by the owner or the contractor, to the Ministerie van Economische Zaken (Ministry of Economic Affairs) by means of a **kapmelding** notification. A topographic map (minimum scale 1:25.000) on which the trees are marked must also be submitted. Only 5 plots can be entered on each kapmelding and a separate one must also be sent for each municipality in which the trees are growing. Felling must take place with a year of submitting the kapmelding, otherwise it has to be re-submitted. An additional permit may be required under other legislation.

A receipt is given after submission of the kapmelding. If there is no response one month after submission, then the trees can be felled.

If the cut is prohibited (kapverbod), the owner is notified within a month of submission and this is also published in the Government Gazette. The reasons are always given. If the owner disagrees with the decision, an objection can be filed within 6 weeks. An appeal decision will be given within 6 weeks of the objection being made. When a landscape of exceptional natural beauty is threatened, the Ministry of Economic Affairs can prohibit felling, but this rarely happens.

After felling, there is a duty to **replant** (herplantplicht) within three years of felling. This also applies if trees have been lost through fire, windthrow or disease. This obligation is attached to the property and, if sold, the new owner has a duty to replant. High fines can be imposed if replanting does not take place. The Forest Act allows planting on a parcel other than that which was felled, but it must occur in a silviculturally acceptable way on a similar-sized area. Natural regeneration is not officially considered to be replanting, but in practice it is allowed if successful (within 6 years).

Thinning and coppicing do not usually include a duty to replant and therefore do not need to be notified by a kapmelding.

A judge adjudicates the difference between thinning and felling: if the canopy cover is reduced to below 60%, it is considered to be a felling.

A kapmelding notification is not required under the following circumstances:

- the trees to be felled are in urban areas and therefore under local authority regulations
- the trees are in gardens and other domestic areas
- the felling is to promote the growth of the remaining trees (thinning)

- coppice or withies are being cut periodically
- felling is taking place as part of an approved development plan
- an exemption has been granted in the Regulations on notification and replanting
- roadside plantations and single-row plantings of poplars and willows on, or alongside agricultural land.

Felling does not have to be reported for the following species: Poplar (*Populus spp.*), lime (*Tilia spp.*), horse chestnut (*Aesculus hippocastanum L.*) and willow (*Salix spp.*,) fruit trees and windbreaks around orchards, spruce up to 12 years old intended as Christmas trees. However, municipal legislation may still apply.

Further applicable legislation:

The 1988 **Nature Conservation Act** (De Natuurbeschermingswet) regulates the protection of areas that the Government has designated as protected natural monuments. It also protects areas in accordance with international agreements such as the Birds Directive (Vogelrichtlijn) and Habitats Directive (Habitatrichtlijn) and the Ramsar Convention, which protects wetlands. In 2005, the Act was amended to better integrate legislation on nature protection, forestry policy and obligations under the Habitats Directive.

For **Natura 2000** areas, special management plans must be developed, including an inventory listing the habitats to be protected. The management plan then provides an overview of the measures that will be taken to protect these habitats. Measures that are included in the management plan may be carried out without a licence, but permission from the province is needed for other activities if they have an impact on protected habitats or species.

The 2002 **Flora and Fauna Act** (Flora- end faunawet) protects designated species. Management, development, hunting, etc., only take place under strict conditions.

As from January 1st 2017 a new **Nature Protection Act** (Wet Natuurbescherming) replaces the Flora and Fauna Act, the Forest Act and the Nature Conservation Act. This will make it easier to apply the law to protect the Netherlands' flora and fauna, Natura 2000 sites and forests. Implementation and controls under the Act will mainly be carried out by each individual Province rather than the Government.

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Norway

Giovanna Ottaviani Aalmo

Facts and Figures

Definitions

Coppice	*Styving, Lauving*

Legal Framework

Standard coppice does not exist in Norway as the Norwegian forestry sector is essentially dominated by conifers. On the other hand deciduous trees represent a very important part of the cultural heritage and the biodiversity and they are regulated under the "Naturmangfoldloven" (Diversity Act). Nowadays, coppicing is still performed in several counties i.e. Akershus, Rogaland, Sogn og Fjordane and Nord-Trondelag (see Map). This practice is maintained essentially to keep the historical value of this tradition and protect the biodiversity. Norwegian farmers can in fact apply for a specific subsidy, which amounts to about 50 Euros/tree from the Regional Environmental Program for Agriculture (RMP) for keeping and managing as coppice the deciduous trees on their properties. The legal framework applies therefore to the procedure for registering the trees and obtaining the subsidies.

Typology

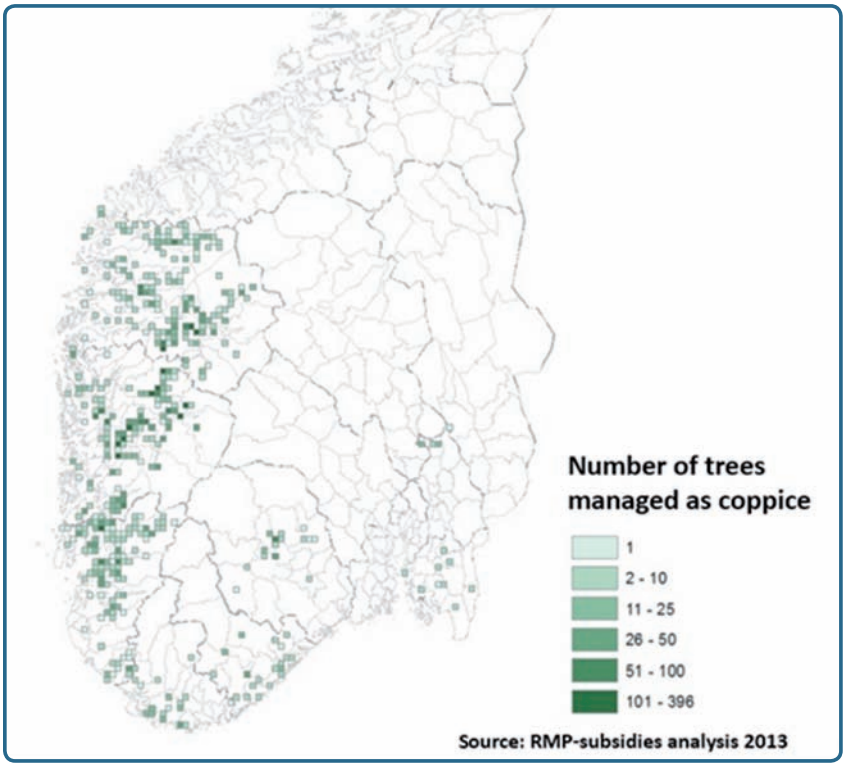
Simple coppice	Practised still in some areas as a cultural heritage. In the past bark was also harvested for tanning.
Coppice with standards	Not practised
Pollarding	Practised still in some areas as a cultural heritage for pastures or boundaries.
Short rotation coppice	Not practised

Images

Coppice managed tree: 1989 (left) and 2009 (right);
Photo by Leif Hauge and Oskar Puschmann;
Location: Arnafjord, Vik Sogn og Fjordane Norway

Year 1903; Photo taken by Anders Beer Wilse; copy of the original belonging to Norsk Folkemuseum, Hardanger, Hordaland, Norway

Map



Number of trees managed as coppice in Norway, 2013

Description

Standard coppice does not exist in Norway as the Norwegian forestry sector is essentially dominated by conifers, although, on the other hand, deciduous trees represent a very important part of the culture and a substrate for biodiversity.

Coppicing in Norway is a traditional farming practice, which was extensively used in the West Coast area. This type of practice was relevant to slightly beyond the 1900s, nowadays it is still minimally used for feeding goats.

Using this old traditional technique, farmers cut the main branches of the trees to form several shoots, this increasing the production of leaves used for feeding sheep and goat in winter and supplementing their diet.

To prevent grazing animals the cutting was performed up to two or three meters from the ground (see Images; left).

The most common types of wood were ash, linden, elm, rowan and birch. Not all had equally good nutritive value or tasted as good as the other.

The harvest in western farms was frequently executed in spring before the leaves started to grow larger. The branches were cut down and either left on site, stored or given directly to the animals. Elm and ash represented the best fodder. Leaves and thin branches were therefore cut and dried. The good quality fodder "Godlauv" from elm and ash was bundled, transported and dried on the farm ground (see Images; right).

The other types were instead dried in outlying areas bundled and hung up on the trees.

Once dried, the bundles were either put in stacks or stored in an outer storage until they were fetched home during winter.

In many localities, linden production was commonly used for the production of ropes and binding cords while other species were more commonly used as fences and along streams.

Nowadays coppicing is still performed in several counties, i.e. Akershus, Rogaland, Sogn og Fjordane and Nord-Trondelag (see Map).

This practice is maintained essentially to keep the historical value of this tradition and protect the biodiversity.

Norwegian farmers can in fact apply for a specific subsidy, which amount at about 50 Euros/tree from the Regional Environmental Program for Agriculture (RMP) for keeping and managing as coppice the deciduous trees on their properties.

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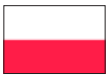
Poland



Piotr Mederski, Martyna Rosińska, Mariusz Bembenek and Zbigniew Karaszewski

Facts and Figures

Piotr Mederski

Definitions

1) Coppice: Even-aged or uneven-aged stand consisting of trees (mainly: *Alnus glutinosa* Geartn., *Betula pendula* Roth) that regenerate wholly or mainly (at least 50%) vegetatively (sprout or root shoot). After 2 years, shoots are reduced to only 2 or 3, after 5 years one shoot might be promoted to high forest and felled at 60 years.

2) Short rotation coppice: Plantation of fast-growing trees or shrubs (mainly *Populus* spp., *Salix* spp.), with the aim to produce renewable wood biomass in several short rotation periods (5-20 years each), mainly used for energy.

3) Pollarding: cuts by which the tree trunks (*Salix* spp.) are cut at 2-3 m height from the ground in order to obtain coppice sprouts on the top of the tree.

1) drzewostany odroślowe: jednowiekowe lub wielowiekowe drzewostany (głównie olsza czarna i/lub brzoza brodawkowata) odnawiane wegetatywnie całkowicie lub częściowo (min. 50%). Po dwóch latach od odnowienia pozostawia się 2-3 pędy odroslowe (pozostałe są usuwane), po 5 latach pozostawia się tylko jeden pęd, który dorasta do wieku rębności (60 lat).

2) odroślowe plantacje drzew szybkorosnących: celem jest produkcja drzew lub krzewów (głównie Populus spp., Salix spp.) w krótkich kolejach rębu (5-20 lat); drewno wykorzystywane jest jako energetyczne.

3) ogławianie: usuwanie wierzchołkowej części pnia wierzby (Salix spp.) do ok. 2-3 m wysokości od ziemi w celu uzyskania krzaczastych odrośli w górnej części pnia.

Statistics

Forests cover almost one third of Poland, of which 7,094,696 ha is under the State Forest National Forest Holding management. The total area of coppice amounts to 21,477.57 ha and almost 89% belongs to the State Forest. Coppice forests grow very often on areas of low access and are considered to be water and soil-protecting forests.

A main coppice-forming species is black alder (*Alnus glutinosa* Geartn.); the other coppice-forming species are oaks (*Quercus* spp.) and silver birch (*Betula pendula* Roth). Additionally, European beech (*Fagus sylvatica* L.), lime (*Tilia* spp.) and hornbeam (*Carpinus betulus* L.) are also used as mixed species in coppice.

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Typology

Simple coppice	Traditional natural forest regeneration used mainly for alder and oak; after 2 years only 2-3 sprouts are left; after 5 years, only one stem is left
Coppice with standards	Alder and oak
Pollarding	For willow only; landscape beautification
Short rotation coppice	Willow and poplar
Other types	Black alder; rotation period 60 years

Description

Martyna Rosińska, Mariusz Bembenek, Zbigniew Karaszewski and Piotr Mederski

Forest management in Poland is focused on a high forest system. Stands of seed origin provide timber of high quality, which corresponds with current demand from the timber sector. Forests cover almost one third of Poland, of which 7,094,696 ha is under the State Forest National Forest Holding management. Coppice forests occur in Poland very occasionally; coppice is considered a less important forest management type. The total area of coppice in Poland amounts to 21,477.57 ha and almost 89% belongs to the State Forest (Figure 1).

Coppice forests often grow on areas of low access and are considered to be water and soil-protecting forests. A main coppice-forming species in Poland is black alder (*Alnus glutinosa* Geartn., Figure 2), which is able to regenerate well vegetatively.

However, coppice trees are characterised by lower height, high tapering trunk, unilaterally formed crown and vulnerability to rotting. Due to these factors, the final felling age for vegetative alder stands was reduced from 80 to 60 years in current forest management (Maciejowski, 1953). Despite all the silviculture treatments, alder coppices are still economically less attractive and their functions are limited to forest protection and biodiversity.

The other coppice-forming species are oaks (*Quercus spp.*) and silver birch (*Betula pendula* Roth). Additionally, European beech (*Fagus sylvatica* L.), lime (*Tilia spp.*) and hornbeam (*Carpinus betulus* L.) are also used as mixed species in coppice.

Oak is the subject of special type of coppice in the State Forest, which is formed after cutting browsed seedlings (mostly *Quercus petraea* and *Quercus robur*). The low cutting is performed 3-8 years after planting the unsuccessful, browsed crop. The damaged plantation is fenced

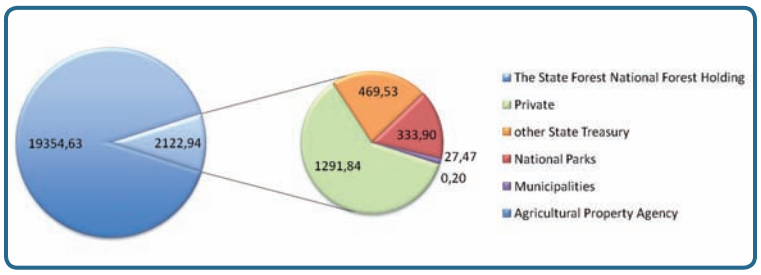

Figure 1. Coppice area (ha) in Poland by coppice owners (Bureau for Forest Management and Geodesy, 2016)

Figure 2. Black alder coppice in Pułtusk Forest District (Photo: M. Rosinska, 2015)

one year prior to the intervention. This low cut results in a rapid growth of coppice shoots, which reach about 1 m height within 1 year.

The oldest and the largest coppice area (about 3,000 ha) is located in the South of Poland, Pogórze Kaczawskie (Sudety Mountains). These *Quercus petraea* coppices were created before the Second World War. The trees were cut in a 14-year rotation period, mainly to obtain material known as mirror bark. Remaining stands create one of the rarest forest areas in Poland and are now excluded from utilisation (Szymura, 2010).

Currently, due to increased demand for renewable energy sources, short-rotation plantations of fast growing trees such as willow or poplar are being established. These plantations could be recognised as expanding coppice utilisation for energy purposes in Poland, together with a share of other (coppice) species.

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Portugal

João Carvalho, Abel Rodrigues, Helder Viana, and Mário Costa

Facts and Figures

João Carvalho, Abel Rodrigues and Helder Viana

Definitions

Coppice is a system where trees originate from vegetative or asexual reproduction. Most coppice forests have been converted into high-forest in the last decades. This has involved oaks (*Quercus faginea, Q. pyrenaica, Q. robur, Q. ilex*) and chestnut (*Castanea sativa*). The aim is to produce better timber quality and for conservation purposes. In the case of holm-oak (*Q. ilex*), many areas have been managed as a sylvo-pastoral system known as montado. The most common coppice forests in the country involves *Eucalyptus* plantations for pulpwood production. The most usual species is *E. globulus* which is grown in rotations of 10 – 12 years.

Coppice
= Talhadia

Coppice with standards
= Talhadia composta

Legal Framework

The Forest Inventory considers forests of over 0,5 ha, minimum cover of 10% and width larger than 20 m. In general, there are no restrictions on clearfellings or on harvesting age. However, some natural parks might put some restrictions for certain species. Restrictions consider size of clearcuttings for species that are relevant for conservation and protection purposes (mostly oak species). Some species are protected by law in respect to harvesting. Cork-oak (*Quercus suber*) and holm-oak (*Q. ilex*) cannot be pruned or harvested without permission from the official authority (Institute for Nature Conservation and Forestry). In relation to forest establishment densities, there are some minimal densities if the afforestation is supported by a financed project. It depends on species: Pine and other conifers 1000 trees/ha; *Pinus pinea* (fruit) 200 trees/ha; broadleaves 600 – 800 trees/ha; cork-oak and holm-oak (sylvo-pastoral system) 250 trees/ha. Forest areas affected by fire cannot be used for another purpose (e.g. construction) and must be forested.

Short rotation coppice is considered in those cases where the rotation is between 2 – 5 years. In Portugal, short rotation coppices are not common.

Statistics

The coppice area is estimated around 863,000 ha. The *Eucalyptus globulus* area tended for pulp production, with a rotation period of 12 years, occupies an area of a 812,000 ha or ~ 26 % of total forest area (3,154,800 ha). Other types of coppicing have much longer rotation periods, such as oaks, *Castanea sativa* (20-50 years; eventually converted to high forest on a significant scale), as well as ash and poplar (20 year rotation), which are produced for timber.

Reference

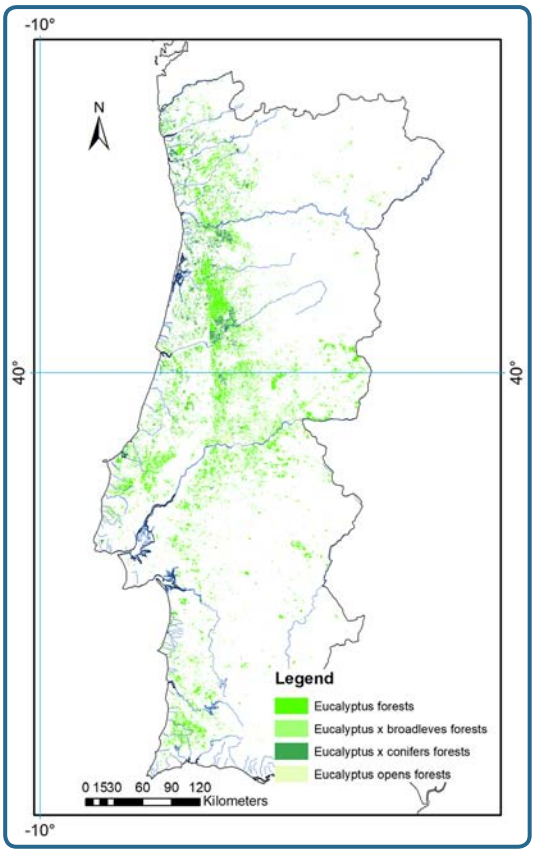
ICNF, 2013. *IFN6 - Áreas dos usos do solo e das espécies florestais de Portugal continental. Resultados preliminares*. Instituto da Conservação da Natureza e das Florestas, Lisboa 34 pp.

