



Managing Continuous Cover Forests



A guide for FC staff

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1. Foreword

This Guidance Booklet is one of a series covering various subjects in the Forestry Commission (FC). We have rewritten this one, *'Managing Continuous Cover Forests,'* to bring it up to date and to help you successfully transform your woodlands.

In this booklet we will give you:

- practical guidance;
- a flexible and adaptive approach; and
- the best advice on managing continuous cover.

We have designed the booklet to be:

- a reference work;
- a supporting and instructional document; and
- the basis for follow-up support visits and audits.

We hope you find it useful. You may also find:



Mandatory elements. These are auditable actions necessary to meet legal requirements or to deliver or report on corporate policy.



Timebound mandatory elements. As above, but to a deadline.



Recommendations. These are auditable actions that you should practise for efficiency and effectiveness. Any variation must be defined and authorised by Unit Managers.



Cautions against certain actions, or things to avoid.

Examples, best practice and important information are shown as Tips in light blue boxes like this.

If you have any comments on this booklet, its procedures, or any new ways of presenting this subject please contact [Doug Mitchell](#) in the Operational Support Unit (OSU) in Silvan House.

We will post updates on the OSU intranet site in the Operational Guidance folder and we will tell you in a linked e-mail.

1.1 Moving around in this booklet

We have designed this document for you to read 'on screen' using Adobe Acrobat Reader 6.0 or later versions. You will find a guide on how to use the various versions of Reader if you click [this link](#).

2. Some terms explained

Term or abbreviation	What it means
ATC	Alternative to clearfell.
CCF	Continuous cover forestry.
Cmpt	Compartment.
DBH	Diameter of a tree at breast height (1.3 metres).
FDP	Forest design plan.
LISS	Low impact silvicultural system.
MT	Management table.
MTI	Management table intensity.
PF	Production forecast.

3. What's mandatory and recommended in OGB 7?

3.1 What's mandatory?

This is the only mandatory element in this booklet, with the section for you to refer to.

No.	Requirement	Reference
1	Areas should be designated for continuous cover management within forest design plans where this approach is considered the best way of delivering key pre-determined management objectives, or where the cost-effectiveness of this designation can be readily demonstrated over conventional practice.	Section 5.2

3.2 What's recommended?

Here we summarise the recommendations in this booklet with the sections for you to refer to.

No	Recommendation	Reference
1	Consider CCF within the context of your FD strategic plan, management objectives and site suitability (see OGB 36 for further guidance on this topic).	Section 10.1
2	We recommend you review existing commitments to CCF as part of the FDP process.	
3	We recommend that the following information should be recorded for each area that is designated as CCF in the FDP. <ul style="list-style-type: none"> Your assessment of the potential for CCF based on stand and site details (see Sections 6.1 and 6.2). Management objectives and plans for achieving these. Past and future interventions. Monitoring plans and information. Other useful information (for your successor). 	Section 10.2
4	We recommend that crop and site data collected using the monitoring options in table 10.1 is used to update the Sub-Compartment Database (SCDB) in accordance with mandatory and recommended procedures covered in sections 4.3.13 / 4.3.14 / 11.5.3 / 11.12.4 and 14.4.2 of the Survey Handbook.	Section 10.3
5	All areas managed using CCF in a FDP must be actively monitored using an appropriate method.	
6	For production forecasting of lower storeys, we recommend using the yield class of the overstorey if the species is the same, or if the species is different, use the mean yield class for the species in the area.	Section 11.2
7	For production forecasting of storeys established using natural regeneration, we recommend you assess the age of at least 10 trees in the stand and use the earliest date from the range as the age of the stand.	

4. Summary

Our aim in this booklet is to provide you with clear, practical advice about managing continuous cover forests. The 'Top 10' things you need to know are listed in Table 4.1.

Table 4.1 Top 10 tips for managing continuous cover forests

1	Continuous cover forestry (CCF) is an approach to forest management in which the forest canopy is maintained at one or more levels without clearfelling. This includes everything from a stand of regenerating Sitka spruce, where the canopy is removed quickly, to a mixture of shade tolerant conifers where trees vary in age. See Section 5.1.
2	A decision to use CCF must be driven by management objectives and you must have a long-term vision for the species composition and structure of your stand. See Sections 5.2 and 8.
3	CCF is new to most people involved with forestry in Britain and so skills and confidence are developing. We encourage you to 'learn by doing'. The key to this is monitoring and recording your actions. See Section 10.3.
4	Sites are different: a successful approach in one area may not be effective elsewhere. We cover this in all sections, but see particularly Section 7.3.1.
5	Do not make life difficult. a) Select stands where CCF is most likely to be successful. See Section 6. b) Start your transformation to CCF in young stands by applying crown thinning from the second thinning. See Section 7.
6	CCF 'works' by balancing thinning and regeneration so that you do not lose control of the ground flora. See Section 9.
7	We recommend you use crown thinning in CCF; this seeks to remove competition from selected trees. See Sections 7.2 and 14.2.
8	Options for regenerating a CCF stand include natural regeneration, planting or a combination of both. Achieving successful natural regeneration requires patience, understanding, and a bit of luck! See Section 7.3.
9	CCF stands require a permanent rack system to give good access to the stand for thinning and regeneration operations. See Section 7.1.
10	Experience so far has been that nearly all operations in CCF stands can be achieved using minor changes to conventional practice. See Sections 7.1 and 13.3.

5. Getting started with CCF

Can you remember what you thought when you first heard about continuous cover forestry (CCF)? For many people in Britain the answer lies somewhere between 'whatever it is, it sounds complicated' to 'that's what they do in central Europe'. This is because CCF is new in Britain and you, with everyone else, are learning. This booklet should help, as its main aim is to provide clear, practical advice about managing continuous cover forests.

Plate 5.1 The move to CCF has been driven by the need to diversify forests (photo by Dave Ellerby)

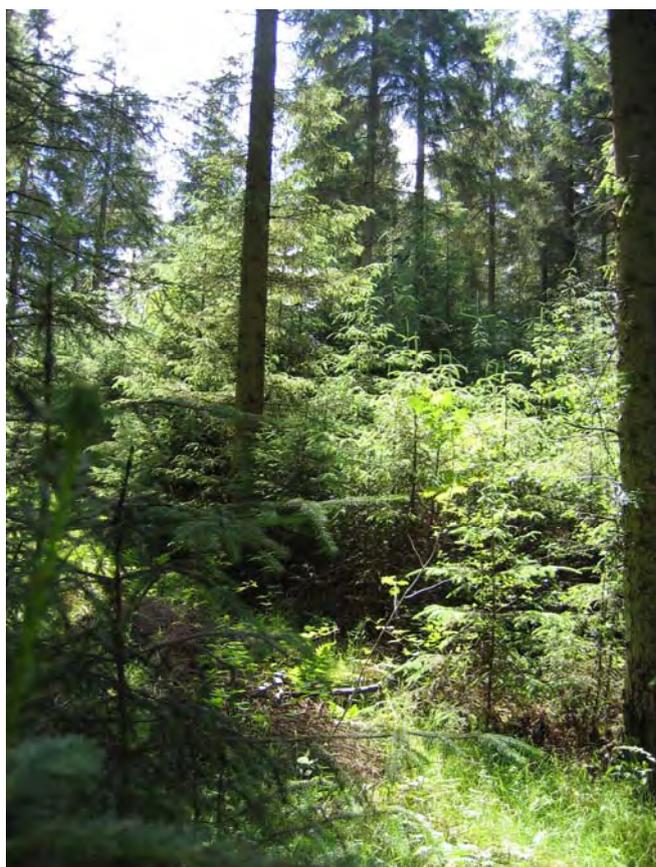


Plate 5.2 Understanding CCF from this view will be key to its success



5.1 What is CCF?

The first thing to be clear about when considering CCF is what it is:

CCF is an approach to forest management in which the forest canopy is maintained at one or more levels without clearfelling.

The word 'approach' is important because:

- you are not following a system;
- there are no standard prescriptions; and
- flexibility is important – take advantage of opportunities as they arise.

In this booklet we interpret CCF in a practical way. The guidance we offer will be useful to a wide range of situations from a stand of regenerating Sitka spruce, where the canopy is removed quickly, to a mixture of shade tolerant conifers where trees vary in size and age.

A question often asked about CCF is, 'How does it relate to other terms such as Low Impact Silvicultural Systems (LISS) and Alternatives to Clearfelling (ATC), not to mention silvicultural systems such as shelterwood systems and selection systems?' Let's not get too hung-up on such things now. We recommend that you forget any preconceived ideas about *systems* of managing forests because they can act as a 'straight jacket' to thinking about CCF. More information on terminology is given in Section 14.1.

Plate 5.3 Whether it is called CCF, ATC or LISS, managing these forests is a significant challenge (photo by Duncan Ireland)



TIP

A move to successfully adopting CCF requires your commitment to a flexible and adaptive approach to stand management.

5.2 CCF and management objectives

Do not adopt CCF because your colleagues are doing it, you have just been on an interesting Continuous Cover Forestry Group (CCFG) meeting, or you are looking for a good excuse for neglect! CCF must be a conscious decision to actively manage a stand to achieve management objectives. At present the FC in each of the three countries has the following policy objective for CCF.

- **Areas should be designated for continuous cover management within forest design plans where this approach is considered the best way of delivering key predetermined management objectives, or where the cost-effectiveness of this designation can be readily demonstrated over conventional practice.**

Making the link between adopting CCF and your management objectives is a key process, and we have designed Table 5.1 to help you consider this. The table makes it clear that CCF can be negative for some management objectives and positive for others.

