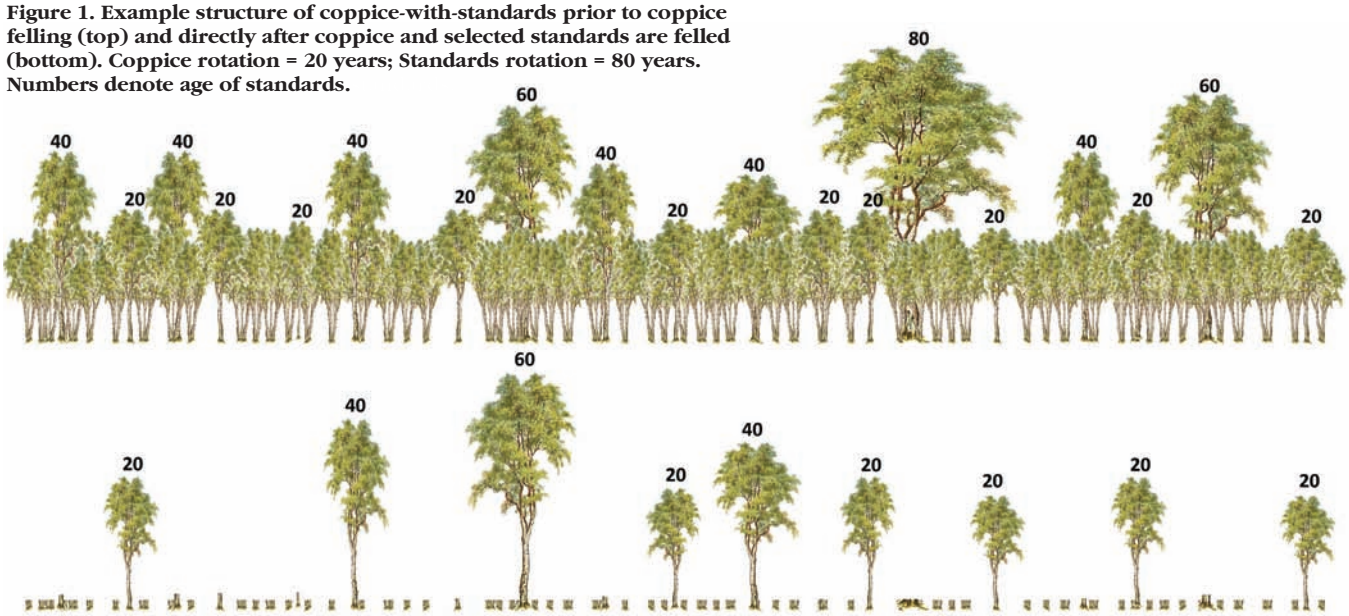
BROADLEAF AFFORESTATION

Coppice–with–standards: An old silvicultural system with new potential?

The last two decades have seen a dramatic increase in the area of broadleaf afforestation in Ireland. Some of these plantations are not performing as well as was expected when planted. Dr. Ian Short and Jerry Campion, Teagasc Forestry Development Dept., report.

Figure 1. Example structure of coppice-with-standards prior to coppice felling (top) and directly after coppice and selected standards are felled (bottom). Coppice rotation = 20 years; Standards rotation = 80 years. Numbers denote age of standards.



In 2010 Teagasc began a 5-year COFORD-funded research programme on the silviculture of broadleaf plantations (the B-SilvRD project) with UCD, one part of which is investigating the rehabilitation of poorly performing pole-stage (10 – 20-year-old) stands. As part of this research coppice-with-standards is being considered as a rehabilitation system.

WHAT IS COPPICING?

Coppice is managed as an even-aged single-storey crop which is cut on a regular rotation, resulting in the regrowth of multiple stems from the stump. The rotation length is dependent on product requirement, species and growth rate. Coppice-with-standards is a traditional silvicultural system that produces a multi-storied stand consisting of a lower storey of an even-aged coppice underwood and an uneven-aged partial upper storey of standard trees grown at wide spacing which is treated as high forest. The lower storey is cut regularly to produce small material whilst the objective of the upper storey is to produce large timber.

