

A New Dawn for Native Woodland Restoration on the Forestry Commission Estate in Scotland

George F Peterken and Alan W Stevenson



Acknowledgments

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Footnote: Forest Enterprise operated as part of the Forestry Commission in Great Britain from 1992 to 1996 and as an Agency between 1996 and 2003. As a result of the Forestry Devolution Review it was split into three country based agencies in 2003. The Scottish Agency now operates as part of the Forestry Commission Scotland.

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Contents

Authors' Note	4
Summary	5
1 Introduction	9
1.1. Setting the scene	9
1.2. Defining the scope of restoration	10
2 Looking Back – The Historical Context	12
2.1. Forestry Commission management of native woods, 1919-1989	12
2.1.1. Native pinewoods	12
2.1.2. Broadleaved woodland	14
2.2. Reviews and plans in the 1990s	15
2.3. Biodiversity Action Plan targets	16
2.3.1. Native pine woodland	17
2.3.2. Upland oak woodland	17
2.4. The social aspects of native woodland management	18
3 Looking Today – A Review and Commentary	19
3.1. The position in 2003	19
3.2. Progress towards HAP targets	19
3.3. How natural is the restored woodland?	19
3.3.1. Persistent artificial elements	20
3.3.2. Renewed natural elements	22
3.3.3. Timing	23
3.4. Longer-term experience	24
3.5. Involving people	24
3.5.1. Recreation in native woods	24
3.5.2. Community involvement	25
3.6. Partnerships and funding	26
3.7. Scope for improvement	26
4 Looking Forward – Some Pointers to a New Future	29
4.1. Components of restoration	29
4.2. Phases and timing	29
4.3. Developing long-term objectives	30
4.4. Introducing diversity by silvicultural operations	32
4.5. Management in the semi-natural stands	32
4.6. Network and forest structural issues	33
4.7. Monitoring and data	35
4.8. Community involvement, public access and appreciation	35
4.9. Future partnership working	36
4.10. Wider significance	36
5 Conclusion	38
References	40
Case Studies	41

Authors' Note

The material assembled in this report stems from a review of progress of native woodland restoration commissioned by Forest Enterprise Scotland. The review was undertaken by George Peterken and involved a tour of key native woodland sites on the Forestry Commission estate in Scotland. A report on the site visits and discussions held with local Forest Enterprise staff is reproduced as Case Studies.

The historical context, review and commentary have been compiled jointly by George Peterken and Alan Stevenson. The forward-looking section and conclusion have been prepared by George Peterken. They are largely his own views and are not intended to reflect or represent current Forestry Commission Scotland policy or plans. These sections should however provide some useful material for future debate both within the Forestry Commission Scotland and also amongst the many stakeholders with an interest in the continuing restoration of native woodlands on the FC estate in Scotland.

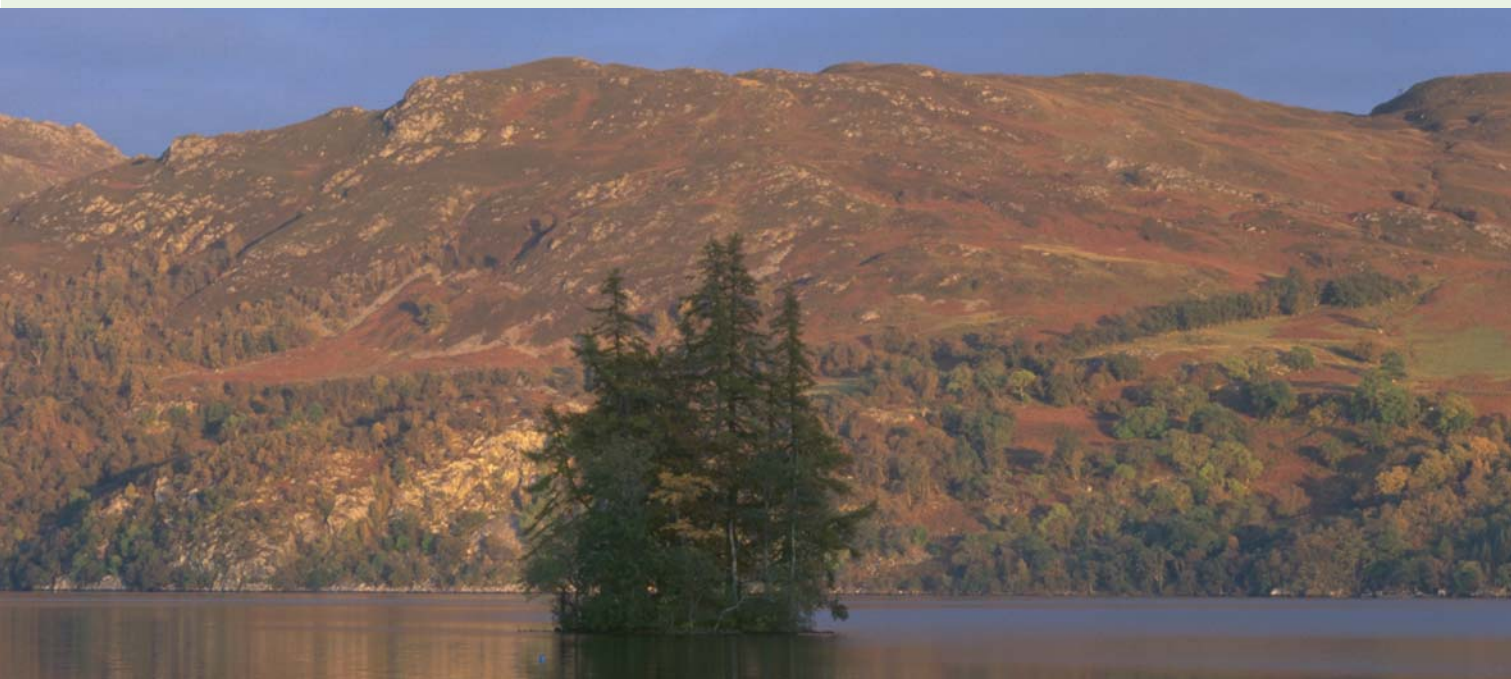
The authors are particularly grateful for the contribution of all Forestry Commission staff involved with native woodland management in general and the site visits in particular. Special thanks are also due to Dr Jonathan Humphrey of Forest Research Agency who commented on the text and Alan Melville who undertook the design of the publication.

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Summary

From a modest start in the mid-1980s and significant momentum gained in the early 1990s, Forest Enterprise in Scotland has implemented a progressively more ambitious programme for restoring native woodland on the Forestry Commission estate in Scotland. Much of the work so far has concentrated on key sites, largely ancient woodlands in which plantations of mainly non-native conifers were established from the 1930s to the 1970s, but native woodland is also being established in ordinary plantation-origin forests and as extensions to plantations. Forest plans for native woodlands have been produced at both strategic and site levels. Operations to date have largely but not exclusively concentrated on removing threats - conifers, rhododendron and excessive grazing. The need now is to determine corporate direction and priorities, long-term management objectives and consolidate progress made thus far. In addition to the work on biodiversity there has been extensive and energetic attempts made to connect people – locals, visitors and tourists – with native woodlands. Much of this has been achieved in partnership with a range of interests and organisations. Considerable success has also been attained in securing funding from partners, including the EU and the National Lottery. The programme as a whole, and several individual projects, form a very substantial contribution to restoring the native woodland cover of the Highlands and a not insignificant contribution in a few key sites elsewhere in Scotland (Figure 1).

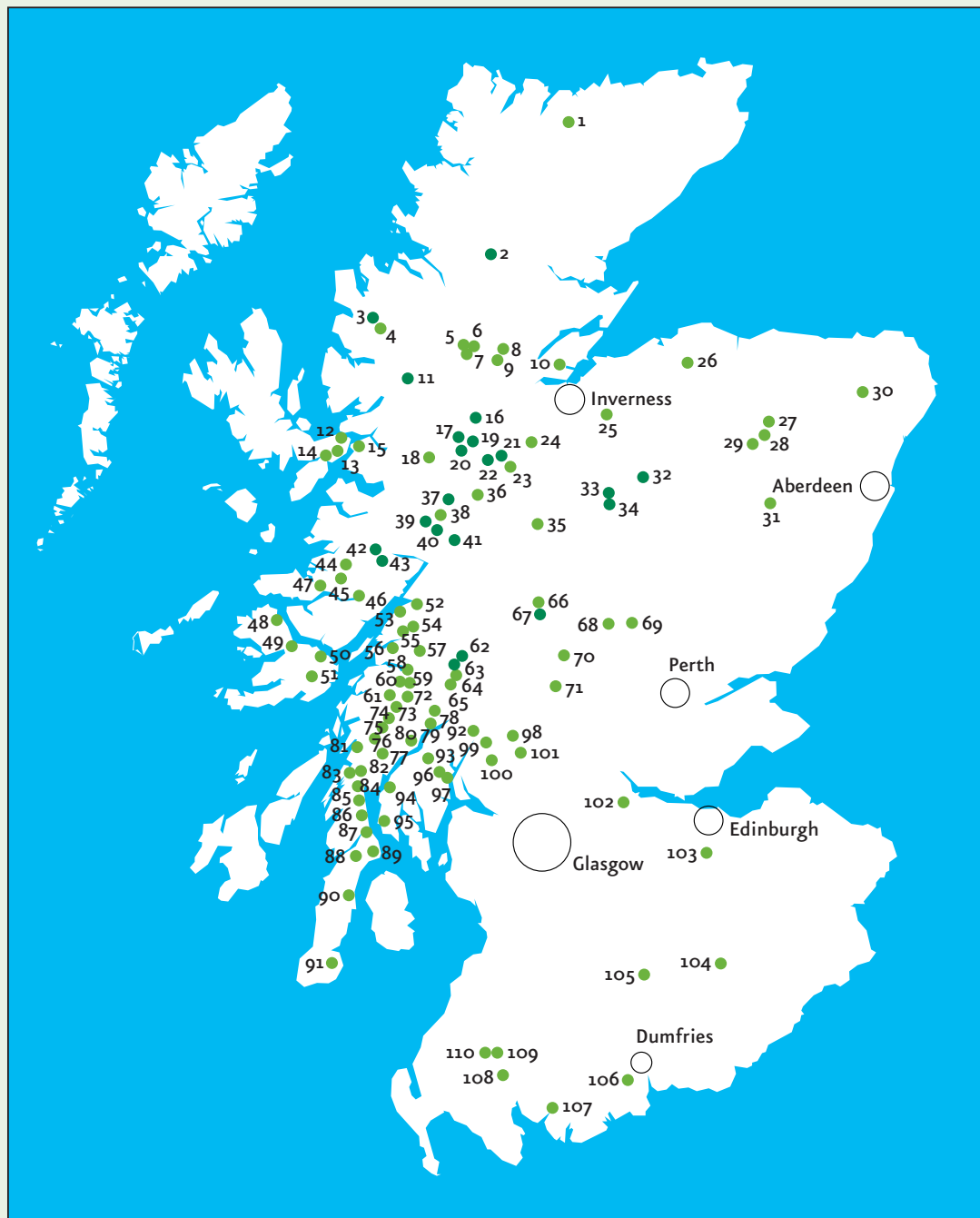


No	Type of Woodland & Site/Woodland Name	Site Designation	OS Grid Ref
1	• Coill' a' Phuill		NC670540
2	• Glen Einig CFR	CFR	NH365996
3	• Eilean Ruaridh Mor	☼ ▲ CFR	NG897733
4	• Slattadale Oakwood		NG913705
5	• Bruach Burn		NH485370
6	• Grudie Oakwood		NH290615
7	• Achanalt Oakwoods		NH258621
8	• Garve Birchwoods		NH404617
9	• Achilty Oakwood		NH395576
10	• Shantullich	☼ ▲	NH592540
11	• Achnashellach	CFR	NH033488
12	• Muldalloch	☼ ▲ CFR	NG773250
13	• Aslaig	☼ ▲ CFR	NG770180
14	• Kinloch	☼ ▲ CFR	NG730160
15	• Glen Elg		NG840230
16	• Glen Cannich	☼ ▲ NNR CFR	NH308330
17	• Glen Affric	☼ ▲ NNR CFR	NH244250
18	• Glen Ciche	☼ ▲ NNR CFR	NH121178
19	• Cougie	☼ ▲ NNR CFR	NH247209
20	• Guisachan	☼ ▲ NNR CFR	NH290237
21	• Achnaconeran		NH415183
22	• Invermoriston		NH360160
23	• Knockie		NH438142
24	• Inverfarigaig	☼ ▲ CFR	NH525234
25	• Glen Kirk		NH831338
26	• Kellas Oakwood	☼	NJ155539
27	• Coynachie		NJ485339
28	• Merdrum		NJ467294
29	• Blackmiddens		NJ429264
30	• Gight	☼	NJ821389
31	• Cambus O' May		NO485987
32	• Glenmore	☼ ▲ CFR	NH976098
33	• Inshriach	☼ ▲	NH837025
34	• Feshie		NN842990
35	• Laggan		NN568905
36	• East Loch Oich		NH315025
37	• Glengarry	CFR	NH201005
38	• Allt Mhuic		NN122918
39	• Arkaig		NN091899
40	• Glenmallie		NN150877
41	• Glen Loy	☼ CFR	NN267842
42	• Glenfinnan	☼ CFR	NM923763
43	• Doire Mor		NM910799
44	• Glen Shiel	☼ CFR	NM792697
45	• Polloch		NM796687
46	• Ariundle Oakwood	☼ ▲ CFR	NM830613
47	• Loch Sunart Oakwoods	☼ ▲ CFR	NM694644
48	• Aros Park		NM517535
49	• Salen		NM572415
50	• Scallastle		NM680390
51	• Glen Forsa		NM605417
52	• Bheinn Bhan		NN066579
53	• Duror		NN005551
54	• Glen Creran	☼ CFR	NN033489
55	• Fasnacloich	☼ CFR	NN017477
56	• Barcaldine		NM967425