Plate 5.4 Natural regeneration is a key aspect of CCF

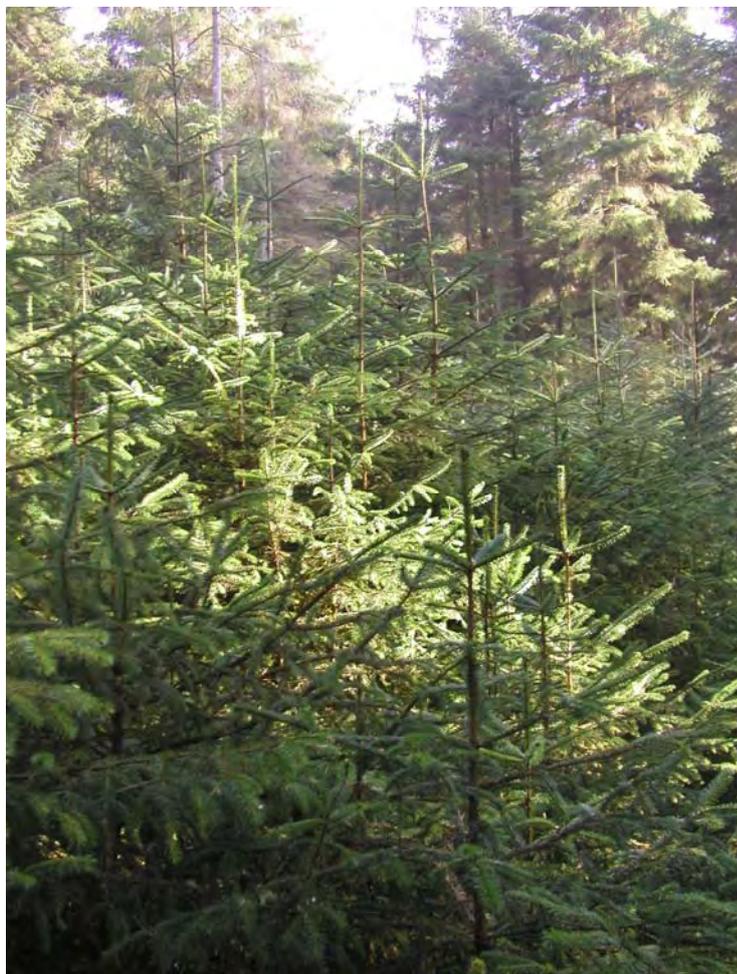


Plate 5.5 Using CCF means that some trees will reach larger sizes than under clearfelling



Plate 5.6 Maintaining a continuous canopy is an important component of CCF



5.3 CCF and climate change

CCF is one measure to consider as part of an adaptation strategy to take account of future changes in the climate. There is a high degree of uncertainty in the detail of how climate change will progress. The main benefit of CCF is in spreading risk and thus enhancing resilience to climate change through:

- promoting regular regeneration;
- regeneration or establishment occurring in a more sheltered environment than a clearfell site;
- creating structurally diverse stands;
- accommodating mixed species;
- encouraging genetic or evolutionary adaptation if natural regeneration is used; and
- there may be a successor stand if the overstorey suffers catastrophic wind damage.

Table 5.1 Linking CCF to management objectives

Main feature of CCF	Implications for management objectives	
Increased use of natural regeneration	Environmental	Increased range of plant and tree species; range of habitats increased by variable spacing. Can be negative if you do not get desirable species.
	Economic	Potential to reduce costs of restocking if successful. However, there may be hidden costs of respacing, or if you do not get desirable species. Potential to improve timber quality with high stocking densities, but quality may worsen if stocking is low or uneven.
	Social	Mitigates problems of poor perception of clearfelling.
Continuous canopy of tree species	Environmental	Continuity of habitats can be important for some species and can preserve archaeology in some situations. Biodiversity can be increased if used in combination with other approaches to stand management.
	Economic	A sheltered and stable environment is maintained and may reduce management costs.
	Social	Views can be obscured, but you can reduce this with good stand management.
Forest structure	Environmental	Biodiversity is enhanced and deadwood levels will generally be higher.
	Economic	Average tree size of thinning will be increased if crown thinning is used.
	Social	Improved experience through providing more permanent and diverse surroundings.
Large trees*	Environmental	Benefits for many aspects including raptor breeding sites and increased levels of deadwood which encourage valuable invertebrates.
	Economic	Can be positive if there are markets; if there is no market or premium, design your CCF to suit.
	Social	Positive benefits as people value presence of large trees.

* CCF can often (but not always) lead to large trees.

6. How do I select stands for CCF?

Our advice is simple: aim to use CCF in situations where it is most likely to be successful. Not all stands are suitable for CCF even if this is desirable for your management objectives.

- If the site is the problem, consider other approaches to management.
- If the stand is a problem, consider clearfelling and then transforming the new stand.

The full method for selecting stands for CCF is explained in FCIN40 (see Section 13.1) and we advise you to follow this for stands in your area. The following advice outlines the points you will have to consider.

TIP

Only select stands for CCF where you have the ability to thin.

6.1 The site

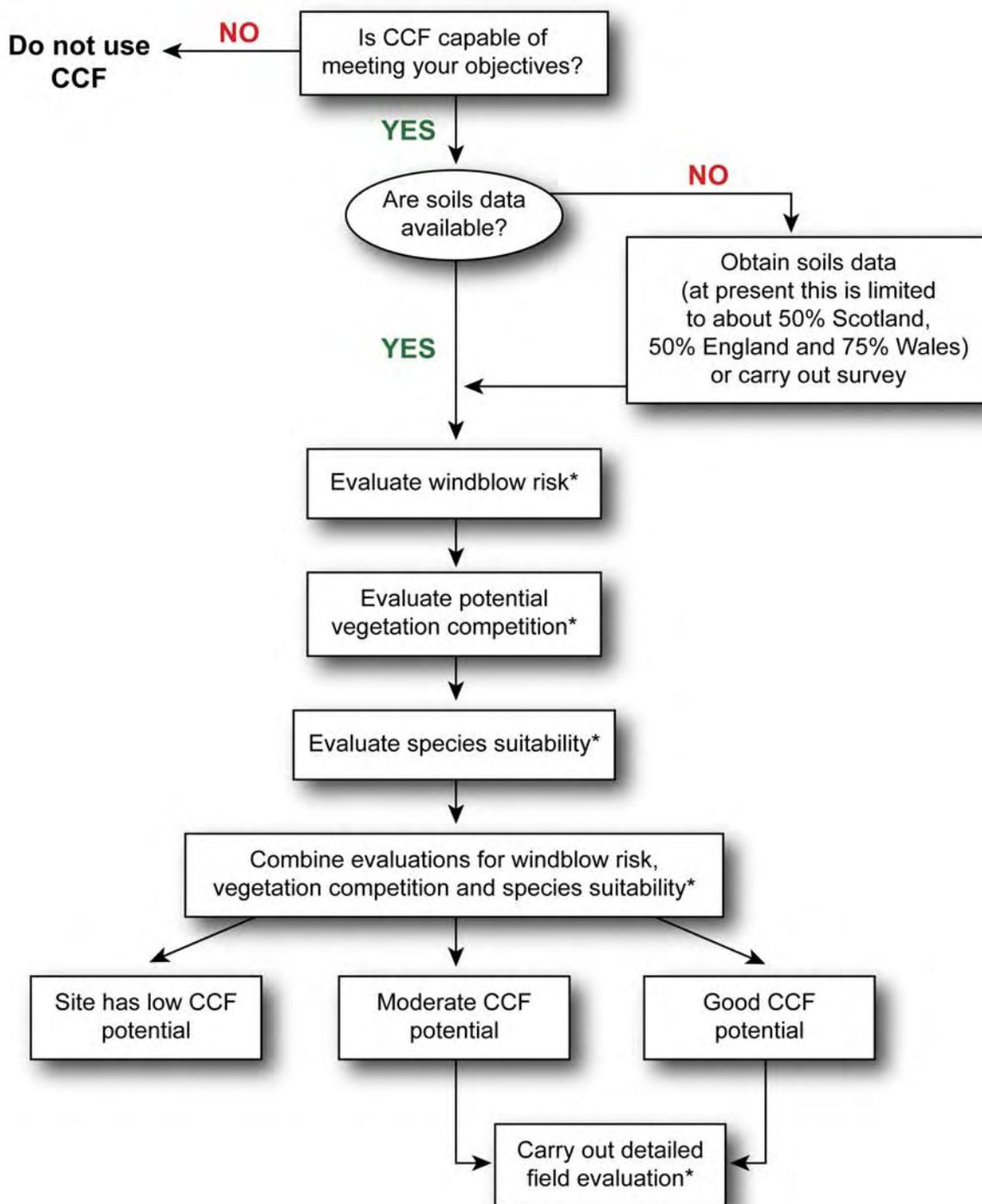
The decision tree in Figure 6.1 (see page 15) shows how you can select sites. We have also designed a field sheet to guide you through the process.* However, consider each site on its own merits and use your own local knowledge to test the results.

- It is essential to have good soils information based on surveys or your own local knowledge (see Survey Handbook - Section 17.15). (To an accuracy of 1 ha is preferable, with a minimum of 5 ha. Published soil survey data from the Soil Survey of England and Wales (SSoEW), Soil Survey of Scotland (SSoS) is unlikely to provide soil data that is accurate enough.)
- The risk of windthrow should be low, which usually means a windthrow hazard class of 1 to 3 (see Survey Handbook – Section 4.3.10).
- The site should be favourable for establishing natural regeneration. In general, achieving natural regeneration on fertile sites is more difficult than on infertile sites due to the reduced potential for weed competition.
- The species in the stand must be suited to the site and acceptable for management objectives.
- Sites where the risks of windthrow are low, with low fertility soils, and trees that are growing well, are the most likely to be successful for CCF. Sites, of which there are many, that do not meet all these criteria may be suitable, but you will need to investigate the stand further.

* download by clicking on this link: www.forestresearch.gov.uk/ccf.

Figure 6.1 Site selection decision tree

Deciding on the right site for CCF



* see Forestry Commission Information Note 40 for details of how to do this.

6.2 The stand

Assess the stand and observe the factors described in Table 6.1.

Table 6.1 Stand factors favouring CCF

Factor	Conditions favouring CCF
Stand structure	Well-thinned stands with no or little wind damage.
Advance regeneration*	Useful indicator of past regeneration success but should be of the desirable species.
	<p>TIP</p> <p>You can find seedlings (if you get down on your hands and knees and look) in most cone producing forest stands, but numbers vary widely from year to year. The presence of saplings indicates regeneration success, low levels of animal impact and good stand conditions for growth – all very important for CCF.</p>
Ground flora	Competitive weeds such as bracken, bramble, grasses, bilberry and heather are sparse.
	<p>TIP</p> <p>To assess the ground flora, it is best to examine areas where the canopy has been removed and observe how the vegetation has developed. Sites with 2 m tall bramble and/or bracken will be more difficult than those with a sparse covering of mosses and soft grasses.</p>
Litter	A thin (<5 cm) layer of litter.
Animals	Low densities of deer, rabbits and hares; no stock.
	<p>TIP</p> <p>You can judge the impact of animals by looking at the effect on coppice stumps, bramble, honeysuckle and other types of preferred browse material.</p>
Access	Easy access to and within the stand for thinning.
	<p>TIP</p> <p>Do not use CCF as a convenient label for areas that cannot be realistically worked.</p>

*Advance regeneration is a general term for seedlings and saplings in the understorey. Seedlings are <1.3 m tall; saplings are ≥1.3 m tall and <7 cm dbh.

Use the features in Table 6.1 to adjust the initial ranking of the site and decide on the chances of success. Make a considered decision and be prepared to learn from it.

