

## **Case Study 13**

### **Devilla and Tentsmuir Forests, Fife (with Cardrona, Borders)**

#### **Location and ownership of woodlands**

This case-study deals with three Forestry Commission forests in eastern Scotland:-

1. Devilla Forest, by Kincardine, Fife [NGR NS 955886] extends to ~750 ha (~1,840 acres) with some 675 ha (~1,650 acres) now designated for non-clearfell silvicultural systems. The forest is primarily a mid-twentieth century Scots pine-larch plantation on wet heath with a very small Ancient Woodland Site included.
2. Tentsmuir Forest, by Tayport, Fife [NGR NO 489253] extends to ~1570 ha (~3,880 acres) with 1430ha (~3,530 acres) now designated for non-clearfell silvicultural systems. The forest is primarily a mid-twentieth century pine plantation established on coastal sand dunes, with little pre-existing tree cover. The site is adjoined by the important Tayport-Tentsmuir coastal SSSI site.
3. Cardrona Forest, by Innerleithen, Borders [NGR NT 300370] extends to ~740 ha (~1,830 acres) with 280 ha (~690 acres) now designated for non-clearfell silvicultural systems. The forest comprises mid-twentieth century plantation crops of spruce, pine, larch and fir on the visually-important southern slopes of the Tweed Valley, established on what had formerly been upland sheep-walks.

#### **Significance/ reasons for selection as case-study example**

These sites have been selected as case-studies in this project for two main reasons:-

1. Although individual site factors differ, these examples represent relevant approaches and early experiences of the regeneration and structural diversification of mid-rotation even-aged plantation stands of Scots pine in southern Scotland. This form of adoption of ATC (under scenarios 4 and 11) is increasingly common on the National Forest Estate, with objectives of recreational amenity, enhanced habitats for red squirrel and reduced costs of extensive restocking operations.
2. Securing natural Scots pine regeneration from these mid-rotation stands, typically 50-80 years old, can be more difficult than in the “classic” Aberdeenshire and Moray examples where crops are 80-120 years old. Site types can be more fertile, with greater weed competition and less favourable conditions for pine. In some cases there is a need to use intensive site preparation and reinforcement planting.

#### **Owner objectives for management (including adoption of ATC systems)**

The Forestry Commission in Scotland manages its estates for a combination of economic timber production, conservation and recreational amenity objectives. The balance between these objective sets varies with the type of forest and its location. ATC is employed on a site specific basis by FC in support of management objectives and there is an overall policy target that 20-25% of the National Forest Estate might be managed towards variants of ATC. Areas within Devilla, Cardrona and Tentsmuir Forests have been selected for ATC based on the nature of existing semi-mature crops, site characteristics (soils, exposure), presence of advance natural regeneration and landscape/ amenity considerations. In these cases, ATC adoption is expected to diversify forest structure, reduce replanting costs and improve recreational amenity.

## **Biophysical characteristics of the sites**

Devilla Forest - located on the Forth lowlands at elevations ranging from 60-90m asl. Climate is warm and fairly moist [AT<sub>5</sub> of ~1360 dd, MD of ~130 mm, annual rainfall 780 mm]. The site is moderately exposed with DAMS of 14. The solid geology is of the Carboniferous millstone grit with poorly drained peat/ peaty gley soils developed over fine-textured glacial tills [ESC SMR Very Moist; ESC SNR Very Poor].

Tentsmuir Forest - located at sea level on the north-east coast of Fife. Climate is warm and slightly dry [AT<sub>5</sub> of ~1400 dd, MD of ~155 mm, annual rainfall 675 mm]. The site is moderately sheltered with DAMS of 12. The solid geology is of the Devonian Old Red sandstone with weakly developed rendzina/ regosol soils from littoral sands of reasonable base-fertility [ESC SMR Slightly Dry; ESC SNR Medium].

Cardrona Forest - located on the north-facing slopes of the Tweed Valley at 150-500m asl (site of interest at 300-350m asl). Climate is cool and wet [AT<sub>5</sub> of 1057 dd, MD of 77 mm, annual rainfall 886 mm]. The site is moderately exposed with DAMS of 15. The solid geology is of the Silurian Llandovery series with giving rise to well-drained upland soils of moderate fertility [ESC SMR Fresh; ESC SNR Medium].

## **Stand history and current composition**

The examples examined in this case-study all comprise regular stands of Scots pine established between 1925 and 1955. In the cases of Cardrona and Devilla, there is also a subsidiary larch component, whereas at Tentsmuir there are significant areas stocked with Corsican pine of similar ages. In all three forests, natural regeneration of Sitka spruce from neighbouring crops has, over the past decade, begun to form a partial understorey to these semi-mature Scots pine stands due to its higher threshold basal area. At Tentsmuir and Devilla there is also a partially-intruded understorey of self-sown broadleaves including much birch at Devilla, with some oak, beech and other species in addition at Tentsmuir. However, there is a desire to perpetuate Scots pine as an element of the crop for species diversity, recreational amenity and wildlife conservation reasons (the latter relating to cone palatability for red squirrel). Only at Tentsmuir, in more open p1920's/ 1930's pine stands, has significant Scots pine natural regeneration yet been recruited and, even there, mainly in peripheral areas where there is an important side-lighting contribution to the overall light budget.