Typology

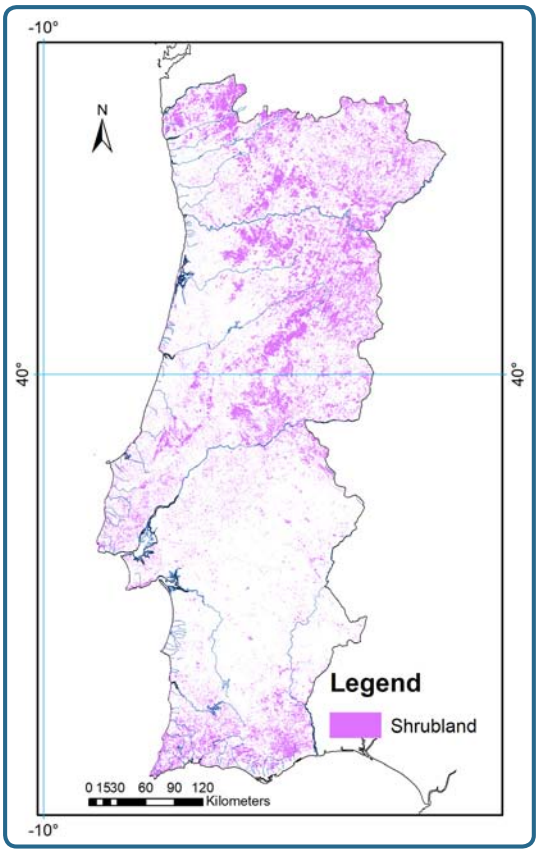
Simple coppice	*Eucalyptus* is the most common type of coppice forest in the country. The most usual species is *Eucalyptus globulus*, which is grown for pulpwood production. Areas with chestnut consist mostly of orchards for fruit production. Only small areas exist with coppice that was used in the past for the production of small sized wood. Some oak species are coppiced (*Quercus faginea, Q. pyrenaica, Q. robur, Q. rotundifolia*) for the production of firewood. Holm-oak (*Q. rotundifolia*) is the most common oak species used as coppice. Most coppice has been converted to high-forest for quality timber and conservation purposes.
Coppice with standards	*Castanea sativa, Quercus faginea, Q. pyrenaica, Q. ilex* subsp. *rotundifolia*
Pollarding	Pollarding may be found in some areas, mostly with ash (*Fraxinus angustifolia*) and poplar (*Populus nigra*)
Short rotation coppice	Hardly practised

Maps

Helder Viana and Abel Rodrigues



Map of the current extent of *Eucalyptus globulus* in Portugal; most of this species is coppiced



Map of shrubland in Portugal; this area has the potential to be converted to simple coppice

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Description

João Carvalho, Helder Viana and Abel Rodrigues

Coppice is a silvicultural system that has been commonly used in Portugal for centuries. It produces a range of small and medium sized materials, such as firewood, poles, charcoal, raw material for basketry and cooperage, on short (10 to 30 year) rotations. It is one of the oldest forms of management in semi-natural forests.

Different types of coppicing, with regeneration by stool shoots, has been practiced for many species, such as common oak (*Quercus robur*), Pyrenean oak (*Quercus pyrenaica*), Portuguese oak (*Quercus faginea*), holm-oak (*Quercus rotundifolia*), chestnut (*Castanea sativa*), ash (*Fraxinus spp.*), poplar (*Populus spp.*), willow (*Salix spp.*) and eucalypt (mainly *Eucalyptus globulus*).

While coppicing of some species has declined over the years, eucalypt coppice, grown on 10 to 12 year rotations for pulpwood production, has expanded enormously in recent decades. *Eucalyptus globulus* (Fig. 1) is now dominant over approximately 812,000 ha (National Forest Inventory, 2013) and, as this is 26% of the total forested area of the country, it is currently the main Portuguese species. *Eucalyptus* makes up nearly 94 % of the total area in coppice management.

Most of the other formerly coppiced species have been converted into high forest. Most common oak (*Q. robur*) occurs as high-forest with coppice retained only in small patches. Pyrenean oak (*Q. pyrenaica*) forests have been improved to high-forest for quality timber production and conservation purposes (Carvalho and Loureiro, 1996). Oak forests are very rich ecosystems and in some regions are important for the survival of rare and threatened plants. Silvicultural practices have been used to improve tree growth and so the production of better quality, larger dimension wood. Portuguese oak (*Q. faginea*) was previously coppiced for firewood and charcoal, but nowadays coppicing this species is not common. There are residual patches of holm oak (*Q. rotundifolia*) in the north and center of Portugal, maintained to produce firewood and charcoal. The southernmost holm oak areas are now part of a silvo-pastoral system known as montado, where trees and livestock husbandry activities are combined. The majority of chestnut (*Castanea sativa*) is in orchards for nut production. Only small areas exist for wood production and there is little coppice.

The coppice rotation for oaks (*Q. faginea, Q. pyrenaica* and *Q. robur*) varies between 10 and 30 years, depending on the species, site quality and final tree diameter. Previously, coppice had many uses, but during recent decades much has been abandoned and converted into high-forest (Carvalho and Loureiro, 1996). Nowadays, only a few oak coppices are maintained for firewood production. In certain areas, it is common to find oaks as small groups and at the edges of fields. Generally they have a secondary production role, forming a reserve to meet occasional needs (e.g., firewood, poles). Some of these areas are also managed for biodiversity, conservation and soil protection.

Pollarding may be found in some areas. Traditionally oak (*Quercus spp.*) and ash (*Fraxinus angustifolia*) foliage was cut for cattle feed, in rotations of 2 to 4 years; this is not common nowadays.

As result of the strategy for climate change mitigation and for secure energy supply (European Commission, 2014), European Union members have been implementing projects for energy production from biomass (e.g. Viana et al.,

2010). The biomass needed by the power plants will generally be supplied from forest residual biomass, but this can be complemented by short rotation woody crops, specifically grown for their energy value. Coppice systems work well with short rotations to produce wood for energy from species such as willows, poplars and eucalypt, as well as lignocellulosic crops such as reed canary grass (*Miscanthus*) and switch grass. Currently, short-rotation coppice (SRC) to produce raw material for energy purposes is very scarce, but several studies are in progress. According to some evaluations there is a potential for these to be used in Portugal, primarily on abandoned, previously agricultural land, (Abel, 2012). These SRC plantations would involve eucalypt (mostly *E. globulus, E. maideni* and *E. camaldulensis*) and poplar (*Populus x euroamericana* clones) in rotations of 3 to 5 and 2 to 3 years, respectively. Yield may range between 8 and 40 tons dry weight ha^{-1} $year^{-1}$ for eucalypts (85% stands between 8 and 30) and 8 to 20 tons dry weight ha^{-1} $year^{-1}$ for poplar.

Figure 1. Eucalypt (*E. globulus*) coppice stands in Portugal

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Forestry Regulations

Abel Rodrigues, Mário Costa and Helder Viana

The forest public service was first institutionalized in 1824, under the aegis of the Navy Ministry, with the creation of the **Royal Forest Administration**, which was subsequently transferred to the Ministry of Industry, Trade, and Public Infrastructures. In 1886, the first public institution was created, which aimed to reforest the Gerês and Estrela Mountains in Northern Portugal. In 1901, the forest regime code was implemented in a law that included the main legislation concerning the forest sector. In 1919, the **Forest Services** were put under the General Direction of Aquaculture and Forests (DGRFA), which developed forest engineering works such as torrent mitigation and the forestation of coastal dunes through the **Law of Forest Settlement** in 1938. Nowadays, the Forest Service's Extension is consolidated within the **Institute for Conservation of Nature and Forests** (ICNF), resulting from

the merger of the former Nature Conservation Institute, part of the Environment Ministry, with the General Direction of Forest Resources from the Agriculture Ministry.

In Portugal, the forest area occupies about 35% of the territory (3.2 Mha), with an additional 1.5 Mha occupied by shrubland. Historical circumstances have dictated that more than 90% of the forest area is in private ownership, a very high percentage compared with privately-owned forest areas in other countries, e.g. 70% in Spain, Finland and Sweden; an average of 60% in the EU 27 countries; 55% in the USA and 8% in Canada. The main forest species in Portugal are managed or are potentially manageable under the coppice regime. Indeed, nowadays, the main forest species is eucalypt (*Eucalyptus globulus*) with an area of 812,000 ha, managed intensively as coppice for pulp production. These coppices run for 4 or 5 rotation cycles, with 8-12 years per cycle. On burnt sites, the ability of eucalypts to re-sprout from stumps enables their partial recovery. After maritime pine (*Pinus pinaster*) high forest, grown only for wood production, the third species in terms of area occupied is cork oak (*Quercus suber*), with 730,000 ha, followed by holm oak (*Quercus rotundifolia*), occupying around 330,000 ha. Other oaks (*Quercus faginea; Quercus rotundifolia; Quercus robur; Quercus pyrenaica*), and chestnut (*Castanea sativa*) cover around 66,000 ha, and 40,000 ha, respectively. The latter species is mainly managed for fruit as high forest, but an area of around 3,000 ha of chestnut is managed as coppice for wood production.

The aforementioned forest regime code of 1901 was replaced by the **Forest Code** under a law of September 2009, but revoked in 2012. Nowadays, in addition to the 1901 regime, forestry legislation includes the following:

- 1996 law on the basis of national forest policy;
- legislation from 1999 and 2009 concerning regional forestry plans (PROF),
- plans of forest management (PGF)
- specific plans of forest intervention (PEIF), which can be adapted to county, district and national levels
- legislation from 2001 for the protection of cork oak and holm oak
- legislation from 2005 on forest intervention zones (ZIF)
- regulation from 2013 on the juridical regime of forestation and reforestation.

The **National Strategy for Forests** (ENF), approved in 2015, is a vast document emphasizing biotic and abiotic risks in forestry, the economic relevance of the main forestry clusters and forecast scenarios of resource allocation and forest diversification until 2030. In 2017, the urgent need for reform in the forest sector, stimulated by political pressure to control forest fires, resulted in 13 legislative acts, with three awaiting ratification.

These **new acts enhance and complement previous forest legislation** with regard to the following relevant topics:

(i) The ENF, reviewing estimates of scenarios for climate change in Portugal, suggested a **reduction of the area suitable for eucalypts** leading up to the end of the 21th century. Taking into account the versatility of this species for production of goods and services, the ENF came up with a proposal to stabilize the actual area of 812,000 ha until 2030. In this context, legislation in 2017 imposed a strict control of eucalypt forestation, limiting the expansion of eucalypt coppices and allowing new plantations only in compensation for former areas of eucalypt previously abandoned, on condition that these abandoned areas should be cleared and left in a suitable condition for either agricultural or forest use. Moreover, if the total eucalypt area surpasses the ENF's threshold, an intervention

for reducing the total area is made, prioritising projects or stands abridging existing eucalypt areas higher than 100 ha.

(ii) the establishment of the so-called **Entities of Forest Management** (EGF), i.e. corporations of forest owners or private agents operating within a specific juridical regime, aiming to manage forests larger than 100 ha, wherein 50% of land assets should consist of areas smaller than 5 ha. The main objective is to promote professional management in small forest properties, creating economies of scale under good practice codes, which allow for economic and sustainable feasibility of the available land assets to be achieved. In this context, the EGF is entitled to fiscal benefits and other forms of public support.

(iii) simplifying the process of establishing **forest intervention zones** (ZIF), defined in 2005 as continuous and delimited areas, subject to a plan of forest management approved by ICNF. Also, if necessary, ZIFs can define specific plans of forest intervention, regulated by ICNF, aimed to control biotic or abiotic risks such as soil erosion, biodiversity, phytosanitary conditions or fire protection. ZIFs are managed by a single private entity, with the necessary technical expertise and a commitment to follow the guidelines and objectives established for the ZIFs, scrutinized by the forest owners' council. Legislation in 2017 simplified the creation of ZIFs, establishing both maximum and minimum areas of 20,000 ha and 500 ha respectively, with no more than 25 necessary associates and 50 forest land properties within each intervention zone. There were provisions for consolidating forest properties from different counties. The ZIFs are covered by fiscal benefits that consider the specific kind of goods and services delivered by forests and agro-forest farms and the long-term returns from forest investment. The philosophy of the ZIFs and EGFs was to consider the prevalence of small private forests and to provide incentives for amalgamating forest and agro-forest farms and to promote professionalization in forestry and forest management.

(iv) the 2017 legislation changed the **juridical status of regional forestry plans** (PROFs), by delegating to municipal authorities the capacity to intervene on soil use, by transferring of some elements of the regional forestry plans to Municipal Directory Plans (PDMs). Municipalities will henceforward be able to include mandatory forestry components in their PDMs. Legislation of 1996 and 1999, actualized in 2009, allocated to ICNF the responsibility of forest planning. The objective was to establish a continuous process of decision-making over the use and conservation of forest areas and resources and to achieve medium and long term targets laid down in national strategies, particularly the National Strategy for Forests (ENF). Forest planning was designed to operate at three levels:

1) regional or supra-municipal, where the PROFs are elaborated in coordination with other public priorities of the regions

2) local, where plans for forest management (PGF) are coordinated with local practices of forest management

3) at a lower operational level, through specific plans for forest intervention (PEIF), dealing with local constraints such as biotic and abiotic risks, recovery of degraded soils, forest diseases, forest fires and improved water retention.

The preparation and execution of PGFs is obligatory in situations such as:

- public and community forests or agro-forestry farms,
- private forests or agro-forestry farms with areas equal or greater than those defined in the respective PROFs,

- candidate forest or agro-forestry farms for national or EU financial support, aimed to benefit forest production and commercially valorize the ZIF areas.

In the latter context, forest owners and economic agents who are committed to PGFs within ZIFs are exempt from the obligation of making their own PGF.

From 1996, national forest policy laws strictly regulate the cutting of trees, so that forest owners must communicate to ICNF the type and extent of scheduled tree cuttings. The **juridical regime of forestation and reforestation** of 2013 (RJAAR) requires forestation and reforestation operations with forest species be referred to ICNF. This legislation controls and evaluates forestation and reforestation operations that do not apply to urban or transport matters, which are regulated by other legislations. The RJAAR also exempts control operations in areas of less than 5000 m^2, with a width greater than 20 m.

Portugal is the premier cork producer in the world; the cork oak stands are traditionally managed as high forest, although the coppicing system operates in other Mediterranean countries. Indeed, as early as 1950, "Subericultura (Cork oak cultivation)", the *magnum opus* of Vieira de Natividade, promoted the environmental advantages of cork oak and holm oak coppice in protecting soil, using cycles of 10-15 years. This is no minor issue in the southern part of the country, where low fertility soils are prone to erosion; cork oak coppicing is then directed towards biomass production with a theoretical density of about 1000 stumps/ha.

The legislation concerning cork oak and oak dates from 2001; it allows for the conversion to coppice from high forest when thought necessary for technical and environmental reasons. Noteworthy additions to this legislation emphasize the need to protect these indigenous species, citing definitions of stand density (number trees/ha): 50 trees/ha for trees taller than 1m, with a perimeter at breast height (dbh) of less than 30 cm; 30 trees/ha, when the average dbh is between 30 cm and 79 cm; 20 trees/ha, when the average dbh of the trees is between 80 cm and 129 cm; and 10 trees/ha, when the average dbh is greater than 130cm. These trees can be rejuvenated when new poles grow from the stumps. An authorization from the ICNF is mandatory when cutting cork oak or holm oak trees, including thinning, which must be registered within a period of 30 days. Conversion from high forest to coppice, or phytosanitary pruning, also needs prior authorization. In cork and holm oak stands, deep soil cultivation is forbidden since it may affect tree root systems and natural regeneration. Soil cultivation is also prohibited on slopes between 10% and 25%, and also above 25% if not carried out along the contour lines. Among the remaining forest species (e.g. *Quercus pyrenaica* and chestnut) that are manageable as coppice, these are candidates for the necessary diversification of the Portuguese forest landscape. These species are subject to the common principles and objectives of the National Strategy for Forests, which aims to protect forest species with special ecological importance and vulnerability.

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Romania

Valeriu-Norocel Nicolescu and Cornelia Hernea

Facts and Figures

Valeriu-Norocel Nicolescu

Definitions

(1) Coppicing (regeneration method) is the general way of managing a forest, based on vegetative propagation (Forest Law, 2015).

(2) Simple coppice (low coppice) - silvicultural system in which the old stand is exploited at young ages (under 30-40 years) by clear-felling, and the regeneration is accomplished by stump stools or root suckers.

(3) Pollarding - cuts by which the tree trunks are shortened at 2-3 m height from the ground, to avoid the death by asphyxiation of the cut trees during flooding.

(4) Coppice with standards - intermediate regeneration method, between the two fundamental ones (coppice and high forest), in which the regeneration is accomplished by both seed and stools.

(1) Regimul crângului constituie modul general de gospodărire a unei păduri, bazat pe regenerarea vegetativă (Codul Silvic, 2015).

(2) Crâng simplu - tratament prin care arboretul se recoltează la vârste tinere (sub 30-40 ani) printr-o tăiere rasă, iar regenerarea se face prin lăstari sau drajoni.

(3) Crâng cu tăiere în scaun - tăieri prin care tulpinile arborilor se scurtează de la înălțimea de 2-3 m de la sol, pentru a feri suprafețele tăiate de asfixie în timpul inundațiilor.

(4) Crâng compus - regim intermediar între cele două regime fundamentale (crâng și codru), în care regenerarea se face atât din sămânță, cât și din lăstari.

Legal Framework

In all Romanian forests, the only legal regeneration method (regime) is high forest.

The only forests in which coppicing is allowed consist of native poplars (black and white), willows, black locust, as well as alluvial forests (pure or mixed willow and/or poplar stands) (Forest Law, 2015).

Rotation Period

Black locust stands: from 20 years (5th yield class) to 35 years (1st yield class);

White willow: from 15 years (5th yield class) to 30 years (1st yield class)

Statistics

Coppice (low) forests cover only about 5% of national forestland.

Typology

Simple coppice	Legally performed only in black locust, native poplars (black and white) and native willow stands; size of logging areas: maximum 3 ha
Coppice with standards	Forbidden since 1948
Pollarding	Performed in white willow (*Salix alba*) stands along the Danube and major inner rivers
Short rotation coppice	Practised on a small scale, only for willows and hybrid poplars

Images

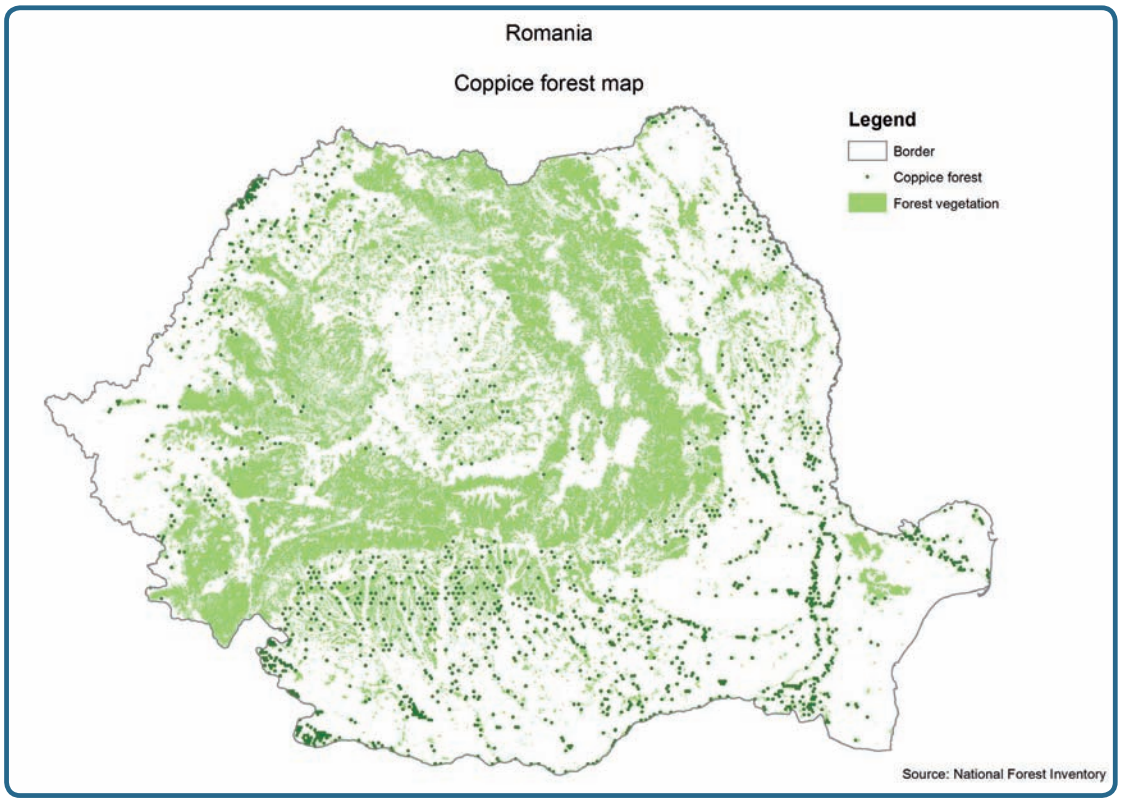
Low coppice, linden; since converted to high forest

Pollarding

Willow clone treated as short rotation coppice

Map

Valeriu-Norocel Nicolescu



Map of coppice forest (dots) and forest vegetation (green) in Romania
Source: National Forest Inventory of Romania, 2017

Description

Valeriu-Norocel Nicolescu and Cornelia Hernea

Coppice forests have always been a major component of Romanian forest land as:

- the forests are historically dominated by broadleaved tree species, mainly oaks (e.g. sessile, pedunculate, Turkey, Hungarian, pubescent) and European beech, but also maples, ash, hornbeam, lindens, alders, poplars, willows, etc. Although their share has decreased in the past two millennia due to human transformations, broadleaves still cover over 70% of the national forest land.
- the country has one of the highest rural populations in Europe; this is still true despite its decrease from 89% in the mid-19th century to about 46% at present.

