

- ▶ Continuous cover forestry (CCF) is a management option in which canopy cover is maintained continuously, the soil is never exposed, and clearfelling is avoided for areas greater than 0.25 ha or more than two tree heights wide.
- ▶ Shelterwood and selection systems can deliver CCF.
- ▶ In shelterwood systems, the old stand is removed in a series of regeneration fellings. The old crop and the new crop co-exist on the site for a period of time.
- ▶ In the single tree selection system small openings are created in the canopy. Group selection is a variation where groups of trees are removed from the stand. This results in a continuous series of age classes and diameters, and uneven-aged forests.
- ▶ Sites suitable for CCF are those which are conducive to natural regeneration, where the risk of windthrow is moderate to low, and those which are free-draining.

Continuous Cover Forestry

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What is continuous cover forestry (CCF)?

A continuous forest is managed so that the canopy cover is continuously maintained and the soil never exposed (Troup 1927, cited in Yorke 1998). Continuous cover forestry (CCF) is defined as the use of silvicultural systems whereby the forest canopy is maintained at one or more levels without clearfelling (Forestry Commission 1998). The distinctive element of CCF is the avoidance of clearfelling of areas greater than 0.25 ha or more than two tree heights wide without the retention of some mature trees (Mason *et al.* 1999). While CCF is not a silvicultural system *per se* it can be implemented using various silvicultural systems that do not involve clearfelling (Yorke 1998). These systems are generally associated with natural regeneration but natural regeneration can be supplemented by planting if required. CCF is considered synonymous with 'alternatives to clearfelling' and the term 'low impact silvicultural system' (LISS). A LISS is one that has little negative effect on either the forest crop or its general environment.



- ▶ A Douglas fir plantation which has been managed as a continuous cover forest.

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Background to CCF

Continuous cover systems have been used for centuries in some parts of Europe. However, the most common silvicultural system in use in Europe is the clear cutting system, which involves clearfelling a stand and restocking artificially. The vast majority of Irish forests are managed in this way. However, the use of the clear cutting system in forests has increasingly been criticised. For example, during the public consultation process conducted by Coillte as part of setting up a Sustainable Forest Management (SFM) initiative, biodiversity and clearfelling were among the top issues raised by the contributors (Pfeifer 1998). The public in Ireland and elsewhere have increasingly objected to the visual impact of clearfelling, even when carefully landscaped. This is especially the case when the forests are highly visible in the landscape. As a result of these concerns, there is a move now in countries to research and ultimately make use of CCF systems.

Continuous cover systems are referred to in the Irish National Forest Standard (Forest Service 2000). One of the measures (i.e. 4.4.2) of the indicator “Forest Management” is the area of forest managed for continuous cover. Continuous cover systems are also referred to in the Forest Management Standards for the Republic of Ireland (FSC) (Mannion 1999). It is suggested in this document that lower impact silvicultural systems be considered in windfirm conifer plantations where they are suited to the site and species present (Criterion 6.E.3). Coillte has adopted the principles of SFM as laid down by the Forest Stewardship Council and thus has to comply with these principles, including consideration of continuous cover systems in windfirm conifer plantations. Thus Coillte, as part of its certification process, has begun to install demonstration areas of these systems.

Silvicultural systems that deliver CCF

The shelterwood and the selection systems (single tree or group) can deliver CCF. Some of these systems are appropriate to Irish conditions.

The following is a brief description of these systems, concentrating on how they differ from the clear cutting system.