No	Type of Woodland & Site/Woodland Name	Site Designation	OS Grid Ref
57	• Ard Trilleachan	☼ ▲	NN076402
58	• Barrs	☼ ▲	NM613574
59	• Bon Awe		NN032320
60	• Inverawe		NN038332
61	• Glen Nant	☼ ▲ NNR CFR	NN007284
62	• Allt Broighleachan	☼ CFR	NN228331
63	• Allt Coire Bhiocair	CFR	NN250360
64	• Catnish		NN230306
65	• Strone Hill, Inverlochry & Succoth	CFR	NN210272
66	• Talladh-a-Bheithe		NN555585
67	• Black Wood of Rannoch	☼ ▲ CFR	NN568555
68	• Weem		NN840500
69	• Sketewan		NN930505
70	• Bohally		NN785595
71	• Laggan Wood	☼ ▲	NN774230
72	• Achachenna		NN033217
73	• Collaig	CFR	NN011206
74	• Lower Fernoch	CFR	NN011191
75	• Inverinan		NM978168
76	• Dalavich Oakwood	☼ CFR	NM968133
77	• Loch Aweside Woods		NM941085
78	• Glen Shira	☼ ▲	NN143154
79	• Achnatra	☼ ▲ CFR	NN116092
80	• Douglas Water	☼ ▲	NN051058
81	• Ormaig		NM820015
82	• Oakfield		NR839906
83	• Knapdale Woods	☼ ▲ CFR	NR800900
84	• Inverneil Burn	☼	NR830818
85	• Artilligan	☼ ▲ CFR	NR855742
86	• Abhain Strathain	☼ ▲ CFR	NR860762
87	• Tarbert		NR870680
88	• Corranbuie	☼ ▲	NR854665
89	• Skipness	☼ ▲ CFR	NR893595
90	• Carradale & Deucheran		NR800415
91	• Dalbuie		NR730145
92	• Tarbet		NN328061
93	• Glenbranter	CFR	NS117969
94	• Glendaruel		NR960840
95	• Glennan, Tighnabruaich	☼	NR923707
96	• Craigoyne, Glen Finart		NS173904
97	• Ardentinn, Loch Long	CFR	NS187887
98	• The Trossachs	☼ ▲	NN405093
99	• Rowardennan Woods (North)	☼ ▲	NN342033
100	• Rowardennan Woods (South)	☼ ▲	NS370960
101	• Drumore Wood		NS487990
102	• Callendar Wood		NS896788
103	• Glenkinnon	☼	NT436348
104	• Ettrick Floodplain		NT290140
105	• Craigieburn		NT121058
106	• Mabie Oakwoods		NX931727
107	• Cally Woods		NX605555
108	• Knockman Woods		NX410690
109	• Glentool Oakwoods	☼ ▲	NX390785
110	• Cree Valley	☼ ▲	NX350785

Native Woodland Projects on the Forestry Commission Estates

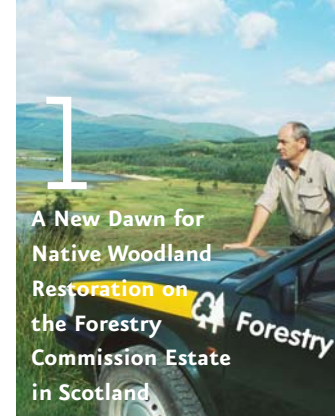
Figure 1



KEY	
22	Site/Woodland Number
●	Native Pinewood
●	Native Broadleaf
✿	SSSI
▲	EU NATURA 2000
NNR	National Nature Reserve
CFR	Caledonian Forest Reserve



*Loch Beinn a' Mheadhoin, Glen Affric.
(Laurie Campbell)*



1 Introduction

1.1. Setting the scene

Following modest pioneering work in the mid 1980s, Forest Enterprise (FE), Scotland embarked in 1991 on a substantial programme of native woodland maintenance, improvement, restoration and expansion. This took several forms, from the extensive removal of plantations of introduced conifer species from within ancient woodlands to limited planting of new native woodlands on hitherto unwooded sites. Before 1985, the Forestry Commission (FC) had made prolonged attempts to restore a few key native woods, but the general practice had been to plant as much ground as possible with



conifers. Almost all the conifer species planted had been introduced to Britain, but in some sites a limited amount of the native Scots pine was included. Fortunately, some existing native stands were retained intact, whilst in many instances planting took the form of under- and inter-planting within native woods particularly in more recent decades when the cost of 'scrub' removal became prohibitive.

The present report reviews progress and considers where the process of native woodland restoration goes from here. It is based on visits made to several sites between 10 and 14 September 2001, including discussions with FE staff on the ground, but brings in experience gained during the evolution and implementation of native woodland restoration policies. Section 2 looks back; section 3 is a commentary on the present position; section 4 looks forward. The Case Studies provide details of the sites visited. The review comes at a significant moment. The majority of the unwanted plantations have been removed, and attention is now turning to the development of both longer-term strategies and management of the woods.

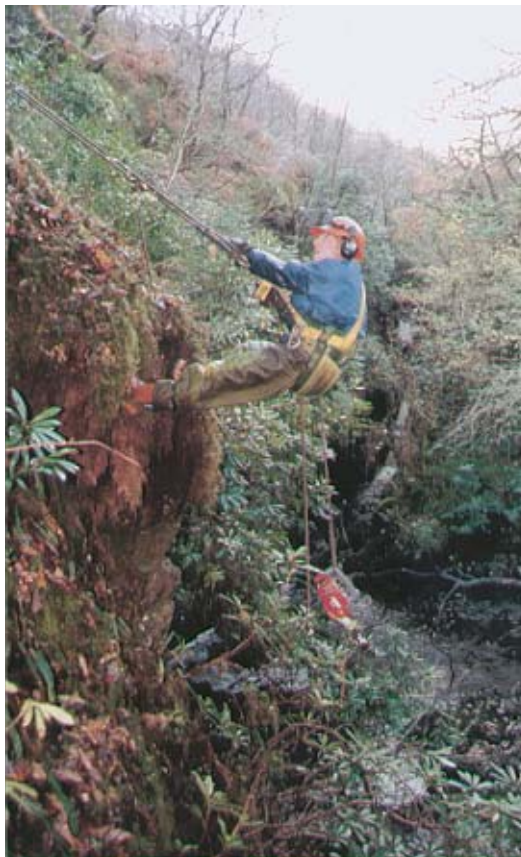


Above: Under and interplanting of Caledonian pinewoods was undertaken in scattered remnants from the 1930s up until the mid 1970s.

*Achnashellach, 1991
(Alan Stevenson)*

Left: Sitka spruce afforestation undertaken in the 1960s and 1970s with an example of a hemmed in native woodland.
*Dalbuie, Kintyre, 1992
(Alan Stevenson)*

Rhododendron ponticum is a major threat to native woodlands. Its removal is both challenging and expensive.
(Forest Life Picture Library)



1.2. Defining the scope of restoration

Restoration is a multi-faceted enterprise. [See also *Restoration of Native Woodland on Ancient Woodland Sites*, Thompson, R. N., Humphrey, J. W., Harmer, R and Ferris, R. (2003)]. The immediate, and currently the most visible aim is to remove threats to the integrity of key native woodlands, principally large, ancient woods. The main threats are:

- Non-native trees, particularly plantations of introduced conifers, established in place of native woodland, and in gaps within the native woodland. Timber harvesting or

felling of the young trees and leaving in situ (felling to recycle) in these plantations is usually a sharply-defined and conclusive operation that can be carried out compartment-by-compartment. In some instances however, mopping up of successor natural regeneration of introduced conifers is required over a number of years on the restored sites. This threat may persist if a seed source remains present in close proximity.

- Naturalised tree and shrub species. Each species has to be separately assessed, but *Rhododendron ponticum* is clearly the greatest threat. Removal may be a discrete operation that achieves the permanent exclusion of unwanted species, but more often requires the development of a removal strategy coupled with on-going vigilance to prevent re-colonisation. Cost and/or ownership limitations sometimes dictate a strategy of containment.
- Introduced stock of native tree species, principally plantations of Scots pine in native pinewoods of stock originating from other pinewoods. The success of removal depends on the scale and juxtaposition of the planting and how long it has been in situ. These factors can determine the degree of 'hybridisation' in any attendant natural regeneration present.
- Excessive grazing and browsing by deer and domestic stock. 'Excessive' has to be defined in this context, but broadly it indicates population levels that have prevented regeneration, even in suitable gaps. This threat is mitigated by controlling populations at lower levels.

Excessive grazing and browsing by red deer prevents woodland regeneration.
(Forest Life Picture Library)



- Inappropriate access and over use/disturbance. This can lead to habitat degradation and disturbance of sensitive species which requires management action in the form of interpretation and recreation planning plus provision of appropriate facilities and services on site.

Once these threats have been removed or mitigated, restoration takes on a more positive hue. Four main elements can be recognised, though it is not always easy to draw a sharp distinction between them:

- Maintaining existing semi-natural stands, particularly mature and well-stocked stands that were never converted to plantations. This will generally take the form of minimal intervention or low-impact treatments designed to allow maximum expression of natural processes.
- Managing restored semi-natural stands. This requires some consideration of the balance between natural processes and stand manipulation. Decisions may be required between minimal intervention and silvicultural manipulations.
- Expansion of semi-natural stands onto hitherto unwooded ground, i.e., both expansion beyond the borders of existing woodland, and allowing open ground within existing woodland to fill by natural regeneration.
- Re-introduction of missing elements. This could include the re-introduction of missing flora and fauna (eg beavers) within the present programme.

These components of restoration apply to the key ancient woods. In some respects, the



removal of threats is a discrete operation that can be applied on a small scale and which reaches a definite conclusion. Once the negatives have been removed, restoration becomes increasingly an open-ended enterprise that must be considered at a larger scale,

usually taking in the whole site and its surroundings. Moreover, the restoration of the key ancient woods is just part of a wider programme of native woodland management by Forest Enterprise on the FC estate, which incorporates a landscape-scale perspective. These other facets include:

- 1 Restoring a proportion of other ancient woods that had been converted to conifer plantations (PAWS), emphasising those sites which still have a significant inheritance of features and species from the preceding semi-natural woodland, i.e., the sites that are most likely to develop into rich native woods after restoration. The east Loch Lomond, Knapdale and Glengarry projects illustrate such restoration (Figure 1).
- 2 Creating new native woodland on open ground (afforestation), and converting non-native conifers originally planted on unwooded ground to native woodland. This includes (i) establishment of substantial areas of native woodland in conifer forests of plantation origin, (ii) establishment of native woodland linkages, e.g., along riparian zones in conifer plantation origin forests., and (iii) creating new native woodland outside the present forest fence, including seed stands to stimulate future expansion by natural regeneration. The Clashindarroch project includes these aspects of restoration.
- 3 Recreating, maintaining and/or restoring other semi-natural habitats associated with the forest. For example, at Glenmore this includes restoration of mires, treeline forest, montane scrub, other montane habitats, meadows, and riparian habitats.
- 4 Managing and supporting the involvement of people in native woodland programmes which will aid and sustain a woodland culture. Considerable efforts are being made across the FE estate to engage people with particularly good examples at the Affric National Nature Reserve (NNR) and Glenmore Visitor Centre.

The restoration of key native woods is thus part of a wider programme that seeks to maintain, restore and expand linked semi-natural habitats within and beyond existing plantation forests, i.e., to make a substantial contribution to developing a wider network of forest habitats which will bring together benefits to both nature and society.

European beaver has been successfully reintroduced to many parts of Europe including localities with similar habitats to those found in Scotland. (© Lionel Lafontaine, Maison de L'Riviere 29450 Sizun, Brittany, France)

2 Looking Back – The Historical Context

2.1. Forestry Commission management of native woods, 1919-1989

Contrary to some perceptions, the Forestry Commission (FC) does in fact have a long record of managing native woods in Scotland, though the approach to management has changed in emphasis over the years. The changing approach to restoring and managing native woods is best illustrated by the treatment of native (Caledonian) pinewoods, which have long enjoyed a higher profile than native broadleaves through their strong regional distinctiveness, charismatic aesthetic appeal, a degree of economic utility, their closer proximity to forestry schools and other influential academic and research institutions (e.g., Aberdeen and Edinburgh Universities), and the pioneering studies of Steven and Carlisle (1959).