Before the nationalisation of all forests at the end of the Second World War and beginning of the Communist period, coppice forests covered important areas in Romania: 1.9 million ha (30% of forest land) of simple coppice in 1948 (Costea, 1989), over 0.229 million ha (3.5% of forest land) of coppice-with-standards in 1928 (Ionescu, 1930). In 1948, the application of coppice-with-standards was completely forbidden, with all coppice forests of this kind being converted towards high forests. Owing to the same process of conversion, the share of simple coppice in Romanian forests has continuously decreased so that they currently cover only 5% of national forest land. According to the current Forest Law (2015), the simple coppice system can be applied only to native poplars (i.e. black, white), willows in floodplain areas, and black locust forests. Yearly, approximately 3,500-4,500 ha of simple coppice stands are harvested in Romania (www.insse.ro); the maximum size of coppice areas is 3 ha.

The application of coppice forest management in Romania is also possible in the floodplain willow forests, which are pollarded (high coppiced) with a rotation of (15) 20 to 30 (35) years when targeting the production of sawn timber. Logging areas in pollard stands are located perpendicular to the watercourses (Figure 1), with a size of maximum 10 ha. The rotation of cutting in pollarding is annual.

Since 2005, the application of short rotation coppice management has started in Romania exclusively on agricultural, non-forest land. Currently over 800 ha of willow cultures, as well as ca. 1,000 ha of poplar cultures have been established.

Coppice forests, mostly of black locust (the species covers over 250,000 ha) are a major supplier of firewood in many rural areas of Romania. They are also important for the protection of river banks (poplars and willows), on sandy soils (black locust), in the honey-related industry, etc.

Since about 800,000 ha of Romanian forests, consisting mostly of broadleaved tree species with a high potential for vegetation reproduction, are owned by over 700,000 small forest owners (average size of forest estate 1.1 ha), the management of such lands as high forests, which is mandatory according to the legal requirements, is a major challenge in technical

Figure 1. Pollards of white willow are a characteristic feature along the banks of Danube River.

and economic terms. Unfortunately, there is no political commitment for re-defining their economic/ecological targets and re-converting these forests into simple coppices or coppice-with-standards, which would affect the ownership rights, as well as the freedom to manage them in a more dynamic and profitable way.

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2015. Codul silvic.

Forestry Regulations

Valeriu-Norocel Nicolescu

Legal framework in relation to coppice

1. Law no. 133/2015 for the modification of Law 46/2008 (Forest Law)

Art. 28:

(2) The high forest regeneration system is applied to the regeneration of all forests.

(3) The exception from (2): stands of native poplars (black, white) and willow, in the floodplain areas, and black locust stands, where the application of a coppice regeneration system is allowed.

Art. 29:

(1) The size of clear-cutting (including coppice) coupes is a maximum of 3 ha.

2. Ministry of Waters, Forests and Environmental Protection 2000: Technical norms for the choice and application of silvicultural systems 3 (*Norme tehnice privind alegerea si aplicarea tratamentelor 3*). Ministerul apelor, padurilor si protectiei mediului, Bucuresti, 78 pp.

Low coppice

Its application is only allowed in native poplars, willow stands in the floodplain areas and black locust stands.

Regeneration is by coppice stools or root suckers.

Cutting is only during the dormant season, preferably close to its end.

Size of coupes: max. 3 ha. Interval between the cuttings in the same compartment: 2-3 years.

Cutting with axes (tree diameters less than 15 cm) or a saw (larger diameters or stools originating from old stumps); maximum height of stump is 5 cm.

The variant with regeneration by root suckers, after the removal of stumps and levelling of the ground: not allowed in sites with mobile sand dunes and with erosion problems.

After 3-4 generations of coppice (by stump stools), the stumps are removed and replaced with plants to avoid the degradation of low coppices.

Pollarding

The system is used for willow stands affected by repeated flooding, i.e. in the Danube Delta and Danube floodplain area.

Stumps are cut high, above the highest flooding levels over a long chronosequence, to avoid the stump being covered by the flood waters.

The old high stumps are removed after 2-3 generations of pollards and replaced by plantations with seedlings or rods (tall cuttings).

Size of annual coupes: 10 ha. Rotation of cuttings in the same compartment: 1 year.

Arrangement of coupes: perpendicular to the watercourse.

Coppice selection system

Can be adopted experimentally in some small-sized black locust stands, in stands located on ravine banks or on degraded lands.

Can be taken into account in small-sized private forests.

Note: even though it's part of the technical norms, this system is NOT included into the table used to choose the silvicultural systems for different forest vegetation formations/types!

3. Ministry of Waters, Forests and Environmental Protection 2000: Technical norms for forest management 5 (*Norme tehnice pentru amenajarea padurilor*). Ministerul apelor, padurilor si protectiei mediului, Bucuresti, 163 pp.

They include:

(i) Calculation of annual allowable cut for management units treated as coppice: for black locust stands (10-year period), as well as native poplar (black, white) and willow stands (5-year period).

(ii) 10-year management plans for:

- exploitable coppice stands, reaching the rotation age (coppice cuttings)
- non-exploitable or pre-exploitable coppice stands, with tending operations
- coppice stands to regenerate artificially.

(iii) Rules for converting coppice forests to high forests:

- conversion by coppice ageing (total cessation of coppice cuttings)
- conversion by coppice replacement and planting

(iv) Technical rotation age in stands/compartments treated as coppice, depending on the species and yield class:

Species	Technical rotation age per yield class...				
	I	II	III	IV	V
Black locust	35	30	25	25	20
Native poplars (black, white)	35	35	30	25	25
Willow (pollard)	30	25	20	20	15

(v) Intensity of thinning (% of standing volume) in coppice stands with canopy cover 90-100%, depending on the species and mean stand age:

Species	Mean stand age (years)	
	11 - 20	21 - 30
	Thinning intensity	
Black locust	35	35
Native poplars (black, white)	30	25

Serbia

Milun Krstić and Nenad Petrović

Facts and Figures

Milun Krstić and Nenad Petrović

Definitions

Coppice forest is a traditional silvicultural form that involves repetitive felling on the same stump, near to ground level, and allowing the shoots to regrow from that main stump or roots. Coppice forests in Serbia can be grouped into three categories based on their productivity: good productivity on a good site; low productivity on a good site; and low productivity on a bad site. Most common are productive coppice stands with valuable wood quality on a good site. The main silvicultural strategy in such coppice stands is indirect conversion towards high forest. Maximum rotation period is 80 years. Coppice is an important asset for private forest owners, especially for a regular supply of fuelwood from their small forest lots. The most abundant species are oak and beech.

Izdanačke šume – panjače su su uzgojni oblik šume obnovljene vegetativnim putem, kada su se nova stabla razvila iz panjeva ili žila posečenih stabala. Izdanačke šume u Srbiji se mogu grupisati prema produktivnositi u sledeće kategorije: Dobre na dobrom staništu, loše na dobrom staništu i loše na lošem staništu. Najzstupljenije su dobre izdanačke šume na dobrom staništu. Glavna mera u toj kategoriji izdanačkih šuma je indirektna konverzija sa ciljem dobijanja visokih šuma. Maskimalna ophodnja u izdanačkim šumama je 80 godinaIzdanačke šume igraju važnu ulogu u redovnom snabdevanju privatnih šumovlasnika ogrevnim drvetom za sopstvene potrebe. Najzastupljenije vrste su hrast i bukva.

Gajenje šuma – konverzija, melioracija i veštačko obnavljanje, 2006

Legal Framework

There is no direct legal framework, but coppice is mentioned in the classification of forests in the Regulation of the Ministry of Agriculture, nr. 453/2006 (coppice and high forest originated from coppice). Coppice is a stand of deciduous trees with re-sprouting ability from roots and tree stools, predominantly in the oak forest vegetation zones.

VÝMLADKOVÝ LES. Výmladkový les tvoria listnaté porasty obnovované koreňovou a pňovou výmladnou schopnosťou, väčšinou v oblastiach dubového vegetačného stupňa.

In the Forest law, 2016:

1. Coppice forest is a stand of coppice origin that has not overgrown the size of a pole stand. In coppice forests, the marking of trees is not mandatory.

2. Short rotation coppice is only allowed on agricultural land.

Statistics

Coppice stands occupy 1,456,400 ha, which is 64.7% of the total forest area. They are predominantly oak (42%) and beech (21%). Most coppice forests are in private ownership with 61.4%. The most common are preserved coppice stands with 76.3%. The share of insufficient stocked coppice stands is 21.3% over the area. Devastated coppice stands represent 2.4%. There is an unfavourable age structure: young (10%), middle-aged (78%) and mature (12%).

Source: National forest inventory of the Republic of Serbia, 2009

Typology

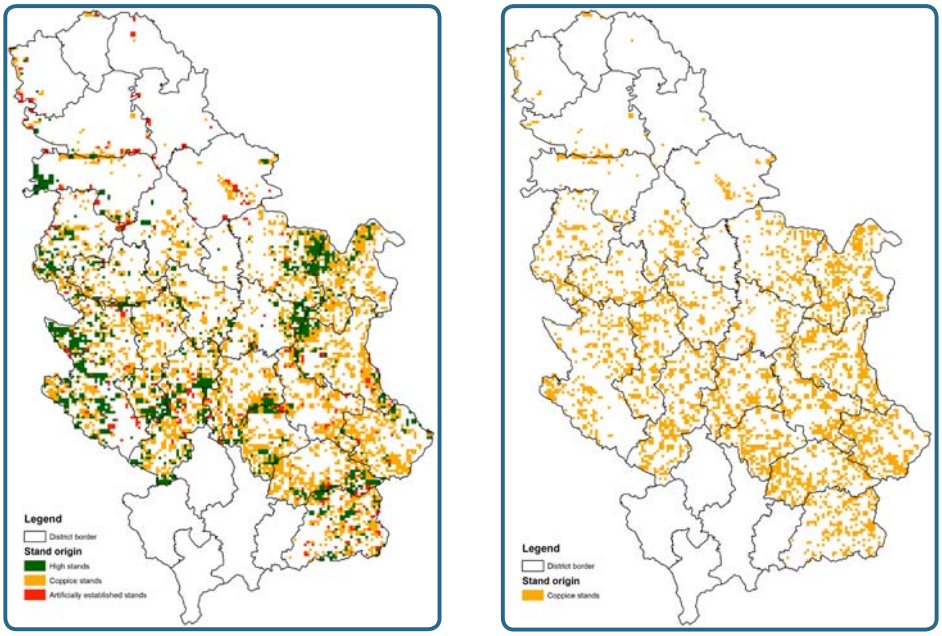
Simple coppice	Traditional natural regeneration methods
Coppice with standards	*Fagus* spp., *Quercus petraea, Q. cerris, Q. frainetto, Carpinus* spp.
Pollarding	Very rare
Short rotation coppice	*Salix* spp.
Other types	False coppice: *Fagus* spp., *Q. petraea, Q. cerris, Q. frainetto*; Very productive. This coppice type is scheduled by planning documents to be converted into high forests Preserved coppice: Dense to complete canopy (1.0-0.6), good health and good-quality trees, there is a favourable ratio of principal and minor tree species. Insufficiently stocked coppice: Incomplete canopy (0.4-0.6), good health and good-quality trees, but a less favourable ratio of principal and minor tree species. Devastated coppice: Characterised either by broken canopy (below 0.4), or by poor tree health and quality, or completely unfavourable tree species ratio (favouring of minor species).

Images




Map

Nenad Petrović



Maps of coppice forests in Serbia (orange); compared to high forest (green) and artifically established stand (red) on the left and coppice on its own on the right (Data: National forest inventory of the Republic of Serbia, 2009)

Description

Milun Krstić

The dominant form of silviculture in Serbia is coppice forests and they make up 1,456,400 ha, or 64.7% of the country's land area, and 50.0% of the forest volume. Most of the coppice forests, 61.4%, are in private ownership; 48% of those are dominated by oak and 25% by beech. The distribution of coppice forests by surface area is as follows: preserved coppice stands 76.3%, under-stocked coppice stands 21.3% and devastated coppice stands 2.4% (NFI 2009). Volume per hectare in preserved coppice forests is 133.0 m^3 ha^{-1}; under-stocked 102.7 m^3 ha^{-1}; devastated 42.5 m^3 ha^{-1}. The age structure in the coppice forests is not favourable with the proportion of young, middle-aged and mature being 10:78:12. Coppice forests classified as energy coppice forests are not recorded as such in Serbia. Coppice forests produce a variety of products from small poles, used for fuel, to larger timber, etc.

The silvicultural methods used are those considered close to nature, in other words promoting permanently sustainable and economically justified activities, limited and conditioned by natural processes. Selection and application of suitable silvicultural or ameliorative methods depend on the precise degree of forest degradation (production, quality, condition, composition, origin, etc.) and the habitat and site conditions (the degree of degradation of soil, etc.), based on scientific criteria.

Figure 1. A typical example of coppice in Serbia

Precise silvicultural measures appropriate for application to coppice are divided into the following basic groups:

- Quality coppice forests of valuable tree species and preserved habitat: *Indirect conversion* into high forest. Young stands are extensively cultivated in the respective stages of development; at maturity they shall be naturally regenerated. According to Forest Law, harvesting cannot take place before the trees are 80 years of age.
- Where forests have been degraded then *direct conversion* processes should be applied, with the land preserved and the degraded forests removed. Amelioration is carried out either by artificial restoration of the same species (restitution) or, where stands and habitats are degraded, planting of appropriate species of trees that can grow successfully under such conditions (substitution).

Where stands are unequally degraded over the site area then the amelioration procedures of indirect methods of conversion, restitution and substitution, can be combined.

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Slovakia

Alexander Fehér

Facts and Figures

Definition

Coppice is a stand of deciduous trees that have the ability to re-sprout from roots and tree stools, predominantly in the oak forest vegetation zones.

VÝMLADKOVÝ LES. Výmladkový les tvoria listnaté porasty obnovované koreňovou a pňovou výmladnou schopnosťou, väčšinou v oblastiach dubového vegetačného stupňa.

Legal Framework

There is no direct legal framework, but coppice is mentioned in the classification of forests in the Regulation of the Ministry of Agriculture, nr. 453/2006. The classifications are coppice and high forest originating from coppice.

Statistics

The extent of coppice forests in Slovakia is 34,463 ha (1.8 % of the total forest area), as well as 76,216 ha (3.9 %) of high forests originating from coppice in the first generation (the latter category is according to the Country Act nr. 453/2006, §19). The area of traditional coppice is decreasing due to conversion to high forest; in 1920 there were still 208,438 ha of coppice. The Slovak legislation does not count on having a significant amount of coppicing in the future.

A total area of SRC on forest land of Slovakia is 520 ha; the potential area for SRC on forest land is 15,000 ha. According to estimations of the National Forest Centre, the theoretical potential for SRC on agricultural land in Slovakia is 45,000 ha (however currently there are only about 150 ha of SRC).

National Forest Centre. 2011. *Národný program využitia potenciálu dreva Slovenskej republiky (National program of wood utilization potential in Slovak Republic)*. Online: http://www.nlcsk.sk/nlc_sk/papvpdsr/n5ndur.aspx

Typology

Simple coppice	Traditional natural forest regeneration method, recently limited use only, in black locust, oak, hornbeam, beech, alder, willow and poplar forests
Coppice with standards	Oak, rarely others
Pollarding	Historically; now rarely on roadsides or in yards & parks; willow, mulberries
Short rotation coppice	Willow, poplar
Other types	Coppice in conversion to high forests (oak-hornbeam, beech etc.)

Description

Species used in different types of coppice are *Quercus cerris, Quercus petraea* agg., *Carpinus betulus, Fagus sylvatica* and *Robinia pseudoacacia*. The most accepted type of coppice management is coppice with standards. Rotations of *Quercus* coppice stands are (or

were) 20-40 years, with the cutting season in winter. Pollarding was historically common, but is now only carried out by individuals, often illegally, and mostly practiced with *Salix*, although previously both *Morus* and *Robinia* were pollarded. In the 19th century, oaks were pollarded in e.g. the Upper Nitra region.

After beech, oaks are the most important deciduous woodland trees in Slovakia; it is, however, usually more difficult to restore than the former. Oak forests are unstable and their abundance fluctuates depending on human activities, but when they are coppiced, it usually increases plant diversity. Oak stands are light-demanding (if there are no clearings created, the oak seedlings die in the shade) and without traditional coppicing, preventing full canopy closure and the dominance of shade-demanding species, the oaks decline. Hornbeam, which is more shade tolerant, can proliferate and create a shrub layer under the oak overstorey that suppresses oak seedlings. In places where foresters removed hornbeam as a 'weed' tree, forests were light and this led to a vigorous herb layer with weeds, grasses and shrubs, which also prevented effective natural regeneration of oak from seed. Therefore, the best way to support the oak is likely to be by coppicing, but this requires further study to provide evidence to counteract currently fashionable views and opinions that are not always based on facts. Reduction of oak cover was also caused historically by the planting or spontaneous growth of other, often invasive species, especially *Robinia pseudoacacia*.

Coppice forests are considered an important part of the landscape pattern, requiring protection, and the NATURA 2000 areas include 10 coppice forest types (91G0*, 91H0*, 91I0*, 91M0, 9170, 9180*, 9110, 9130, 9140, 9150) although the 'best practice' manuals do not recommend future coppicing, except for habitat 9180*. In the context of nature conservation, decision making is a challenge. It is unclear whether forests should be preserved by less intensive management, although this risks oak decline, as well as light demanding components of the herbaceous layer or, alternatively, whether forests should be managed more intensively, even in protected areas, so there would be more light and the rare (and often protected) species would be retained. Furthermore, drier areas require simple management with thinning, while wetter forests require more frequent management.

Regulations do limit the planting of new black locust (*R. pseudoacacia*) forests, but they are not registered on the official list of invasive plant species (Regulation of the Ministry of Environment SR Nr. 158/2014).

The Slovak legislation does not include coppicing in future plans and there is no clear regulation of coppice management.

Short rotation coppice (SRC) is a new challenge. The total area of SRC on Slovakian forest land is 520 ha, although the potential area is 15,000 ha. The anticipated annual production is 10 t per ha of dry matter. According to estimates by the National Forest Centre, the theoretical potential for SRC on agricultural land is 45,000 ha, although currently there is only about 150 ha on agricultural land. The main tree species used in SRC are *Salix* and *Populus*. Rotation time is three (*Salix*) to twenty (*Populus*) years, with expected annual yields of 12 to 18 t fresh biomass per hectare (6 to 10 t dry matter under good conditions and management).

Figure 1. Aged coppice forest: *Quercus petraea* and *Q. dalechampii* at Nitra (SW Slovakia) (Photo: A. Feher)

Slovenia

Nike Krajnc, Matevž Mihelič and Anton Poje

Facts and Figures

Nike Krajnc, Matevž Mihelič and Anton Poje

Definitions

Coppice forest is forest with a short rotation period and is characterized by rejuvenation with stump shoots.	*Panjevski gozd je gozd s kratko obhodnjo, ki se obnavlja s poganjki iz panja.*

Legal Framework

1. Short rotation coppice is allowed only on agricultural land (Forest law, 2016).

2. Coppice forest is a stand of coppice origin that has not overgrown the size of a pole stand.

In coppice forests, the marking of trees is not mandatory (Forest law, 2016).

Rotation Period

Distinctively short rotation; felling age is between 12-30 years.