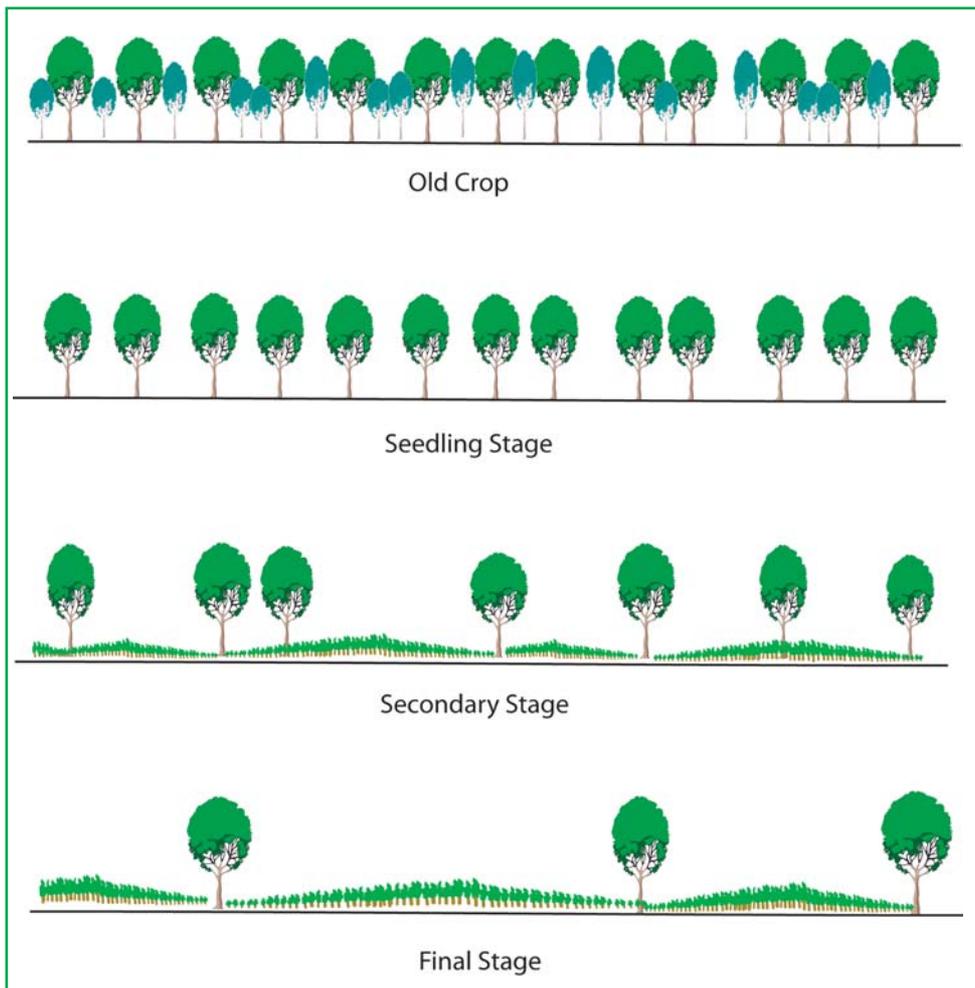
In the clear cutting system, the entire stand is felled in

one operation (Hart 1995) and the new tree crop is most commonly regenerated by planting (Mathews 1989). The new stand therefore becomes established without any shelter from the old canopy. Thus the clear cutting system is one that best suits species that demand full light to grow such as larches, pines and birch.

The main distinction between the clear cutting system and CCF systems is that in the latter systems, the old crop is not removed in one operation. In the shelterwood system, the old stand is removed in a series of fellings known as regeneration fellings. The manner in which the regeneration fellings are carried out in time and space distinguishes the various shelterwood systems. When the old crop is opened in a uniform manner over a large area, the term uniform shelterwood system is used. In the group shelterwood system, the regeneration fellings commence around several nuclei (Hart 1995), which are either gaps where there is already evidence of natural regeneration or gaps that are artificially created. The regeneration fellings gradually extend outwards from these gaps and eventually meet and thus the whole stand is regenerated. Where the risk of wind or snow damage is a concern the strip or the strip and group shelterwood systems can be used. In these systems regeneration fellings advance progressively against the wind direction in a series of narrow strips (Mathews 1989).

In all the shelterwood systems the old crop and new crop co-exist on the site for a period of time. The speed at which the old crop is removed is dependent on how adequate seed production is, how tolerant the species is to shade and ultimately how successful the natural regeneration is. If natural regeneration occurs rapidly, the old stand is quickly felled and there may be very little difference in the appearance of the stand and one that is established after clearfelling. But where seed production occurs at a slower pace the new crop may appear irregular in the early years of the rotation but after early thinnings will become more regular in appearance (Hart 1995).

The single tree selection system results in a completely uneven-aged type of forest. Fellings involve the removal of single trees. These include dead and diseased trees and trees of exploitable size. In a true selection forest there is a continuous series of age classes (size classes) and the diameter distribution is such that each diameter class has fewer stems than that in the adjoining smaller diameter class. Hart (1995) describes a selection forest as one where



▶ Shelterwood uniform system showing successive stages of regeneration (after Matthews 1999).