Plate 6.1 Stands with a high risk of windthrow generally have low potential for CCF (photo by Glenn Brearley)



Plate 6.2 Seedlings can be found in most cone producing stands



Plate 6.3 Canopy opening on fertile sites usually produces vegetation that will hinder natural regeneration



Plate 6.4 Much advance regeneration can be traced back to disturbance caused by previous thinning



TIPS

- You will need to develop your understanding and appreciation of these stand factors, how they relate to each other, and how they change over time. Through this process your own experience and confidence will develop.
- If the stand has serious *Fomes* damage, transformation to CCF may not be the best way forward; consult specialist advice in Forest Research.

7. How do I make CCF work?

The main tools to use to make CCF work are thinning and regeneration.

- If you are transforming a young stand to CCF, all you need to do is make some simple adjustments to thinning and you have started.
- If your stand is regenerating with desirable species, you are in a good position.
- If after at least 10 years, natural regeneration has been unsuccessful, use planting.

TIP

The main thing to do is start the process, making sure that you record what action you take and then learn from what you do.

7.1 Operational considerations

One of your main concerns may be about how to plan and manage operations. If so, we encourage you to visit one of the FC Trial Sites that have been established (see Section 13.3).

Experience from these Trial Sites is that, with some small changes, most operations can be carried out using existing methods and equipment. More information on this subject is available in a Technical Development report: *Operational experiences of CCF* (see Section 13.1). The most important consideration is to develop a permanent rack system that gives good access into the stand (Plate 7.1).

Plate 7.1 Well planned access routes and extraction tracks are important in CCF



TIP

Involve your machine operators in the layout of your rack network. They know the limits and capabilities of their machines better than anyone.

Experience from the FC Trial Sites has shown that FC staff and contractors working in the forest will adapt to CCF with enthusiasm if given the correct training and support. We encourage you to visit the FC Trial Sites as they have much to offer; see details in Section 13.3.

7.2 Thinning

Thinning is essential for success with CCF because:

- it's the main way you control development of the stand;
- it can improve conditions for natural regeneration; and
- it produces income.

Stands that have been regularly thinned are more likely to be successful with CCF.

We recommend crown thinning when transforming to CCF rather than low or intermediate types, as used in plantations. The basis of crown thinning is to remove competition from around selected trees, even if the trees to be removed are as big. Using crown thinning usually increases the average tree size, so there is potential for more income. You can find a step-by-step guide to crown thinning in Section 14.2. An added bonus of crown thinning is that stands look more mature as can be seen from Plate 7.2 and Plate 7.3 from the Fernworthy Trial Site.

Plate 7.2 Intermediate thinning of SS at Fernworthy, Dartmoor



Plate 7.3 Crown thinned area at Fernworthy



When thinning in CCF there is often regeneration in the stand. Studies by Forest Research have shown that with good access to the stand only 20% of young trees were damaged.

7.3 Regeneration

In Britain most people involved with forest management have developed good systems of restocking woodland using planting. However, in CCF there often seems to be an assumption that natural regeneration should be used, not least because it has the potential to reduce establishment costs. CCF is suitable for using natural regeneration, but planting can also be an effective method of regeneration. For any stand where timber production is important, the objective of regeneration must be to meet the stocking density criteria specified in [OGB4](#). For CCF, this means any area being regenerated must have 2500 saplings per net hectare of commercial species that are reasonably evenly spaced.

Plate 7.4 Natural regeneration of Sitka spruce



7.3.1 Natural regeneration

Because natural regeneration has not been commonly used in British forestry, many people are unfamiliar and uncomfortable with it. One way of understanding natural regeneration better is to use a simple gardening analogy of attempting to grow lettuces on your lawn. If you sow one hundred thousand lettuce seeds on a 0.05 ha lawn what will your chances be of eating home-grown salads throughout the summer?

Here are the facts:

- most of the seed will be eaten before it germinates;
- any seed that germinates will dry out quickly unless the root can supply moisture and nutrients;
- any seedling will encounter strong competition from the lawn; and
- an animal will eat most successful plants before you can harvest them!

In conclusion, carry on buying your salad ingredients from a shop, or sow the lettuces elsewhere! As we shall see there are many similarities between natural regeneration of a forest and trying to grow lettuces in a lawn. For the best chances of success with natural regeneration you need:

- a good supply of seed;
- a receptive seedbed for germination;
- favourable stand conditions;

- control of competitive weeds; and
- little or no browsing.

The key to natural regeneration is to do your best to ensure a good combination of these factors over a ten-year period; you will then have a fair chance of success. You will need to be patient!

TIPS

- If you improve the conditions for natural regeneration then some plants will be more able to take advantage than others. Examples include bramble, birch, rhododendron and western hemlock, but you may not want them.
- If advance regeneration of the desired species is present, this shows that regeneration has been successful in the past and your chances of success are good.
- Experience shows that the most common reasons for problems with natural regeneration are poor seed supply and the belief that there are fewer animals than there actually are.

A good supply of seed

The production of seed by trees is highly variable from year-to-year and is also affected by the age of trees, species and site. When planning your approach to natural regeneration the following guidance will help.

- Most forest trees do not start producing large quantities of seed until they are 30-40 years old; older trees produce even more seed.
- For most conifers, seed dispersal begins during the autumn and extends through to the spring. The exceptions are larch and pine, which release seed in spring and summer; see Table 7.1.

Plate 7.5 Seed production is essential for successful natural regeneration.
Douglas fir cones on a 29-year-old tree



Good potential for natural regeneration will be shown by a significant number of cones (50-100) visible on 25-50% of trees in the stand, not just edge trees. This is best assessed using binoculars at the times shown for coning in Table 7.1.

The majority of seed from a tree will fall within 2-3 tree lengths. However, there are exceptions such as birch.

Plate 7.6 Evidence of seed production, seed and pollen cones of Sitka spruce



A receptive seedbed for germination

The best surface for seed to fall onto for germination and seedling growth is bare mineral soil, because it will supply the seedling with moisture and nutrients. Germination can often occur in litter, but unless the seedling get its roots quickly into mineral soil it will die as the litter dries out. Some forms of vegetation can support germination and growth such as mosses and liverworts, as the level of competition with the seedling is low.

Plate 7.7 Over thinning of this stand of Norway spruce has led to poor seedbed conditions



Plate 7.8 Evidence of good seed supply of Douglas fir, but seedbed conditions are poor. Light scarification would improve access for seed into mineral soil, but must be well-timed to make sure fir seedlings can take advantage as other plants will also grow



To improve seedbed conditions consider the following.

- Thinning will lead to mineral soil being exposed. Use this in combination with vegetation control to prepare a seedbed before seedfall.
- In other stands take advantage of good seed years by carrying out appropriate cultivation and or vegetation control before or during seed dispersal.

Note: conifer seed rarely remains viable for longer than 12 months.

TIP

Much advance regeneration can often be traced back to the last time a stand was thinned.

Plate 7.9 Good seedbed conditions for regeneration



Favourable stand conditions

Successful establishment of natural regeneration depends on achieving a balance between canopy cover, vegetation competition and seedling growth. In this respect every site is different. For example, a compartment in a valley with north and south facing slopes may require a different approach for the two aspects.

A key point to understand is that the stand conditions needed for establishing seedlings are different to those required for seedling growth. In addition, the seedlings of most conifers vary in their ability to tolerate shade. We have provided guidance on the best stand conditions for different tree species in Table 7.2. Use this guidance in combination with knowledge of the site.

Table 7.2 Basal area guidance for natural regeneration

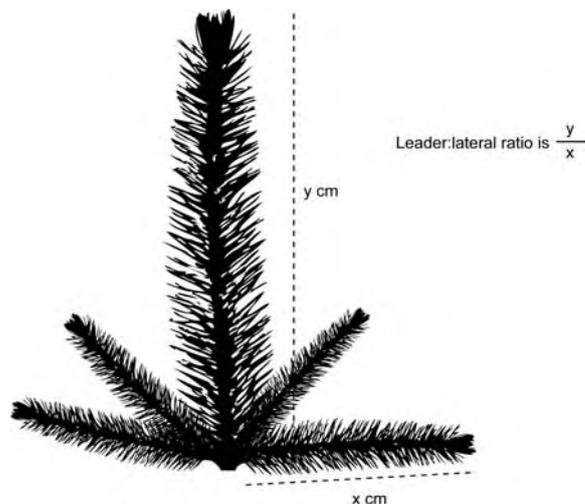
Species/ group	Shade tolerance of seedlings	BA (m ² ha ⁻¹) Establishment ¹	BA (m ² ha ⁻¹) Seedling growth ²
Larches	Intolerant	20-25 ³	15-20
Pines	Intolerant	25-30 ³	20-25
Sitka spruce	Intermediate	30-35	25-30
Douglas fir	Intermediate	35-40	30-35
Norway spruce	Tolerant	40-45	35-40
Western hemlock	Tolerant	40-45	35-40

¹ On moderate to fertile sites where vegetation regrowth will be faster and more severe, you may need to increase the BA for establishment. Examining successful stands nearby will help you determine which BA ranges are best in your locality.

² Seedlings and saplings are growing well under a canopy when the ratio of the length of the leader to the length of laterals in the upper whorl is ≥ 1 , as shown in Plate 7.10.

³ Stands of larch and pine at these basal areas will usually have well-developed vegetation and you will need to consider control or cultivation to start regeneration.

Plate 7.10 A leader to lateral ratio of ≥ 1



TIPS

- It is quite common to observe good natural regeneration at edges or on roadsides and conclude that natural regeneration requires plenty of light. These areas are often disturbed (to expose mineral soil) and the trees above them produce large quantities of seed from well-developed crowns. Access to full light explains the good growth of these trees, but is only one of a number of factors explaining why they are there in the first place.
- You can find a useful guide to how the vegetation on a site will respond when basal areas are lowered if you look in canopy gaps and nearby open areas on similar sites – see Plate 7.11.

Competitive weeds

In fully stocked woodlands the tree canopy generally holds back the development of the ground flora. If you follow the guidance in Table 7.2 you should be in a good position. However, there will be situations where other interventions will be required.

- Where there is no regeneration present, a range of herbicide and/or cultivation options may be needed depending on the site.
- Where there is some regeneration that you wish to preserve, your range of options is reduced and you may need to consult specialist advice from Forest Research. The best option may be to plant trees using the guidance in Sections 7.3.2 and 9.
- In all cases it is important to identify the weed and tree species and look for a combination of techniques, herbicides, timings and application rates that will be effective.

You will find more information and guidance in the publications listed in Section 13.1.

Plate 7.11 Examine nearby canopy gaps for evidence of how the ground flora may respond to thinning



Plate 7.12 Poor conditions for natural regeneration in a stand of Scots pine at low basal area



Browsing

Successful control of mammals (mainly deer, sheep, rabbits and hares) is essential for achieving natural regeneration. You must therefore involve your Wildlife Rangers when considering how you can achieve this. There are many signs of mammal activity in woodlands (see Plate 7.13).