2.1.1. Native pinewoods

By 1959, FC had acquired an interest in all or part of ten of the native pinewoods recognised by Steven and Carlisle (1959), the first being

Glenmore (1923), succeeded by other early acquisitions in Glen Loy (1931), Guisachan (1935) and Glen Garry (1927 and 1960s), and later major acquisitions in Black Wood of Rannoch (1947) and Glen Affric (1951). In many, perhaps most, instances, the pinewoods were taken over in a poor condition, after prolonged overgrazing (e.g. Glengarry), heavy felling, or both (e.g., Glenmore, Rannoch). Although Glenmore was designated a National Forest Park in 1948, this was primarily for recreation, and it did not fundamentally alter the prospects for native pinewood conservation..

Interest in regeneration developed with each acquisition. A step-change followed Professor H.M. Steven's address on 'Native Pinewoods and their Management' to the 1959 excursion of the Society of Foresters (Steven 1959) and the publication in the same year of *The Native Pinewoods of Scotland* (Steven and Carlisle 1959). Another marked increase in interest followed in the 1970s after surveys by the Institute of Terrestrial Ecology, the formation of the Native Pinewoods Discussion Group, and the 1975 conference at Coylumbridge (Bunce and Jeffers

Old abandoned native pinewood
trial plot.
Achnaschellach, 1991
(Alan Stevenson)



1977). Plots initiated in the Black Wood of Rannoch in 1948 by H.M.B. Brown were recorded again in the 1950s, but then forgotten until the Nature Conservancy Council revived them in the 1980s (Peterken and Stace 1985).

The FC generally took an interventionist and experimental approach to regeneration. In Glen Loy 50 acres (20 ha) were enclosed in 1933, at which time the stand contained only old and mature trees, and no seedlings could be detected (Gibson 1937). Experimental treatments started in 1935 when turf was removed from plots, the ground disturbed and ammonium phosphate applied. More intensive treatments started in 1936: flushes were drained and sown with birch, whilst knolls were drained, the heather burned and strips ploughed. By 1937 there was substantial natural

essentially to be treated as commercial plantations with introduced conifers. Later comments show that, even in the amenity working circle, the birch was to be removed as a 'weed', and the failed areas of pine might be planted with 'other conifers more likely to succeed'. Planting was with local stock, but selected from superior trees, and it was assisted



Above: Glen Affric prior to the construction of the hydroelectric dam in the 1950's. (Alan Melville)



Left: The same view today. (Malcolm Wield)

regeneration of birch and pine (some of which pre-dated the enclosure) in canopy openings on both treated and untreated ground. Soil disturbance proved beneficial, but burning and fertilizer did not. Today, the body of the wood has a fine mixed structure with no obvious signs of these early regeneration treatments. Similar experimental treatments were undertaken in parts of Glenmore and Glengarry.

Glen Affric was divided into three working circles, 'Amenity' (1900 acres, 770 ha), 'Semi-amenity' (2600 acres, 1050 ha) and 'Non-amenity' (4400 acres, 1780 ha). The first was to be treated by removing up to 20% of the pine volume every five years, creating large gaps in the birch stands, and planting Scots pine to fill the gaps. The second was to receive similar treatment, except that larch and spruce were to be included in the planting. The third was

by fertilizer applications. By 1975 natural regeneration was judged to be sufficient and planting had come to be regarded as possibly damaging to the landscape (Finlay MacRae, personal communication). In 1978 an agreement was reached with the Nature Conservancy Council (NCC) to maintain this more natural form of management. A major feature of the pioneering work undertaken during the 1960s and 70s was the reduction of the deer population in the core pinewood area. This was achieved by erecting deer fencing to create a number of large exclosures. These were rigorously patrolled by FC forest rangers and the cull stepped up to reduce deer numbers within the fences. This approach persisted during the 1980s with a marked recovery in the ground flora and continuing natural regeneration. Further exclosures were added during the 1990s

to exclude deer from areas of remnant woodland and to allow some limited planting of trees and shrubs where seed sources were absent. This work was accompanied by the removal of the now redundant fences from the original exclosures. The application of new deer management methods developed in the 1980s by Philip Ratcliffe of the FC were also taken up in both planning and operational activities. During the late 1990s and into the new century FE staff have worked ever more closely with neighbouring estates and the Deer Commission for Scotland to develop a more landscape scale and collective approach to manage deer in balance with their natural environment.

These examples illustrate several general points about the management of pinewoods before 1989:

- Management was strongly interventionist, especially in the 1960s. This was based on the belief that the pine were moribund and incapable of regeneration, so treatments included drainage, ground treatments and fertilizer applications. However, treatments evolved towards a less interventionist approach in the 1970s.
- Interventions included felling of mature pines. Large numbers appear to have been taken from some sites, such as Glenmore, Cannich, Glengarry and Glen Morriston. This was driven largely by harvesting opportunities including some (David Patterson, personal communication) which were undertaken by previous owners, who had reserved the timber.
- Planting was common. In some sites (e.g., Glen Affric) only local provenances were used. Substantial parts of many native pinewoods were planted with spruce and other non-native conifers. They were even planted in core pinewood areas where pine had failed.
- There was a rigid view that the core native woodland sites should all be pine woodland. Thus, open mires within the woodland were drained in an effort to develop woodland, and birch was cut out in an effort to assert pine. Similar attitudes and practices were apparent in Beinn Eighe NNR, managed by the Nature Conservancy (NC), over the same period.
- Experimentation was common in an effort to find suitable techniques for natural regeneration. However, the results were not

thoroughly published. Parallel efforts were being made by the NC in Beinn Eighe and Rothiemurchus.

- Early records were rarely maintained, though five of the eight 1948 plots in Rannoch survive as long-term research plots, and in Glenmore old plots from the 1930s still persist.

These treatments were motivated by the foresters' desire to get trees back on the ground and improve timber productivity and quality. They would probably be criticised by most modern conservationists as too interventionist, especially the felling of mature pine to preserve pine woodland, and the widespread planting of spruce, etc. Today, however, those parts that were not planted with spruce, etc., appear to be reasonably healthy, with a range of age classes. Moreover, the disturbance brought about by forestry operations of all kinds, together with a reduction in grazing by deer (at least initially when new fences were erected) and domestic stock, allowed pine to regenerate within plantations. By 1989 much of the Black Wood of Rannoch, Glen Loy and Glen Affric pinewoods had a natural appearance and a full range of age classes.

2.1.2. Broadleaved woodland

Progress in the management of native broadleaved woodland was far more limited. Until the Government's Broadleaves Policy review in 1985, the FC had largely ignored or removed native broadleaves, including removing birch from parts of some native pinewoods. However, in the mid 1980s a local management plan was prepared and a start was made on restoring native broadleaved stands in Dalavich oakwoods at Inverlue Forest, Argyll, where underplanted conifers were removed and a small coupe was cut in overstood coppice-origin sessile oak wood. By 1989, Kirby and May (1989) recorded considerable recovery of ground vegetation, and by 1999 good regrowth from cut coppice stools in a matrix of regenerating birch, rowan and a few seedling-origin oak was apparent in the exclosure.

Initially, conversion of native stands to conifer plantations involved respacing of the overstorey followed by planting and progressive removal of overstorey, i.e., a form of shelterwood, but this proved to be very labour-intensive and expensive. By the 1950s, places like Dalavich were still being converted by this technique, except that the overstorey was not



Far left: Late 1950s underplanting of Atlantic oakwoods with spruce. The conifers failed as a timber crop but continued to cause damage to the oakwood habitat until their removal. Dalavich, Lochaweside, 1992 (Alan Stevenson)

Left: Early clearance of conifers by 'felling to recycle' undertaken in the mid 1980s. Stems were merely severed and crosscut but not delimbed in order to maximize the area treated with a limited budget. Dalavich oakwood, Lochaweside, 1992 (Alan Stevenson)



subsequently removed, and there was also increasing recognition of the need to retain some stands for amenity. By the 1970s, conversion involved scrub clearance and planting where there were gaps, mitigated by a general reluctance to fell oak. During the early 1980s, costs and increasing sensitivities further restricted removal of native stands, and from 1985 onwards the Broadleaves Policy started to provide the basis and some resources for retention and restoration. The inherited condition of native woodland remnants depended partly on when in this sequence the stands were converted. Prior to 1985 the main mechanisms for conservation management and protection from conifer forestry were designation as a Site of Special Scientific Interest (SSSI) or purchase by NCC.

2.2. Reviews and plans in the 1990s

In 1991, FE set up a staff working group (Alan Stevenson, Charlie Taylor, Graham Tuley) to review native pinewood restoration on the FC estate and make plans for the future, and their report (January 1992) was almost wholly accepted in March 1992. A similar group then considered native broadleaved woodland on the same basis (report, November 1992). The outcome was the designation by FE of Caledonian Forest Reserves that encompassed both pinewoods and broadleaved woods - all components of the original Caledonian Forest. At the same time, a clear statement of targets and techniques was formulated, and a programme of survey and monitoring was

Above: The view south from Creag Mhor overlooking Lochaweside, Barnaline lodge and Dalavich village (top right) and the Dalavich oakwoods (top third of shot) in the late 1950s. The oakwoods have been recently under and inter planted following heavy thinning, draining with turfs cast and ploughing of the open areas. The only area retained intact, as overgrown oak coppice with no coniferisation was the area adjacent to the village (far top right of shot). The squad have now moved on to planting open hill. (Don MacCaskill, c. 1959)

Above left: The same view today with many of the conifers removed during restoration operations undertaken from 1984 onwards. (West Argyll Forest District, 2003)

Threshold sign for Glen Affric Caledonian Forest Reserve, which was designated in 1994 and is now a National Nature Reserve. Glen Affric, 1994 (Alan Stevenson)



initiated. Two publications, *A Future for Forest Enterprise Native Pinewoods* and *A Future for Forest Enterprise Highland Broadleaves* (Anon, Forestry Commission, 1992) were launched by Jimmie MacGregor and David Bellamy.

Hamilton (1995) summarised the position reached in respect of native pinewoods in 1994. The aim was 'to restore all of the remnants [of native pinewoods in FE holdings] to a sound state of health and to create the conditions which will allow them to expand, largely through natural regeneration'. The core area of native pinewoods would be extended by creation of a restoration zone from 3000 ha to 6000 ha by 2000. Protection from deer would be essential, and removal of non-native conifers would be virtually complete by 2000. By

September 1994 some 1000 ha had been cleared of non-native conifers, and a gratifyingly large amount of self-sown Scots pine had been revealed (and retained) within the plantations. Monitoring was set in place, including detailed records at Glenmore and a further recording of the Rannoch plots. Interestingly, 'it has not been thought prudent to set out firm directions for the management of [native pinewoods] beyond the year 2000', i.e., the early restoration measures deliberately concentrated on removing what was not wanted, and left long-term decisions until more was known about the state of the woods and how they responded to treatments.

The initial programme of restoration has since become more diversified, and in 1997 the area targeted for pinewood regeneration was expanded to a gross area of some 9000 ha. The original emphasis on native pinewoods has been complemented by work on native broadleaved woodland. Some 6000 ha of the latter were found in a survey of FE holdings in North Scotland. Plans have been developed not only for rehabilitating existing stands, but also for substantial expansion. Initial plans grew in scale as new information became available: at Glengarry for example, the initial 250 ha of pinewood restoration increased to 500 ha and then to over 1300 ha.

2.3. Biodiversity Action Plan targets

During the 1990s, conservation aspirations were increasingly expressed within the suit of UK Biodiversity Action Plans, and FC has participated fully in this process. The current targets for various types of native woodland, expressed in Habitat Action Plans, related to the whole of the resource and covered all ownerships. FE has broadly assessed its holdings of native woodland and their condition, prior to the development and allocation of HAP targets to localities and ownerships. FE therefore identified its own targets for maintenance and restoration. The planned FE contribution to HAPs is considered in the following sections in relation to native pinewoods and upland oakwoods. Contributions were also being made to a range of other HAPs including upland ash woodland, wet woodland and the forthcoming upland birch woodland HAP. Minor Woodland HAPs are currently managed as components of pine and oak woodlands, given that they could not be separated out from the larger areas of



Above: Lodgepole pine clearance within the upper margins of a Caledonian pinewood remnant. 'Felling to recycle' has revealed naturally regenerated native pine which have been retained. Glenmore Forest Park, 1994 (Alan Stevenson)

Right: Restoration of Caledonian pinewood by careful harvesting of mature 60 year old conifers. Glenmore Forest Park, 1994 (Alan Stevenson)



major HAPs due to the limitations of GIS and database. FE's priorities as declared in the 1990s were to:

- improve and maintain remnant woods;
- put in place the necessary measures to restore, regenerate and expand remnant woods using natural regeneration;
- expand remnant woods using planting only as a last resort and to create future seed sources in key localities.

