

## **Case Study 12**

### **Kilmichael Forest, Argyll and Penninghame Forest, Galloway**

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

This case-study deals with two Forestry Commission forests in western Scotland:-

1. Kilmichael Forest, by Lochgilphead, Argyll [NGR NR 918923] extends to ~8800ha (~21,750 acres) (including Ardcastle, Kilmory and Minard blocks) with some 2700ha (~6,700 acres) now designated for non-clearfell silvicultural systems. The forest is primarily a mid-twentieth century spruce plantation with very small inclusions of remnant ancient semi-natural woodland and PAWS sites.
2. Penninghame Forest, by Newton Stewart, Galloway [NGR NX 363690] extends to ~3600ha (~8,900 acres) with 470ha (~1160 acres) now designated for non-clearfell silvicultural systems. The forest is primarily a mid-twentieth century spruce plantation established on open moorland, with riparian broadleaves.

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

These sites were selected as case-studies within the project for two main reasons:-

1. They represent the fairly widespread situations on the public forest estate in Scotland where attempts are now being made to implement ATC in upland Sitka spruce stands (adoption scenario 6) on sites regarded as marginal for its use. By contrast with the FC examples reported at Fernworthy, Cwm Berwyn and Clocaenog, these Scottish examples have not been conducted as part of the national trial series. Hence they have not received such detailed attention in terms of inventory and monitoring or adoption of formalised ATC conversion protocols.
2. Due to the extent of even-aged upland Sitka spruce in Scotland, Northumberland and Wales, reliable methods for cost-effective ATC implementation (under adoption scenario 6) are essential to give managers greater confidence. It is inevitable that these may be pursued under relatively extensive, informal regimes responding to natural regeneration and using conventional forestry machinery.

#### **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 a broad policy target that 20-25% of the National Forest Estate might be moved towards variants of ATC. Areas within Kilmichael and Penninghame 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**

Kilmichael Forest - located on the Kintyre Peninsula at elevations ranging from sea level to 350m asl. ATC areas typically 0-200m asl and south-east facing. Climate is warm and moist [AT<sub>5</sub> of ~1280 dd, MD of ~93 mm, annual rainfall 1900-2500mm]. The site is noticeably exposed for ATC with DAMS of 17-18. The solid geology is of the Dalradian schist series with mainly peat and peaty gley soils [ESC SMR Moist to Wet; ESC SNR Poor or Very Poor]. Site conditions significantly constrain ATC here.

Penninghame Forest - located some four miles north-west of Newton Stewart at elevations ranging from 40-120m, with predominantly south-easterly aspects. Climate is warm and moist [AT<sub>5</sub> of ~1470 dd, MD of ~122 mm, annual rainfall 1300 mm]. The site is moderately sheltered with DAMS of 14. The solid geology is of the Ordovician Ashgill-Caradoc shales with varied upland soils [ESC SMR Moist-Wet; ESC SNR Poor-Very Poor]. Site conditions constrain ATC to a limited extent here.

These upland sites have distinct ecological and silvicultural similarities and represent the typical conditions under which ATC might be attempted in western Scotland.

## **Stand history and current composition**

Kilmichael Forest - this area of ground (including Ardcastle) was acquired by the Forestry Commission and originally afforested in the 1930's. Stocking was primarily Norway spruce (on better soils) and Sitka spruce elsewhere, with local Douglas fir, western hemlock, pine, larch. Many of the p1930's plantings were destroyed in the 1968 gale and restocked with similar species - particularly with Sitka spruce. A spontaneous understorey of western hemlock has developed in places, with more localised advance regeneration of Sitka spruce where the canopy has been opened.

Penninghame Forest - this area of ground was acquired by the Forestry Commission and originally afforested in the 1950's. Stocking was primarily Sitka spruce with more localised Norway spruce, Scots pine, Japanese larch and grand fir. Large areas of the original p1950's stands have been felled and replanted since 2000. A spontaneous understorey of Sitka spruce has developed under retained stands of larch and pine, with advance Sitka regeneration in small spruce group felling areas.