Plate 7.13 Mammal activity in woodland: deer slots



Excluding animals using fencing (Plate 7.14) or individual tree protection are alternatives for reducing their impact on trees. The Forestry Commission Technical Guide: *Forest fencing* is a useful source of information on all types of fencing, including low cost temporary solutions for two to five years (see Section 13.1).

Plate 7.14 Excluding animals can have a significant effect on the development of natural regeneration



TIP

The impact of animals can be judged by looking for browsing damage to coppice stumps, bramble, honeysuckle and other types of preferred browse material. Many people underestimate the impact of animals in their area.

Plate 7.15 Here Genguards show the effect of deer browsing on bramble



Self-test questionnaire

Now test your knowledge of natural regeneration by completing the **self-test evaluation** in Section 14.5.

7.3.2 Planting

Planting trees can be a reliable method of regeneration (Plate 7.16 and Plate 7.17) and you should use it in CCF in the following ways:

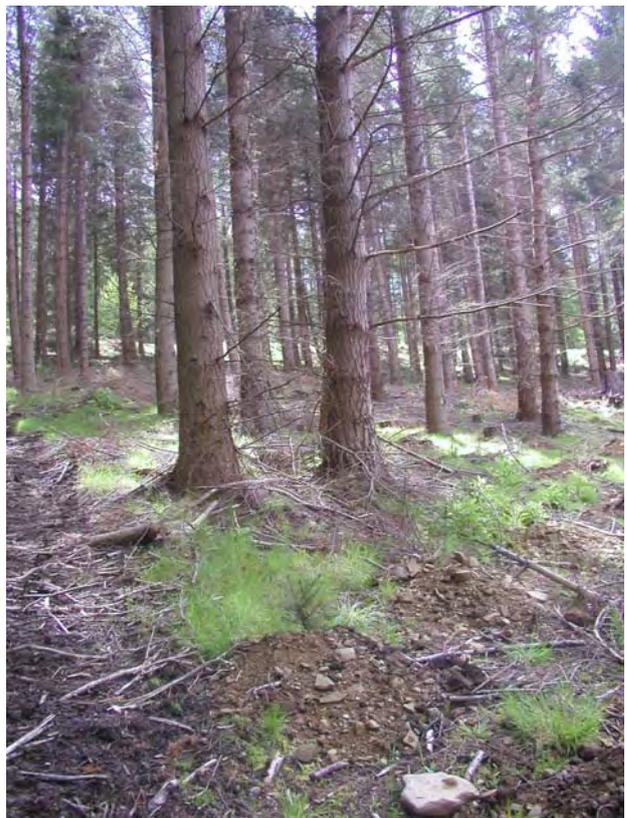
- where natural regeneration has not been successful; and
- where you need to increase the density of regeneration, change the species mixture, introduce improved stock, or introduce a more suitable origin or provenance .

We do not recommend direct seeding within woodlands because small mammals feed on seed which usually prevents successful regeneration.

Plate 7.16 Planting trees can be a successful method of regeneration in CCF...



Plate 7.17 but planting this close to the edge of groups is not recommended



TIP

Using planting is not a failure in CCF. However, many trees planted into CCF stands fail because of poor practice.

The answer to the question of, 'What is good practice in CCF?' has two parts:

- do not forget good planting practice as used on non-CCF sites; and
- make sure your approach matches the type of CCF stand you are trying to create; you will find more guidance on this in Section 9.

TIP

It is common to see that after planting trees natural regeneration appears. This is not surprising in many cases, as you have disturbed the site exposing mineral soil and controlled the vegetation and possibly animal impacts.

7.4 Respacing

Using natural regeneration can create dense areas of young trees that are competing strongly with each other. In many cases you should respace these stands so that you can exert some control on their development. Plate 7.18 and Plate 7.19 compare a stand of regenerated Sitka spruce where one part was respaced and the other left; the latter is now almost unworkable and therefore has limited potential for CCF. Situations in which respacing is justified include:

- where the presence of many dead trees will hinder future operations or become a significant health and safety risk;
- where the large number of small diameter trees hampers harvester working;
- to improve visibility within the stand; and
- to change the species balance, for example removing western hemlock from a mainly Douglas fir stand.

Plate 7.18 Stand of Sitka spruce c.20 years old, respaced



Plate 7.19 Stand of Sitka spruce c.20 years old, not respaced



The best method of respacing is to treat young trees when they are about 2-4 m tall and select the best formed and most vigorous trees at about 2 m spacing (Plate 7.20). You will need to cut the trees you wish to remove as low down as possible and definitely below the lowest whorl of branches.

Plate 7.20 Respace stands when trees are 2-4 m tall and select well-formed vigorous trees



In general, if respacing is not required to improve visibility in the stand, respacing is best done after thinning. This will allow you to use the rack system for access during respacing and may save you from investing money in areas that would have been damaged in the thinning.

Respacing is an expensive operation and can cost between £500 and £1000 per hectare. So look at all opportunities to reduce costs. Although respacing can be one of the main component costs of establishing the next stand, total costs may still be less than those of traditional establishment. Interestingly, research has shown that with Sitka spruce, respacing has limited effects on the growth and development of final crop trees, because the competing trees die over time. Although, as you can see from Plate 7.19, not carrying out respacing can create operational problems in the future.

TIP

Respacing can be an important operation in CCF, but always be clear about your objectives.

8. What are you aiming for?

If you have adopted CCF in response to the needs of management objectives, it follows that you should have some idea what type of forest you are trying to create. The most important aspects are:

- species composition; and
- structure of the forest.

8.1 Species composition

If you are trying to naturally regenerate a pure conifer stand, it is unrealistic to expect the canopy species to be the only component of the regeneration. However, you should be clear what proportion of other species is acceptable for the objectives you are trying to achieve (see for example Plate 8.1).

Plate 8.1 Good regeneration, but is it of the required species?



TIP

When using CCF, expect the number of tree species to increase. If you have 90% Japanese larch and must maintain this, then is CCF really your best option?

8.2 Structure of the forest

There are two main types of structure:

- **Simple** – in which there will be one or two canopy layers of trees (Plate 8.2); and
- **Complex** – where there are three or more canopy layers of trees (Plate 8.3).

(Note that seedlings and saplings in the understorey are not canopy layers.)

Plate 8.2 A simple structure



Plate 8.3 A complex structure



In Britain most of the widely used conifer species have intolerant or intermediate light requirements. These species are best suited to simple structures, but it should be possible to produce complex structures with some species on certain sites. The choice of simple or complex is important, as there are differences in the approach to thinning (see Section 14.2). Experience has shown that the most common CCF structure used so far in Britain is simple. In fact, there are very few working examples of complex structures in Britain and they are generally in areas with a high public profile.

8.3 CCF and PAWS

The principles of transformation to CCF as described in this OGB can be readily applied to PAWS. There are three main points.

1. Although you have decided to remove non-native conifers from the site, a slow gradual approach is usually the best option as all trees help to maintain woodland conditions.
2. The trees you select to remain in the stand will be native species and may be relatively small or of coppice origin. To make sure of the continued stability of these trees, and to maintain forest condition, do not be too extreme with your crown thinning.
3. Favour regeneration of native broadleaved trees and in some circumstances remove conifer regeneration by respacing.

9. Guidance on transformation

In this section we give you practical advice on transforming an even-aged stand to a simple or complex structure.

TIP

In either case the best advice is to start the process as early as possible, such as at the second thinning.

9.1 Transformation to a simple structure

The basic idea is to try to achieve reasonably even regeneration of the desired species and then remove the canopy in a number of thinnings.

Plate 9.1 Developing SS regeneration in a simple structure



Plate 9.2 Suppressed SS regeneration under a stand at high basal area



- Early crown thinning should be heavier (10-20%) than management table intensity and aim to develop 100 equally distributed 'Seed' trees per hectare.
- Seed trees can be defined as well-formed dominant trees with good crowns at reasonably even spacing.
- When the trees begin to cone, thin the stand to the basal areas shown in Table 7.2, column 3 to develop good conditions for regeneration to establish.
- If and when you achieve natural regeneration, it will be more variable than on a planted site, so be prepared for more variability in age, density and species.
- Canopy removal should aim to maintain a leader-to-lateral ratio of > 1 in the regeneration (see Plate 7.10); generally this will be achieved using the basal areas in Table 7.2, column 4.
- The final removal of the overstorey need not involve all the trees (Plate 9.4); depending on management objectives and windthrow considerations, consider some 'green tree retention'.

Plate 9.3 In many situations you will need to be patient!



Plate 9.4 Final removal does not always remove all the trees



- If natural regeneration is only partially successful and you wish to increase the number of young trees, or change the balance of species, consider planting trees. Concentrate planting so you know where trees are and they can be maintained. We recommend you do this using a minimum of 16 trees in each group with the trees planted at 1.5 m x 1.5 m to form robust groups.

- If natural regeneration has been unsuccessful and you want to plant trees to form the new canopy layer, the following guidance will increase the chances of success.
 - Before planting, thin the stand to the basal areas for 'seedling growth' in Table 7.2, Column 4. In some cases they may need to be lower; check this by examining stands at the proposed basal areas in the locality.
 - Consider the felling and extraction of the canopy trees when deciding where to plant.
 - Aim to plant 2500 trees per hectare in a well-defined pattern so you can find them for subsequent maintenance, but leave 'blanks' when the planting position is close (<1 m) to canopy trees. This should ensure compliance with [OGB 4](#) (if applied) as the area under the canopy is not part of the net area.
 - As on restocking sites, give close attention to site preparation, vegetation management, plant quality and reducing the impact of mammals to make sure of successful establishment. In general opportunities for site cultivation are constrained by the overstorey.

If you start between the ages of 20 and 40 years, plan for a transformation period of up to 50 years.

9.2 Transformation to a complex structure

The basic idea is to create a wider dbh range than under a simple system by:

- retaining small trees; and
- encouraging fast growth of selected 'Frame' trees.

(We have defined 'Frame' trees below.)