Statistics

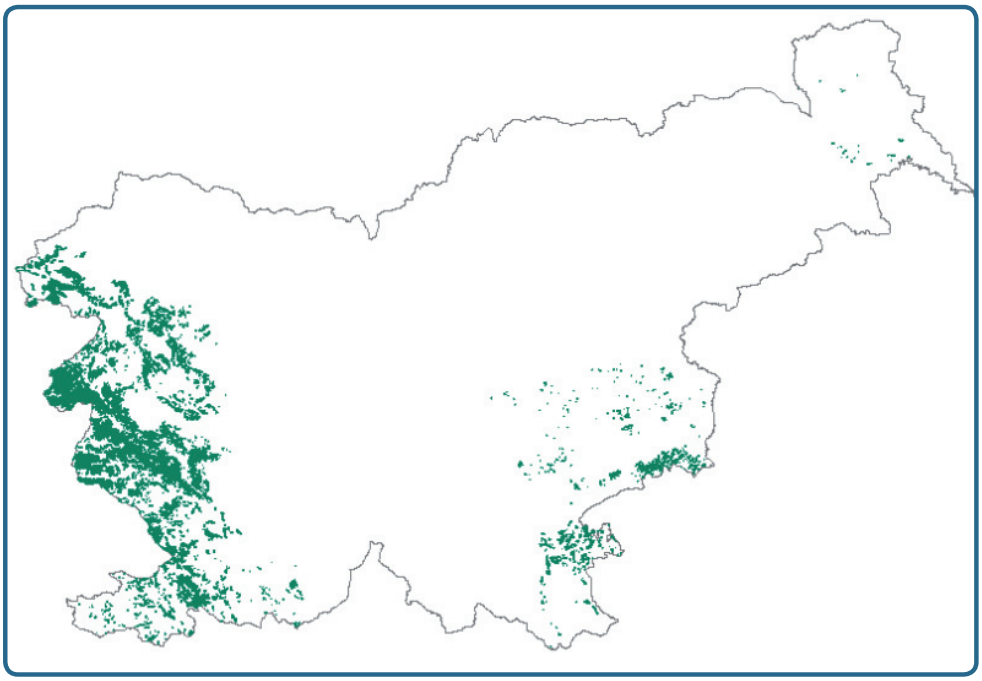
Coppice forests in Slovenia currently cover only 36,340 ha, which is less than 3,1 % of total forest area (Slovenian Forest Service, 2015). These forests are present in the west, south west, and south-east part of the country (see Map).

Typology

Simple coppice	Traditional natural forest regeneration method (beech, chestnut, black locust, oak)
Pollarding	Historically present in the south of the country
Short rotation coppice	Present on test plots – *Salix* spp.

Map

Nike Krajnc, Matevž Mihelič and Anton Poje



Map of coppice forests in Slovenia (in green)

Source: Slovenian Forest Service (2015)

Description

Nike Krajnc and Matevž Mihelič

Traditional coppice forests in Slovenia

According to official data from the Slovenian Forest Service, coppice forests in Slovenia (Figure 1) cover only 36,340 ha, which is less than 3,1 % of total forest area (Slovenian Forest Service, 2015). These forests are present in the west, south-west, and south-east parts of the country. Coppice production in the country uses distinctively short rotations of 12-30 years.

The traditional coppice forests in Slovenia can be divided into several types:

1. In the west, coppice was mostly used for production of poles and firewood. The main tree species used were *Robinia pseudoacacia, Quercus* spp. and to a lesser extent *Castanea sativa*.

2. In the south, coppice forests were mainly used for production of charcoal and are mostly dominated by beech. The high demand for charcoal originated from the ironworks and glass production that emerged at the end of the 18th century. However, this use of forests declined in the last century, which is why the share of beech coppice forest is decreasing; they have mainly been transformed into high forests.

Figure 1. Coppice forests in Slovenia (Photos: N. Krajnc)

3. Recently found evidence has indicated that coppice used to be heavily interconnected with animal grazing (Panjek, 2015). During the last 50 years, however, land use in the alpine region has changed and many grazing areas in mountain areas have been overgrown by natural vegetation (high forests).

4. In the east, chestnut coppice was also used for poles in vineyards and for other, mostly agricultural purposes. In the 1950s, a new and quite massive production of tannin started, which intensified coppicing (Wraber, 1955). The tannin industry and production of flooring from chestnut is still very much alive today. The company producing tannin in Slovenia, TANIN Sevnica, requires more than 50.000 m^3 of chestnut wood per year.

Short rotation plantations

Besides traditional coppice forests, there has also been a strong initiative to start short rotation plantations with willow in an area affected by mining activities. The mining company established 4 ha of test plantation measurements and measured the production potential of two different clones of willow (*Salix* sp., clones *Tordis* and *Inger*) as an alternative energy source. The measurements were performed each year for four years.

The quantity of accumulated biomass (absolutely dry) from these trials has been calculated as a product of mean volume of the coppice, number of coppices per hectare (where mortality is also considered) and mean basic density of the shoots. The quantity of wood biomass produced in the first year of coppice growth was 0.88 dry tons ha^{-1}, in the second year 4.58 dry tons ha^{-1} and 27.29 dry tons ha^{-1} in the third year in the case of the *Tordis* clone. The equivalent for the *Inger* clone gave lower values of 0.63, 3.49 and 9.17 dry tons ha^{-1}. The results are presented in Table 1.

Table 1. Results of the analysis of short rotation plantation in Velenje (Pilar et al., 2014)

Willow (*Salix* sp.) clones	*Tordis*			*Inger*		
Year	2010	2011	2012	2010	2011	2012
Survival of plants (%)	87	85	84	85	81	75
Mean number of shoots per stool	2.3	2.1	2.2	2.2	2.6	2.6
Mean height of the plant (cm)	147	319	624	136	290	403
Diameter at 1 m height (mm)	8.15	14.5	28.4	7.6	13.5	16.7
Mean volume of the shoot (cm^3)	95	559	2955	90	416	1000
Yield (t atro/ha)	0.88	4.58	27.29	0.63	3.49	9.17

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South Africa

Keith M. Little

Facts and Figures

Definitions

Various exotic eucalypts (and their hybrid combinations), which are grown for commercial timber production, resprout from the cut-stump (cut-surface ca. 5-15 cm in height) following harvesting, predominantly from epicormic buds, and/or lignotubers. For commercial production, these coppice shoots are selectively thinned over time and managed as a coppice stand for pulp wood, mining timber or poles. In general, the coppice shoots are reduced to the original stocking in two operations: the first to 2 or 3 shoots when the dominant height is about 4 m, and the second to the original stocking when the dominant shoot height is about 8 m. Rotation-lengths vary according to site productivity and/or product and range from ca. 7 -15 yrs. Increasingly, rurally-based small growers are managing eucalypt coppice stems for multiple products (droppers, laths, poles and pulp wood), with a higher management intensity in terms of repeat visits to remove product, and over a much shorter rotation (ca. 1 - 7 yrs).

Legal Framework

As *Eucalyptus* stands regenerated via coppicing are generally managed for commercial timber production, the same legal framework that applies to all exotically grown tree species would apply. As such, there is no direct legislation that applies specifically to the management of coppice stands.

Rotation Period

The rotation period will depend on the eucalypt grown, desired end-product and site productivity. For laths/droppers the rotation period may be 3 years, extending to 7-15 yrs for pulpwood and poles. The general rule is to "plant - coppice - replant - coppice" due to improved genetics, species and/or hybrid combinations (the idea being to only coppice once before replanting).

Statistics

Of the total land area, ca. 1.1% (1.275 million ha) is planted to exotic plantation forests. The main tree species planted for commercial purposes include pines (51%), eucalypts (42%) and wattle (7%). A rough estimate of the area managed for coppice would be 25 - 33% of the area planted to eucalypts at any one time, but this figure will fluctuate from year to year.

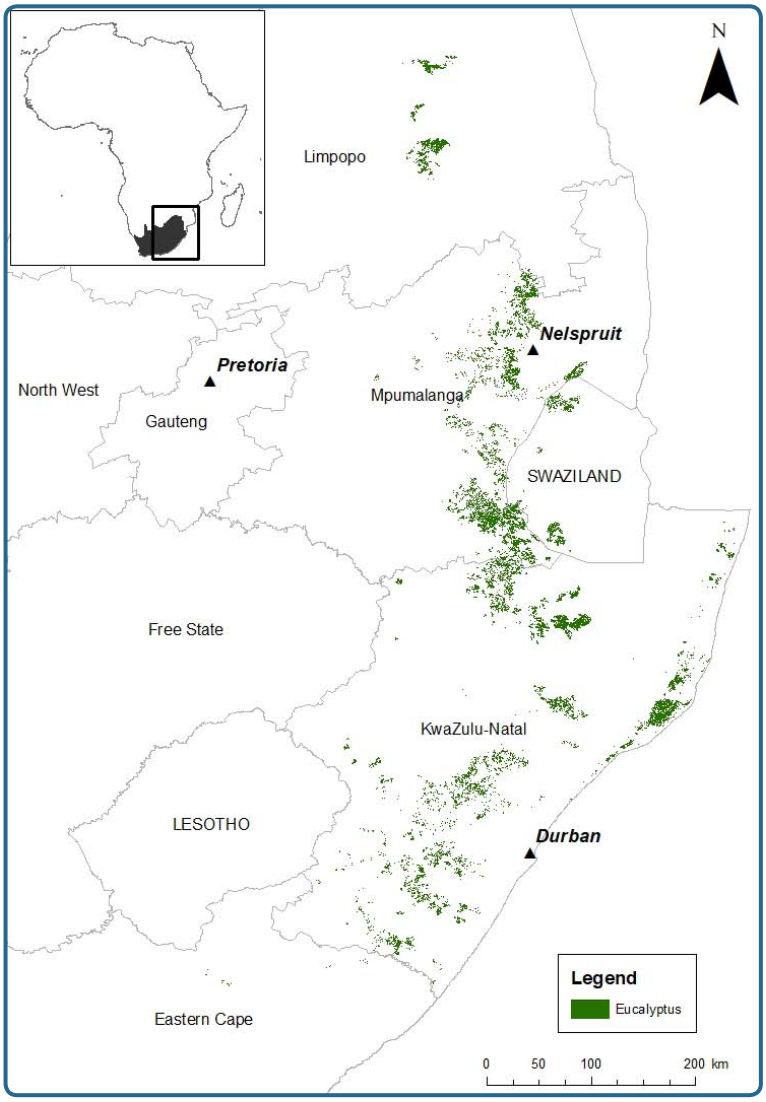
Most of the plantation forests are located within the summer rainfall region and along the eastern seaboard of South Africa (see Map section, following page).

Intensive silvicultural regimes are practised to maximise volume production, with mean annual increments ranging from 15 to 60 m^3 ha^{-1} $annum^{-1}$, dependent on site quality. Although eucalypts are planted at various inter- and intra-row distances, the target density at felling age is 1,300-1,600 sph.

Typology

Short rotation coppice	SRC using the "coppice selection system" Selected shoots (linked to product) are cut when needed, giving rise to uneven-aged stands. This system is used mostly by rurally-based growers on smaller areas (< 5 ha) planted to eucalypts. Mainly for the production of firewood, laths, droppers, poles and some pulpwood, with multiple cuts carried out within 1 – 7 year cycles. SRC using "singling" All shoots in a stand are felled, with the resultant regrowth "singled" to leave 1-2 stems per stump. Occurs in commercial plantations, mainly for the production of pulpwood and poles over 7 – 15 year rotations.

Map



Areas within the summer rainfall regions of South Africa within which various eucalypts and/or their hybrid combinations are planted (ca. 605 000 ha). Of this area, 25 - 33% of the eucalypts will be managed for coppice once felled, but this figure will fluctuate from year to year. Map source: Institute for Commercial Forestry Research, Pietermaritzburg, South Africa.

Description

Within South Africa, the forestry sector contributes 1.2% to the Gross Domestic Product of the country. Of the total land area, about 1.1% (1.275 million ha) is planted as exotic plantation forests, with less than 0.9% occupied by indigenous forests. The main tree species planted for commercial purposes include pines (51%), eucalypts (42%) and wattle (7%), which supply timber products (sawlogs, veneer, pulpwood, mining timber, poles, matchwood, charcoal and firewood) to both the local and export markets.

Most of the plantation forests are located along the eastern seaboard of South Africa, where various eucalypts and/or their hybrid combinations are matched to the site conditions (Figure 1). *Eucalyptus nitens, E. macarthurii* and *E. smithii* are planted in the cooler temperate regions, *E. grandis, E. dunnii* and *E. grandis x E. nitens* in the warmer temperate regions and *E. grandis x E. urophylla* in the sub-tropical regions. These eucalypts are grown over short rotations (typically 7 to 15 years), predominantly for pulpwood production, and to a lesser extent mining timber. Intensive silvicultural regimes are practised to maximise production volume, with mean annual increments ranging from 15 to 60 $m^3\ ha^{-1}\ annum^{-1}$, dependent on site quality.

Figure 1. A coppiced stand of six-year-old *Eucalyptus grandis x E. camaldulensis* clones in the sub-tropical region of Zululand, South Africa.

Although eucalypts are planted at various inter- and intra-row distances, the target density at felling age is 1,300 to 1,600 stems per hectare.

One of the notable attributes of eucalypt species is their ability to survive and produce new growth following adverse environmental conditions, and this is largely a function of their bud systems being able to coppice. This survival mechanism is exploited in commercial plantations for re-establishment following felling, where the coppice shoots are selectively thinned over time and managed as a coppice stand for the production of pulpwood.

Previous research on coppice management in South Africa focused primarily on optimising the number of stems remaining on the stump and on the effects of frequency and timing of reduction (or thinning) of the shoots on timber volume and properties. This produced robust recommendations that are still used today, and state that coppice should be reduced in two operations: first to two or three stems per stump when the dominant shoot height is 3-4 m, and later to the original stocking when the dominant shoot height is 7-8 m.

Decisions as to whether to coppice or replant

Dependent on a number of factors, felled eucalypt stands may be coppiced once (seldom more than twice) before being replanted. Although stand regeneration through coppicing is more cost-effective than replanting, decisions as to coppice or replant specific stands takes into consideration a number of different factors, some of which include determining:

- whether the planted eucalypt has the ability to coppice (there is a range in terms of different eucalypts and their coppicing ability),
- whether the correct species is growing on the site (for example is the species the best in

terms of potential yield, genetic improvement, disease resistance, drought tolerance, frost tolerance, snow tolerance etc.),

- whether trees were planted at the correct spacing (matching stand density to site productivity),
- or if rotation-end stocking of the originally planted stand is adequate.

Challenges

Current challenges in terms of coppice management centre mainly around issues associated with (1) increased mechanisation of forest operations, (2) the incidence of pests and disease, and (3) a change in land ownership.

1. Until recently, South Africa made extensive use of manual labour for both silvicultural and harvesting (motor-manual) operations. Planting densities (especially between tree spatial arrangements), thinning (reduction) operations, and the remaining number of stems per hectare (based on manual operations), will need to be optimised for mechanisation. This will ensure that the currently higher harvesting costs associated with felling coppiced stands is optimised.

2. The impact of recently introduced pests and disease into South Africa has meant that many of the susceptible eucalypts have been replaced with more resistant, alternative eucalypts and/or hybrid combinations. The coppicing potential and subsequent silvicultural management of these eucalypts will need to be tested.

3. Changes in the South African land reform policies has meant that ca. 50% of commercially afforested land is under "land claim". This will result in a change in ownership of existing areas under plantations from larger corporate companies to that of small-scale timber growers. In contrast to commercial companies, where maximising rotation-end product at lowest input cost is important, rurally based, small-scale timber growers require constant product throughout the rotation, either for personal use and/or cash-flow (for example droppers and poles for fencing, laths and poles for building, or as a source of firewood). Although the average size of each of these planted areas is small (ca. 1.5 ha), collectively the large number of growers provides an important source of timber to the commercial companies. Best management practices will need to be tested that support the needs of these small-scale growers, whilst still securing timber for South Africa's pulp-wood needs.

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Forestry Regulations

As eucalypt stands regenerated via coppicing are generally managed for commercial timber production, the same legal framework that applies to all exotically grown tree species in South Africa would apply. Thus, there is no coppice-specific legislation that applies to the manner in which coppice stands are managed. Within South Africa, the protection of natural forests and the sustainable development of commercial timber is governed by a legal framework that covers a range of sector activities. This policy and legal framework is extensive and includes structures and policies that range from International Conventions to Government Acts that give effect to these, and the Regulations passed in terms of the Acts that enable their implementation. In general, these policies and supporting guidelines (in terms of criterion, indicators and measures) ensure sustainable forestry management in terms of:

- the protection of biodiversity within forest management units,
- the management of impacts such as erosion and alien invasive plant species,
- the management of outputs that reduce environmental quality such as waste,
- fair and appropriate labour practice,
- ensuring the health & safety of labour,
- the protection of heritage resources,
- the regulation of land tenure & rights

Although the two most relevant acts governing forest practices in South Africa are the National Forests Act (Act No. 84 of 1998) and the National Water Act (Act No. 36 of 1998), sections relating to forestry are also contained within other National Governmental Departments (for example Environmental Affairs, Labour, Rural Development and Land Reform, etc.).

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Spain

Míriam Piqué, Rubén Laina, Pau Vericat, Mario Beltrán, Eduard Busquets and Eduardo Tolosana

Facts and Figures

Míriam Piqué and Rubén Laina

Definitions

Management system applied to hardwood forests where regeneration is due to sprouting from roots or stumps after clearcutting.	*Método de beneficio aplicado a una masa forestal de frondosas que busca la regeneración mediante brotes de cepa o de raíz.*
Rubén Laina	
Coppice forests - forest composed of trees originating from stump or root resprouts.	*"Monte bajo" - Masa arbórea compuesta por pies cuyo origen es un brote de cepa o raíz.*
Míriam Piqué	

Legal Framework

There is no specific legal frame affecting coppice forest management in Spain. Management practices must follow "general good practices" in terms of proper rotation period (depending on species and objective), silvicultural criteria, as well as the organization and implementation of logging works. Harvesting plans are supervised and approved by the Government Forest Service to ensure that good management practices are included.

Rotation Period

1. 20-30 year rotation coppice of *Quercus ilex*, *Q. faginea* or *Q. pyrenaica*, with 1500-3500 trees/ha density and 10 to 20 m height.

2. 12-16 years *Eucalyptus* plantations, 600 trees/ha, three rotations before planting again.

3. Chestnut forest; several thinnings before clearcutting at 80 years.

Typology

Simple coppice	Most common type for obtaining fuelwood; evergreen oak (*Q. ilex*), deciduous oaks (*Q. faginea, Q.pubescens, Q. pyrenaica, Q. canariensis, Q. petraea, Q. robur*) and other species such as *Betula pendula/pubescens*, *Salix caprea*, *Eucalyptus* spp., *Castanea sativa, Platanus* and *Alnus*
Coppice with standards	*Quercus pyrenaica*
Pollarding	Was often used in the past with species such as beech, deciduous oaks, chestnut, ash, poplar, elm and willow in order to combine grazing with fuelwood or timber production; mostly abandoned nowadays
Short rotation coppice	*Populus*

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Images

Quercus ilex ballota low coppice (Photo: Pau Vericat)

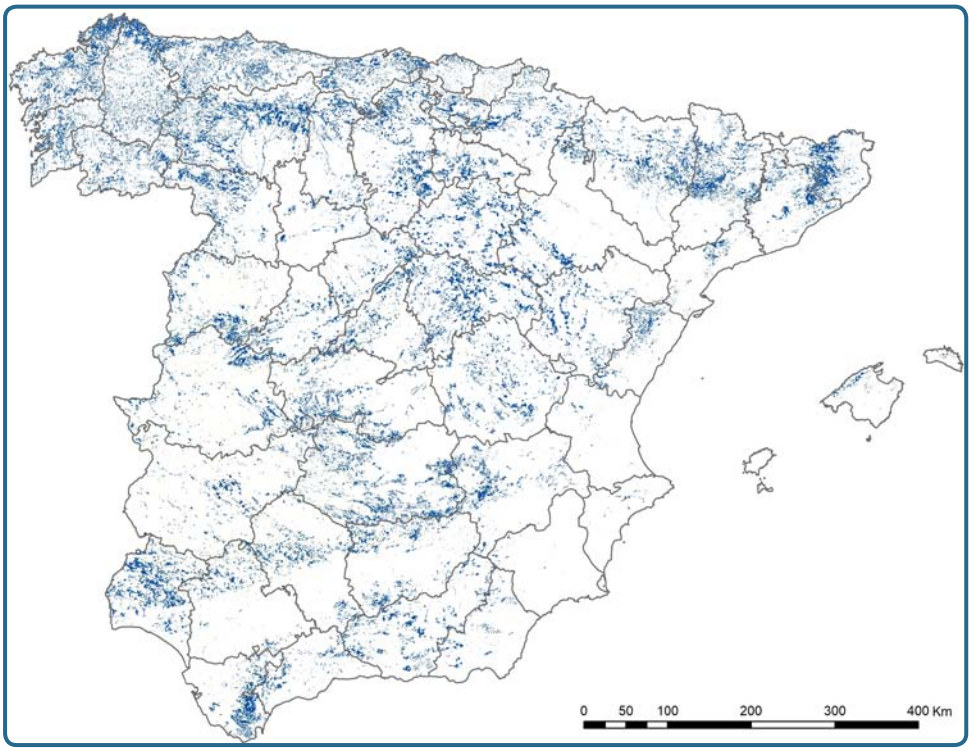
Quercus ilex ilex selection coppice (Photo: Pau Vericat)

Quercus humilis conversion to high forests (Photo: Míriam Piqué)

Quercus faginea abandoned conversion to high forest (Photo: Pau Vericat)

Map

Mario Beltrán, Pau Vericat, Eduard Busquets, Eduardo Tolosana and Míriam Piqué



Map of approximate areas of coppice forests in Spain, based on the official Forest Map of Spain (Spanish Ministry of Agriculture and Fisheries, Food and the Environment)

Description

Míriam Piqué and Pau Vericat

Coppicing has been widely applied for centuries in Spain to almost all hardwood species with re-sprouting ability. Several coppice methods and rotations have been used in order to obtain a wide range of products, depending on the species. Coppice was the most usual management method to obtain fuelwood, charcoal and tannins, medium sized saw wood (e.g. staves, poles, stakes) or rods for basketry. Pollarding was also applied to some species in order to combine grazing with fuelwood production and to obtain fodder from the branches.