## **Silvicultural treatments applied to date and intended future silviculture**

Over the past decade, two distinct approaches have been applied to attempt to transform these Scots pine plantations to alternative silvicultural systems. The first is thinning of the crop matrix, on a uniform/ irregular shelterwood model, aiming to reduce the stand basal area towards the threshold for Scots pine regeneration (22-25 m<sup>2</sup>/ha). This has been applied at all three forests, but has only resulted in significant recruitment of Scots pine within the more open, older stands at Tentsmuir. Here, volumes of pine regeneration can be expected to steadily expand. Elsewhere, regeneration of Sitka spruce, which can persist at stand basal areas of 27-30 m<sup>2</sup>/ha, proves more competitive, alongside native broadleaves and rank ground vegetation. The more moist, fertile ground conditions at Devilla and Cardrona also tend to limit the window of opportunity for Scots pine regeneration once the canopy is opened. At Cardrona, some scarification trials were undertaken to encourage pine regeneration

and a deer fence has subsequently been erected to protect any that does arise. A complementary strategy has recently been implemented at Devilla, where pine crops are younger (p1950's), with resulting lower cone production and greater difficulty in reducing the stand basal area sufficiently. Small coupe fellings of 0.5-1.0 ha have been removed from the mature crops in the hope of recruiting regeneration within these. Where that has not arisen within a suitable period, due to site conditions or lack of seed supply, these coupes have been replanted. It is hoped that as the matrix matures and is progressively thinned, pine regeneration will arise on a shelterwood basis, alongside the younger groups established by replanting within the mini-coupes.

### **Evaluation of current silvicultural status in terms of ATC adoption/ regeneration**

Silvicultural development at these sites has reached *developmental category 3* (early-stage transformation) in the cases of Tentsmuir and Devilla Forests, although progress at the latter continues to rely heavily on replanting the mini-coupes with Scots pine due to lack of natural regeneration recruitment. At Cardrona, only *developmental category 4* (preliminary stage adoption/ transformation) has been reached due to the lack of Scots pine natural regeneration, although it could be argued that if progress towards mixed Scots pine-Sitka spruce stands was the objective, *developmental category 3* has already been achieved there. Continued progress with adoption of ATC at Devilla and Cardrona is likely to depend on securing Scots pine regeneration in the future or, alternatively, accepting stand diversification with more shade tolerant conifers and semi-natural broadleaves that will regenerate more readily. It may be that natural regeneration in Scots pine should not be expected before 80-90 years.

### **Commentary on inventory and monitoring protocols/ demonstration potential**

At present these sites are managed using an approach based on periodic visual inspection of stand condition and natural regeneration levels, followed by thinning, coupe-felling and reinforcement planting interventions. No detailed enumeration is carried out along the lines of the FCIN45 protocol. The sites currently have only basic-level demonstration potential for self-guided visits, but this could be enhanced by undertaking quantitative monitoring and preparing portable interpretation material.

### **Commentary on economic and operational implications of ATC adoption**

Detailed economic comparisons of working systems are not available for these sites. Management of stands of this type using ATC systems typically requires a more cost-intensive approach during the rotation (monitoring, thinning, small coupe-felling, reinforcement planting) but can reduce costs for site preparation and final restocking. The Forestry Commission has access to direct labour and contracting resources able to perform ATC thinning operations, but there are constraints on the volume of working.

### **Other relevant field examples recorded within the project**

Due to the emphasis on use of ATC systems to perpetuate and diversify Scots pine stands in southern Scotland, useful comparisons can be made with the English examples at Wykeham Forest (Case Study 9) and Sherwood and Thetford Forests (Case Study 20) where comparable work is being undertaken. Examples in older plantation Scots pine crops in northern Scotland at Cawdor (Case Study 4) and Blelack (Case Study 6) and Curr/ Anagach Woods (Case Study 7) are also relevant.



Photographic record



Left: thinned Scots pine stand prior to significant natural regeneration

**DEVILLA FOREST**

Right: semi-mature Scots pine stand recruiting Sitka spruce regeneration



Left: thinned Scots pine stand with birch-dominated natural regen.

**DEVILLA FOREST**

Right: combined artificial and natural pine regen. in mini-coupe



Left: mature Scots pine stand recruiting hardwood regeneration

**TENTSMUIR FOREST**

Right: mature Scots pine stand recruiting Sitka spruce regeneration



Left: mature Scots pine stand recruiting Scots pine regeneration

**TENTSMUIR FOREST**

Right: mature pine stand recruiting pine regeneration with side lighting



Left: initial condition of Scots pine shelterwood site, 2004

**CARDRONA FOREST**

Right: partial development of Sitka spruce understorey



Left: imposition of deer fencing to recruit natural pine regeneration

**CARDRONA FOREST**

Right: imposition of deer fencing to recruit natural pine regeneration