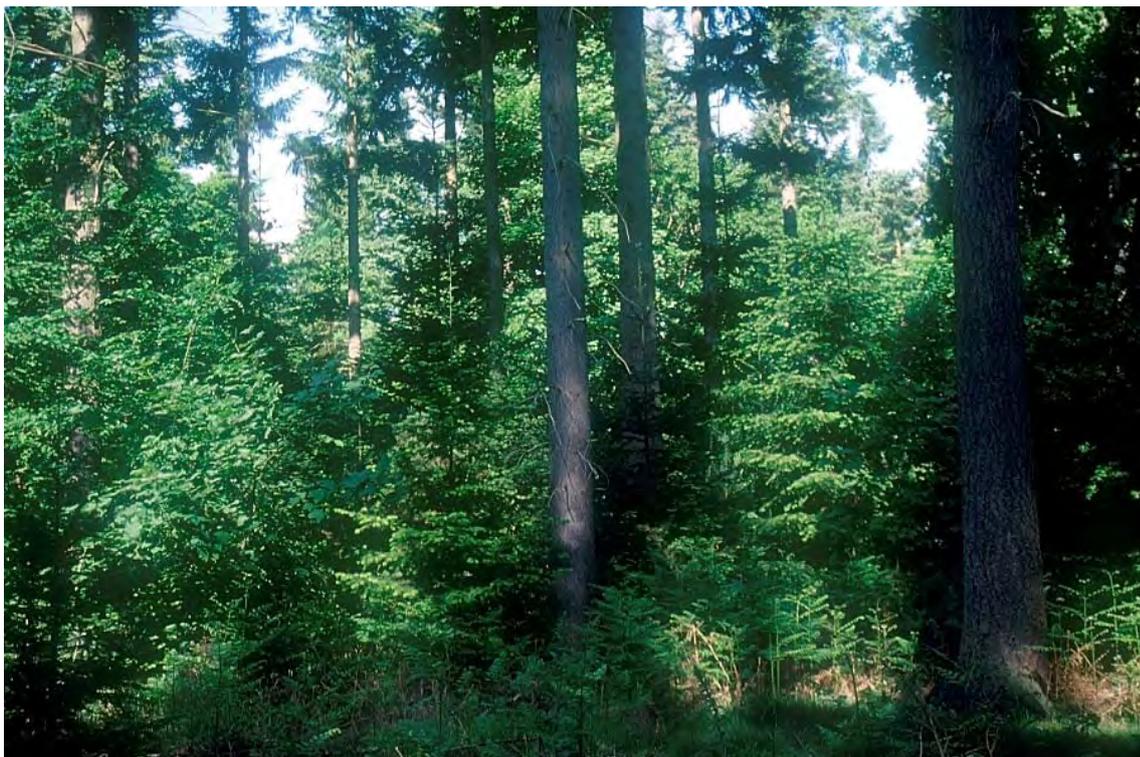
The pattern of regeneration must also be different to a simple structure, and ideally this should be arranged in groups that only cover up to 20% of the area at any one time.

Plate 9.5 Early crown thinning in Douglas fir with Frame trees marked



- Select up to 50 'Frame' trees per hectare and crown thin these to make sure you keep as many small trees as possible (Plate 9.5).
- 'Frame' trees can be defined as stable, well-formed dominant trees, as they may need to be present on the site for a long time; spacing should be 'clumpy' and not regular. Stable trees will have a larger diameter for a given height.
- Select a residual basal area for the stand, which on current knowledge should be about 18-25 m² per ha for larches and pines, and 25-35 m² per ha for spruces and Douglas fir. The choice within this range depends upon the site and the balance between the overstorey and any regeneration. If there is little or no regeneration, then choose higher values to provide suitable conditions for seedlings to establish. If there is enough regeneration, which needs to be released, then favour lower values. The aim at each thinning is to remove enough trees so that you achieve the chosen residual basal area.
- There can be too much regeneration. If so, concentrate thinning on releasing the best regeneration and attempt to hold it back in other areas.
- A spreadsheet is available from Forest Research to help with the thinning of stands developing into a complex structure. Contact [Gary Kerr](#).

Plate 9.6 A developing complex structure. Careful thinning is now required to fully develop the structure as there are too few intermediate size trees



You can use planting in complex structures (Plate 9.7), and you should consider the following points to increase your chances of success.

1. Plant trees in canopy gaps; experience suggests a minimum size of 0.1 ha. It is possible to use smaller gaps with intermediate and shade tolerant species, but do not underestimate the rate of closure of canopy.
2. Plant trees on half the area of the gap in the centre.
3. Use close spacing (1.5 m x 1.5 m) to make the groups robust.

For example, when planting a canopy gap of 0.1 ha use 200 trees at 1.5 m spacing on half the area in the middle of the gap. Close spacing will make sure of rapid canopy closure and by planting only half the area you are ensuring minimal competition from the canopy trees, allowing opportunities for natural regeneration and increasing operational access.

Plate 9.7 If you use planting to develop complex structures, make sure the groups are big enough



TIP

Assess the area of canopy gaps from the canopy edge rather than the stems of trees.

If you start between the ages of 20 and 40 years, plan for a transformation period of 100 years.

Plate 9.8 Developing complex structures will improve conditions for shade tolerant species, in this case sycamore



9.3 Transformation in older stands

You may wish to consider transforming stands that are older than 40 years. This is possible, especially on wind-firm sites, but the opportunity to steer the development of the young stand in thinning has been lost. The main implications of this are:

- for simple systems there will be reduced opportunities for developing the crowns of 'Seed' trees and the window for natural regeneration is reduced; and
- in complex systems the main risks are that 'Frame' trees will become too large to be marketable, and the stand will still be quite uniform when windthrow starts.

10. How does CCF fit in with FD planning?

10.1 Forest design plans

In all forest districts the design planning process is well established. It sets the framework for up to the next 50 years, wins stakeholder and FC approval, and has become the 'kick-off point' for all other processes that districts carry out, such as restocking, maintenance, protection and harvesting. CCF must be integrated with the forest design plan (FDP) process because:

- it encompasses many design plan periods;
- it is a long-term commitment;
- a single design plan period (10 years) is only a fraction of the timescale involved and staff can change within this period; and
- it is an important platform for delivering management objectives.



Consider CCF within the context of your FD strategic plan, management objectives and site suitability (see [OGB 36](#) for further guidance on this topic).

Within the existing FDP there may also be opportunities for increasing the amount of CCF. For example, you may already have areas that were originally identified as 'long-term retentions', or areas scheduled for clearfelling may now have established natural regeneration.

- What is happening in these areas?
- Would it now be better to reclassify them to CCF?



We recommend you review existing commitments to CCF as part of the FDP process.

Remember, our policy is that areas should be designated for CCF management where you consider it to be the best way of delivering predetermined management objectives, or where the cost effectiveness of designation can be readily demonstrated over conventional practice.

However, do not use CCF as a convenient label for areas that cannot be realistically worked.

OGB 36 on Forest Design Planning states that the first ten years of a design plan should be achievable on the ground, see Section 4.4.6 of OGB 36 for more information.

Because CCF is a relatively new approach to managing forests in Britain, everyone is learning. It is also highly likely that within one design plan period (10 years) people involved in the management of an area may change. This means that when adopting CCF it is important that you record your objectives and, in addition, use good monitoring techniques to make sure that management will achieve these aims.

The following sections guide you through management planning for CCF; as you will see it is not onerous and fits in with other FD systems.

10.2 Management pro-forma

It is important to record information about each area managed using CCF so that you and your successors can learn. At present this is often either not being done or records are being kept in different formats. The following guidance seeks to encourage a standard approach for recording basic information.



We recommend that the following information should be recorded for each area that is designated as CCF in the FDP:

- *Your assessment of the potential for CCF based on stand and site details (see Sections 6.1 and 6.2).*
- *Management objectives and plans for achieving these.*
- *Past and future interventions.*
- *Monitoring plans and information.*
- *Other useful information (for your successor).*

Two examples of management pro-formas, based on examples used by Forest Districts, are given in Section 14.4 and may suit your needs.

TIPS

- Keep an electronic and a paper copy, making sure that a paper copy is kept with FDPs or woodland files – which ever you feel is most robust and likely to survive.
- One FD keeps a separate list of CCF stands where regeneration is required so that they can be closely monitored.

10.3 Monitoring and recording

The subject of monitoring and recording is much discussed, but little practised! A number of important points need to be made.

- Collection of information must comply with agreed FD procedures.
- Only collect information that will be useful.
- Make sure information is accessible now, and can be retrieved in the future.

Table 10.1 outlines the main monitoring systems which will provide you with knowledge for CCF.

Table 10.1 Monitoring options

System	Notes
Observations and making notes	Essential for CCF; make sure your observations apply to the whole area as things can change over quite small distances.
Fixed point photographs	A picture is worth a thousand words but make sure your successor can access and understand it (see the Survey Handbook, Section 17.10).
OGB 4	This booklet is mainly for clearfell and restocking systems but will have some application in simple CCF structures.
Thinning control	Can usefully be used for many stands in the early phase of transformation to CCF, or in stands aiming for a simple structure where sapling densities are high (see OGB 9).
FCIN45	This is particularly useful for stands showing early signs of regeneration or where you need to understand why there is little or no natural regeneration. Further guidance is in Section 14.3; the key point is to tailor the data gathered to your needs, rather than apply it universally wherever CCF is practised.

Any information you collect should be stored with the pro-forma management plan. As we mentioned previously, the successful adoption of CCF requires a commitment to a flexible and adaptive approach to stand management. Using information from monitoring to inform interventions is a key part of this process. If you record this, and it is accessible to your successors, then they will be able to carry on your good work.



All areas managed using CCF in FDP must be actively monitored using an appropriate method.

TIP

A useful combination of methods is to use thinning control in the early phase of transformation and when the features of the new stand have expressed themselves. Use FCIN45 to inform management decisions during the regeneration period.



We recommend that crop and site data collected using the monitoring options in table 10.1 is used to update the Sub-Compartment Database (SCDB) in accordance with mandatory and recommended procedures covered in sections 4.3.13 / 4.3.14 / 11.5.3 / 11.12.4 and 14.4.2 of the Survey Handbook.

11. Production forecasting

The following notes complement existing guidance in [OGB 32](#) (January 2008) and the [Production Forecast Fact-File](#) (June 2005).

11.1 Introduction

During our visits to forest districts before starting the revision of this OGB, the subject of production forecasting was frequently raised as an area where staff needed more guidance. One source of concern was the use of a system primarily designed for even-aged stands to represent all the variations possible with CCF. However, the good news is that as long as you can answer 'yes' to the following questions, it is possible to predict likely volumes from the majority of CCF stands.

- Can you describe the species, area and yield class of each crop component?
- Are you clear if you are aiming for a simple or complex structure?

In some CCF stands you will need to describe different stories but, as we will see, in many cases this is not necessary.

The first step is to be clear about the difference between the existing structure of the stand, which may be similar to an even-aged stand, and your future management intentions; is it a simple or complex structure? Which of the options in Table 11.1 best represents the coupe you are dealing with?

Table 11.1 Options to describe structure and future intentions for production forecasting

Existing stand structure	Future management intentions	
	Simple	Complex
Simple with one storey	1	3
Simple with two storeys*	2	4
Complex		5

* The lower storey must be clearly identifiable and composed of trees ≥ 7 cm dbh. You can find guidance on this in Section 4.3.3 of the [Survey Handbook](#).