The rotation length used for coppices in Spain varies widely depending on geographic areas, dominant species, type of coppice, site quality and desired characteristics of the products. The most common rotation is around 30 years (from 20 to 40), but shorter rotations were not unusual, especially for pollards.

Coppice forests in Spain cover around 4 million ha, which constitutes around 50% of the total area covered by spontaneous hardwood, and more than 20% of the total forest area. The most important species are *Quercus*, mainly *Q. ilex* (Figure 1) and *Q. pyrenaica*. Since 1950, coppice forest management has been gradually abandoned all across Spain and, at present, only particular species and regions still maintain a significant use of coppices (e.g. *Q. ilex* in the North East, *Q. pyrenaica* in the North West and *Castanea sativa* in the North of Spain).

As a result of this general abandonment, all current coppices have exceeded the usual age of rotation, most of them doubling that age. The excessive density of these abandoned coppices, combined with much of the photosynthetically derived energy being used to maintain the significant underground biomass, has caused a reduction in growth and loss of vitality.

The main emerging risks are related to global change. In this context, abandoned coppices are very vulnerable to water stress and forest fires, both great threats to Mediterranean forests. In addition, low seed production and reduced gene flow can compromise their ability to adapt to new scenarios. Furthermore, the dense and homogeneous stands resulting from abandonment become simpler in terms of structure and specific composition and so tend to be unfavourable from the viewpoint of biodiversity.

Finally, some specific types of coppice, such as pollarding of beech or ash, are very interesting from their historical, social and environmental values, and are at risk of disappearing.

Therefore, in general, the priority is to renew the management of the large area of abandoned coppice in order to ensure the provision of economic, environmental and social services. For this, it will be necessary to reintroduce the traditional management, enhancing this when necessary, or using other silvicultural approaches such as conversion, where it is economically, environmentally, and socially sustainable. Integrating fire prevention and improved habitat conditions is an imperative in all cases.

Figure 1. *Quercus ilex* and *Quercus suber* uneven-aged coppice with standards in Catalonia, Spain.

A major challenge is to improve the profitability of management and exploitation. The current scenario of increased demand for biomass as an energy source is favourable in this respect. Finally, social awareness is also needed to facilitate the acceptance of coppice management, which involves clear felling in many cases.

Major areas of research on Mediterranean coppices in Spain are:

- Silviculture: developing, assessing and transferring new management alternatives in order to achieve a true multi-functional management;
- Improving harvesting techniques;
- Ecology and dynamics of Mediterranean coppice forests;
- Eco-physiology of coppiced species and the relationship of this to silvicultural practices and ecological conditions (carbon balance, stump lifespan, re-sprouting ability in relation with age/size of regrowth);
- Seedling regeneration and genetics of coppice systems, in order to understand the effects and the long term sustainability of the coppice system.

Forestry Regulations

Mario Beltrán, Eduardo Tolosana and Míriam Piqué

The forest legal framework in Spain is characterized by the division of competencies between the Central State and the Autonomous Communities. General regulations are made by the Spanish Ministry in charge of forests, while the 17 Communities develop specific regulations adapted to their own characteristics. Furthermore, Communities are responsible for environmental issues in a broad sense and the State is only responsible for basic regulation, coordination and support.

Despite this division, the Spanish forest policy is usually introduced as a wide common framework subscribed to by all the public bodies of the forest sector, as a group. In this sense, the Spanish Forest Programme comprises legal regulations, forest planning tools and some general sustainable forest management tools. The main elements are the Spanish Forest Act (created in 2003; revised twice in 2006 and 2015), the Forest Act of each Community (where it exists), the Spanish Forest Plan (2002) and some of the Forest Plans of each Community.

The aim of the Forest Acts is to ensure the sustainability and conservation of forests. They establish a system of administrative guardianship concerning forest management, both in private and public ownership. The Spanish Forest Act makes the preparation of Forest Management Plans compulsory in certain cases for protective forests (private) and public utility forests. In all cases, the different administrations are in charge of enhancing and promoting forest planning. However, the Regional Forest Acts can extend the obligation to have a management plan to other cases, such as public forests larger than a certain area (depending on the region). The supervision of forest management actions is done through the management plans, or specified administrative procedures where plans are absent.

Regarding coppice forest management, there is no specific regulation; it is usually regulated as any other type of forest management. Nevertheless, the coppice system is described through different guidelines developed for certain species that are mainly managed as coppice (*Quercus ilex, Q. pyrenaica Q. pubescens, Q. faginea, Castanea sativa, Fagus sylvatica, Eucalyptus spp.* among others); hence, coppice management is allowed as a valid system for certain species. Some other regulations can affect coppice, especially those in relation to clear-cuts. In many regions, these clear-cuts are limited by areal extent and require a special administrative procedure.

As the regulation and descriptions of best practice for coppice forests in Spain are linked to certain species, the Autonomous Community has the direct responsibility for administering forest management. We describe below the case for two representative regions in Spain with managed coppice forests: Catalunya and Galicia. There are major differences between their species, ownership characteristics and forest management systems, as Catalunya is situated in the Mediterranean basin, while Galicia is situated in the very humid NW of Spain.

Catalunya

The Catalan Forest Act was published in 1988 and revised several times, while the Catalan Forest Plan was approved in 2014. These two elements form the main reference for the Catalan forest sector and they treat coppice as any other management system. Since 2011, some planning tools are available in order to ensure a common technical basis for forest management, known as the Sustainable Forest Management Guidelines for Catalunya (ORGEST). These include coppice management guidelines and provide silvicultural information for different coppice forests. Silvicultural models describe the treatments and management actions to achieve different objectives based on environmental conditions, always applying sustainable principles. Guidelines referring to resprouting species are focused on the coppice system, mainly oaks and chestnut. In Catalonia, forest practices related to plantations of short rotation broadleaved species are very uncommon.

Galicia

The Galician Forest Act, published in 2012, makes no direct reference to coppice management or to coppice species. Nonetheless, every domestic hardwood species, including those that are commonly coppiced (oak, holm oak, deciduous oak, beech and chestnut) are mentioned in an Annex and declared as priorities when planting in public forests. Forest owners applying for felling licenses for these species have to wait longer than *Eucalyptus* or softwood plantations' owners to get a specific licence prior to harvesting. In the stands composed of domestic hardwood species, planting with *Eucalyptus* is banned, even after harvesting or a wildfire.

Galician forest administrators must check and list every domestic hardwood stand greater than 15 ha, the owners of which are then obliged to have an approved management plan prior to harvesting. In order to write these management plans, the administrators may sign temporary agreements with the owners.

The Galician Forest Plan was approved in 1992, but is presently under revision. In 2014, the Galician forest administration created forest management guidelines and a code of best practice for Galician forests, again focused on the dominant species. Guidelines aimed at resprouting species focus on the coppice system. Plantations of broadleaved species are very common in Galicia, particularly of *Eucalyptus* or birch.

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Sweden

Magnus Löf, Ioannis Dimitriou, Tomas Nordfjell, Martin Weih, Jenny Mills and Peter Buckley

Facts and Figures

Magnus Löf

Definitions

Coppice forests - forest composed of trees originated from stump or root resprouts.	*Lågskogsbruk / skottskogsbruk*

Legal Framework

There is no specific legal frame for coppice forests in Sweden. Except for *Salix*, which is considered as a agricultural crop, coppice has mainly been practised historically and is very limited nowadays. Pollarding and coppice with some trees, such as alder, is sometimes practised.

Rotation Period

Rotation period is 3-5 years for *Salix*.

Typology

Simple coppice	Have been used historically, but not anymore
Coppice with standards	Have been used historically, but not anymore
Pollarding	Widespread historically, nowadays only for restoration purposes and along roads etc. in the southern most part of the country
Short rotation coppice	*Salix* plantations

Description

Ioannis Dimitriou, Magnus Löf, Tomas Nordfjell and Martin Weih

In Sweden there are limited areas where traditional coppice forest management has been applied, while coppice with standards does not exist at all. The national statistical authority of Sweden (Forest Statistics - Riksskogstaxeringen) does not record these types of forests, which is indicative of the status and condition of coppice forest management in the country.

The same concern regarding recording applies to pollards, although there are several sites in Sweden where there has been a recent restoration of pasture with pollarded trees of *Tilia cordata*, *Sorbus aucuparia* (mountain ash), *Fraxinus excelsior*, alder (*Alnus* spp.), aspen (*Populus tremula*), willow (*Salix* spp.) and poplar (*Populus* spp.).

There are a number of sites of simple (low) coppice managed forest in the South (Scania) and in the mountainous areas of Sweden, however these are not very extensive compared to 'conventional' forestry. The species used for simple coppice are alder (*Alnus* spp.), birch (*Betula* spp.), aspen (*Populus tremula*), willow (*Salix* spp.) and poplar (*Populus* spp.).

The most common coppice system in Sweden is willow (*Salix* spp.) short rotation coppice (SRC), which is used to produce biomass for energy. Today, approximately 11,500 ha are being grown. Willow cultivation is fully mechanized, from planting to harvest. In the initial phase, approximately 12,000 cuttings per hectare are planted in double rows to facilitate future weeding, fertilization and harvesting. Conventional inorganic fertilizers have commonly been applied in the years following planting. The willows are harvested every three to five years, during winter when the soil is frozen, using specially designed machines. The above-ground biomass is chipped on-site, and then stored or directly burned in combined heat and power plants. After harvest, the plants re-sprout vigorously, and replanting is therefore unnecessary. The estimated economic lifespan of a short-rotation willow coppice stand is between 20 and 25 years. Average yields from commercial SRC willow plantations in Sweden are between 6-10 tons dry matter per hectare each year.

There is an increased interest in using willow SRC in phyto-remediation systems to clean soils, for example from heavy metals, especially Cadmium, and waste water that is nutrient-rich. Several plantations have been established specifically for these purposes. At the same time, there is an interest in coppice plantations designed to promote biodiversity (such as birds and wild game) and this can also be a reason for implementing willow coppice systems.

The ambition for future coppice sites in Sweden is to design new forms of production that produce biomass for energy and also enhance bio-diversity, landscape diversity and cultural values. It is important to incorporate new ideas on modifying coppiced stands to meet current needs and designing systems that will satisfy society's requirements in an economic, environmental and energy efficient way. For example, trees in urban forests, urban environments, under power line corridors, as well as strips within 5 to 7 meters of forest roads and agricultural fields, should all be seen as a resource. Production systems could be designed so that they fulfill the requirements mentioned above. Some specific thinning regimes of dense young stands, around 5 to 7 m in height, might be considered as a relevant 'coppice approach' to forestry.

Forestry Regulations

Jenny Mills, Peter Buckley and Magnus Löf

In Sweden nearly 70% of the land area is covered by 28.1 million hectares of forest, 23 million hectares of which are productive. The forests are mainly of spruce and pine (82%). The remaining percentage includes broadleaf species such as birch, aspen, alder, willow and poplar, and, in the south, oak and beech. Even-aged forestry is the norm. Traditional simple coppice management and pollarding, which were very common in the past, are now rarely practiced and then only on very small areas of conservation interest. Pollarding is also still practiced near farms and in villages to keep the traditional scenery.

The **Forest Act** was first enacted in 1903 and covered only privately-owned forests, in 1979 it was revised to include all forests. The main forest policy of maintaining high levels of industrial wood production was amended in 1993 to include ecological provisions concerning environmental improvement and biodiversity and later to give regard to social values. The aim of Swedish forest policy is also to ensure sustainable forest management in line with

international agreements. A **National Forest Programme** was established in 2014.

The **Swedish Forest Agency** (SFA, Skogsstyrelsen) is responsible for enforcing the Forestry Act and the 1999 Environmental Code where it affects forestry. On their website (http://www.skogsstyrelsen.se/en/forestry/The-Forestry-Act/The-Forestry-Act/) some of the provisions of the Act are summarised:

Reforestation

New forest must be planted or naturally generated after felling when the land's capacity to produce timber is not fully exploited. Planting or measures for natural regeneration must have been completed by the end of the third year after felling, or by the fifth year in northern areas where regeneration is slower.

Disused agricultural land must be reforested within three years of the land falling into disuse. This does not, however, apply to land to be protected for its natural characteristics or its cultural heritage.

Reliable methods and suitable species of trees must be used in the forestation work. Natural regeneration can be a good method if the site is suitable. Otherwise, the land must be sown or planted. Mechanical soil scarification is often a prerequisite for good results.

If there are insufficient numbers of seedlings, supplementary planting must take place before it is too late. Subsequent weeding and thinning may be necessary.

Felling

Thinning encourages forest development. Timber stocks after thinning must be large enough to utilise the production capacity of the land.

After thinning the trees must be evenly distributed on the area. Damage to trees and the ground must be avoided as far as possible.

Regeneration felling must not be carried out until the forest has reached a certain age. For predominantly coniferous forests, the age varies between 45 and 100 years, although this is much debated as it does not really apply to continuous cover forestry practices.

Regeneration felling is restricted on forest holdings larger than 50 hectares. Up to half of the land may be made up of finally felled areas and of stands less than 20 years old. Additional rules apply to holdings larger than 1,000 hectares.

Notification of regeneration felling

Regeneration felling of stem wood on 'productive forest land'* sites larger than a half hectare must be notified to the Swedish Forest Agency at least six weeks in advance of harvesting.

*Defined as land outside protected areas and other than mountainous forest, and forest with noble broad leaved trees and that can produce no less than 1 m^3 $year^{-1}$ stem wood including bark and that is not used for any other purpose such as agriculture, buildings or infrastructure.

'Regeneration felling' replaces the term 'final felling', and includes all felling with the exception of thinning and cleaning. Notification is made on a special form (Timber Harvesting Notification, TFN*) available from the Swedish Forest Agency. The area to be felled and the regeneration methods to be used must be specified. A copy of a forestry map must be attached. A description of the intended natural consideration measures to be used, and measures to protect existing cultural heritage within the area, must also be stated.

*The SFA inspects TFNs within a 6-week period using the Forest Agency's processing system, comparing the notifications to maps and register data. Local knowledge and staff expertise are also used. A proportion of the notified areas are inspected in the field before harvesting begins.

Notification must also be given if the land is to be used for purposes other than timber production, i.e. if forest fuel is to be removed, foreign tree species are planned be used, or in the event of protective ditching.

A permit is required for regeneration felling in mountainous areas in the interior of northern Sweden. Details of measures planned to secure regeneration and to safeguard the balance of nature, the cultural heritage and reindeer husbandry, must be given.

A permit is required for regeneration felling in forests that contain so-called 'noble broad leaved trees', i.e. stands of temperate broadleaved tree species of which at least 70 % of the basal area consists of broad leaved trees and at least 50 % consist of oak, beech, ash, lime, elm, cherry, maple and hornbeam. Regeneration and conservation measures to be taken must be stated. Normally, felled hardwood stands must be regenerated with a new hardwood species stand.

Insect damage

Insect pests breed in the bark of newly felled coniferous wood. Insect damage is controlled by removing damaged trees if they exceed 5 cubic metres per hectare. Unbarked conifers must not be stored in the forest or at the roadside during the summer.

Nature consideration & cultural heritage

Biological diversity in the forests must be preserved. At the same time, the cultural heritage must be safeguarded and social aspects must also be taken into consideration. Therefore, it is important that due care and attention is paid to all forestry measures. The conservation requirements must not be so far-reaching that they make on-going forestry activities significantly more difficult. Where there is a choice of methods to be used, the promotion of biological diversity must always be given priority.

Reindeer husbandry

The size and locations of felling areas in northern Sweden must be decided with due regard to reindeer husbandry. Further consideration can be shown by leaving groups of trees standing on felling sites and on non-productive land, such as migration routes.

Forest Management Plans (FMP)

These are voluntary in Sweden. In a response to a questionnaire from the EU's Directorate-General for the Environment in 2013 (European Commission 2014), Sweden reported that: "The obligation of having a FMP was taken away from the Swedish Forest Act in 1994. Instead a nationwide GIS database was established. The information in the database covers all forest properties and is available for forest owners and authorities, free of charge through the internet. The database includes information on Natura 2000 and other protected areas as well as other ecosystems with biodiversity and social values. All forest land is covered by regularly updated satellite imagery and aerial photography."

All past and planned (for the following 2 years) harvest activities are shown for each individual property, including the regeneration method used / planned, outtake of bioenergy, scarification method, environmental and cultural protection activities, etc. Forest owners must send harvest notifications to the Swedish Forest Agency, which is possible through the database. As the GIS database integrates data on Natura 2000 areas, other nature reserves, and areas with special considerations (hydrological, historical, biological, etc.), the SFA system for monitoring the implementation of the forest legislation is highly interactive and automated.

Most of the forest owners in Sweden have their own FMP, often offered by timber-buying companies as a service to the forest owners. FSC- and PEFC-certified forest owners are obliged to have a FMP due to certification

requirements. An estimation is that for family forestry, approximately 8.5 M ha are covered by FMPs and for productive forest land 22.5 M ha, half under FSC, half under PEFC, with some overlap because of double-certified forest owners. An overall expert estimation is that >95% of forest land is covered by some sort of management plan in Sweden. In Sweden FMPs are considered a tool for forest owners and managers to plan their business activities in the medium-term (normally 10 years) and to plan environmental care in detail for each stand.

Adoption of Natura 2000 forest management plans in forests designated as Natura 2000 sites

In Sweden the County Administrative Boards have the overarching responsibility, at regional level, for Natura 2000 areas. Forest management plans are not normally used for Natura 2000 forest areas. The management of these areas are regulated through conservation plans as most Natura 2000 forest areas in Sweden are nature reserves. Currently, the Swedish Environmental Protection Agency is preparing guidelines for updating the existing Natura 2000 conservation plans.

The SFA is the responsible authority when it comes to forestry measures that could affect the environment in Natura 2000 areas. Consideration is given to forestry measures within designated areas and measures adjacent to, or in the vicinity of, designated areas. The County Administrative Boards are the competent authority for measures other than forestry operations taken in forested and other types of Natura 2000 areas. Permission needs to be obtained from the County Administrative Boards for measures that are likely to have a significant effect on the environment in Natura 2000 areas. In cases where the SFA is the competent authority – i.e. concerning forestry operations – the SFA evaluates whether or not a planned activity or operation needs permission. Thus, the SFA ensures that forestry operations that might affect a Natura 2000 area are not taken without prior consent from the County Administrative Board. The operator must evaluate if the planned activities need prior consent and seek permission from the County Administrative Board.

All forest owners have to notify the SFA when planning a final felling. The SFA then has six weeks to respond – i.e. giving detailed instructions on how and where certain activities should be conducted or if they are prohibited. In cases when a notification is received that concerns a Natura 2000 area or its vicinity, the SFA evaluates the planned activity regarding prior permission. The management restrictions included in the conservation management plans form the basis for that decision. If the planned activity does not need prior permission, it is treated like any other notification to the SFA. If it needs prior permission, the operator is informed in writing. An activity might be partially allowed or allowed under specific preconditions. If the County Administrative Board gives permission under certain preconditions, the SFA is responsible for checking that they are followed.