HISTORY OF COPPICING

Coppicing was widely practised in both Ireland and Britain until the end of the 19th century when the increased availability of coal during the industrial revolution reduced the demand for domestic and industrial charcoal and fuelwood. Coppicing has continued to decrease. In Britain in 1905 there were 230,000 ha in coppice. This has dramatically reduced during the last century with the 2011 National Forest Inventory identifying approximately 2,000 ha of coppice. The system has a long history of extensive and continued use in Europe: it is still widely used in France as the most common silvicultural system. It was also common in Belgium in the 1990's where the major stand types in private woodlands in the Wallonian region were conifer (55%), coppice-with-standards (20%), coppice (11%) and hardwood high forest (14%) and In Austria where half of the approximate 150,000 ha of oak stands were managed as coppice or coppice-with standards. Over 3.5 million ha of Italian forest, 43% of the total forest area, are currently managed as coppice-with-standards, where the standards are left to produce seed for stump reproduction. It is surprising that a silvicultural system that is still in extensive use in many industrialized temperate and boreal countries (see Table 1), and was once relatively common in Ireland and the UK, has so fallen out of favour during the last two centuries.

Table 1. Estimated areas (ha) of coppice woodland[a] in industrialized temperate/boreal countries

Region	Utilizable	Non–utilizable[b]
Nordic and Baltic	16,000	0
Central Europe	7,687,000	64,000
Southern Europe	13,506,000	4,411,000
Commonwealth of Independent States	12,643,000	16,071,000
USA & Canada	0	0
Australasia & Japan	56,000	0
Total	**33,908,000**	**20,546,000**

[a] Figures are for both simple coppice and coppice–with–standards.
[b] Non–utilizable, not available for wood supply for a variety of conservation, protection, or economic reasons.

THE MANAGEMENT OF COPPICE–WITH–STANDARDS

The management of coppice-with-standards requires greater silvicultural skill than the majority of other silviculture systems. Generally, the forest is arranged into a number of coupes, also known as cants, corresponding to the rotation length of the coppice, such that one coppice cant can be harvested annually. The coppice rotation length is normally from 10-30 years.

When the coppice of a cant is cut, some existing standards are retained for at least another coppice rotation whilst the remainder are felled.

A number of new standards of similar age as the coppice are selected from natural regeneration, preferably from seed origin, and reserved. Vacancies caused by the removal of standards or the

Figure 2. Poor quality oak:ash mixture prior to intervention

death of coppice stools are filled up using seedling natural regeneration or transplants to ensure a future supply of both coppice and standards. After numerous coppice rotations the result is a multi-aged stand that consists of an even-aged coppice understorey with a multi-aged overstorey (Figure 1).

The key to successful coppice-with-standards management is getting the right balance of standards per hectare and the right distribution of ages.

The number of standards depends upon their target diameter at felling, the target rotation age and the shade cast by the standards and the shade-tolerance of the coppice.

Generally the crowns of the standards should not occupy more than 50% of the ground area with the area equally apportioned amongst the different age classes.

The number of stems of each age class therefore reduces with increasing age and canopy size (see Table 2 for example).

Table 2. Number of standards in coppice cut on a 20–year rotation

Age of standard (years)	Number of stems to remain (ha^{-1})	Approximate canopy cover m^2 ha^{-1}	
		Average tree	Total
20	50	20	1,000
40	30	33	1,000
60	13	77	1,000
80	7	143	1,000
Total		**100**	**4,000**

SPECIES SELECTION

The coppice species must be able to tolerate some shade, produce satisfactory stool shoots and be marketable in small dimensions. The overstorey is particularly suited to light-demanding species with rapid growth and valuable timber and may be the same as, or different from, the understorey species. Ideally the overstorey species should cast only light shade.

Table 3 provides a selection of species suitable for the coppice-with-standards system.

Table 3. A selection of species suitable for coppice-with-standards

Coppice	Standards
Hazel	Oak
Hornbeam	Ash
Birch	Sycamore
Ash	Larch
Oak	Sweet chestnut
Sycamore	Norway maple
Willow	Cherry
Alder	Birch
Holly	
Lime	
Sweet chestnut	

ADVANTAGES OF COPPICE–WITH–STANDARDS

Coppice-with-standards can fulfil a multitude of woodland owner objectives with a wide range of additional options, such as farm shelter, shooting, small roundwood production for fuelwood and fencing, production of valuable sawlog, landscape enhancement and wildlife conservation. The system can provide material of various sizes and therefore can supply local demand for fencing material, pulpwood, fuelwood poles, charcoal, turnery wood and timber.