In almost all cases the main challenge you face is to describe the existing structure of the crop accurately. For stands in options 1 and 3, this should be no more work than if you were managing it using clearfelling. For stands in options 2, 4 and 5 the main difference is the presence of understoreys. However, many of these understoreys, particularly those in options 2 and 4, may not be well developed and therefore will have an insignificant effect on short-term (5 year) and medium-term (5-20 year) production forecasts, particularly if the coupe represents a minority crop type. If resources are available for crop assessment, check the accuracy of data describing the overstorey and use lower cost methods to characterise the understorey.

There are two main elements to production forecasting for CCF stands:

- describing the existing structure of the stand; and
- defining future management of the stand.

11.2 Describing the existing structure of the stand

The three key things to get right are:

- area (by species);
- yield class; and
- planting year.

Most people will be familiar with the process of determining the correct entries for even-aged stands and the following notes will help you for CCF stands.

Area

At present the PF system can handle up to nine species components, and it is important that the area of each species component is described accurately as a percentage of the total sub-compartment area. Things can change quickly in CCF stands and it is important that this is reflected in the data available in the PF system. You can find guidance on how to do this in section 4.3.2 of the Survey Handbook.

Yield Class

Yield class is the primary indicator of the potential for production from each component of a sub-compartment. You must base your assessment of general yield class (GYC) on accurate information about age (see below) and top height. You can do this for all species in the main canopy using procedures described in section 18.3.4 of the [Survey Handbook](#).



For lower storeys we recommend using the yield class of the overstorey if the species is the same, or if the species is different, use the mean yield class for the species in the area.

Age

In CCF, some components of a stand may have been naturally regenerated over a number of years, and this may create uncertainty about the correct age to use. With most tree species it is possible to 'count back' the increments to give a fairly reliable estimate of age.



For natural regeneration we recommend you assess the age of at least 10 trees in the stand and use the earliest date from the range as the age of the stand.

Storey

As described above, some stands managed under CCF will have understoreys and these may need to be described in the PF system. Information on storeys is important, but generally a lower priority compared with species, area, yield class and planting year. Advice on how to deal with storeys in the PF system is contained in the Table 11.2.

Table 11.2 Dealing with storeys in the PF system

Options from Table 11.1	Storey code	Advice
1 and 3	1*	Attribute all species and age components to a single storey. See examples 1, 3 and 4 in Section 11.4.
2, 4 and 5	2 and 3*	Two storeys must exist and be described in terms of species, area, yield class and age. Give priority to the accuracy of the overstorey (Code 3). See examples 2 and 4 in Section 11.4.

* A constraint of the PF system when using storey codes 1 and 3 is that the % area occupied must be 100%. The examples in Section 11.4 show different ways of dealing with this to make sure you characterise CCF stands accurately.

11.3 Defining future management of the stand

In the PF system the future management of the stand is defined by:

- selecting a yield model for each crop component; and
- assigning a management coupe type.

11.3.1 Yield models

The choice of yield models available for each component is explained in Section 6.3.4 of [OGB 32](#). In general, when selecting yield models for use with CCF, select the one that most closely resembles the component in terms of species, yield class, initial spacing and thinning. For stands managed as CCF, select intermediate thinning or, if one exists, a crown thinning model. Do not worry that the yield models are for even-aged stands and the stand is being managed as CCF. This difference is taken into account by selecting the management coupe type.

11.3.2 Management coupe type

The management coupe type is essential to inform the production forecast how a particular area will be managed as CCF. The key point to understand is that the PF system has only two methods for simulating the management of a CCF coupe. These can be described as simple and complex as shown in Table 11.3. At present OGB 32 lists six different coupe types for CCF using the names of silvicultural systems that we have tended not to use in this OGB. The six coupe types neatly fit into simple (strip shelterwood, group shelterwood, uniform shelterwood and irregular shelterwood) and complex (group selection and single tree selection). Because there are only two methods for simulating CCF, the choice of a group or irregular shelterwood coupe makes no difference to how the PF system forecasts volume using the data you have input and the selected yield model. One difference between simple and complex coupe types is that the former needs to have a final felling year specified.

Table 11.3 Management coupe types

Options from Table 11.1	OGB 32 coupe types	Need a fell year?	Description
1 and 2	Strip shelterwood Group shelterwood Uniform shelterwood Irregular shelterwood	Yes	Simple system The stand is thinned at MTI until a specified 'conversion age' ¹ . After this each thinning removes an equal number of trees until the overstorey is removed at the felling year ² .
3, 4 and 5	Group selection Single tree selection	No	Complex system The stand is thinned at MTI until a specified 'conversion age' ¹ . After this the stand is thinned at 2 x MTI until the overstorey is removed.

¹ Conversion age is set by the user.

² Felling year can be set by the user, if not it is assumed to be 45 years after the felling age from the basic yield model.

11.4 Examples

Example 1

A 4.2 ha stand of Norway spruce, beech and oak being crown thinned during transformation to a complex structure. Option 3 in Table 11.1.



PF description						
Component	Storey	Species	P.Year	YC	% area	Area (ha)
A1	1*	NS	1962	16	85	3.6
A2	1*	BE	1962	6	5	0.2
A3	1*	OAK	1962	6	10	0.4

* If you use storey codes 1 or 3 a constraint of the PF system is that the % area must add up 100%.

Example 2

A 7.6 ha stand of Sitka spruce with variable regeneration, a small part of which can be classified as trees forming an understorey. Option 2 in Table 11.1.



PF description						
Component	Storey	Species	P.Year	YC	% area	Area (ha)
A1	3	SS	1964	18	100*	7.6
A2	2	SS	1995	18	15	1.1

*Adjust stocking, dbh and volume to show the overstorey has been thinned heavily to release the understorey.

Example 3

A 3.5 ha stand of Sitka spruce with an understorey of western hemlock. The hemlock has been ignored as it is not planned for it to develop into a productive part of the crop. Option 2 in Table 11.1, but really an option 1, due to planned removal of the western hemlock.



PF description						
Component	Storey	Species	P.Year	YC	% area	Area (ha)
A1	1	SS	1969	18	100	3.5

Example 4

A 26 ha stand of various conifers and broadleaved species, previously managed as 73 different stand elements on a group fell and replant system. Option 5 in Table 11.1.



PF description: two options are possible.

OPTION 1: as one sub-compartment						
Component	Storey	Species	P.Year	YC	% area	Area (ha)
A1	3	DF	1905	18	100*	26
A2	2	WH	1957	16	5	1.3
A3	2	SS	1959	16	20	5.2
A4	2	NS	1957	14	5	1.3
A5	2	JL	1959	12	20	5.2
A6	2	BE	1957	6	10	2.6
A7	2	ASH	1963	8	5	1.3
A8	2	OAK	1957	6	10	2.6
A9	2	WH	1994	16	10	2.6

*Adjust stocking, dbh and volume to show the overstorey does not occupy 100% of the 26 ha.

OPTION 2: as two sub-compartments						
Component	Storey	Species	P.Year	YC	% area	Area (ha)
A1	1	DF	1905	18	100	5.2

Component	Storey	Species	P.Year	YC	% area	Area (ha)
A1	1	WH	1957	16	6*	1.3
A2	1	SS	1959	16	23.5*	5.2
A3	1	NS	1957	14	6*	1.3
A4	1	JL	1959	12	23.5*	5.2
A5	1	BE	1957	6	12*	2.6
A6	1	ASH	1963	8	6*	1.3
A7	1	OAK	1957	6	11.5*	2.6
A8	1	WH	1994	16	11.5*	2.6

*Adjust % area to total 100% for the second compartment (by dividing each figure by 0.85, the proportion of the 26 ha occupied by the understorey).

12. Acknowledgements

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Dave Ellerby	Planning Forester	Llanymddyfri FD

13. Further support and guidance

Now that you know more about managing continuous cover forests it is worth outlining what other support and guidance is available.

13.1 Essential further reading

We suggest you read this booklet along with the following Forestry Commission Information Notes that are available free from the FC website.

- [FCIN29](#) *What is continuous cover forestry?*
- [FCIN40](#) *Transforming even-aged stands to continuous cover management.*
- [FCIN45](#) *Monitoring the transformation of even-aged stands to continuous cover management.*
- [FCIN63](#) *Managing light to enable natural regeneration in British conifer forests.*
- [IPIN 13/06](#) *Operational experiences of continuous cover forestry: UK case studies (only available on the FC intranet).*
- [IPIN21/07](#) *Transformation thinning in CCF with advanced natural regeneration case study: Bron Bannog, Clocaenog, North Wales.*

The following publications contain essential information and guidance on the subjects of vegetation management and fencing.

Forestry Commission Practice Guide 15 – *Reducing pesticide use in forestry*. Forestry Commission, Edinburgh.

Forestry Commission Field Book 8 – *The use of herbicides in the forest*. HMSO, London.

Forestry Commission Technical Guide – *Forest fencing*. Forestry Commission, Edinburgh.

13.2 Training courses

Training courses are presently run by the Continuous Cover Forestry Group (see Section 13.5), and FC Learning and Development (L&D) are currently designing new courses and details will be published soon.

13.3 National network sites for CCF and national representatives

The Forestry Commission has established a network of sites to help improve our knowledge and understanding of managing continuous cover forests. The main trial sites are listed on our website: www.forestresearch.gov.uk/ogb7 and we encourage staff in other forest districts to visit these sites.

TIP

Include a visit to one of the FC Trial Sites in your Forward Job Plan after discussion with your reporting team.

Each of the three GB countries has a representative on the FC CCF Working Group who will be able to give advice on training and support. At present these are:

- England [Chris Marrow](#) and [Simon Wallis](#)
- Scotland [Charlie Taylor](#)
- Wales [Rachel Chamberlain](#)

13.4 Guidance from Forest Research

Staff in Forest Research are available to provide help and guidance and the first points of contact are:

- England [Gary Kerr](#)
- Scotland [Colin Edwards](#)
- Wales [Chris Jones](#)

Useful information on the Continuous Cover Silviculture Programme in Forest Research can be found at www.forestresearch.gov.uk/ccf

13.5 Continuous Cover Forestry Group

The Continuous Cover Forestry Group (CCFG) is an excellent forum for learning more about continuous cover forestry as it organises visits in Britain and abroad; see www.ccfg.co.uk. The CCFG has also compiled a very useful bibliography for anyone seeking to read more widely about CCF.

13.6 Further reading

The following publications are relevant to the management of CCF stands.