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Switzerland

Josephine Cueni, Marco Conedera, Patrick Pyttel, Jenny Mills and Peter Buckley

Facts and Figures

Marco Conedera

Definitions

Coppice - Forest grown from coppice sprouts or root shoots with a short rotation period. Oldest form of regulated forest use, mostly to obtain firewood. This management system favours tree species that can develop coppice sprouts like chestnut, beech, hornbeam, and oak. Coppice forests are regularly clear-cut (every 10–30 years).

(German) Niederwald - Aus Stockausschlag oder Wurzelbrut hervorgegangener Wald mit kurzer Umtriebszeit. Älteste Form der geregelten Waldnutzung, vorwiegend zur Brennholzgewinnung. Die Bewirtschaftungsart begünstigt Baumarten mit der Fähigkeit zum Stockausschlag wie Edelkastanie, Buche, Hagebuche und Eiche. Niederwald wird in kurzen Zeitabständen (alle 10–30 Jahre) kahl geschlagen.

(Italian) Ceduo - Bosco cresciuto da polloni di ceppaia o radicali a turno breve. È la più antica forma di gestione regolamentata del bosco, finalizzata prevalentemente alla produzione di legna da ardere. Questo tipo di gestione favorisce lo sviluppo di specie arboree capaci di generare polloni, quali il castagno, il faggio, il carpino e la quercia. Il ceduo viene tagliato a raso a brevi intervalli di tempo (ogni 10–30 anni).

(French) Taillis - Forêt à courte rotation, issue de rejets de souche ou de drageons. C'est la plus ancienne forme d'exploitation forestière réglementée, qui sert avant tout à produire du bois de chauffage. Cette forme d'exploitation privilégie les essences pouvant donner des rejets de souche, comme le châtaignier, le hêtre, charme ou le chêne. Les taillis sont exploités à intervalles courts et réguliers (tous les 10 à 30 ans).

Legal Framework

Clearcuts are not allowed according to the law; exceptions can be authorised by the Kantone.

Statistics

See table below. No data for pollarded (high) coppice and short rotation coppice (in part because they are close to non-existant).

	Simple Coppice	Coppice with Standards
Area (ha)	25,800	9,400
Percent total Swiss forest (%)	2.1 %	0.7%
Average stem density (N/ha)	622	528
Average growing stock (m^3/ha)	189	267
Average growth rate (m^3/ha/yr)	5.5	6.7

Typology

Simple coppice	Coppicing of chestnut stands or alder stands close to the rivers (0.1 to 0.3 ha). Coppice forests in and to the north of the Swiss Alps are dominated by beech, oak, ash and alder. In the south, sweet chestnut is the main tree species.
Coppice with standards	This type has almost disappeared; it is only exceptionally practised in chestnut forests. Historically, there were forest stands composed of oaks from seeds (for masting) and hornbean from coppice (for firewood) in the north of the country.
Pollarding	Former chestnut orchards treated as pollards starting in the late 1960s; now abandoned. Willows were pollarded and used on yearly basis for fixing the yearly growth of grapevines.
Short rotation coppice	Not relevant in Switzerland at the moment

Images

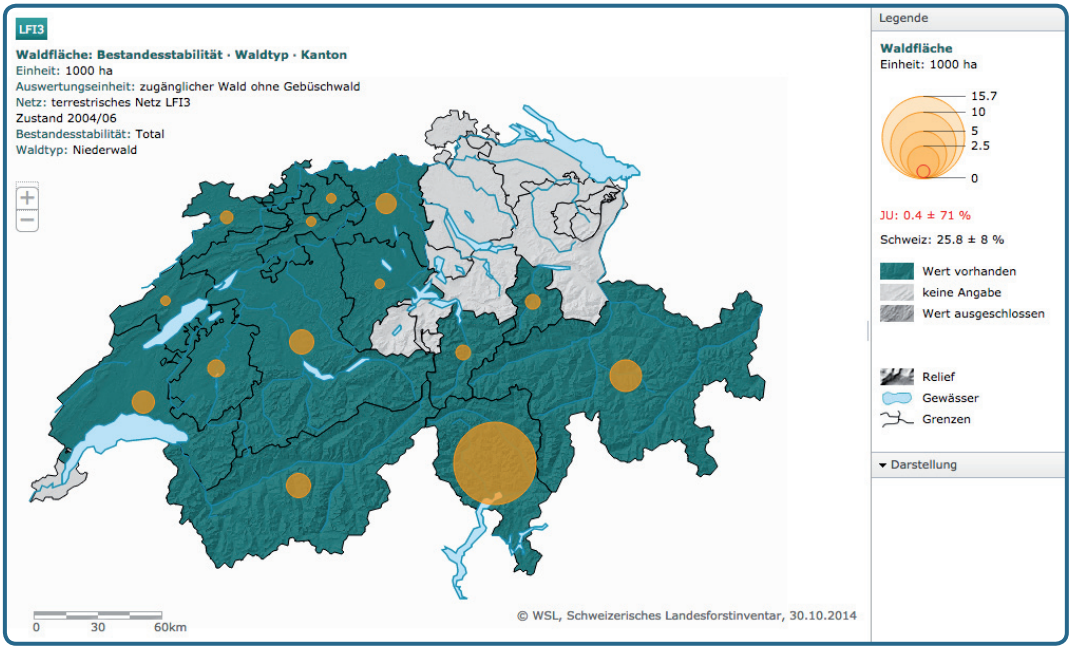
Ceduo samplice; chestnut simple coppice

Chestnut coppice with standards

Pollarded former orchard; chestnut

Map

Josephine Cueni



Map of the area of simple coppice in Switzerland per Kanton in 1000 ha
Source: LFI3, Abegg et al. 2014.

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Description

Josephine Cueni and Patrick Pyttel

As in many other European countries, coppice forests with and without standards were brought to Switzerland by the Romans around four centuries B.C. Both forest types have been characteristic elements of the Swiss landscape for centuries. Due to socio-economic changes, most coppice forests, with and without standards, were abandoned or converted into high forests during the 19th century (Schuler et al., 2000; Meier, 2007; Imesch et al., 2015).

Today, coppice forests (excluding coppice with standards) cover about 25,800 ha, which is 2.1% of the total Swiss forest area (Abegg et al., 2014). The majority of the remaining coppice forests were last harvested between 1959 and 1963. These forests currently show slow growth (ca. 5.6 m^3 ha^{-1} a^{-1}), low mean annual harvesting rates (0.5 m^3 ha^{-1} a^{-1}) and increasing dead wood volumes (ca. 1/3 of the annual increment; Abegg et al., 2014; Häfner et al., 2011). They occur in all regions of Switzerland (Jura, Midland, Pre-Alps, Alps, South), although the majority are located south of the Alps. There they make up 20% of the regional forest area (Abegg et al., 2014). Most are found on fertile sites and at elevations ranging from <600 m to 1000 m. Coppice forests in and to the north of the Swiss Alps are dominated by beech, oak, ash and alder. In southern Switzerland, sweet chestnut is the main tree species (Bachofen et al., 1988).

Due to the prevailing orography, protection is a key role of Swiss forests. Around 16.900 ha or 66% of all coppice forests in Switzerland are located in the area of protection forests. Of the coppice forests in the Alps and in southern Switzerland, 71% and 86% serve as protection forests, respectively (Abegg et al., 2014). This management type is only thought to be suitable for this function under certain circumstances, i.e. when slopes are short (<75 m), and rocks likely to fall are less than 40 cms diameter (Frehner et al., 2005; Gerber and Elsner, 1998). Consequently, coppicing is not suitable in the majority of protection forests and (the naturally occurring) conversion of coppice stands into high forest is welcomed (Frehner et al., 2005).

Since 1991, the Swiss Government has offered monetary incentives for the supply and use of fuel wood (BUWAL, 2005). Within this context, the resumption of coppicing and the need for short rotation plantations has been the subject of controversy (Schmidt et al., 2008; Zimmermann, 2010). Generally, coppice forests and short rotation plantations are not considered important for fuel wood since regional demand can be satisfied by day-to-day forest management and because of concerns regarding landscape aesthetics (Oettli et al., 2004; Meier, 2007; Ansprach and Roesch, 2014). The Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) has investigated the economic potential of chestnut coppice forests for valuable wood production (e.g. Zingg and Giudici, 2006) and there are some innovative enterprises that are trying to market assorted products from over-aged coppice forests (Castagnostyle 2015, online).

The Swiss Ministry of Environment (BAFU) considers coppice forests (with and without standards) as valuable forest types important for biodiversity, culture and history. The Ministry promotes the preservation of these by paying subsidies for restoration and tending of coppice forest with and without standards (4000 CHF ha^{-1} per intervention; Imesch et al., 2015; BAFU, 2011). Between 2004/06 and 2009/13 re-coppicing occurred on 400 ha

(Abegg et al., 2014). To date between 600 and 700 ha of simple coppice and 400 to 800 ha of coppice with standards were designated parts of forest reserves (WSL, 2015). It can be assumed that these forests are being -or will be- managed traditionally (WSL, 2015). Some of them also serve as study sites for the WSL (e.g. Rothenfluh BL; WSL, online).

To conclude, few previously coppiced forests in Switzerland continue to be managed in this way. The exceptions are some study sites and parts of some forest reserves. The unsuitability of coppice for protection forest and the production of enough fuel wood as a byproduct of day-to-day forest management do not encourage the continuation of this ancient management system. There is probably more managed coppice, both simple and with standards, in the context of nature conservation and the preservation of cultural historical landscapes than for economic reasons. It is possible that increasing fuel wood prices will encourage more coppicing in the future.

Figure 1. Aged coppice forest on steep slopes in the Untersiggenthal, canton of Aargau (Photos: Pro Natura, Christoph Oeschger)

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Forestry Regulations

Jenny Mills, Peter Buckley, Josephine Cueni and Patrick Pyttel

A third of Swiss territory is forested, but coppice and coppice-with-standards now covers only small areas. However, the guidelines issued by the Swiss Federation BAFU in 2015 concerning biodiversity in forests indicates that there are noteworthy remnants of coppice-with-standards in the cantons of Baselland, Aargau, Zurich, Schaffhausen and Thurgau, where projects are taking place to boost coppice-with-standards management. Areas of relict coppice are located mainly in the canton of Fribourg, along the River Sarine, in the canton of Vaud along the foot of the Jura, in the canton of Bern along the Old Aar river, in the Grisons, and in the Rhine valley around Chur. The guidelines suggest that traditional coppice management to increase biodiversity could be reintroduced in a sustainable way in former coppice stands or be newly established in other places.

At the national level, the Swiss Confederation has passed a **Federal Act on Forest** and a **Forest Ordinance**, among other laws that relate to the environment. The aims of the Federal Act are to conserve the forest area and its spatial distribution; to protect the forest as a near-natural community, to ensure that the forest can fulfil its functions and to promote and maintain the forestry sector. One particularly vital forest

function in Switzerland is the protection of human life and important material assets against avalanches, landslides, erosion and rockfall.

The **26 cantons which make up the Federation define plans and enact regulations** taking into account the forest functions, the requirements of wood supply, near-natural silviculture and respecting the federal law for nature protection and cultural heritage. They also have to take into account the **Swiss Biodiversity Strategy**, which was adopted in 2012 by the Federation.

Each canton therefore has its own forest law in compliance with the Federal Forest Law and the Forest Ordinance and, while also respecting other environmental laws and guidance, makes cantonal forestry plans, forestry development plans and maintains a forestry service. For ecological or landscape reasons, forest management does not always have to be carried out, but where the forest serves a protective function, the cantons must ensure a minimum level of management. Forest owners (corporations, private owners, political communes, cantons) must carry this out and in return they receive federal and cantonal subsidies.

Silvicultural measures are defined as all maintenance interventions that contribute to the conservation or restoration of the stability and quality of a stand. Measures to be carried out as part of young forest maintenance include maintaining regrowth in selection forests, in other multi-layered forests, in coppice-with-standards and coppice forests, as well as in multi-layered forest margins; protective measures against damage caused by game; and path creation in areas difficult to access. Thinning and regeneration measures are slash removal and creation of new stands with the necessary accompanying measures, wood harvesting and transport. For protective forests, interventions are restricted to ensuring the long-term stability of the stand; felled wood is used locally to improve the protection function or left on site, as long as it does not pose a risk.

Deforestation is prohibited but, exceptionally, permits may be issued by the Federal or cantonal authorities with reference to the Federal Office for the Environment (FOEN/BAFU/OFEV/UFAM) where necessary. Compensation in kind must usually be made for any deforestation but can also lead to revaluation measures in other ecosystems.

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Turkey

Halil Barış Özel and Murat Ertekin

Facts and Figures

Halil Barış Özel and Murat Ertekin

Definitions

Coppice - a forest that has a sprout origin/background and that is destined to be regenerated by sprouts, for harvests of small and medium-sized wood.

Halil Barış Özel

(1) Coppice Forests - Even-aged stands consisting of trees and shrubs (mainly: *Quercus* spp., *Carpinus betulus, Castanea sativa, Alnus glutinosa*) that regenerate wholly or mainly vegetatively (as sprouts or root shoots) and are harvested in small clearcuts (0.5-1 ha) in short rotations of 20-40 years.

(2) Short rotation coppice: Plantations of fast-growing trees or shrubs (mainly *Populus* spp., *Salix* spp., and *Eucalyptus* spp.), with the aim of producing wood as a renewable resource in several short rotation periods (5-15 years each).

Murat Ertekin

(1) Baltalık Orman: Farklı yaştaki ağaç ve çalılardan (Meşe, Gürgen, Kestane, Kızılağaç) oluşan, meşcere bazında (0.5-1 ha) 20-40 yıllık periyotlarla tıraşlama kesimleri vejetatif (kök ve kütük sürgünü) yolla gençleştirilen ormanlardır.

(2) Kısa süreli baltalıklar: Hızlı büyüyen ağaç ve çalılardan (kavak, söğüt ve okaliptus) oluşan, odun üretimi amacıyla kısa rotasyon süreyle (5-15 yıl) işletilen plantasyonlardır.

Legal Framework

There is a 40-50 year rotation for coppice of *Quercus petraea, Q. robur, Fagus orientalis*; oak coppice has a density of 2,500-4,200 trees per ha, and 15 to 25 m height.

Coppice forestry, as all other forestry, is regulated mainly by two legal acts:
1) Turkish Forestry Law
2) Forest Management Plan of Regional Directorate 2010-2020

Turkish oak forests cover 5,150,000 ha and are generally state owned; it is the main coppice species. The management of these coppice oak forests is intensive, with a clear cutting cycle of about 20 years.

Rotation Period

Minimum rotation period: 8 years for poplar, willow; 15 years for eucalyptus; 20 years for oak. Maximum rotation period: coppice forests older than 50 years must be converted to high forest. Short rotation coppice is seen as agriculture. It is defined as: Woody biomass plantation of willow, and poplar with the aim to produce woody biomass. It is harvested at least every 5-10 years.

Statistics

In 2010 there were 21,537,091 ha of forest in Turkey, 4,874,712 ha of which were coppice (23%). The growing stock of coppice was only 6% of the total for forest (78,509,363 m^3), while the annual increment of coppice accounted for 10% (3,881,926 m^3) of the total. The trend is clearly towards a decrease of coppice area, growing stock and annual increment.

Republic of Turkey Ministry of Forestry and Water Affairs (2013). *Forestry Statistics 2011*. Turkish Statistical Institute, Printing Division, Ankara ISBN 978-605-4610-18-1 https://www.ogm.gov.tr/ekutuphane/Istatistikler/Ormanc%C4%B1l%C4%B1k%20%C4%B0statistikleri/Ormanc%C4%B1l%C4%B1k%20%C4%B0statistikleri%202011.pdf

Typology

Simple coppice	Small clearcuts, rotation 20-40 years
Coppice with standards	Yes - standards often of oak
Pollarding	Only in gardens, roadsides and urban streets
Short rotation coppice	*Populus* spp., *Salix* spp., *Eucalyptus* spp.
Other types	Conversion of coppices to high forest, especially oak and beech

Images

Productive coppice of oriental beech (*Fagus orientalis* Lispky.) (left) and degraded coppice of European Hornbeam (*Carpinus betulus* L.) (right) in the Western Black Sea Region

Description

Halil Barış Özel

The main coppice product in Turkey is firewood, especially in rural villages. The coppice forests are damaged by fire, storm and snow but there are no risk assessments for them. The coppice forests are comprised of *Fagus orientalis, Sorbus torminalis, Sorbus domestica, Alnus glutinosa, Acer pseudoplatanus, Robinia pseudoacacia, Carpinus orientalis, Carpinus betulus, Platanus orientalis, Quercus petraea, Quercus robur* and *Castanea sativa* (Fig. 1).

There are coppice forests on the north and northwest slopes and on the 500-650m altitude gradient level. Productivity is generally very low, but the highest volume increment is found for *Fagus orientalis, Alnus, Salix, Platanus* and *Populus* coppice near rivers as a gallery forest type. *Buxus* coppice is used for hand-made kitchenware, but this coppice type is currently in a degraded state.

Figure 1. *Castanea sativa* coppice in Turkey

There is no regeneration programme for coppice forests undertaken by the General Directorate of Forests in Turkey. The public forest service strives to convert all current coppice to high forests. However, this is not a successful conservation measure and is adding to the area of degraded coppice forest annually. There is potential for coppice forests to be used for energy but there have not been any studies on this subject; specific clones would be required. Coppice forests near rivers are damaged because of water pollution in Turkey. This caused the destruction of about 500 hectares of *Platanus* coppice forest between 2008 and 2014.

Coppice forest vegetation is continually being destroyed. Research has shown that about 130 plant species have been lost from the coppice forest resource in Turkey. Coppice is necessary for the long-term productivity of the forest but breeding and silvicultural planning is required. Protected stands to be converted to coppice forests should be properly identified in Turkey. Coppice forests should be protected for ecology as the ecological balance has been damaged over a long period of both legal and illegal harvesting.

Forestry Regulations

Murat Ertekin

The **General Directorate of Forestry** (GDF) was established in 1869. From this date, forests seen as a source of income were protected by the law; the GDF began to sell forests to domestic and foreign traders. Forestry directorates were established in the countryside with the aim of protecting forest and regulating sales. **Forestry Law No.3116**, enacted in 1937, was revolutionary in that private sector forest management was terminated and management by the state began. In this context, forestry directorates were subject to a new assessment: these were named "forest directorates" (32 units) in 1937 and the "forest infirmary authority" in 1944. Since 1937 "**Forest Sub-District Directorates**", known as "forest district chieftaincy", have been created under different forest directorates. The **State Forest District Directorate** was initiated within the framework of Law No.4767, enacted in 1945, in the provincial organization (Gümüs, 2013).

In 1956, the present **Forest Law** (numbered 6831) was enacted and has been modified many times since then. It defines the principles of forest land use and types of ownership and quality: forest ownership types are defined as State Forests, forests belonging to the public legal entities and private forests. In the Republic of Turkey, all affairs concerning State Forests or the places regarded as State Forests are handled or organized by the GDF. All forests owned by parties other than the State are subject to the inspection of the GDF in accordance with the provisions of the aforementioned Turkish Forest Law 6831. Articles 26 to 44 state that production and harvesting in forests can only be done by the State itself in State Forests and only in compliance to management plans.

General forest ownership for Turkey:

- Publicly owned forest: 21,678,134 ha (99.9%)
  ... of which simple coppice: 4,417,542 ha
- Privately owned forest: 18,000 ha (0.83 %)
  ... all of which is simple coppice: 18,000 ha

Turkey has some short rotation coppice forests of different species:

- 2,500 ha *Eucalyptus camadulensis* and *E. grandis* (publicly owned)
- 6,500 ha Poplar plantation (Privately owned)

Legal framework in relation to coppice

(1) **Coppice Forests:** even-aged stands consisting of trees and shrubs (mainly: *Quercus* spp., *Carpinus betulus, Castanea sativa, Alnus glutinosa*) that regenerate wholly or mainly vegetatively (as sprouts or root shoots) and are harvested in small clear cuts (0.5-1 ha) in short rotations of 20-40 years.

(2) **Short rotation coppice:** plantations of fast-growing trees or shrubs (mainly *Populus* spp., *Salix* spp., and *Eucalyptus* spp.), with the aim of producing wood as a renewable resource in several short rotation periods (5-15 years each).