The inclusion of coppicing within the system provides early returns, and since the standards are grown with their crowns entirely open, they exhibit unusually rapid growth, resulting in the production of a few trees of exceptional size and value in a comparatively short time. The cash-flow resulting from a well-managed coppice-with-standards system will be more stable than that from high forest because the same amount of each product will be harvested at the end of each coppice rotation.

The predominant product from coppice-with-standards, in terms of volume, is small roundwood from the coppice stools. Oak may produce 3–7 m^3 ha^{-1} yr^{-1} on a 20–35 year rotation whilst ash, sycamore and other hardwoods may produce 6–10 m^3 ha^{-1} yr^{-1} on a 20–25 year rotation. This is imminently suitable for firewood.

It has been estimated that 4–5 hectares of coppice on a 20–25 year rotation, arranged as 0.25 ha cants, will yield 8 dry tonnes of

Figure 3. Oak:ash mixture post intervention

fuelwood per year, sufficient to heat a typical house. The Irish market for firewood has grown by 35% over the period 2006 – 2010 with nearly 200,000 m³ of firewood (roundwood equivalent) sold in 2010. With the current and expected future high demand for firewood, coppice-with-standards has increasingly greater potential as a multi-functional silvicultural management system in Ireland. The coppice-with-standards system provides a multi-strata, multi-age canopy cover which provides a multitude of habitats and highly rated visual amenity.

DISADVANTAGES OF COPPICE–WITH–STANDARDS

As was highlighted previously, the management of coppice- with-standards requires greater silvicultural skills. It also requires more labour than monoculture high forest or simple coppice. The yield of coppice in coppice-with-standards can also be less than that of simple coppice due to the competition for light from the overstorey.

However, in some situations the overstorey can protect the coppice from frost. The standards can often be more branchy and short-stemmed than those grown in high forest due to reduced lateral competition. This can lead to an increased requirement for judicious pruning.

PILOT TRIAL

A coppice-with-standards system is being trialled as a method of bringing a poorly performing pole-stage ash/oak mixture in Co. Mayo into a productive state. Two plots have been established within a stand that was planted in 1992. It was original planted with 1:3 lines of ash: oak, respectively, with lines 2 m apart. Since being planted, the stand had been largely neglected resulting in the ash being in a situation resembling free-growth prior to intervention because the oak growth rate was poor, most likely due to suppression from the adjacent ash, and therefore there was little competition from the side. The stem form of the oak in the stand was very poor (Figure 2). The best ash stems (93 stems ha^{-1} per plot) have been selected for retention as standards and the remainder have been felled. All the oak, except those very few stems that exhibited some potential as standards (33 and 120 stems ha^{-1} for the two plots respectively), has been stumped back (Figure 3). It is hoped that the resultant oak coppice will exhibit greater vigour than the original planting due to the release from overhead competition, deeper and more extensive root systems and a better-developed forest soil.

The conversion of the stand to coppice-with-standards will provide some flexibility for future management. If the coppice growth rate is acceptable, a decision can then be made to either single the coppice regrowth (remove all coppice regrowth except the best shoot per stool), resulting in a two-tiered high forest, or to maintain it as coppice-with-standards. If the growth rate is unacceptable, then the coppiced area can be reconstituted via natural regeneration seedlings or replanted with a suitable species to create a two-tiered high forest. Whichever choice is finally made, the end result will hopefully be an aesthetically pleasing productive mixed broadleaf stand that will become financially beneficial to the owner in later years.

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CONCLUSION

The coppice-with-standards system has been successful in the past in Europe, the UK and Ireland. It may have potential to be successful again in Ireland. It can result in aesthetically pleasing, biodiverse, sustainable and productive stands producing products of various sizes.

With the increased demand for fuelwood and greater broadleaf plantation area, some of which may require alternative silvicultural management to the conventional due to poor performance, the coppice-with-standards system has the potential to fulfil many objectives.

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