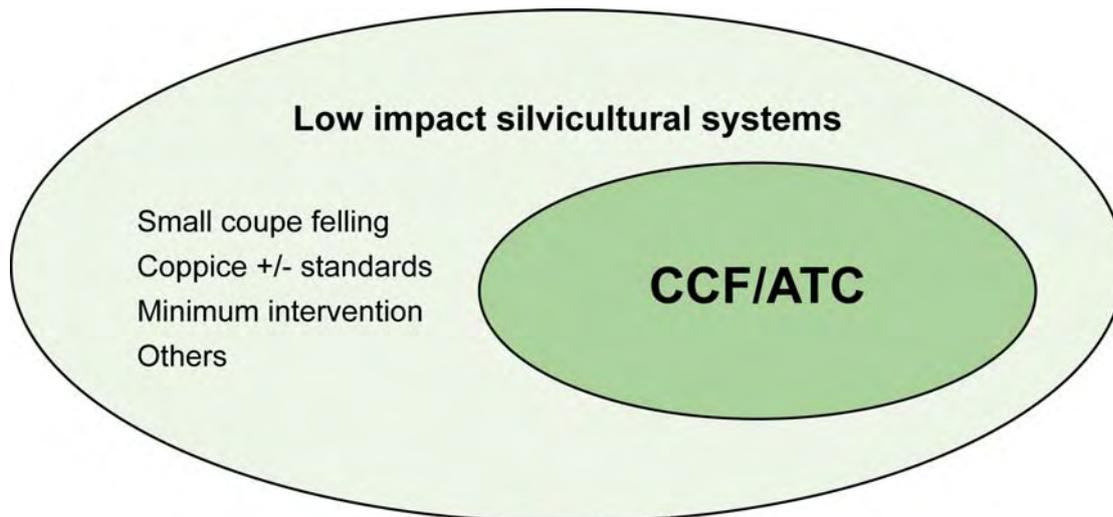
1. *The potential for natural regeneration of conifers in Britain*. Forestry Commission Bulletin 120.
2. *Silvicultural systems* by J.D. Matthews; a book published by Clarendon Press, Oxford.
3. *The management of continuous cover forests: an alternative to clear felling* by Mark Yorke; available from the author, CCFG or CCFG training courses.
4. *Continuous cover forestry* 2nd edition by Rodney Helliwell; available from the author at Yokecliffe House, West End, Wirksworth, Derbyshire DE4 4EG.
5. *Alternative silvicultural systems to clearcutting in Britain: a review*. Forestry Commission Bulletin 115.
6. *How many deer? A field guide to estimating deer population size*. Forestry Commission Field Book 18.
7. *Forest stand dynamics* by C.D. Oliver and B.C. Larson; a book published by John Wiley and Sons; it is North American but the principles can be applied to Britain.

14. Appendices

14.1 Appendix 1 – CCF terms explained

What is the difference between low impact silvicultural systems (LISS), alternatives to clearfelling (ATC) and CCF? The Venn diagram in Figure 14.1 aims to clarify this.

Figure 14.1 Venn diagram showing the relationship between CCF, ATC and LISS



In simple terms:

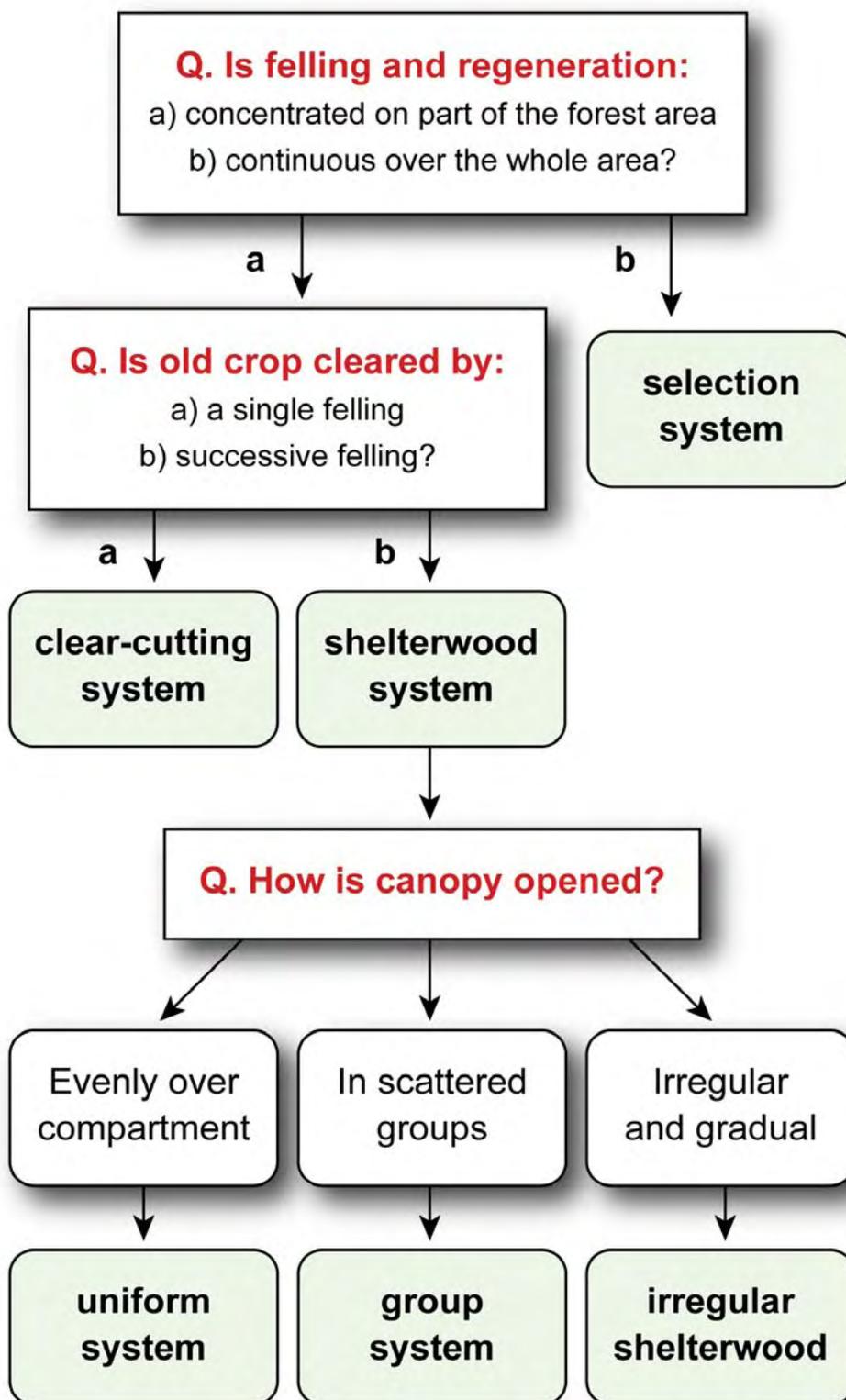
- CCF and ATC are the same (see FCIN29 for more information).
- LISS accommodates a wider range of approaches including the use of small coupe felling (such as small clearfells of between 0.5 and 2.0 ha).

Some knowledge of silvicultural systems may also be useful when using CCF. The decision tree in Figure 14.2 helps to classify the main systems.

Note that:

- generally, simple structures are produced using shelterwood systems and complex structures by selection systems; and
- the main difference between a shelterwood system and a selection system is that in the latter felling and regeneration are continuous over the whole area, so that it is not possible to map separate regeneration and felling units within the stand.

Figure 14.2 A decision tree for classifying the main silvicultural systems



Note that selection systems can be further subdivided into group or single-tree selection depending upon the shade tolerance of the species involved.

14.2 Appendix 2 – How to mark a crown thinning

Use the following procedure at the second thinning or later.

1. The first thinning should establish access into the stand to set out the route of racks. The design of the racks will have consequences for future harvesting method and equipment and you should consider them carefully.
2. Assess the BA of the stand or obtain this information from other sources.
3. Use the information in this booklet to decide what the BA should be after thinning (Table 7.2 and Section 7.3.1).
4. Select and permanently mark up to 100 **Seed Trees** if you are aiming for a simple structure or up to 50 **Frame Trees** if you are aiming for a complex structure. These trees should be stable and have good form.
5. **Seed** trees should be evenly spaced over the area, for example when marking 100 per ha this means one every 10 m on a grid pattern. Achieving an even spacing is not important for selecting **Frame** trees, which should have a 'clumpy' distribution.
6. Mark trees for removal that:
 - release the selected **Seed** or **Frame** trees from competition. As a general rule remove the two main competitors – this will mean marking some large trees; and
 - will selectively thin the matrix giving high priority to removing trees of poor form.
7. Check that your marking is removing the necessary BA and if not make adjustments.

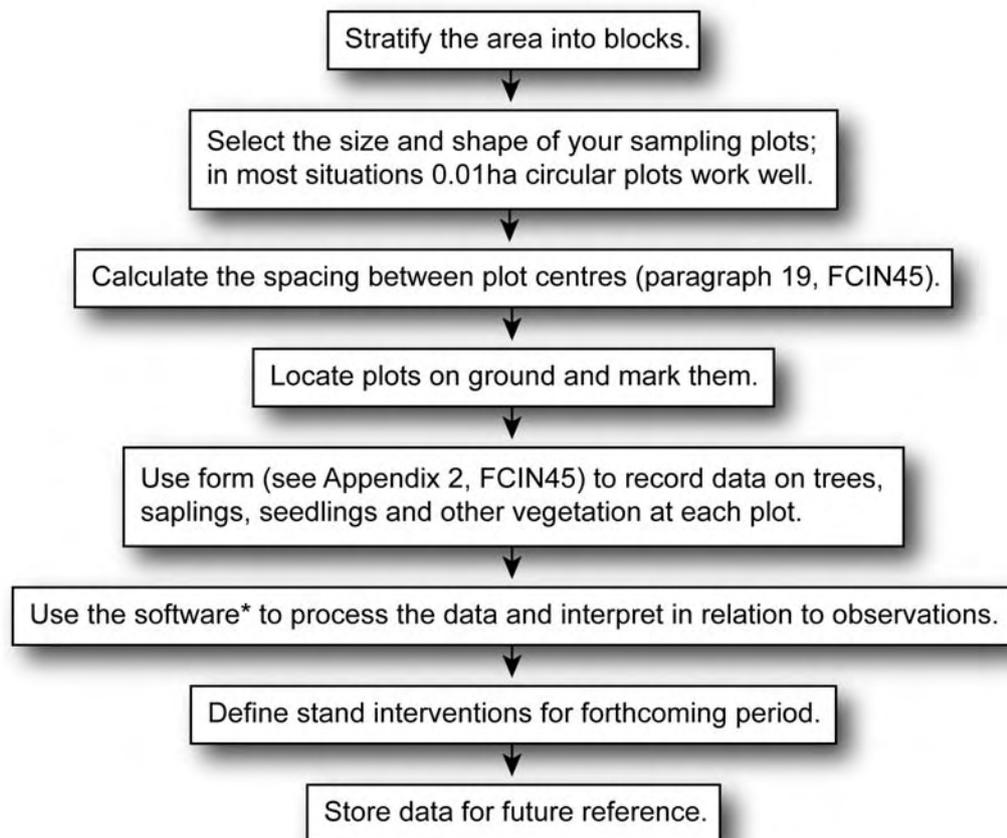
TIP

In a crown thinning the mean dbh of trees removed should be the same as the stand before thinning.