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

Kilmichael Forest - efforts have been pursued over 10-15 years to prepare reputedly more windfirm areas, especially at Ardcastle, for non-clearfell silviculture. Recording of detailed operations has been incomplete and inconsistent. Small groups were cut from p1930's Norway spruce crops and partially replanted with Sitka spruce. Post 1968 second rotation crops should have been thinned 1988-1998 but this was often delayed for between 5 and 15 years for operational reasons. Catch-up thinnings in the past 5-10 years had allowed promising recruitment of some Sitka spruce regeneration but many of the shelterwoods were lost to the January 2012 gale (return period of ~45 years after the similar 1968 event). Prolific undesired advance hemlock regeneration has been left untended. Heavy machinery sets available in this locality are suboptimal for ATC thinning work with limited brush availability. Specialist thinning equipment is really required. Intervention frequency at 5-7 years is too long to protect marginally stable stands. Some consideration is being given to reversion to clearfell working.

Penninghame Forest - areas of the original p1950's and p1960's stands that have been retained to date are now being converted to ATC, especially close to recreational foci. As advance regeneration of Sitka spruce has mainly arisen to date in more open adjoining stands of pine and larch, spruce stands have been thinned to reduce basal area towards the threshold of 27 m<sup>3</sup>/ha for regeneration. Thinning to date has been an informal intermediate/ crown prescription without marking of frame trees. A number of small group fellings have been implemented within the spruce crops, resulting in profuse spruce regeneration, suggesting that this might be a valuable way forward in situations where there has been an imperfect record of thinning and it is difficult to reduce the standing basal area of retained stands sufficiently without destabilisation.

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

At Kilmichael, work to date has progressed to *developmental category 3* (early-stage transformation) with some advance regeneration of Sitka spruce (desired) and western hemlock (undesired). Both irregular shelterwood thinnings and group selection fellings have been carried out but many stands have subsequently been lost to catastrophic windthrow. Future continuation of ATC working is under some threat.

At Penninghame work to date has progressed to *developmental category 3* (early-stage transformation) with some areas arguably achieving *developmental category 2* (progressive/ mature transformation). An interesting feature at this site is the counter-point of Sitka spruce regeneration under a uniform shelterwood of pine/ larch alongside the successful group shelterwood approach in the retained spruce stands.

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

At present these sites are managed using an approach based on periodic visual inspection of natural regeneration levels, volume tariffing followed by thinning interventions. No detailed enumeration is carried out. The sites currently have only basic demonstration potential for self-guided visits, but this could be enhanced were quantitative monitoring to be undertaken and suitable interpretation material prepared.

### **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 intensive approach during the rotation (monitoring and thinning) but can reduce costs for site preparation and restocking. The Forestry Commission has access to both direct labour and contracting resources able to perform ATC thinning operations, but these do not have sufficient capacity to undertake all desirable works. Significant operational factors at Kilmichael Forest have arisen due to wind instability of crops.

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

As an example of the application of ATC working to near-pure upland Sitka spruce, experiences at these sites, especially Penninghame, can be compared with the Welsh examples at Cwm Berwyn and Cefn Llwyd Forests (Case Study 11), Clocaenog Forest (previous report) and Fernworthy Forest in south-west England (Case Study 10). Work at Kilmichael Forest demonstrates the greater challenges posed for ATC adoption by the wind regime and severe winter storm incidence in western Scotland.

**Photographic record**



Left: sporadic windthrow after delayed thinning in p1960's Sitka

**KILMICHAEL FOREST**

Right: clearing partial windthrow after thinning of p1960's Sitka



Left: hemlock regeneration under p1930's Norway spruce crop

**KILMICHAEL FOREST**

Right: hemlock regeneration under p1960's Sitka spruce crop



Left: replanting SS within a small group felling of p1930's NS crop

**KILMICHAEL FOREST**

Right: natural regeneration of SS initiates around edges of same gap



Left: Sitka spruce regeneration arising under adjoining pine/ larch

**PENNINGHAME FOREST**

Right: Sitka spruce regeneration arising under adjoining pine/ larch



Left: thinned p1950's Sitka spruce prior to any advance regeneration

**PENNINGHAME FOREST**

Right: Sitka spruce regeneration in group felling within p1950's crop



Left: Sitka spruce regeneration in group felling within p1950's crop

**PENNINGHAME FOREST**

Right: Sitka spruce regeneration in group felling within p1950's crop