2.3.1. Native pine woodland

National (i.e., all in Scotland) UK HAP targets for all native pine woodland in Scotland can be summarised as follows:

- 1 Maintain all the existing stands listed in the Caledonian Pinewood Inventory (16,046 ha).
- 2 Regenerate and expand a total of 35% (5616 ha) of the current wooded area by 2005.
- 3 Create the conditions by 2005 for a further 35% (5616 ha) to be naturally regenerated over the following 20 years.
- 4 Establish new native pinewoods over a total of 25,000 ha by planting or natural regeneration within the natural range of native pine woodland.

By 1997, the Forestry Commission's Caledonian Pinewood Inventory had recorded a total of 16,046 ha of pine woodland, of which 3,927 ha (24%) was on the FC estate. However, defining and measuring pine woodland is notoriously difficult, the boundaries being irregular and diffuse. Taking a broad view of what counted, and including open space habitats and native woodland of other types that were intimately associated with pine woodland, together with associated areas being cleared of non-native plantations, FE estimated there was a gross area of approximately 9,860 ha of native pinewood in various conditions on its holdings (see Figure 2).

FE committed itself in 1997 to removing non-native plantations and most Scots pine of non-local stock. By 2005 it planned to regenerate and expand at least 1000 ha, to have prepared a further 600 ha for regeneration, and to have established 100 ha of new pinewoods. By 2005 some 9400 ha of maintained, restored or new pine woodland was to be managed by FE. It is difficult to reconcile FE's data with the UKHAP target given that different definitions have been used to enumerate the pinewoods. To date FE has not been assigned targets which related to the UKHAP.

Fig 2: Pinewood condition	Area (ha)
1 Regenerating pine woodland	3720
2 Pine woodland awaiting regeneration, i.e. with little or no current regeneration	2430
3 Pine woodland regeneration area, now restocked, i.e., with very few or no mature pine trees	490
4 Genuinely native pine woodland affected by introduced conifers	100
5 Stands with some pines, still stocked with non-native conifer plantations	2490
6 Open space habitats associated with pine stands that may regenerate with some pines	630

Fig 3: Oakwood origin and condition	Area (ha)
1 Ancient and long-established semi-natural oak woodland	2130
2 Semi-natural oak woodland of more recent origin	1050
3 Oak plantations on ancient and long-established woodland sites	380
4 Oak plantations in woodland of more recent origin	150
5 Degraded oak woodland of all periods of origin, with substantial stock of rhododendron or planted conifers	2450
6 Potential upland oak woodland, i.e., ancient and long-established woodland sites where conifer plantations and/or rhododendron now predominate	2430

2.3.2. Upland oak woodland

National HAP targets can be summarised as follows:

- 1 Maintain the estimated 70,000–100,000 ha of existing upland oak woodland, and restore, principally by reduction in grazing.
- 2 Expand the area by 7,000–10,000 ha on open ground, whilst avoiding other habitats of high conservation value.
- 3 Restore 7,000–10,000 ha of degraded oak woodland by removing planted conifers and invading *Rhododendron ponticum*.

In 1997, the total area of existing and potential upland oak woodland on the FC estate in Scotland was approximately 8600 ha, of which 3700 ha was dominated by oak (see Figure 3).

Over a period of at least 15 years FE committed itself to maintaining and restoring existing and degraded oak woodland, and converting potential oak woodland to actual oak woodland. Once completed, FE in Scotland was to have made a modest contribution to national target (1) and a substantial contribution to target (3). There was also to be small amounts of new oak woodland on open ground (target 2), but this was not to be the main focus. However, as was the case with pinewoods it is difficult to reconcile the datasets and align targets. To date FE have not been assigned targets which relate to the UKHAP.

2.4. The social aspects of native woodland management

At the beginning of the 1990s FE provided a number of recreational facilities and opportunities associated places with native woods. Most of these were located at established tourist destinations such as Glenmore and Glen Affric. In addition a number of lower key facilities had been provided for local recreation stemming from a large investment programme during the 1970s. All of these facilities had suffered from lack of investment, ad hoc piecemeal development and little by way of interpretation of the native woodlands. In a few places there were also issues of footpath erosion, inappropriate 'wild' camping and camp fires, potential disturbance to wildlife – many of which were identified in the FE native woods reviews. On a more positive note some examples of good practice together with many opportunities for improved links between the visiting public and native woods were unearthed. However, FE realised that it had to rise to the challenge and started to find ways of making the necessary improvements.

The 1980s were a period when the environmental movement found much to criticise in the way that forestry was being practised. This applied to a number of issues including the low priority which native woodland management was accorded coupled with a view to arrest, decline and damage and move forward to restore and expand the

resource. This conflict with environmental stakeholders had started to diminish by the time that FE launched its native woodland initiatives. There were however still tensions and suspicion as to FE's motives, intentions and commitment to native woodlands. Undoubtedly dialogue and sharing of information and ideas between NGOs such as WWF, RSPB, SWT and FE and also NCC (latterly SNH) helped to shape common understanding, new ways of working and real progress on the ground. The advent of the FC's Native Woodland Advisory Panel in which FE participated, was an important vehicle in this process of change.

FE's engagement with community interests in the early 1990s was fairly poorly developed. Consultation was largely confined to key stakeholders supplemented by the issue of information via the media. The development of a FE community involvement strategy and the acquisition of the necessary skills by FE staff (and other stakeholders) emerged at the end of the decade. There were however some emerging ambitions and ideas which initiated the process both in local communities and within FE. These remain to be fully developed.

Discussion of native woodland management with other agencies and stakeholders helped to shape Forestry Commission plans. Glen Affric, 1995 (Alan Stevenson)



3 Looking Today – A Review and Commentary

3.1. The position in 2003

The accelerated programme of restoration has been in progress for a decade, and it is more than five years since the FE's restoration projects were set within the context of national HAPs. This report can therefore record a good deal of progress. It comes at a time when the threats to many of the (large) ancient woods have been removed, but before most of the new native woodland has had time to develop beyond the recruitment and sapling stages. Much of the detail is contained within the individual sites (see Case Studies).

The following sections consider a range of general issues. Is FE keeping to schedule in meeting its contribution to HAP targets? How 'good' will the restored native woodland be in nature conservation terms? Given that restoration is necessarily a long-term enterprise, to what extent has FE been able to learn from experience gained in early restoration measures, and will currently accumulating experience be available to the successors of present managers? To what extent have people and other organisations been involved, and can this inclusiveness be increased? Have any weaknesses emerged, and can these be improved?

3.2. Progress towards HAP targets

Neil Mackenzie and Rick Worrell have recently completed a review of progress across Britain by sampling a representative set of woods managed by FE or within a Woodland Grant Scheme (Mackenzie & Worrell, 2003). As far as Scotland is concerned, they concluded that acceptable progress has been made on maintaining/improving, expanding and restoring upland oak woodland, native pine woodland and upland birch woodland, but that progress for all three targets in upland ash woodland and wet woodland has been deficient. They noted that the restoration targets in Scotland were being achieved largely through the work of FE but that FE had not contributed to expansion targets. This result concurs with FE's stated intentions.

3.3. How natural is the restored woodland?

One aim is to restore the natural elements in the forest, i.e., not only the native species, but also natural processes, patterns and structures. Clearly, the impact of several decades of plantation forestry will be apparent for years to come, and it would be easy to assume that the



Natural regeneration of spruce and birch with a few native pine. Glengarry, 2001 (George Peterken)

Wetwoods and bogwoods are an important component of the Forestry Commission's estate. Their restitution in locations such as Strathspey (right) as part of an EU LIFE Nature project has involved removal of conifers and drain blockage (below).



restored woods will not be as natural as semi-natural woods that have not passed through a plantation phase. Nevertheless, the woods will be classified as semi-natural as soon as the plantations have been removed, and natural processes and states will increasingly assert themselves.

3.3.1. Persistent artificial elements

Several artificial features will inevitably persist for many decades, or forever:

- Drainage modifications will remain visible. Forest roads, with their marginal ditches, will remain. Some drains within mires have been abandoned and, in the case of some selected sites, deliberately blocked to aid wetland recovery, but this has not been considered to be a priority.
- Planting on a limited scale will be necessary, even though the planted species will be site-native. Most of the planting undertaken so

far has been of oak or pine in woods where the strong flush of birch, combined with the failure of oak and pine to regenerate within the narrow window of opportunity, threatens to exclude these traditionally dominant site-native species from large areas for a generation.

- Introduced tree species will still be present, albeit as a result of natural regeneration, though most will probably be removed in early cleaning operations.
- Genetic changes to native tree populations as a result of planting non-local stock may persist. Pine and oak have been widely planted, and many western oakwoods are obvious monocultures, some grown from very distant sources. Nevertheless, FC managers have removed non-local stock from some pinewoods and have sourced stock for planting site-native tree species from local



Above: Supplementary planting of oak on mounds amongst natural regeneration of native broadleaves. Rowardennan, Loch Lomondside, 2001 (George Peterken)

Thinning and group felling treatments undertaken in Dalavich oakwood in the early 1990s. Dalavich oakwood, Lochaweside, 1995 (Alan Stevenson)



stock wherever possible. The present policy of using natural regeneration ensures a degree of localness: even where some of the seed parents came from distant stock, locally-suited genotypes will be favoured (c.f., land races of introduced species). The planting of locally collected stock has a similar, though weaker legitimacy.

- The structure of all inherited mature semi-natural stands has been influenced by past management, sens.lat., and managers are inevitably limited by this. Whilst stand structures on 'difficult' ground, such as outcrops and incised streambanks, are reasonably natural, even-aged oak monocultures, for example, are clearly artificial. In a pre-emptive attempt to

- Widespread even-aged, younger stands, the product of a flush of natural regeneration after removing plantations, will prevail. This even-aged element is likely to be attenuated in the long-term. Nevertheless, a strong even-aged element is likely to have been a natural feature of pine and birch woods (see below).
- Fires will continue to be controlled. The structure, and to some extent the composition, of natural pine woods were probably controlled by fires, some of which would have been extensive, but limitations imposed by the small size of most native woods, public safety and continued regard for neighbouring crops must over-ride this natural process.

Below left: Natural regeneration not reflecting adjacent native woodland stands. Conifers were felled in 1995 and the oak overstorey was thinned. Birch regeneration though patchy is 5m high with a few small oak saplings and strong regrowth from oak and alder stumps.
Blair wood, Loch lomondside, 2001 (George Peterken)

Below: Felled to recycle conifers beneath a restored oak stand with birch regeneration present in the open glade.
Dalavich oakwood, Lochaweside, 2001 (George Peterken)



remove harsh boundaries and facilitate natural structural development, some limited modification of pine and broadleaf plantation structures by group felling and thinning 'unevenly' has been undertaken (e.g., at Dalavich and Glen Affric).

- Imbalances in fauna will continue. In particular, natural populations of large carnivores are unlikely to be tolerated or sustainable.
- Many woods will continue to be restricted to a limited altitudinal range. Most were so



Fire can be considered as a natural process, a management tool or a threat to native woodland restoration.
(Morris McDonald, 2003)

A young aspen planted by Trees for Life after six growing seasons, Glen Affric.
(Alan Watson)



limited well before the phase of plantation forestry. Scope for completing a full topographical range is restricted due to the FC estate boundaries. Opportunities for developing a full altitudinal range may eventually present themselves.

- Most sites will continue to be influenced by more intensively managed surroundings. Most will be large enough to be free of the effects of ecological isolation, but some buffering may be needed around the margins.

3.3.2. Renewed natural elements

The programme of restoration will renew and enlarge natural elements of several kinds:

- Blocked drains will restrict the rate of outflow from forest mires to more natural rates. This should allow watertables to be restored to more natural levels and allow some restoration of mire vegetation.
- Natural regeneration from local seed sources will be the main mechanism of restocking, in accordance with FE's strategy of favouring natural regeneration in all its semi-natural stands.
- Natural regeneration is producing a substantial change in composition, usually with far more birch and sallow and far less oak or pine than is currently present or was present in the recent past. This is a typical natural response to a substantial disturbance (which is how one can characterise the presence and removal of a generation of conifer plantations). In some sites, the resulting composition is arguably more natural than the former pine- or oak dominance, which was due to planting, the deliberate historic culling of 'weed' species such as alder, and the loss of short-lived species such as birch during prolonged periods of over-grazing.
- Some lost site-native species may be reintroduced. The problem is to know which species have been lost, and to assess the chances that such species will return naturally. Reintroduction of aspen and other broadleaves to pine woodland may be the most justified measure, but thus far this has only been considered at Glen Affric.
- Persistent spruce, beech, sycamore and any other introduced species should develop local land races in the long-term. Whilst this



Above: Montane scrub regenerating at the treeline in the northern Cairngorms Glenmore Forest Park, 2000
(Michael Scott/SNH)

Right: Caledonian pinewoods and Atlantic oakwoods in a Natura 2000 site adjacent to Loch Etive were part of a large scale restoration project supported by the EU LIFE Nature programme. Loch Etive, 1997 (Alan Stevenson)



is hardly restoration of a past-natural element, it would arguably be future-natural (Peterken 1996).