14.3 Appendix 3 – Making FCIN45 work for you

The method described in Forestry Commission Information Note 45 is a **flexible** method of collecting useful information for the management of CCF. Figure 14.3 will help you make decisions about its use.

Figure 14.3 Making FCIN45 work for you



* available from Forest Research (email: gary.kerr@forestry.gsi.gov.uk).

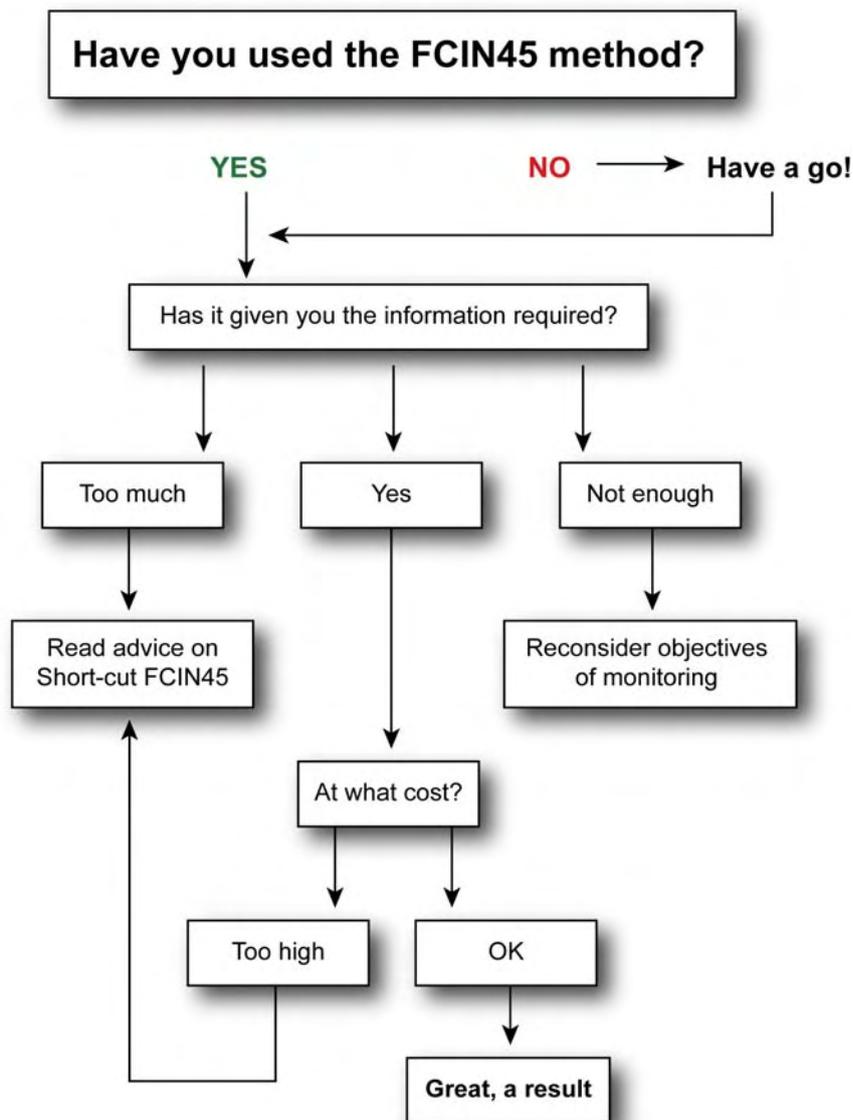
14.3.1 Short-cut FCIN45

If the full version of FCIN45 produces too much data, or the costs are too high, then use it flexibly for your needs (Figure 14.4). For example:

- group similar areas of the forest into blocks or strata;
- do not count saplings on plots that are fully stocked, estimate numbers of each species present;
- only measure what is useful for your needs; this may be only tree diameters and number of saplings, or only regeneration and ground flora; and
- reduce the number of plots used (the absolute minimum is 8), however, remember your data will be less accurate.

The recommended number of plots is given in FCIN45.

Figure 14.4 Have you used FCIN45?



14.4 Appendix 4 – Management pro-formas

Sections 14.4.1 and 14.4.2 provide examples of management pro-formas in use with CCF at present. They are based on an example from Tay Forest District and an example from East Anglia Forest District.

You can also find them if you use this link: www.forestresearch.go.uk/ogb7

14.4.1 Pro-forma from Tay FD

FOREST PLAN					Prepared by			Date		
Plan ref and cmpt range	Management objective/Reason for selection	Long-term structure* and desirable species	Age Trans. period and return time (years)	Regeneration and ground flora	Observations (e.g. likely barriers to achieving objective)	Next treatment required**	Proposed monitoring	Other useful information		
1 4501	Conservation Good, slow growing SP on stable ground. Capercaillie habitat. Future timber quality.	Simple. W18 species mix.	65 40 7	Well developed saplings and bank of seedlings <i>Vaccinium</i> .		Crown thin to MT + 2 years + removal of other conifers.	Thinning control.	SSSI		
3 4512-14	Landscape and timber production. Potential for big trees in prominent location and good quality timber on stable ground.	Simple. 90% DF/NS.	42 50 5-7	DF and BI seedlings. No NS. Grasses and bracken.		Crown thin to MT + 2 years.	Thinning control.			
17 4632	Recreation. Large area surrounding car park.	Complex. 90% DF.	65 100 10	Some DF saplings, few seedlings. Grasses and bracken.	Deer?	Consider planting 2 x 0.2 ha groups in 08/09.	FCIN45 every 10 years.			
109 4845	Timber production. Good stand of maturing SS with developing natural regeneration.	Simple. 90% SS.	34 50 5	None. SS needle litter and sparse grass.		Thin to MT + 2 years.	Thinning control + note any regeneration.			

* Continuous cover stands: simple = 1 or 2 layers in canopy structure; complex = 3 or more layers in canopy structure

** Presumption will be that regeneration will be natural, unless otherwise stated.

14.4.2 Pro-forma from East Anglia FD

1. Forest Name: FDP ref:

Summary FDP Objectives for forest area:

2. Site and Stand Details (as FCIN40) Coupe ref:

Site

Feature	Score	Notes
Soils		
Risk of Windthrow		
Soil fertility		
Species suitability		

Stand

Cmpt No.	Species	Age	GYC	Area	BA	SPH
Features	Notes					
Advance regen						
Floral litter						
Animal impacts						
Potential for CCF	GOOD / MODERATE / POOR					

Management objectives and plans

Coupe management objectives	Relating to CCF
Desired stand structure	Simple/complex; species composition; other specific details
Transformation period	

Interventions

Past intervention	Year	Details and Notes
Future intervention	Planned Year	Details and Notes

Monitoring

Year	Feature	Notes*
	Species composition	
	Stand structure	
	Regeneration	
	Animal impacts	
	Ground flora	
	Other	

* Attach any data recorded

Prepared by:

Date:

14.5 Appendix 5 – Natural regeneration self-test evaluation

Which of the following statements about natural regeneration are true?

1. Natural regeneration is:
 - A. Easy to achieve when about 5% of trees have up to 50 cones per tree.
 - B. A good method of regeneration where deer densities are high because it produces lots of seedlings.
 - C. Unpredictable and sometimes difficult to achieve.
 - D. Suitable for all sites because once you understand the process it is possible to produce generalised prescriptions.

2. In which of the following situations is natural regeneration generally easier? In woodlands:
 - A. On moisture retaining, heavy and fertile soils (e.g. W8 woodland).
 - B. With a full canopy of dominant trees produced by crown thinning.
 - C. On light, dry infertile soils (e.g. W16 woodland).
 - D. With a sparse canopy with occasional large trees.

3. Which of the following statements about seed production are correct?
 - A. It is not necessary for trees in a stand to produce seed to achieve natural regeneration.
 - B. The main period of seed dispersal for conifers is the spring; except SP, CP and EL which release seed in autumn through to spring.
 - C. Most conifers only start to produce large quantities of seed when they are 30-40 years-old.
 - D. Most tree seed is dispersed by the wind and will usually fall at least 50 m from the parent tree.

4. Which of the following statements about seed germination are true?
 - A. An important precondition for germination of most tree seed is access to light.
 - B. Seed of some tree species can lie dormant in the soil.
 - C. A good environment for germination of tree seed is to be buried in mineral soil.
 - D. A good environment for germination of tree seed is to be buried in organic matter.

5. In order to improve conditions for germination of tree seed much continental literature recommends the use of ground preparation. In which of the following situations would the use of ground preparation be beneficial for natural regeneration?
 - A. On light soils with a thick cover of vegetation and sparse canopy.
 - B. On thin base rich soils overlying chalk or limestone.
 - C. On all sites.
 - D. On sites where there is a thick layer of organic matter.

6. What do you understand by the term advance regeneration?

- A. Seedlings produced from tree seed with low dormancy.
 - B. Seedlings which are above the height of existing vegetation.
 - C. Seedlings which are present beneath the canopy before regeneration felling occurs.
 - D. Seedlings which have grown beyond the browse level of animals in the area.
7. Why is the presence of advance regeneration useful?
- A. It is a reliable indicator of likely success.
 - B. If present in sufficient densities managers should plan to ensure its survival.
 - C. If not present it is important to understand the factors which have caused this.
 - D. It reduces the need to protect trees from mammal damage.
8. A well-developed ground flora of competitive plants can adversely affect seedling growth. Which of the following are suitable methods of vegetation control for natural regeneration: yes (Y), possibly (P) or no (N)?
- A. Application of glyphosate as an overall spray.
 - B. Maintaining canopy cover.
 - C. Use of treeshelters.
 - D. Non-intervention in areas of dense regeneration.
9. In order to control the rate of canopy removal once regeneration has established it is important to know the light requirements of young seedlings. Are the following shade tolerant (S) intermediate (I) or intolerant (light demanding, L)?
- | | |
|-------------------|---------------------|
| A. Sitka spruce. | E. Western hemlock. |
| B. Norway spruce. | F. Douglas fir. |
| C. Scots pine. | G. European larch. |
| D. Grand fir. | |
10. The effects of animals on natural regeneration can be both helpful and harmful. Which of the following are true statements?
- A. Birds and small mammals can help natural regeneration by dispersing seed such as oak, holly and hawthorn.
 - B. Relatively large seeds such as Douglas fir and Corsican pine are less susceptible to predation because they tend to bury themselves when they fall off the tree.
 - C. Browsing is an important factor preventing the development of advance regeneration.
 - D. Young regeneration which is taller than 60 cm is certain to survive no matter what the density of deer.

You can find the answers at: <http://www.forestresearch.gov.uk/ogb7>