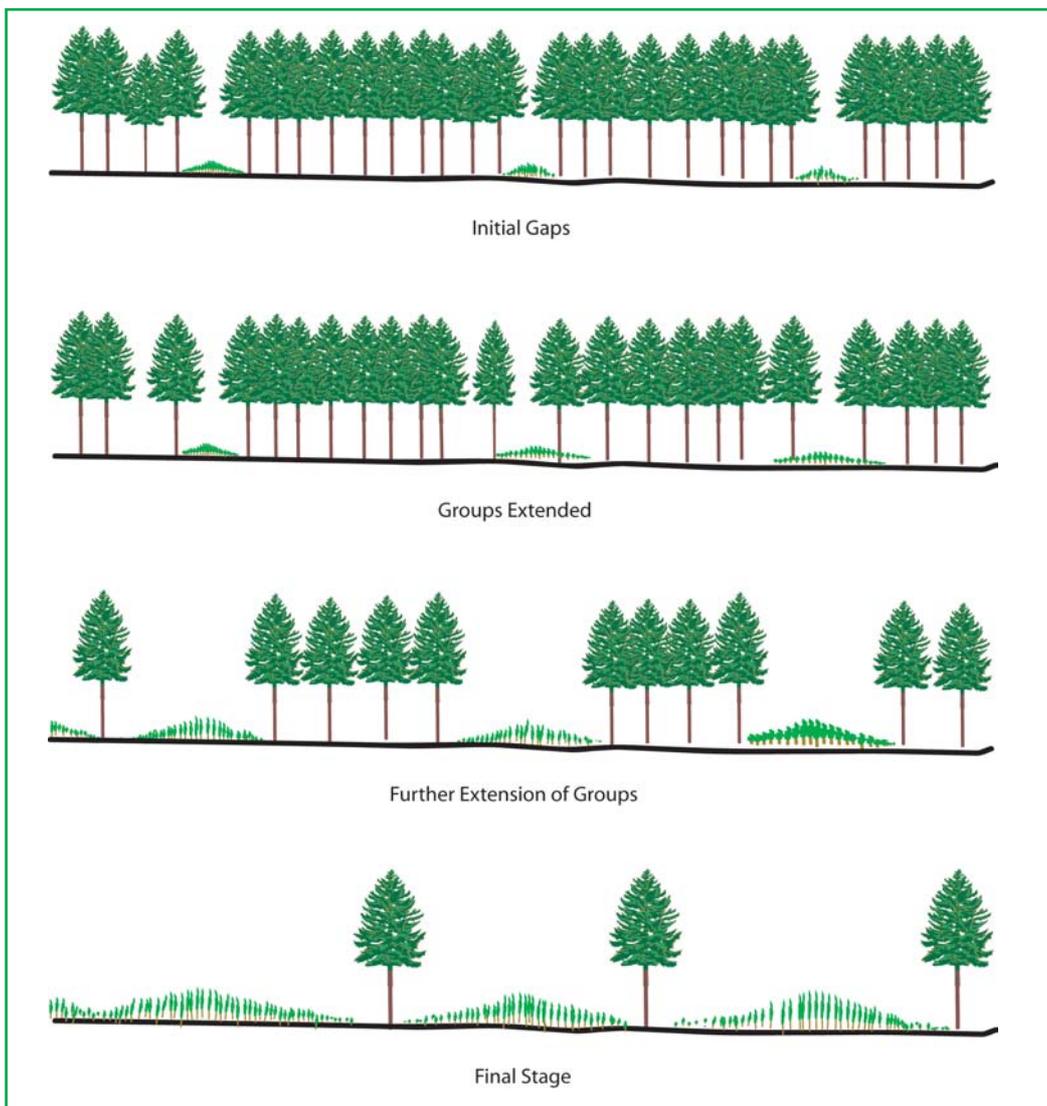
the “canopy is complete and very deep, extending right down to ground level; there are usually three canopy layers which approximate to small-sized, middle-sized and large trees”. Typically the single tree selection system is found in mountainous areas of Europe in mixed stands of Norway spruce, European silver fir and beech. As only very small openings are created in the canopy, the selection system is suited only to shade tolerant species. A variation of the selection system is the group selection system where groups of trees are removed. The selection of the trees for felling is similar to that practiced in the single tree selection system.