- Many of the restored woods will develop a two-storied structure, with individual old trees and clumps in a matrix of younger growth. This will have been developed from a particular history of management, but it is also the structure that forms in natural pinewoods subjected to large fires, and natural broadleaved stands subjected to extensive blowdowns.
- Natural processes will be increasingly tolerated. Thus far FE has decided as a matter of policy not to recover windthrown timber subject to safety consideration, and will allow endemic disease to take its course. This has included abandoning the treatment with urea (to combat fungal attack) of the stumps of conifers removed in restoration operations. At this stage of the restoration process FE continues to take precautions to avoid forest fires and also quickly extinguish any that do start. Equally no prescribed controlled burning of ground vegetation has been undertaken to encourage regeneration. No changes to these policies are foreseen at present. However catastrophic damage would need to be reviewed on a case by case basis. Significant parts of FE-managed native woods are being earmarked as natural reserves where minimum intervention management will be practised.
- More natural populations of large herbivores, will be maintained. Vera (2000) has recently suggested that pasturage is a natural component of woodland, and that some natural woodland would have taken the form of open wood-pasture. The implications will take some time to determine, but it seems reasonable to assume that a proportion of open ground and parkland would be present within natural mixed deciduous woodland as well as in birch and pine woodland. FE proposals to incorporate some pasturage on a pilot basis by allowing cattle into selected woods will result in diverse stands within the natural range, and will also recreate a traditional condition.
- Restoration of full altitudinal range of native woodland types in some sites. Natural woodland ranges from treelines to riparian habitats, i.e, it would cover the full topographical and edaphic range. Proposals

for some sites will result in a more complete range than hitherto (e.g., Glenmore, Kinloch, Affric), but not in others (e.g. Glengarry).

- The large-scale structure of natural woodlands depends on the pattern of natural disturbances and the response of the various tree species. In Boreal forests the natural pattern is thought to include large even-aged patches. The restored stands will take this form, though the patches will be more rectilinear than they would be naturally. In oak and most other broadleaved woodland, the natural patchwork is likely to be smaller in scale, and to that end FC has started some limited localised small-scale fellings in mature stands.



Grazing by cattle in selected native woodlands can make a valuable contribution to habitat restoration and maintenance. (Lorne Gill, SNH)

- Restored woods will be increasingly linked to semi-natural forest environments in large-scale habitat networks (see *Habitat Networks for Wildlife and people*, Forestry Commission, SNH 2003). In so far as such networks can be restored, all forests will increasingly function as parts of one large forest, i.e., the original-natural condition.

3.3.3. Timing

If the restoration process can be sustained, the woods will become increasingly natural. Physical changes to sites will persist, but these are part of the history of the woods and would be regarded as archaeological features. The woods will probably never be entirely natural, if only because outside influences can never be wholly excluded, and a natural fauna cannot in practice be restored. The impact of the phase of plantation forestry on the pattern, structure, composition and genetic make-up of the woods will persist through the next generation of trees, but it will be progressively attenuated. Within a few decades, the forests will be perceived by most visitors as essentially natural.

3.4. Longer term experience

Conservation of native woodland is a long-term enterprise. Necessary initial restorative measures may be completed in a few years, but the development of the desired structures and patterns, and the responses of wildlife species may take centuries. Experience of management and understanding of its consequences must be built up over decades.

Three pinewoods have been the subject of experimental restoration by FC over more than 50 years, during which national forestry policies have at times presented a substantial disincentive to sustained restoration. Glen Loy, Glen Affric and the Black Wood were treated as woodland nature reserves before the establishment of the Nature Conservancy. From 1950 until the 1980s, the Forestry Commission did not have responsibility for nature conservation, but nevertheless maintained these reserves.

The benefits of long-term involvement have been mixed. The early reserves have remained as mature native pinewoods, with a varied structure and a sustainable age-class distribution. Sufficient knowledge remains of the history of treatment to draw general conclusions about their long-term responses. On the other hand, detailed records of treatments have not been made and kept, and direct monitoring of stand development and species responses has been limited. This mixture of achievement and lost opportunity was characteristic of the era: the same verdict could

be reached for woods that have long been National Nature Reserves and managed directly by the nature agencies.

A long-term record has been sustained in five permanent plots in the Black Wood of Rannoch (since 1948). Some early records also survive from Glenmore, though in this research site the management did not have nature conservation objectives until recently. The Rannoch plots were supplemented by comprehensive baseline plots in the 1970s and 1980s, and permanent plots were initiated in Dalavich in 1989, and these now have the potential to reveal long-term trends. These records have been maintained with the help of NCC, SNH and Institute of Terrestrial Ecology Centre for Ecology and Hydrology (ITE/CEH). Following a general review of monitoring in Caledonian Forest Reserves in 1992, monitoring plans have been set in place for each restoration project, the bulk of which involve fixed-point photography with some permanent transects in flagship sites. The baseline record made at Glenmore, for example, is more comprehensive and will provide a firm foundation for tracking change.

3.5. Involving People

3.5.1 Recreation in native woods

Since 1993 a considerable investment has been made by FE and its partners in the provision of new and refurbished facilities and also services for local people, day visitors and tourists within and adjacent to native woodlands on the FC



estate. This has included major capital projects such as the redevelopment of the Glenmore Visitor Centre to act as a gateway to not only the native pinewoods in Glenmore Forest Park but as a facility which services the needs of visitors to the whole of the Glenmore basin and the Cairngorms. The project which was realised through a wide partnership has delivered a new interpretative display, forest shop and café, extended car park, the introduction of a new



ranger service as well as outreach facilities – car parks, trails, on site interpretation and an events programme. The result has been growth in the number of visitors using the facility from around 25,000 to in excess of 100,000 per annum. Major improvements have also been made at other key pinewood sites such as Glen Affric where a visitor management and interpretation plan was developed and implemented to reduce negative impacts and improve the visitors' experience and appreciation of the locality and its native woods. A key aspect of this programme of work (and others) was to measure the number of visitors to the glen and also capture information on their needs, ideas and views on what was provided. These surveys revealed that far more people visited than was previously thought (70,000 per annum) including a very high proportion from overseas (40%). Such information has not only contributed to FE's thinking but has proved valuable in the evaluation of Glen Affric's contribution to the emerging forest nature based tourism industry. Similar but lower key recreation provision has



Crosscountry skiing through Ryvaon pass, Glenmore Forest Park.
(Forest Life Picture Library)

been made at other native pinewoods including Glengarry, Glen Loy, Arkaig and the Blackwood of Rannoch.

Improvements have not just been confined to pinewoods: the Atlantic oakwoods have also benefitted from improved access and interpretation. Early work at Dalavich oakwood and Glen Nant in Argyll was followed up at Loch Sunart, Kinloch on Skye, Knapdale, Cowal and on the eastern shore of Loch Lomond. Most of these places are relatively remote with fragile communities where tourism provides a key source of income particularly when traditional economic activities are in decline. FE's provision of facilities and services in interesting and attractive locations such as native woodlands has become increasingly recognised as a valuable contribution.

Affric Interpretation panel.
(Forest Life Picture Library)

3.5.2 Community involvement

FE launched its strategy for involving communities in 1999. By that time there was already an established demand from a number of local communities for both a greater say in the management of forests and also a realisation locally of some of the economic benefits which forests can provide. This, coupled with a growing awareness of environmental issues, has put native woodland projects to the fore in the eyes of local communities. There is a growing list of localities where this has and continues to happen – Sunart, Strathglass, Laggan, Glenmore, Minard, Glengarry, Cree Valley, Ettrick, Crianlarach, Tyndrum and Huntly.

Community Involvement publications.



The EU LIFE Nature programme has contributed via five significant projects to the restoration and management of native woodland habitats and species within Natura sites on the Forestry Commission estate. Cannich Hall, 1994 (Alan Stevenson)



3.6. Partnerships and funding

The advent and development of partnership working has been both a revelation and a big challenge for FE and its staff. On one hand partnerships have provided FE with access to new funding streams and helped to develop new ideas and foster improved understanding and relationships with stakeholders. On the other hand it has been a steep learning curve for all concerned – it has challenged the traditional FC culture and way of doing things, it has introduced a whole new vocabulary, new presentational requirements and developed wider networks both locally and nationally. Overall however the balance has been positive and the growth in number and value of partnership projects year on year clearly

contributions have been supported either with cash or in kind by a wide range of organisations in the public and NGO sectors and also by local people and volunteer groups such as Trees for Life and British Trust for Conservation Volunteers (BTCV).

3.7. Scope for improvement

FE is seeking to establish diverse and relatively natural woodland on a long-term basis, and in collaboration with others, including neighbours who can help to implement large-scale networks of forest habitats. Judged on that basis, this review of a decade of greatly enhanced activity has revealed a few apparent weaknesses:

- 1 Rapid removal of plantations followed by copious regeneration is generating extensive even-aged stands, and there is a danger that one form of uniformity will be replaced by another. Even-agedness is well within the traditions of native woodland management in the Highlands, and would also develop in natural woodland, but even-agedness on the scale of whole restoration projects could limit diversity and generate long-term management problems. Admittedly, even-

Right: A Trees for Life volunteer plants a pine seedling at Athnamulloch in 1992 within a deer-fenced enclosure. (Alan Watson)



Far right: the same location 10 years later. The pine is growing, some broadleaves have seeded in and the ground vegetation has recovered due to the reduced grazing pressure. (Alan Watson)



demonstrates this. There is no doubt that FE's native woodland improvements programmes have not only been met but in many instances surpassed. This is largely due to partnership working and the additional investment and expertise which this has brought. The EU LIFE Nature programme has been a key catalyst in this process with FE being the single largest player in five projects – Caledonian Pinewood Restoration, Atlantic Oakwoods, Wet Woods, Core Forest Sites and Capercaillie – all of which were managed by the Caledonian Partnership. EU structural funds have also played a significant role in native woodland restoration and the provision of recreational facilities. The Millennium Forest for Scotland also made a substantial contribution using Lottery funds at seven locations involving FE. These major

agedness will not be absolute, due to both retention of older trees and patches of slow regeneration, and it could be mitigated naturally by storms, fire or other disturbances. Nevertheless, there is a case for either spreading the restoration fellings over a longer period, or intervening in the new native stands at an early stage or seeking opportunities in the future to add new age classes through expansion. Delaying restoration can run the risk of leaving unwelcome seed sources and adding to future costs. Intervening in young stands also has cost and is limited in some instances by conservation considerations. Overall, FE needs to be alert to this issue and take opportunities to develop improved stand and forest structures.

- 2 There has been only limited consideration of long-term management plans. This was a deliberate tactic while the priority was to remove unwanted plantations and other immediate threats (Hamilton 1995), and before the success of natural regeneration could be estimated, but the time has now come to concentrate on the long-term aims. A longer term 'vision' at Affric and a few other places already exists. More recently, Forest Districts have developed 'strategic' plans which contain guidance on, inter alia, native woodland restoration and management, and habitat networks. FE needs to develop (and publish) in conjunction with stakeholders a corporate vision for its management of native woodlands in Scotland.
- 3 Only limited attempts have been made by FE to develop native timber utilisation. Again, this is a by-product of the initial concentration on removing unwanted plantations, combined with the small-scale nature of the wood supply and non-existent timber markets. Some oaks were felled at Dalavich, the green woodworkers are active in Knapdale, and guidance on growing native pine timber has been published (Worrell and Ross 2001), so the subject has not been ignored. Nevertheless, in developing long-term plans, FE needs to consider more actively the place of native timber utilisation and pursue opportunities where there is the scope to intervene in native stands.
- 4 Collaboration with Scottish Natural Heritage, and other neighbours who are also restoring native woods, has been limited. This point comes through most strongly at Loch Lomond and Knapdale, where SNH has nearby reserves, but it also applies to some extent in the pinewoods. The FE is now taking a landscape-scale view of native woodland restoration in both large native woods and the native elements in conifer plantation forests, and is adopting a network-type approach, so there is a clear case for relating all restoration to the larger context. This wider view is developing at Glenmore, Affric and Glen Nant. The FC has a role in developing forestry frameworks and habitat networks, which could help both private owners and others to work more closely together at a landscape or catchment scale. FE needs to work more closely in conjunction with FC, other public organisations and NGOs to encourage neighbours to engage in a partnership approach to catchment/landscape scale native woodland management, restoration and expansion.
- 5 Good quality data on FC's native woodlands is urgently required to:
 - inform strategic decision making and determine priorities for resource allocation;
 - assist local managers planning and operational activities at both landscape and site levels;



Small scale local processing provides a small but useful contribution to the local economy and also helps to stimulate management of native woods. (Forest Life Picture Library)



Looking north across the core of the Atlantic oakwoods pSAC at Knapdale. Restoration here has been at a landscape scale with linkages to SNH managed NNRs and Natura 2000 sites to both the north and the south.
(Patricia and Angus Macdonald)

- allow progress to be measured, evaluated and reported against BAP and other policy indicators and targets.