Art. 298/2014 - Technical principles of silvicultural applications; prepared by Ministry of Forestry and Water Affairs, General Directorate of Forestry according to the Turkish Forest Law (Law 6831):

(1.1.2.2) The high forest (monoculture or mixed forest) regeneration system is applied to the natural regeneration of all forests.

(1.1.4) Exceptions to 1.1.2.2 are stands of short rotation coppice with fast-growing species, stands on floodplain areas, other coppice forest regeneration systems and those that apply artificial regeneration or the clear cutting system. The size of clear-cutting (including coppice) coupes is a maximum of 3-5 ha.

(1.1.4.1) and (1.1.4.2) Specifications include:

(i) Calculation of annual allowable cut for management units treated as coppice: 20 year period for *Quercus* spp., *Carpinus betulus, Castanea sativa, Alnus glutinosa* stands and 5-10 year period for poplar, eucalypt and willow plantations.

(ii) 20-year management plans for compartments treated as coppice for: exploitable coppice stands reaching the rotation age (coppice cuttings), or non-/pre-exploitable coppice stands with tending operations for coppice stands to regenerate artificially.

(iii) Rules for the conversion of coppice forests to high forests: conversion by coppice ageing (total cessation of coppice cuttings) and conversion by coppice replacement and planting.

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Ukraine

Ivan Sopushynskyy, Vasyl Zayachuk, Iryna Matsiakh and Volodymyr Kramarets

Facts and Figures

Ivan Sopushynskyy

Definitions

(1) Coppice: Even-aged stand consisting of trees and shrubs (mainly: *Quercus* spp., *Fraxinus* spp., *Betula* spp., *Carpinus betulus, Alnus glutinosa*, occasionally *Fagus sylvatica*) that regenerate wholly or mainly vegetatively (sprout or root shoot) and are harvested in small clearcuts (0.5-1 ha) in short rotations of 30-60 years. In some cases combined with standards that have longer rotation periods.

(2) Short rotation coppice: Plantation of fast-growing trees or shrubs (mainly *Populus* spp., *Salix* spp.) with the aim to produce in several short rotation periods (5-20 years each) wood as raw material for weaving furniture and a renewable resource, mainly for energy.

(1) Переліски - невеликі здебільшого вузькі, витягнуті ділянки лісу, які межують або чергуються з окремими полянами, полями або луками, сюди також відносяться рідкостійні ліси, що з'єднують лісові масиви. Гай - невеликий за площею ліс, сформований деревами однієї породи близького віку.

(2) Підлісок - чагарники, рідше деревні породи, що не досягають висоти верхніх ярусів, не входять в основний деревний ярус і не здатні утворити деревостан у даних умовах.

Rotation Period

The rotation period varies depending on forest species. However, the most common minimum rotation periods are: 5 years *Salix*; 30-60 years *Quercus*, *Alnus, Betula, Alnus, Populus, Fagus,* and *Carpinus*.

Statistics

Coppice forests comprise about 16% of the Ukraine's 9573.9 thousand ha of forest. These are differentiated into natural coppice with rotations of up to 60 years and coppice with rotations of 2-5 years (wood energy plantations). The density of coppice plantations (up to 20 thousand trees ha^{-1}) has been established mainly with *Populus* and *Salix* species. The main products extracted from natural coppice forests are firewood, charcoal, pole wood and branches for brooms.

The coppiced trees were mainly selected for firewood (e.g. *Carpinus betulus* L., *Robinia pseudoacacia* L., *Fagus sylvatica* L., *Betula verrucosa* Ehrh., *Salix alba* L., *Salix caprea* L., *Alnus glutinosa* (L.) Gaertn., *Alnus incana* (L.) Moench, *Sorbus aucuparia* L., *Malus sylvestris* Mill., *Populus tremula* L., and *Corylus avellana* L.), while the uneven-aged standards were selected to produce timbers (e.g. *Quercus robur* L., *Quercus rubra* L., *Fraxinus excelsior* L., *Fagus sylvatica* L., *Alnus glutinosa* (L.) Gaertn.).

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Sopushynskyy I.M., Vintoniv I.S., Kharyton I.I., Ostashuk R.V. (2015): *Some Features of Firewood Qualimetry* // Scientific Bulletin of UNFU, Issue 25.1: 162-166.

Forests in Ukraine. http://dklg.kmu.gov.ua/forest/control/uk/publish/category?cat_id=32867

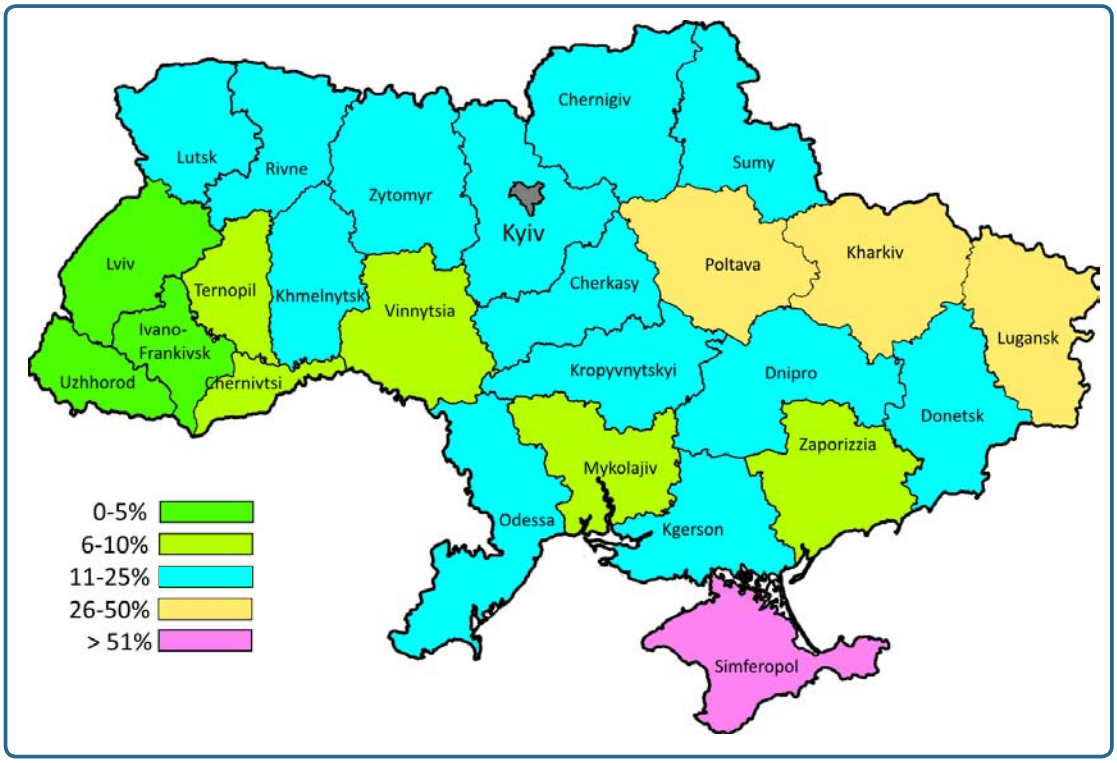
Typology

Simple coppice	Traditional natural forest regeneration method
Coppice with standards	*Populus, Alnus, Betula, Salix, Fraxinus, Quercus, Carpinus*
Pollarding	Only on roadsides and in gardens
Short rotation coppice	*Populus* spp., *Salix* spp.

Images

Map

Volodymyr Kramarets



Coppice forests in the regions of the Ukraine (in percent of the region's total forest area)

Description

Ivan Sopushynskyy and Vasyl Zayachuk

In the Ukraine, 9573.9 thousand ha are covered by forests; approximately 16% of this is coppice forest. Mixed broadleaved forests composed of pedunculate oak (*Quercus robur* L.), common ash (*Fraxinus excelsior* L.), hornbeam (*Carpinus betulus* L.), European beech (*Fagus sylvatica* L.), Norway maple (*Acer platanoides* L.), sycamore (*Acer pseudoplatanus* L.) and other tree species are dominant coppice tree species. They are differentiated into traditional coppice with rotations up to 60 years and wood energy plantations with rotations of 2-5 years.

The stands of coppice for wood energy were initiated in the past two decades and are mainly practiced for the economic reasons. The density (up to 20,000 trees ha^{-1}) of these coppice plantations has been established, mainly with *Populus* and *Salix* species. Short-rotation coppice is expected to expand with the predicted increase in demand for second generation biofuels.

The main products extracted from traditional coppice forests are firewood, charcoal, pole wood and branches for brooms. The coppiced trees were mainly selected for firewood (e.g. *Carpinus betulus, Robinia pseudoacacia, Fagus sylvatica, Betula verrucosa, Salix alba, Salix capraea, Alnus glutinosa, Alnus incana, Sorbus aucuparia, Malus sylvestris, Populus tremula,* and *Corylus avellana*), while the uneven-aged standards were selected to produce timbers (e.g. *Quercus robur, Quercus rubra, Fraxinus excelsior, Fagus sylvatica* and *Alnus glutinosa*).

Generally, coppice forests are located in poor rural communities. Coppice forests are often irregularly structured and disorganized.

There are some problems with coppice forests in the rural communities:

(a) the lack of forest management plans,

(b) frequent damage due to illegal cutting and random fires,

(c) over-use of coppice forests,

(d) unfavourable national energy policy,

(e) no real data on coppice in cadastres.

Traditional coppice forests in Ukraine occupy significant ecological niches that are of great social and economic value. They are mostly divided into two types regarding the site conditions and biotopes:

(1) along small rivers with temporarily wet soils

(2) on poor forest soils with low fertility and moisture content.

In both tradtional coppice forest types there is no regular forest management planning in the rural areas. The silvicultural treatments are mostly linked to the demands of the rural community for wood as raw materials and as non-wood forest products.

Figure 1. Traditional mixed broadleaved coppice forests in the Ukrainian Subcarpathians

References

Forests in Ukraine. http://dklg.kmu.gov.ua/forest/control/uk/publish/category?cat_id=32867

Sopushynskyy, I.M., Vintoniv, I.S., Kharyton, I.I., Ostashuk, R.V., 2015. *Some Features of Firewood Qualimetry.* Scientific Bulletin of UNFU, Issue 25.1, pp. 162-166.

Forestry Regulations

Iryna Matsiakh and Volodymyr Kramarets

The forests of Ukraine are located in different natural zones: Polesia, forest steppe, steppe, and in mountainous regions (Carpathians and Crimea). The different topographical, edaphic and climatic conditions determine the main forest tree species distribution, their age, spatial structure and their productivity. Forests in Ukraine are not uniformly spread. The vast majority are concentrated in the Carpathians and Polesia regions. The largest forest areas are located in the oblasts (the admin divisions of the Ukraine) of Trans-Carpathia (51.1% of total land), Ivano-Frankivsk (41.0%), Rivne (36.4%), Zhytomyr (33.6%), and Volyn (31.0%). The smallest forest areas occur in eastern-southern regions: Kherson (4.1%), Mykolayiv (4.0%) and Zaporizzya (3.7%) oblasts.

Generally, Ukrainian forests are in state and communal ownerships; only 0.1% of the total forest area is found in private ownership. Forests are managed by institutions and enterprises that are **subordinated to more than 30 different Ministries and Departments**. The main forest users in Ukraine are the State Forest Resources Agency (65.2 % of the total forest area), the Ministry of Agrarian Policy and Food of Ukraine (5.5%), and the Ministry of Ecology and Natural Resources of Ukraine (1.6%). Communal forests (within local governments) comprise 12.5% of the forest area.

Data on State forests

The following data all refers to forests of the State Forestry Agency of the Ukraine:

Forests in Ukraine have long been exploited and still undergo intensive economic impacts. As a result, forest plantations dominate with 51.5% of the total forest area, while natural, seed-originating forests occupy 32.0% and coppice forests cover 16.5% of the forest area. The largest areas of coppice forests (155,800 ha, 67.8% of the total area of such forests) are found in the Autonomous Republic of Crimea. Coppice forests are also distributed in the Zhytomyr (111,600 ha), Volyn (93,500 ha), Kharkiv (92,300) and Rivne (90,200 ha) regions.

The eastern part of Ukraine (Luhansk, Kharkiv and Poltava regions) has the greatest distribution of coppice forests - in each of those oblasts more than 30% of the total forest area is of coppice origin. Compared with the western part of the country, there are small parts of coppice in Lviv, Ivano-Frankivsk and Trans-Carpathian regions, where coppice forests occupy only 3.8%, 3.7% and 2.0% respectively of the total forest area. Mature and over-mature coppice stands dominate, occupying 47.2% of all coppices, compared with only 8.3% in young categories.

Coppice forests in Ukraine developed without any clear intention to grow this type of forest. After World War II, part of the felled area remained as coppice, providing a fairly rapid supply of wood for heating and timber. In order to provide the best growing conditions for the main tree species (e.g. pedunculate oak, European beech, common ash, etc.), thinning of minor tree species such as hornbeam, silver birch and aspen was carried out. According to forest management plans, these stands are of seed origin, whereas they can contain up to 5-6 secondary tree species of coppice origin. This situation is typical in the forest enterprises of Poddilya and Lisostep (Tkach and Golovach 2009). Thinning favoured the main tree species, removing the secondary ones. Although a portion of these stands include a significant amount of coppice, unfortunately this factor is ignored in forest management activities.

Recently, it has been shown that the cultivation of coppice tree stands can have a number of advantages. In studies conducted in the Poltava region, comparisons of oak coppice forests with artificially planted oaks (Bojko 2006) indicated that: the time period of forest formation is decreased in coppices; a more complex structure develops than in oak forest plantations; coppices have higher productivity and a greater contribution to biodiversity conservation; and they reduce erosion and promote environment-specific functions (water and soil protection). Mature coppice oaks possessed a larger stock and a greater yield of small and medium-size wood than planted oaks. At the same time, the condition of coppice forests was often poor and a large share was affected by root and stem rot pathogens (Tkach 1999; Ustskiy and Bugayov 2014).

Usage of coppice stands for firewood production has a long tradition in Ukraine. Various species of willows were pollarded, for example, along with smaller amounts of poplar or other tree species. These willows were regenerated vegetatively using cut branch lengths, which quickly rooted up, on rich, wet soils along rivers or ponds. These were then periodically cut at 1.5-2.5 m above ground to aid the development of brushwood and sprouting. After several years, the willow branches were cut and used as firewood. Even nowadays, in many regions of the Ukraine local populations plant lines of willows along roads or in private gardens for firewood and heating, especially in the lowlands of Ukraine and in the Pre-Carpathian and Carpathian regions with a high forest cover. After the World War II, considerable attention was also paid to the selection of fast-growing poplar plantations (Shevchenko 1958), but this tree species is rarely used. Currently, biomass plantations to generate industrial energy are the subject of experimental research, but there are none on the territories of Forests Enterprises of the State Forest Resources Agency of Ukraine. Nevertheless, both the natural and economic conditions do allow fast-growing plantations for energy purposes to be established (Fuchylo et al. 2007).

Due to the problems concerning gas supplies from Russia and the war in the eastern part of Ukraine, where the coal mines are concentrated, our country faces the acute problem of finding alternative sources of energy. Thus, the **National Action Plan for Renewable Energy 2020**, approved by the Cabinet of Ministers of Ukraine on 01.10.2014, includes measures to promote bio-energy (National Action Plan 2014). The most realistic of these is the production of biomass for heating of private households, and for public, industrial and commercial consumers. There is also the prospect that biomass for energy production might be grown on an industrial scale. Private companies (Rika Biopalyvo, Eco-Energy) have made a commercial offer to establish energy plantations (Rakhmetov 2017), and the agro-energy company "SalixEnergy" is planning the cultivation of willow biomass for thermal and electric energy. On 1.05.2016, this company established 1,700 ha of energy plantations in the western part of Ukraine (Gnap 2016).

The growing and cultivation of energy crops requires support from the state and legislative regulators. The **Law of Ukraine "On Amending Certain Laws of Ukraine Concerning Ensuring Competitive Conditions for the Production of Electric Power from Alternative Energy Sources"** was adopted (04.06.2015) for the promotion of renewable energy, in particular:

- The "green tariff" for electricity generated from alternative sources (including wood) is approaching average world prices;
- If components of Ukrainian production are used to design and construct alternative energy sources, the remuneration is set as an allowance for the "green tariff";

- Stimulation of bioenergy is provided by setting the "green tariff" rate for electricity generated from alternative energy sources (including biomass).

The **Law of Ukraine "On Amendments to the Law of Ukraine "About Heat Supply" on Stimulation of the Production of Thermal Energy from Alternative Energy Sources"** (21.03.2017) promotes the production of energy for heating from alternative sources at local level. Moreover, domestic and foreign investments are guaranteed on the return of their investment, and can adjust the bioenergy tariff depending on the current gas tariff.

The tariffs for biological energy produced from alternative sources, including renewable resources (wood) for the local population and the state institutions, are set at 90% of the current tariff of heat produced from gas. Licensing activities for producing heat energy from alternative sources and setting tariffs is done at the local level, which allows for varying conditions in different regions within Ukraine and aims to stimulate small and medium businesses. In the new version of the **Law of Ukraine "About the Electricity Market"** (13.04.2017) considerable attention is paid to stimulating the production of electricity from renewable and alternative energy sources.

To summarize, the coppice forests of Ukraine result from a lack of effective forest management, especially after the World War II. However, there is a growing interest in the cultivation of fast-growing coppice tree species in plantations, which could become an important source of renewable energy in modern Ukraine. In addition, as shown above, domestic and foreign investors are given guarantees on returns from their investments in producing thermal energy from biomass, which in the future will further stimulate the cultivation of fast-growing coppice plantations.

Acknowledgement

We would like to thank M. Popovych, the Chief Specialist of the Department of Forest Protection from State Forest Resources Agency of Ukraine for information included in this report.

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United Kingdom

Debbie Bartlett, Peter Buckley, Jenny Mills and David Rossney

Facts and Figures

Debbie Bartlett and David Rossney

Definitions

Coppice in the UK really just means any tree that is cut at - or near - ground level, so that it regrows with multiple stems. These trees would then be described as 'coppiced'. Coppice woodland is woodland where this management technique has occurred and this may be carried out repeatedly, and so called rotational (or in rotation) coppice. We would refer to such woodland as managed by coppicing or in coppice management.

Debbie Barlett

Woodland comprising broadleaved trees, areas of which are clear felled, often regularly, and which then re-sprout (sometimes including suckering species). These sprouting root stocks will grow another crop of trees in the absence of grazing and browsing.

David Rossney

Legal Framework

There is no legal framework. In fact we have some problems defining woodland. Short Rotation Coppice is usually *Salix* spp., although chestnut can be managed on a wide range of rotations depending on end use, for example 3 years for walking sticks.

Debbie Barlett

There is no special legal framework for coppice, but it is mostly covered by general UK Forestry legislation and tree felling controls.

Coppice often grows in ancient semi-natural woodland which is itself subject to legal protection from damage. This does not mean that felling coppice cannot take place, but that the woodland must be allowed to re-grow again. This in effect means not cleared for building or agriculture and protected from grazing farm animals and wild browsing animals like deer.

David Rossney

Statistics

In 1999, total forest cover in the UK was over 2.6 m ha. Coppice and coppice with standards amounted to 0.9% of this total (24,000 ha). Historically this was higher and estimated at 1.5% in 1980 and 5.3% in 1947.

Source: Forestry Commission Research Report 2010

Much of the broadleaved woodland was, in the past, managed as coppice even if this practice has not been continued.