Transforming even-aged conifer stands to continuous cover management

The first stage in the process of managing stands for CCF involves identifying areas that are appropriate and suitable for CCF. Yorke (1998) lists the following locations as appropriate for CCF:

- ▶ within forests and woods that fit well into the landscape where minimal landscape change is desirable (i.e. a backdrop to a high profile recreation area);
- ▶ stands to be retained to biological maturity (i.e. long retention stands);
- ▶ within woods and forests where successful/economic restocking may be difficult to achieve with clearfelling.

Sites that are suitable for CCF are those where conditions are conducive to natural regeneration, i.e. sites where there is evidence of natural regeneration or sites without prolific vegetation that will suppress seed germination. CCF sites should also have a moderate to low windthrow risk and be free draining. Browsing damage is a major constraint to successful natural regeneration. Thus if the candidate site has a high population of deer, hare or rabbits, fencing will be required. The Forestry Commission



◀ Group system showing successive stages of regeneration (after Matthews 1999).

recommend that deer densities should be less than 5-10 animals per 100 ha to minimise damage to regeneration or they should be excluded from areas by fencing (Mason and Kerr 2001).

If the candidate site is considered suitable on the basis of the above considerations, the decision as to how to manage the stand so as to achieve CCF will depend on the type of stand that is desired by the forest owner. As highlighted earlier, stands managed for CCF using shelterwood systems often appear similar to those managed under the clear cutting system during the lifetime of the crop, i.e. they are even-aged. However, those managed for CCF using selection systems will be irregular in appearance with components of the overstorey always retained in the stand.

Recent research on CCF Ireland

The recent and current research being undertaken in Ireland relating to CCF have focussed primarily on the two immediate silvicultural implications of CCF namely, natural regeneration and the impact of the forest canopy on establishment. A number of studies on the factors influencing the occurrence of natural regeneration has been undertaken in Ireland. Von Ow *et al.* (1996) and Dagg (1998) examined the factors affecting the establishment of natural regeneration of Sitka spruce in Wicklow. Tiernan (1998) looked at the phenomenon in lodgepole pine and focussed on the distance that lodgepole pine seed was blown from mother trees. A form of CCF has been successfully demonstrated in lodgepole pine stands in the

west of Ireland over the last five years (O’Keefe 2002). More recently O’Leary (2000) concentrated on examining the occurrence of natural regeneration of lodgepole pine and common ash while O’Leary *et al.* (2001) have quantified the amount of natural regeneration within the Coillte estate.

The use of CCF will require forest managers to be *au fait* with the management of a forest canopy so as to encourage the successful establishment of a new crop under this canopy. To this end a number of experiments have recently been laid down throughout the country to quantify the effect of the forest canopy on the survival and early growth of a number of tree species. These experiments are located in mature Sitka spruce stands in Coillte forests in Djouce Woods, Enniskerry Forest, Co Wicklow; Ballard Property, Laragh Forest, Co Wicklow; and in Ballinagapogue Property, in Aughrim Forest, Co Wicklow. The objective of these experiments is to evaluate the performance of naturally and artificially regenerated stock under different levels of a Sitka spruce overstorey. An



▲ Research site at Djouce.

experiment has also been laid down in two mature Sitka spruce stands in a section of a private forest estate, owned by Robert Tottenham, in Co Clare. Two coupes have been created in each of the stands and a seeding/fencing/scarification experiment laid down.

Thinning encourages the development of large crowns, which is linked to greater seed production subsequently. Thinning also allows more light to reach the forest floor which encourages seed germination. It is envisaged that there will be a greater use of crown thinning in stands managed for CCF (Mason and Kerr 2001). A section of a 27-year-old Sitka spruce stand in Brown Hill Property, Aughrim Forest, Co Wicklow has been used to demonstrate thinning in a stand managed for continuous cover.

Conclusion

There is increasing interest in continuous cover forestry in Ireland. While it is unlikely that this approach to forest management will reach the level of importance in Ireland that it has in Britain, nevertheless foresters in Ireland will have to become familiar with CCF as it is implemented in areas of the forest estate. Specifically this means:

- ▶ identifying areas where CCF is suitable;
- ▶ deciding what silvicultural system to implement to achieve CCF;
- ▶ taking steps to implement these silvicultural system.

The results of the research described above will help foresters in these steps.

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