Traditionally, FC data requirements centred around the need to manage the forest growing stock for timber production, to fulfil various estate management and legal requirements and to identify management opportunities and constraints eg protected sites. The FC sub-compartment database was modified and 'grown' to accommodate some environmental data but the balance has been held on local records such as conservation plans. Native woodland data has tended to suffer from a lack of consistency and the absence of robust management methodologies or systems. This has applied as much to other environmental organisations, agencies and NGOs as it has to FC. Lack of an agreed approach has frustrated sharing information and consolidation of data sets.

In the past 5 years a specialist GIS known as 'Forester' has been developed by FE, which is already starting to revolutionise the way forest management works in the more 'traditional' aspects of forestry eg production planning, forest design. The second phase of

'Forester's' development which is currently underway involves building new systems to handle environmental data including habitat and species information, spatial distribution, condition and status etc. It will also accommodate management information on work programmes which are planned or completed. Progress with development has been frustrated by lack of agreed inventory protocols and definitions of habitat attributions such as condition. A pilot study has been commissioned which is intended to help develop a robust approach which can then be made available to Forest Districts. It is also planned to involve SNH in this work so that a more 'integrated approach' can be arrived at across different habitats and sources of data. Speed of progress and quality of data and systems will be determined by the availability of resources which are currently scarce.

4 Looking Forward – Some Pointers to a New Future

4.1. Components of restoration

Most of the sites examined for this review were key ancient woods that had been extensively planted with non-native conifers, but which had retained a substantial fraction of mature, native elements. Many had retained conservation designations despite the planting, some had attained designation with the plantations in place, and others had attained designation after restoration work by FE. The restoration of these key native woods is part of a wider programme that seeks to maintain, restore and expand linked semi-natural habitats within and beyond existing plantation forests, i.e., to make a substantial contribution to developing a wider network of habitats. It includes the restoration of other ancient woods within a strategy and priorities developed for each Forest District.

4.2. Phases and timing

The process of restoration, as defined in section 1.2, falls conveniently into two phases:

- **Phase 1**

Removal of threats, comprising unwanted conifer plantations, inappropriate non-local genotypes of native trees, unwelcome naturalised species, and excessive numbers of large herbivores.

- **Phase 2**

Long-term regeneration and management of the resulting semi-natural woodland and other habitats.

The great majority of the effort so far can be referred to phase 1. In many sites, this phase is almost complete, and attention is turning to phase 2. On a Forest District scale, however, phase 1 is planned to continue well into the 21st century, i.e., Districts will be managing phases 1 and 2 in parallel for 50 years or so. Restoration has so far concentrated on the most important sites, so increasingly phase 2 will be running in key native woods, while phase 1 will continue elsewhere. Experience in key sites will thus tend

to be applied later in less important sites and remaining key sites, and this reinforces the need to monitor progress in the key sites.

At the scale of Forest Districts, this phasing of restoration will generate a wide range of age classes in restored native woodland, but at the scale of individual sites it could easily generate almost even-aged native woods. From the perspective of timber utilisation (albeit relatively small scale) from native woodland as a whole, there would thus be some prospect of sustained supply, but from the perspective of habitats in individual sites there is a prospect of feast and famine as the predominant even-aged cohort works its way through the system.

Admittedly, the timber aspect may not matter much, given the environmental objectives and the likely uneven nature of regeneration. However, local supply irregularities may be more significant, given the low value of the timber products, likely small supply catchments, and the probability that processing/utilization will be locally based. On the ecological side there may be scope to increase diversity on a truly landscape scale by involving more adjacent private ownerships. This is already happening in a small way e.g., at Affric with the National Trust for Scotland, and at the adjacent Glenmore/Rothiemurchus/Abernethy Forests, and there will be scope for further collaboration in due course.

The two phases can be used to describe the condition of whole sites. Whilst initial work is in progress, and especially if it is extended over many years, sites will for a time be a mosaic of restored and unrestored stands. Eventually, a point is reached when native woodland and other semi-natural habitats come to occupy the majority of the ground and thereby become the matrix surrounding the remaining conifer plantations. This is the important threshold at which the wood as a whole passes from phase 1 to phase 2. Once passed, the remaining conifer plantations could be removed at a pace and pattern designed to contribute best to the long-term management plan.

4.3. Developing long-term objectives

Strategies for phase 2 are already being considered, and all sites possess a management plan. As plans are developed and revised, the principal issue will be the degree to which foresters will intervene with stand development, and the pattern of any interventions. Two options exist, between which there is a range of intermediates.

One option would be to adopt *minimal intervention* management with the aim of allowing natural structures and patterns to develop. This would be truly long-term, since the effects of past management would still be detectable in the age-class distribution for 500 years or so. However, the goal would be reached according to most criteria long before this: stands would be recognised as mature within a few decades, natural levels of dead wood would build up within a century or so, and stands which inherit old trees will have a very wide range of age classes from the outset.

The case for this objective would be based on the special character of near-natural woods, their small area relative to Highland forests as a whole, on opportunities to safeguard (or re-introduce) species that have been adversely affected by past exploitation and management, and the value of 'wilderness' areas. Stands with large trees and substantial volumes of dead wood tend to have the richest overall assemblages of native wildlife species (see *Life in the Deadwood*, Forestry Commission 2001). It is also likely that those woods remote from 'civilisation' (ie infrastructure – roads etc) will be managed less intensively due to economic as well as wilderness considerations. The converse will most likely also apply.

The alternative would be silvicultural interventions in restored woods with the aim of growing and harvesting timber from native tree species. The case for this may be summarised as follows:

- **Aggressive naturalised trees and shrubs may continue to colonise from outside the site. Control would be necessary, which would inevitably introduce a degree of intervention.**
- **Managed woods would be structurally more diverse than minimum-intervention woods, especially during the next century or so when strongly even-aged stands will prevail in many sites. This greater diversity would take the form of both greater**

variety of stand structures and greater amounts of open space habitats and natural colonisation should leave a 'natural' proportion of open space within the wooded matrix. In the long-term, minimum intervention woods would be expected to develop substantial structural diversity.

- **Use of at least some of the timber would enlarge the range of benefits to society without impairing the ecosystem. This would be important if there are resource limitations (expensive or limited imports) or sentiment turns against the wilderness aspects of conservation. A greater range of benefits may confer greater security for long-term objectives and enable management plans themselves to be sustained through periods when conservation, heritage and landscape attract less political support.**
- **A degree of utilisation would be consistent with the long-term traditions of these woods.**
- **There is considerable uncertainty about the character of natural woodland, and about whether the woodland generated by minimum intervention in the absence of natural populations of large herbivores and carnivores is in fact natural. Furthermore, minimum intervention stands would not be allowed to be subject to some kinds of natural disturbance, notably fire in pinewoods.**

In practice, many of the restored Highland woods are large enough to accommodate both minimum intervention and utilisation: a stark choice does not have to be made. Sites could be zoned as a coarse-grained mosaic of minimum intervention and utilisation. In fact, a combination of minimum intervention with utilisation would generally be the optimum solution. The balance would vary from site to site, thereby generating a spectrum from mainly minimum-intervention woods to woods in which most timber would eventually be utilised. It might also vary with time: there would be a case for utilisation in the medium term to introduce more structural variety to otherwise strongly even-aged woods, leaving later generations to decide whether to go further down the minimum intervention route from a diverse starting point. This mixture of treatments is the approach proposed for the Sunart oakwood SAC (Peterken and Worrell 2001),



Fallen logs provide a rich bryophyte habitat occasionally colonised by vascular plants such as wood sorrel *Oxalis acetosella*. (Forest Life Picture Library)



*The Sunart pSAC is one of the largest and most diverse restoration projects in Scotland. The FC played a key role in the initiation of the project by working in partnership with local people, SNH, landowners, NGOs with financial support provided from EU Life Nature and the Millenium Forest for Scotland Trust.
(Patricia and Angus Macdonald, 2003)*

a locality where FE continues to undertake substantial native woodland restoration as part of a wider initiative. The degree of management within intervention zones will undoubtedly fluctuate in accordance with the prevailing economics of the day, i.e., it would be essentially opportunistic, much as it was in the past. This will in turn be determined by the (probably local) demand for timber products being developed and sustained.

The sites that would most appropriately be assigned to minimum intervention would usually be existing mature stands, especially

those that escaped most of the conifer planting. Good examples would be the old-growth pine blocks in Glen Loy and Ryvoan (Glenmore). The aim would generally be large, compact blocks, covering at least 50-100 hectares, buffered by stands treated on long rotations. Once designated as minimum intervention there should be a strong management presumption that they remain so.

4.4. Introducing diversity by silvicultural operations

Accepting that some parts of some restored sites should be diversified by management, three general approaches are available:

- Tapering the completion of phase 1 with the objective of establishing a range of age classes in the successor native stands.
- Silvicultural interventions in the semi-natural stands (section 4.5).
- Further expansion of the area of native woods.

The case for removing unwanted conifer plantations as soon as possible is that the current opportunity for restoration is seized, seeding of non-natives into successor semi-natural stands is minimised, any old trees in the conifer stands will be freed from competition immediately, and generally that any ambiguities about FE's intentions will be minimised. The case for the slow removal of the remaining conifer plantations over a span of, say, 20 years, is that it would introduce some diversity into the age structure of restored woods at the sub-compartment scale, and, depending on the age of the retained stands and marketing conditions, it could realise greater value from the removed crop. Old trees suffering from competition could be relieved by immediate group fellings, though there seems to be little justification for heavy thinning before felling, since most native trees are light demanding, and little advance regeneration would develop. In practice, it is likely that short-term local practicalities will determine the best solution in each site.

4.5 Management in semi-natural stands

A range of silvicultural techniques could be used in semi-natural stands, with the aim of diversifying stand structure. (The booklet *Growing Scots Pine for Quality Timber*, Cairngorm Partnership, 2001) demonstrates the approach in native pinewoods).

- Some kind of irregular shelterwood system of regeneration may be most appropriate for both pine and oakwoods. Silvicultural interventions would generate temporary open space habitats, but they need not eliminate mature features. Some retained trees might grow through a second rotation.

- Coppice management of some oak, hazel, alder and ash within mixed stands might be worthwhile in habitat terms, but old stands of these species may be best reserved to minimum intervention for their epiphytes. Coppicing may not be practical in a 'compartment' scale, but coppiced strips could be maintained on roadsides.
- Some variation of rotation length would be desirable, with long rotation stands clustered around any minimum intervention reserves.
- A key objective, even in managed stands, should be to promote large trees and deadwood, which would help to link the habitats in nearby minimum intervention stands.
- In order to establish the intervention principle and gain management experience, and bring immediate diversity to uniform stands, some harvesting of mature oak, birch and pine may be desirable in some sites, though it appears that local markets are rarely available at the present time.
- Consideration should be given to restoring wood pasturage with cattle as this would help to restore not only a traditional system of management but it would help to maintain open habitats, diversify stand structure and possibly facilitate the regeneration of oak.
- There is a tendency in management planning to think in terms of a few, simple categories, such as 'native woodland' and 'conifer plantations'. Recognising a standard approach or best technique by central directive would be undesirable, since this would promote uniformity between sites. A better approach would be to combine the different treatments in each site. When planning the future of native elements in the forests of the Highlands, there may be some merit in recognising a spectrum of management, as suggested in the BOX on the opposite page, since this could in turn encourage a more subtle approach. Concomitant modifications to the sub-compartment database will be implemented to facilitate this.

Far right: The acquisition of open land with some native woodland sandwiched between two FC plantations has provided a range of opportunities to improve the management of the existing woodlands, to strengthen habitat networks and designate Scotland's first butterfly nature reserve in partnership with Butterfly Conservation.
(Pat MacDonald, 2003 and Forest Life Picture Library)

4.6. Network and forest structural issues

Forestry Strategies published by the FC for England, Scotland and Wales emphasise the need to **develop forest habitat networks (FHN)**. FE's native woodland programme will contribute to these developments through its work in **restoration** and also by **expansion** (creation of new woods which fill gaps) and **providing connecting corridors of native woods** (eg riparian zones) within productive plantations.

Thus far, the FE restoration programme has been largely confined to existing FE holdings and has not changed the pattern of green on the map, save for the few instances of native woodland afforestation. However the main limiting factor has been funding rather than lack of ambition. Some small examples at Glenmore and Arkaig illustrate that FE is not adverse to **acquiring native woodlands to expand and consolidate the FC estate**. **Collaboration with neighbouring landowners would be needed to generate larger-scale networks**. FE (at time of press) is



in discussion with Scottish Water regarding the acquisition of a lease to manage the 9000 hectare Katrine catchment with native woodland the key objective following water shed management. **However, FHN issues also relate to the pattern of components within individual holdings and how these relate to patterns on neighbouring properties** (Peterken et al 1995, Humphrey 2003).