Typology

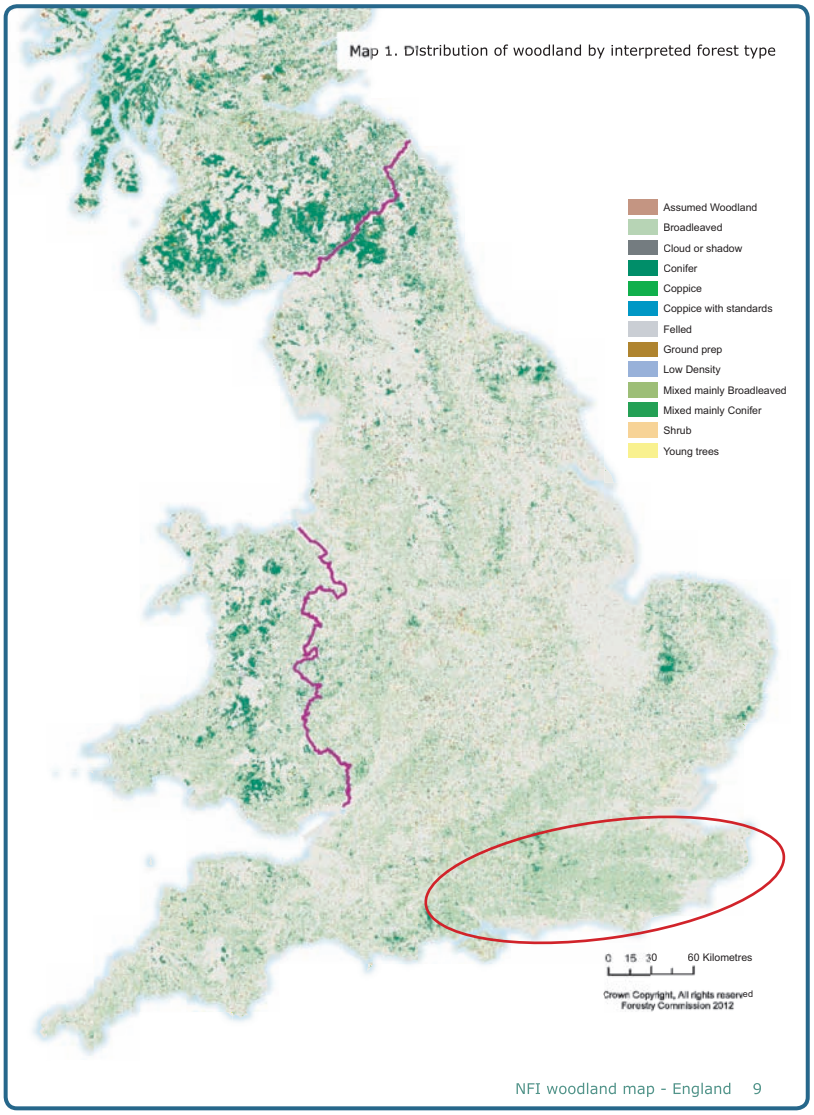
Simple coppice	Traditional natural forest regeneration method still practised, particularly in Southeast England, mainly sweet chestnut, hazel or mixed species and may include standards.
Coppice with standards	UK - Very common, usually with oak as the standard. This was, in times past, important for timber, particularly ship building. The recruitment of standards is no longer the norm, but is encouraged for biodiversity. England - standards often of oak.
Pollarding	UK - Practised in historic wood pastures and also within coppice areas as one way of marking boundaries between felling areas and changes in ownership, parish boundaries etc. England - historically - now regarded as archaeological features of cultural/ biological significance.
Short rotation coppice	UK - Practised as an agricultural alternative to normal farmed crops. Not really part of the UK's woodland management heritage, unless counting hazel coppice cut on 7-9 year rotation. England - limited and considered as agriculture rather than forestry.
Other types	Self-seeded stands and newly planted coppice. A little new planting is still undertaken with the intention of creating new coppice woodland, particularly for sweet chestnut. Seed regeneration, especially of species such as silver birch, is often mistaken for or mixed in with coppice and is effectively managed in much the same way. After cutting, some stools will coppice, but with birch, most new trees come from self-seeding.

Images





Map



Map of the distribution of woodland in England by interpreted forest type, from the National Forest Inventory (NFI) 2011 (Contains Forestry Commission information licensed under the Open Government License v3.0). Coppice is currently a significant component of the landscape character in the south-east of England (circled in red).

Description

Debbie Bartlett

Coppice management has been practiced since the earliest times with archaeological evidence including the remains of trackways laid across boggy ground showing the marks of felling axes. The composition of the woods has varied over time as particular tree species were preferentially encouraged to meet the demands of markets. Similarly, rotational cycles were developed to provide roundwood of the required dimensions.

Forestry as a whole has undergone dramatic changes in recent centuries. The demands of oak for ship building, particularly in the 17th and 18th centuries, led to the development of

the coppice with standards system. In this, oaks were grown over coppice, encouraging branching and the development of the 'crooks' or angled branches required by the master ship wrights.

In the immediate aftermath of the First World War the Forestry Commission was set up in response to the shortages of timber and this Government organisation, which still exists today, set about increasing self-sufficiency in timber. This was done by buying woodland, planting conifers and providing financial incentives for private woodland owners to do the same. In many cases this led to previously coppiced native broadleaved woods being cleared and over-planted with fast growing conifers.

After the Second World War, which again had a major impact on woodlands, particularly coppice, there was a period of agricultural intensification, driven by the food shortages. This led to a reduction in the woodland area as land was cleared for agriculture. The rise of the environmental movement and increasing awareness of the effect on native flora and fauna led to a change in forestry policy with a move from coniferisation to encouraging native broadleaves in the mid-1980s.

So how has this affected coppice woodland management? The area managed as coppice has risen and fallen with changes in market demand, policy and overall woodland area. By the turn of the century it had virtually died out in most parts of the UK as an economic activity and was practised, primarily by nature conservation organisations, to maintain specific habitats. The exception to this trend was the chestnut industry, concentrated in the south eastern counties, and producing fencing materials. This has remained largely 'hidden' as there is no legislation affecting it (i.e. no permissions are required for harvesting roundwood of small diameter). There has been continuity with coppice workers often working in family groups and with skills and knowledge passed from father to sons.

There has been a revival in hazel coppice crafts apparent in the last decades of the 20th century with some choosing to take up this livelihood, often after becoming disillusioned by working in more high powered careers. These tend to sell products directly to their customers, as opposed to feeding produce into 'coppice merchants' as is the case for the chestnut industry, and supplement this by demonstrating at craft fairs and country shows.

In addition to these two sectors, based on specific tree species, woods are coppiced for firewood.

Figure 1. An example of coppice with standards in the United Kingdom

Forestry Regulations

Jenny Mills and Peter Buckley

England, Scotland and Wales

There are 3.16 million hectares of woodland in the UK according to national forestry statistics published in 2016. This represents 13% of the total land area in the UK, 10% in England, 15% in Wales, 18% in Scotland and 8% in Northern Ireland. 1.35 million hectares of woodland in the UK is independently certified as sustainably managed. Conifers, mainly Sitka spruce and Scots pine, cover around 51% of the UK woodland area, although varying from 26% in England to 74% in Scotland. The main broadleaf species are oak, beech, sycamore, ash, birch, alder, sweet chestnut and hazel.

UK forestry statistics define woodland as land under stands of trees with a canopy cover of at least 20% (or having the potential to achieve this), including integral open space, and including felled areas that are awaiting restocking. There is no minimum size for a woodland or minimum height for trees to form a woodland at maturity; the definition therefore includes woodland scrub but not areas with only shrub species. During the 20th century, the area under working coppice in the UK greatly decreased; the last official estimate in 2011 was only just over 2,000 ha. This is distributed mainly in south-east England, where it represents approximately 1% of the forest cover (Forestry Commission, 2015).

The **Forestry Act 1967** and subsequent amendments regulate forestry in England, Scotland and Wales. Responsibility for administration and enforcement is vested in the Forestry Commission, Forestry Commission Scotland and Natural Resources Wales.

Under the Forestry Act, it is illegal to fell trees in the UK without prior approval, apart from the exemptions listed below. **Felling licences** are usually granted subject to restocking and maintenance for a period not exceeding 10 years. The Forestry Commission will discuss any proposed restocking condition with the applicant before a licence is issued. However, licences without the requirement to restock are issued for silvicultural thinning operations. They may also be issued if there are overriding environmental considerations, e.g. to restore important habitats, and such applications are assessed under the **Environmental Impact Assessment (Forestry) Regulations 1999**. It is recommended that a felling licence application is made at least 3 months before felling is planned to take place.

In England, Scotland and Wales, a felling licence is not required if the owner wishes:

- to fell less than 5 cubic metres in a calendar quarter, but only 2 cubic metres of this can be sold per quarter (i.e. can fell 20 cubic metres a year, but sell only 8)
- for trees that have the following diameters when measured 1.3 metres from the ground: 8 cm or less; 10 cm or less for thinnings; 15cm or less for cutting coppice

A licence is not needed if the owner has a current permission under an approved **Dedication Scheme** plan or planning permission granted under the Town & Country Planning Act.

A licence is not needed to fell dangerous or nuisance trees, diseased trees in accordance with a notice served by a Plant Health Officer, to comply with an Act of Parliament or to undertake duties as a statutory service provider (gas, water, electricity).

No licence is required for lopping, topping, pruning or pollarding unless the tree is covered

by a **Tree Preservation Order** or by **Hedgerow Regulations**, in which case permission must be sought from the Local Planning Authority and they also have to be consulted if a tree is to be felled in a historical **Conservation Area**.

Application for a felling licence can be made on its own or as part of a management plan submitted to the Forestry Commission, Forestry Commission Scotland or Natural Resources Wales. An application to fell trees can be made as part of a grant scheme application. A separate felling licence application is not required as a felling licence will be issued with the grant scheme contract.

An offence under the **Wildlife & Countryside Act** (1981) may be committed if felling, and in particular, clear felling, is carried out during the breeding season of protected species, including all wild birds. A **European Protected Species** (EPS) licence may be required from Natural England under the **Conservation of Habitats and Species Regulations** (2010) if felling operations could adversely affect any EPS.

Natura 2000 sites in the UK are also designated as Sites of Special Scientific Interest (SSSIs). Consent for forestry operations, which include afforestation, planting, clear and selective felling, thinning, coppicing, modification of the stand or underwood, changes in species composition and the cessation of management, on these designated sites is required from Natural England, Scottish Natural Heritage or Natural Resources Wales as well as the Forestry Commission, unless statutory permission has been received from another public body such as the Environment Agency who have already consulted the national environmental body.

Within SSSIs, and so by association in all SACs (Special Areas of Conservation), lists of damaging operations notified by the above conservation organisations include the cessation of tree or woodland management, which in the case of coppice, could mean keeping the coppice within rotation. However, Natural England is not aware of any action being taken for sites where coppice is being neglected, even if it was being actively coppiced when listed.

Northern Ireland

The **Forestry Act (Northern Ireland)** passed in 2010 applies in this part of the UK. Owners of private woodlands of 0.2 hectares or more need a licence to fell trees from the Forestry Service of the Northern Ireland Department of Agriculture and Rural Development. They are required to re-establish the woodland under an approved felling management plan. The exemptions from the requirement for a felling licence are similar to the rest of the UK.

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Summary of Data from the 35 Country Reports

Alicia Unrau

Throughout the duration of COST Action FP1301, much coppice-related data and information was collected on the 35 countries involved. Each of the countries were featured in the previous sections of this chapter; a few of the key aspects are summarised below. First is a table on the amount of coppice in each country, followed by a list of the tree species. Finally, countries that offer coppice-related subsidies are highlighted. This summary is by no means all-encompassing, it is only meant to give a brief overview of some of the key information on coppice forests in Europe.

Coppice forest area

Table 1 lists the countries in this chapter by their reported area of coppice forests, from lowest to highest. The **data was extracted from the Country Reports**; if several figures were cited, generally the more conservative amount, closer to the amount of active coppice, was taken (e.g. the 1,351,815 ha of "conversion coppice" in Bulgaria are excluded) and for cases in which only a percentage as given (e.g. Romania), the area of coppice was calculated based on the share of the total forest area. The countries without figures have either a negligible and/or unknown (e.g. Latvia) amount of coppice.

The **figures on land and forest area** were taken from the State of Europe's Forests (SoEF) 2015 report (FOREST EUROPE 2015), from Table 1 and Table 2 of Annex 8, respectively. The "forest area (ha)" figures only include forest, not "other wooded land (OWL)". Coppice forests as a share of total forest area was calculated based on those figures.

It must be noted that there are the usual difficulties here in stating and comparing forest area statistics, which are in fact magnified for coppice due to its relative neglect as a forest management form. The figures cited here **can only be viewed as approximations**, since the definitions of coppice between countries vary, as do the inventory methods.

The figure of 29 million hectares of **total coppice forest area in Europe** is higher than other sources, such as Zlatanov and Lexer (2009), who cite the UN/ECE-FAO (2000) for over 23 million ha of coppice forests in Europe, as well as giving their own figures per country. In another source, the SoEF 2015 (FOREST EUROPE 2015), the sum comes to approximately 8.7 million ha of coppice. Concerning the latter, the countries with the largest variation in data compared to the Country Reports are France, Spain, Italy, Turkey, Greece, Serbia and Bosnia & Herzegovina, which are, apparently, underreported in the SoEF 2015 report by between 4.67 and 1.25 million ha, with some countries not having provided any data. Bulgaria is an exception, in which 1.29 million ha more are reported in the SoEF 2015 report than in Table 1 here (for the reason stated above, first paragraph).

Despite this comparatively high figure, the **area of forests of coppice origin, including overaged coppice, can be considered to be greater than reported here**, because of: the use of rather conservative estimates (see first paragraph above); overaged coppice is often not included in the forest inventory (e.g. in the German National Forest Inventory, forests are only considered to be coppice if they were cut within the past 40 years); and in many cases the OWL areas could be coppiced (e.g. Albania, in which 60 % of the total wooded area is managed as coppice, as opposed to the 38 % from forest cited here).

Table 1. Area of coppice forests in Europe based on data from the Country Reports, compared to total forest area (excludes the reports from Israel and South Africa).

	Land area (ha)*	Forest area (ha)*	Forest as share of land area (%)	Coppice forest area (ha)†	Coppice as share of forest area (%)
Ireland	6,889,000	754,000	11 %	-	0 %
Lithuania	6,267,500	2,180,000	35 %	-	0 %
Estonia	4,522,700	2,232,000	49 %	-	0 %
Latvia	6,218,000	3,356,000	54 %	-	0 %
Norway	30,427,000	12,112,000	40 %	-	0 %
Finland	30,389,000	22,218,000	73 %	-	0 %
Sweden	41,033,000	28,073,000	68 %	-	0 %
Netherlands	3,375,000	376,000	11 %	1,500	0.4 %
United Kingdom	24,193,000	3,144,000	13 %	2,000	0.1 %
Denmark	4,243,000	612,200	14 %	6,000	1.0 %
Czech Republic	7,721,600	2,667,400	35 %	11,703	0.4 %
Poland	30,622,000	9,435,000	31 %	21,477	0.2 %
Slovakia	4,810,000	1,940,000	40 %	34,463	1.8 %
Switzerland	4,000,000	1,254,000	31 %	35,200	2.8 %
Slovenia	2,014,000	1,248,000	62 %	36,340	2.9 %
Germany	34,861,000	11,419,000	33 %	78,120	0.7 %
Austria	8,243,500	3,869,000	47 %	93,000	2.4 %
Belgium	3,027,800	683,400	23 %	115,000	17 %
Albania	2,751,500	785,000	29 %	295,440	38 %
Romania	23,002,000	6,861,000	30 %	343,050	5 %
Bulgaria	10,856,000	3,823,000	35 %	481,747	13 %
Croatia	5,596,000	1,922,000	34 %	533,828	28 %
Macedonia	2,543,000	987,500	39 %	564,000	57 %
Hungary	9,303,600	2,069,100	22 %	581,420	28 %
Portugal	9,025,500	3,182,100	35 %	863,000	27 %
Bosnia & Herzegovina	5,120,000	2,115,000	41 %	1,252,200	59 %
Serbia	8,746,000	2,720,000	31 %	1,456,400	54 %
Ukraine	57,938,000	9,657,000	17 %	1,531,824	16 %
Greece	12,890,000	3,903,000	30 %	1,930,000	49 %
Italy	29,414,000	9,297,000	32 %	3,666,310	39 %
Spain	49,880,000	18,417,900	37 %	4,000,000	22 %
Turkey	76,963,000	11,943,000	16 %	4,874,712	41 %
France	54,766,000	16,989,000	31 %	6,372,000	38 %
TOTAL	611,651,700	202,244,611		29,180,734	

* Data from the "State of Europe's Forests 2015" (FOREST EUROPE 2015)

† Data from the 35 Country Reports in this volume, "Coppice Forests in Europe"

Table 2. Main tree species managed as coppice by country, according to data from the Country Reports and supplemented by feedback from the authors. Modified version of table in Lazdina and Celma (2017).

	Alder	Ash	Beech	Birch	Black locust	Elm	Eucalypt	Hazel	Hophornbeam	Hornbeam	Linden	Maple	Oak	Plane tree	Poplar/Aspen	Rowan	Sweet chestnut	Willow
Albania	xx	P	xP		xx	P		xx	P	xx	P	P	xx		xx			xx
Austria										xx			xx		S			S
Belgium	xx	xx		xx				xx		xx		xx	xx		S		xx	S
Bosnia & Herzegovina			xx										xx					
Bulgaria		x	xx		xx					xx	xx		xx				x	
Croatia	x		xx		x				xx	xx			xx		x		x	x
Czech Republic	xxS	xxS		x	x	x		xx		xx	xx	xx	xx		xxS			PS
Denmark	xx	x		x				xx				x	xx		x	x		x
Estonia	xS														xS			xS
Finland	S			xS				x			x				S	x		xS
France	x		x	x	xS		S			xx			xx		xS		xx	S
Germany	xx		x		S			x		xx	x		xx		S		x	S
Greece			xx										xx		S		xx	
Hungary	xx				xx										xx			
Ireland		xx						xx					xx		xxS			xxS
Israel													xx		x			
Italy	xS		xx		xS	S	S	x	xx	x			xx	S	S		xx	xS
Latvia	xxS	x		xx				x			x				xxS			xxS
Lithuania	xxS	xx		xx											S			S
Macedonia		xx	x						xx	xx		xx	xx		xx			
Netherlands	xx	xx	x	x		x					x		xx		S			S
Norway		xx		xx		xx					xx					xx		
Poland	xx		x	xx						x	x		xx		S			S
Portugal		P					xx						x		P		x	
Romania					xx										x			x
Serbia			xx		xx					xx	xx		xx					S
Slovakia	x	x	xx		xx					xx			xx		xS			PS
Slovenia			xx		xx								xx				x	S
South Africa							xx											
Spain	x			xx			xx						xx	x	S		x	x
Sweden	xx	P		xx							P				xx			xxS
Switzerland	xx	xx	xx					x		x	x		xx				xx	P
Turkey	xx		x				S			xx		x	xx	x	S		xx	S
Ukraine	xx	xx		xx	x			x		xx			xx		xxS	x		xxS
United Kingdom								xx		xx			xx				xx	S

xx = species used for coppice (current/historic) x = species less commonly used for coppice (current/historic)
P = species only/mainly used for pollarding S = species used for Short Rotation Coppice (SRC)

Tree species managed as coppice

The main tree species managed as coppice (Table 2) are taken from the sections of the Country Reports; the authors were subsequently given the opportunity to make further adjustments. Most of the tree species mentioned in the reports are listed, although there are a few exceptions, such as wild cherry (Czech Republic) and elder (Denmark).

The categories were kept rather open by using the common names that could encompass several species. In the reports, quite a few authors specify major species that are particularly important for coppice in that country, such as oriental hornbeam in Bulgaria and European hop hornbeam in Italy.

Subsidies for coppice forest management

Some of the Country Reports mention subsidies related to coppice forest management. These range in their aims and instruments, for example:

Croatia: subsidies are possible in protection areas and for conversion to high forest (the latter in Chapter five, "Socio-Economic Factors Influencing Coppice Management in Europe"); management plans are necessary when applying.

Denmark: subsidies were introduced in 1994 to support traditional silvicultural systems.

France: the replacement of coppice through conifers was strongly encouraged through subsidies in the second half of the 20th century.

Netherlands: 1955-65 conversion to high forest; current policy to protect coppice forests, with management subsidies of 2,563 €/ha/yr for coppice forests on wet soil, 394 €/ha/yr on dry soil.

Norway: 50 €/tree managed as coppice, Regional Environmental Program for Agriculture (RMP)

Switzerland: 4000 CHF/ha^{-1} per intervention for the restoration and tending of coppice forest with and without standards.

United Kingdom: some coppice-specific subsidies for coppice in some areas of England (in Chapter five, "Socio-Economic Factors Influencing Coppice Management in Europe").

Considering this diversity, a closer look at different subsidies related to coppice management could be an interesting topic for further research.

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Editors: Alicia Unrau, Gero Becker, Raffaele Spinelli, Dagnija Lazdina, Natascia Magagnotti, Valeriu-Norocel Nicolescu, Peter Buckley, Debbie Bartlett and Pieter D. Kofman

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