No new Core Forest Areas (CFA) are being produced at present given that there has been limited funding available for expansion of the FC estate. Rather, **the native content of some existing large forests is being greatly increased and cores of native woodland are being recreated** in some densely forested

SPECTRUM OF MANAGEMENT

1. Site-native stands treated as minimum intervention. Intervention would normally include eviction of any non-native species, so this would remain a predominantly site-native stand. Some mature non-native species would be tolerated provided they are not regenerating and they make a contribution to biodiversity, e.g., old beech in oakwoods retained for saproxylics.
2. Stands with a dominant site-native element reserved as strict non-intervention. Naturalised species colonising from elsewhere would not be evicted. In theory, such stands could become dominated by naturalised, non-native species, and remain dominated by these species indefinitely.
3. Site-native stand treated by low-intensity harvesting and regenerated naturally without site treatments. Any non-native species would be removed. This would remain a predominantly mature stand.
4. Site-native stand with a moderate level of harvesting, regenerated naturally, but assisted where necessary by site treatments (such as screening).
5. Site-native stand managed as a timber crop with felling according to timber-growing criteria and restocking by planting as necessary. Planting with local provenance only.
6. As (5), but restocking with any provenance of site-native species.
7. Site-native species in mixture with planted or naturally-colonised stock of non-native species. This could include a spectrum of intensities of management, and a spectrum of species from almost-native (e.g., beech) to unambiguously introduced (e.g., Douglas-fir).
8. Introduced trees dominate stand. Site-native species incidental.

The Forest of Strathspey is an example of a range of forest owners and managers including FE collaborating to share information, expertise and develop compatible approaches to management at a landscape scale. (Patricia and Angus Macdonald, 2003)



districts as the main priority. In the longer-term it is possible to envisage a truly landscape-scale CFA, crossing several ownership boundaries, treated largely as a **near-natural reserve**, to which Glenmore would be a major contribution.

Within predominantly plantation forests, the main blocks of native woodland will be linked by corridors of native woodland. Most will be riparian links containing a variety of non-woodland habitats, but in some sites natural (Glenmore) or simulated (Loch Lomond) treelines will also be generated. These predominantly natural forms will be augmented by corridors of native woodland along roads. The restoration programme thus seems well designed to provide a **high degree of connectivity between native woodland components within forests.**

External linkages have been less thoroughly implemented. Many FE holdings have forested neighbours, including ownerships with conservation objectives (e.g., SNH at Loch Lomond and Knapdale; RSPB at Glenmore). Greater co-ordination of management with neighbours seems desirable, including perhaps the production of joint management plans. This point has been made by FE to some neighbours, largely during consultations over forest plans, but with only limited response. However, there is a general level of **awareness and collaboration**, and there are some particularly good examples such as at Sunart where more

than 30 owners and managers, including FE, **are working together to deliver a shared vision.** Likewise, in Glen Affric a number of owners are collaborating. Elsewhere, without such collaboration, FE plans could be compromised by seed-sources of non-native species just over the boundary.

Networks need to have a coherent pattern of stand structures, age classes and other habitats within the forest, otherwise specialised forest species will still remain as isolated sub-populations. Open space species are currently more than adequately provided for in newly restored woods, though there will come a time when their populations could be fragmented if large-scale even-aged stands are allowed to develop. More critically, saproxylics or old-growth associates are particularly vulnerable, since they are likely to survive as small, isolated populations that must be nurtured through a long restoration process. This points to the need for a battery of provisions: **(i) retaining all large old trees and snags, (ii) leaving old-growth stands within minimum intervention regimes, (iii) thinning to facilitate the growth of new large trees quickly, especially in the vicinity of existing old-growth, (iv) augmenting dead wood by girdling or felling without extraction of timber.** FE's approach to managing deadwood is set out in 'Life in the Deadwood' (Humphrey et al, 2002).

Open spaces are an integral component of a forest, from roads, rides, power lines and quarries in managed forest to mires and riparian openings in semi-natural forest. These and their margins are often the richest habitats, and they can be important refuges for unwooded semi-natural habitats in places, such as NE Scotland, where agriculture treats land outside forests intensively. **The restored woodlands will include a well-connected set of open space habitats if (i) portions of the native woodland are managed semi-commercially, (ii) the wood-pasturage schemes prove to be practicable, and (iii) efforts are intensified to restore the natural hydrology of wetlands.**

4.7. Monitoring and data

Monitoring is necessary, but open-ended, and tends to be difficult to sustain over the decades during which actions and responses take place. **Like any major forest owner, FE needs (i) to know how their properties are changing, (ii) measure progress against targets, (iii) identify where and when operations have not had the desired result, (iv) be able to demonstrate progress to others, and (v) accumulate and demonstrate experience of native woodland management that can be used elsewhere. This points to a need to record what is done in each site and the responses of the woodlands to various treatments.**

FE Scotland has developed a simple methodology for site monitoring as part of its native woodland initiatives. It comprises a hierarchy of monitoring intensity from simple fixed point photography through to periodic transect surveys of forest structure and attendant optional features. The former has been deployed at most localities whereas the latter has been instigated at key flagship sites, such as the Black Wood of Rannoch and Glen Affric.

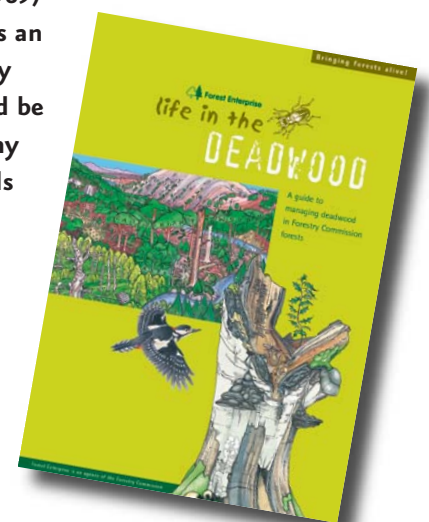
Other sites such as Dalavich and Knapdale have benefited from more detailed habitat and species surveys which have been undertaken by SNH. This seems a reasonable approach: if the sites recorded in detail are representative, the conclusions can be extrapolated to the whole population of restored woods.

Nevertheless, there is scope for improvement.

- **There has been little attempt to record work on the ground, i.e., a diary or**

event record. Much knowledge lies with the local staff, which is fine until they move or retire.

- **Photographic and other records are in some instances properly stored, but there is no consistent link to the FE sub-compartment database. In time, it will be important to ensure that the system brings the existence of photographic and other records to the attention of new members of staff.**
- **The value of old records is acknowledged by FE staff, but (understandably) only limited effort has been made to find them. The 19th century Ordnance Survey maps have apparently rarely been consulted. Possible early 20th century photos have not always been sought, though most parts of the FC estate with native woods were remote from early photographers. Archaeological surveys have been completed in many woods, and in two pinewoods the age-structure of semi-natural stands has been studied. Greater understanding of the pre-plantation development, state and use of the woods would be helpful in developing heritage aspects and understanding the patchy distribution of many species.**
- **The paper by Kirby and May (1989) on the Dalavich plots provides an ecological account of the early stages of restoration. It would be worth building on this and any other detailed baseline records by regular re-survey and publication of results in peer-review journals. This would add scientific value and credibility to the restoration programme.**
- **There is scope to include much of this data in electronic web based formats, provided that the resources are found to establish the system and undertake the necessary inventory work.**



Life in the Deadwood publication.

4.8. Community involvement, public access and appreciation

If current trends continue with both a growing desire for community involvement and greater demand for recreation and leisure activities in

the Scottish Countryside this will undoubtedly have a significant bearing on native woodlands and their management by FE. A review of FE's approach to community involvement is currently underway prompted by the FC's Foresters for People Panel. There is also a growing desire to provide more and 'smarter' access to wildlife using new technology as a means of developing eco-tourism. Current examples of this include a small number of remote viewing facilities and interest in developing a Scottish Wildlife website. It is clear that there will be an ongoing, if not growing demand for FE to be involved in such projects. This will require additional resources for planning, implementing and managing such services to ensure that the environmental value of the sites and wildlife involved are not compromised and that the viewing public receives the quality of service and experience which ensures satisfaction and success. Partnerships will help deliver these aspirations but they will require financial and other support to underpin them. FE is well placed to be involved and contribute.

4.9. Future partnership working

As FE involvement in native woodland changes and develops there will be a need to forge new partnerships and seek new resources. This will in itself require resources and further development of FE staff experience and skills – a trend which is already being implemented with the appointment of a new person within FE Scotland dedicated to the task. There should also be opportunities for FE to work in partnership at a landscape scale. Again current trends suggest that this is feasible. The advent of the Scottish Forestry Alliance, involving FE, RSPB and the Woodland Trust with BP providing financial support has already developed a project spanning FE and RSPB native woods in Strathspey. A project is also being explored where FE would work with Scottish Water on their Loch Katrine catchment. This property which contains substantial areas of native woodland lies adjacent to a RSPB reserve on the eastern shore of Loch Lomond and the Woodland Trust's native woodland project in Glen Finglas to the east. To the south lies the Queen Elizabeth Forest Park managed by FE. It includes a major native woodland project on the eastern shore of Loch Lomond and the development of an extensive native woodland habitat network. Collectively these three holdings provide an opportunity for a truly

landscape scale project spanning 15-20,000 hectares in the heart of Scotland's first National Park. The SFA partnership will play a key role in realising this long-term and ambitious vision. Undoubtedly further opportunities of a similar ilk will emerge. FE, FC and the Scottish Executive need to work closely with each other and their respective partners to ensure that opportunities become reality.

4.10. Wider significance

FE has made an impressive impact on many important woods, and has plans an ongoing programme of native woodland restoration. The recent evaluation by *Mackenzie and Worrell (2002)* has found that this programme forms the major contribution in Scotland to HAP targets for woodland restoration, and with restoration comes improved prospects for proper maintenance of existing native stands, another HAP target. Moreover, in private woods, much of the restoration and expansion has been achieved by planting, which is not fully in accordance with the advice offered in *Rodwell and Patterson (1994)* and in the Forest Practice Guides (Forestry Commission 1994). However, this review also noted that, where natural regeneration was the adopted method of restoration, targets would only be fully achieved after there has been enough time to achieve a reasonable stocking density and that this has implications for the target dates.

The Mackenzie and Worrell report is only a preliminary, sample-based assessment that assesses progress by comparing areas of activity with targets. There is a case for a more comprehensive FE assessment of native woodland restoration and conservation, which would bring out the scale of the operation, the achievements so far, responses of wildlife, the developing patterns, and issues of future development. Such a survey could usefully update the Millennium Guide GIS dataset, which was founded on 1988 aerial photos and thus predates much of the recent restoration activity. The contributions of different organisations and mechanisms might also be assessed, though, since so many projects are partnerships, there may be only limited point in quantifying contributions in detail. FE have made the first steps towards establishing a new data set and development of an extension of their GIS to accommodate environmental data.



The view from over Loch Lomond looking east over Loch Arklet and Loch Katrine.

There is scope to link native woodlands to form a habitat network at a landscape scale.
(Patricia and Angus Macdonald, 2003)



5. Conclusion

It is worth acknowledging that Forest Enterprise's native woodland restoration programme is a massive, almost heroic, (in some commentators' eyes) enterprise. It represents a profound broadening of forestry objectives, policy and practice, and a shift in modus operandi to working in partnerships. The scale of some individual restoration projects is an order of magnitude larger than we see outside the Highlands, only matched by FE's restoration programmes in, for example, the New Forest and East Midlands.

The restoration programme has reached the point where most of the key sites, i.e. the large ancient woods, have been largely restored to native status by the removal of immediate threats largely from introduced conifer plantations and excessive grazing. The need now is to develop long-term management plans based on a mix of minimum intervention management and diversification through utilisation, planned in a way that ensures diversity within and between sites. Eventually, these core native woods should be linked by native elements within commercial plantation

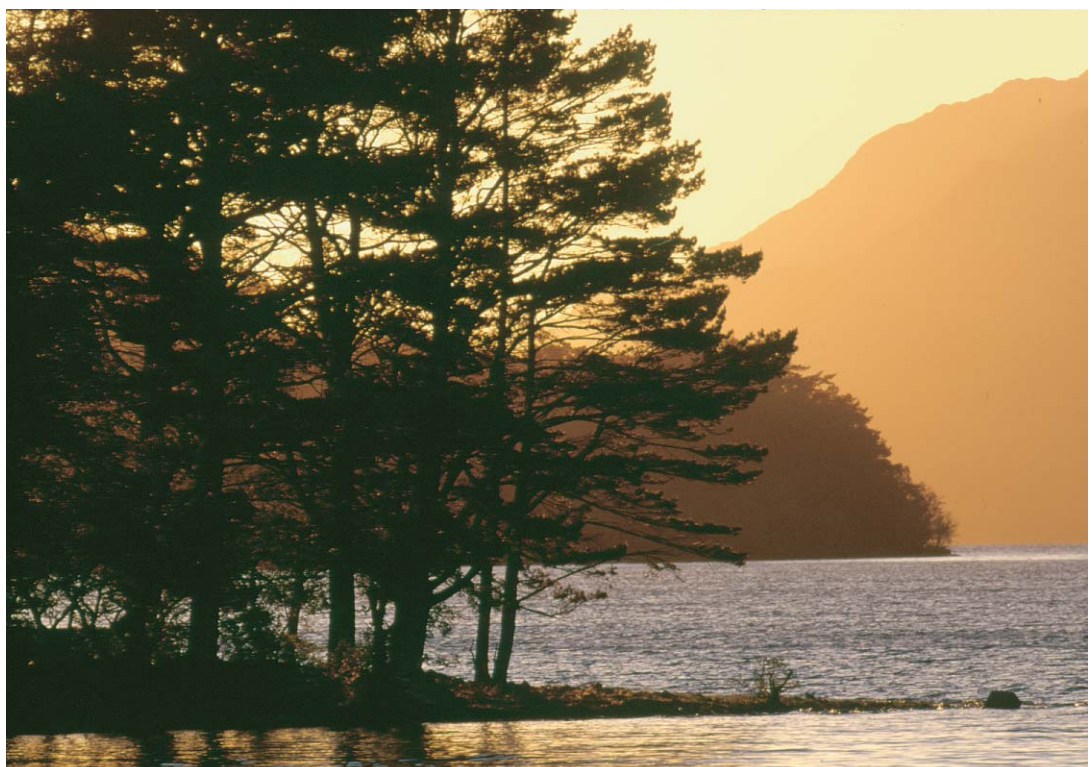
forests combined with larger-scale strategies for a forest habitat network.

The work which has been undertaken should continue to be brought to the attention of a wider audience by FE and other commentators. This will help to ensure that public support and the necessary funding will continue to be forthcoming and increase to levels which will allow more to be done.

The approach advocated is very much in line with the thinking in 'Biodiversity Matters – The Scottish Biodiversity Strategy' which places people at its very heart.



Native pinewood, Loch Maree.
(Laurie Campbell)



Key Points

The programme of native woodland restoration by Forest Enterprise, Scotland, is a substantial and impressive exercise, which must already have brought substantial ecological benefits in many important ancient woods, and is making a major contribution to upland oak and native pinewood Habitat Action Plans.

Progress during the last 15 years represents a step-change from earlier work by FC in native woods, starting with the reservation of native pine woodland at Glen Loy in 1931. Changing priorities in national policy have enabled plantations of non-native conifers to be removed from many ancient woods.

FE restoration programme has been carried out in partnership with other conservation organisations and several different sources of funds, which include the EU LIFE Nature programme and the Millennium Forest for Scotland Trust (Millennium Commission).

In many important ancient woods, the majority of the unwanted conifer plantations has been removed, and the need now is to move decisively to a second phase by defining long-term management objectives.

The emerging restored native woodland already have a considerable degree of naturalness, some of which represents survival of inherited elements through the period of conifer plantations. However, regeneration has often been so prolific that extensive, new even-aged stands are developing. Management will need to devise ways of ensuring that the current burst of activity will not generate monotony of structure and composition within a few decades.

The management plans should be drawn up on the basis of a national management strategy that provides for diversity within and between sites, based on several general types of native woodland management, such as (i) minimum intervention, (ii) long-rotation utilisation, (iii) semi-commercial utilisation. Proposals for

incorporating woodland pasturage would have benefits in many sites.

Completion of conifer plantation removal could be beneficially delayed in some sites in order to generate a wider range of age classes in successor native stands.

A degree of utilisation of native timber would have environmental benefits and help to sustain long-term management plans. There appears to be an immediate need to develop local utilisation.

The concept of a forest habitat network is being thoroughly implemented within FE holdings, but there appears to be only limited progress in integrating forest design and management with neighbours.

Whilst baseline photographic monitoring is routine, and detailed baseline records are being made in a selection of sites, there is no overall monitoring strategy, and only weak links to compartment databases. Monitoring in the broad sense is important, since experience of innovative management techniques and the responses of wildlife will need to be accumulated and passed to the successor staff.

It would be useful to compile a quantitative assessment of progress in native woodland restoration throughout Scotland. A great deal has happened in the last 15 years or so, particularly in FE woodlands, but there are many players in the field.

FE has invested substantially in new and renovated facilities for visitors to existing and restored native woodlands. A strategy for involving local communities has been developed. Provision for visitors and local community involvement is likely to be expanded.

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Case Studies

Commentary on Individual Restoration Projects

A selection of restoration sites was examined by George Peterken in September 2001. The sites were selected by FE to include a wide geographical spread in a crescent from Loch Lomond in the south-west running north and east to the Cairngorms. The object was to take a broad but concentrated view of progress, and consider the next steps. The staff who discussed their management on site are listed with each site account.

The native woodland types represented were mainly oak woods and pine woods, but small areas of other types were included. TABLE 1 summarises the woodland types represented in each site in terms of the woodland types recognised by Habitat Action Plans.

TABLE 1. Summary of native woodland types in each restoration site visited.

Sites	Pine	Upland oak	Upland mixed ash	Wet woods	Upland birch	New woodland
Loch Lomondside		++++	+	++		+
Knapdale		++	+++	++	+	
Dalavich		++++	++	++		
Glen Loy	++++	++	+	++		
Glen Garry	++++	+		+	++	
Knockie					+++	
Glen Moriston	++++					
Glen Affric	++++	+				
Glen More	++++			+		
Clashindarroch			+		++	++++

The following accounts were compiled mainly by GFP, but some comments by Alan Stevenson have been incorporated. Each account provides a summary of the main site characteristics and a set of bullet-point comments and suggestions. The points covered are not meant to be comprehensive. Rather, they concentrate on issues raised in discussion on site, i.e. they are a mixture of personal views and points made by site managers.

East Loch Lomondside

pSAC

Visited with Mike Steward

The woods along the eastern side of Loch Lomond were traditionally treated as oak coppice, but coppicing ceased a century ago and the oakwoods have grown into high forest. Portions became part of the Loch Lomond NNR, but the majority was incorporated within a large FC holding that extended above the traditional treeline and was planted, or underplanted, with conifers. The district has long been part of a Forest Park, and in 2002 it became part of Scotland's first National Park. Meanwhile, over the last decade, FE have instituted a substantial programme of native woodland restoration in areas where they had formerly planted conifers. Much of the lower ground is now freed from conifers, having spent around 40 years (1950s to 1990s) under their influence.

Restoration is being undertaken to fulfil FE obligations for managing the pSAC, but also as a major project to convert the whole of the FC holding on East Loch Lomondside to broadleaves. The latter arose out of the Ben Lomond Memorial Park.

The restoration will generate a consolidated lower zone of native broadleaves. From the

shore line upwards, the sequence of zones will be: (i) restored ancient woodland (PAWS) with some new semi-natural woodland, regenerated by low intensity treatments, (ii) site-native tree species (oak, birch, Scots pine) managed for timber, (iii) low density planting and natural infill to generate a sort-of-natural treeline, and (iv) unstocked ground within the forest fence which, after felling Sitka spruce, will develop a 'treeline' scrub. Moorland will remain above the forest fence (NTS ownership). All stock for planting will be locally collected and grown.

The initial removal of planted conifers generates a bleached landscape of woody refuse on the ground reflected in exposed grey trunks and the dead lower crowns of retained old oaks, but this quickly fills with birch regeneration. Where old oaks, alder and birch have been felled, coppice sprouts have proved to be vigorous, and some oak regrowth has recently been thinned. A few oak pollards and stubs have also responded well. Groups of birch and oak have been planted in mounds, and these are growing vigorously. Fencing against roe has generally been necessary.

Particular points:

- Restoration beside Loch Lomond is extensive and will generate a predominantly native woodland. Elsewhere in the district restoration will be less extensive, and even some PAWS will not be restored where negligible native content remains on the ground. This variation in emphasis seems entirely appropriate, and will generate some consolidated, large native woodlands.



Above: Clearfell of spruce, larch and hemlock with older oaks lopped and showing vigorous pollards and stubs. Birch has been planted on mounds. Strathcashel, Loch Lomondside, 2001 (George Peterken)

Right: Recent restoration harvesting which has released oaks previously restricted while encased in conifers. The Anchorage, Loch Lomondside, 2001 (George Peterken)





- Where native stands form only one component of the forested ground, there is a strong need to ensure good connections between the main native woods, which can be achieved by (i) links of native woodland, and (ii) enhanced native elements within conifer plantations. FE commissioned a report on the network approach from a group led by Philip Ratcliffe (December 2000), and this adopted many of the points made in his earlier report to SNH on the Cairngorms (Ratcliffe et al 1998). The Loch Lomondside native stands will inevitably be well connected simply because of the scale of the restoration. Elsewhere in the District there is a concentration on riparian and roadside native woodland links. However, the network approach does not yet seem to extend to full integration with neighbouring managers, including SNH.
- The oakwoods are themselves largely plantations, and there is little merit in attempting to maintain oak dominance for nature conservation reasons. The general target should probably be mixed native woodland with a significant oak content.
- There is every reason to accept utilisation of native timber. This generates a variety of stand structures, maintains open space habitats, allows large trees to be generated quickly where these have not been inherited, and provides a wider base of public involvement in the restoration process. The main need now seems to be to develop local utilisation of native timber,

which would require some felling of oak in mature stands (as has recently been suggested in a report to SNH and others in respect of the Sunart oakwoods (Peterken and Worrell 2001). This, too, would have conservation benefits in diversifying oak monocultures inherited from past coppicing.

- Experience of silvicultural techniques will accumulate. An example of this was in Blair Wood, where a localised thinning of oak sprouts was tantamount to revival of the practice of mid-rotation thinning in the former oak coppices. Oak regeneration from seed might be facilitated by allowing moderate grazing and browsing (to maintain open spaces, encourage the formation of patches of light grassy sward, mitigate competition from regenerating birch), followed by a cull that would allow young oaks to get away.
- Mound planting is as a reasonable facsimile of pit-and-mound microtopography, and a successful technique for ensuring that some oaks are established in each compartment.
- Recording of management operations and monitoring of consequences seems particularly important in circumstances where new objectives and techniques are being tried. Photographic recording at Loch Lomondside seems well established, but there appeared to be some doubt about whether the institutional memory was secure enough, and much of the detailed management experience appeared to remain unwritten with individual officers.

*All of the FC conifer forest on the eastern shore (right hand side of Loch Lomond above) will be progressively converted to native woodland.
(Patricia and Angus Macdonald, 2003)*

Barnaluasgan, Knapdale

pSAC

Brent Meakin, James Anderson-Bickley, Ross Preston

This Caledonian Forest reserve forms part of the remarkable landscape of parallel narrow ridges and valleys, all orientated NE – SW, that make up much of Knapdale. The valleys are occupied by a series of small, elongated lochs and mires, separated by slopes and ridges covered in conifer plantations and patches of semi-natural woodland. Beavers may soon be introduced to this reserve, which will make it famous. Indeed, it is already increasingly visited because native woodland is being restored in association with improvements in access, recreational facilities and interpretation.

Native woodland appears to have remained fairly common on Knapdale. Although some comprised oak-dominated coppices that may originally have been planted, most was a diverse mix of birch and sallow fringes round the lochs and hazel-rowan-birch on the base-rich soils of the ridges. Much of this native woodland was replaced by conifer plantations, now well into second rotation, but native species seem to regenerate well, and a strong native component has been retained. Conifers have largely been removed from the reserve, and native species are starting to regenerate, aided by a recently increased deer cull. Existing broadleaves are utilised within the site by Argyll Green Woodworkers, though they evidently bring in most timber from elsewhere.

- The reserve is part of a large FC holding, most of which will remain under commercial conifers. The broad pattern of native woodland envisaged seems to comprise large blocks linked by riparian multi-habitat corridors. This ‘network’ approach could be extended to neighbouring land holdings.
- The combination of (i) the scale of the forest and of the native woodland restoration within it, and (ii) the diverse and generally rugged land forms will ensure that habitat and species diversity remains high, whatever treatments are carried out. This implies a freedom to experiment with different forms and rates of restoration, and to tolerate some regeneration-inhibiting browsing.
- As in other large-scale restoration projects, there is a strong case for spreading the operation over a long period once the initial impact has been made. This will enable new native stands to include a range of age classes.
- A unique combination of approaches to non-native species seems likely to develop. There is the emblematic re-introduction of beavers. Red squirrels remain as yet unthreatened by grey squirrels, but measures may be needed to prevent the latter colonising. As a contribution, there is a strong case for eliminating sycamore and beech, which are currently poorly represented, though well-established on the margins. The remote and somewhat isolated position and configuration of Knapdale appears to offer opportunities to control ecosystem composition that are impractical elsewhere.
- The presence of the Argyll Green Woodworkers Association brings a welcome element of utilisation to the native woodland restoration. At the risk of commenting on the basis of total misunderstanding, it seemed almost ironic that utilisation was established where most broadleaves are young, and not in the mature oak monocultures elsewhere, where the need for utilisation is more immediate.



Looking north across the core of the Atlantic oakwoods pSAC at Knapdale Restoration here has been at a landscape scale with linkages to SNH managed NNRs and Natura 2000 sites to both the north and the south.
(Patricia and Angus Macdonald)

Dalavich Wood, Lochaweside

**Brent Meakin, James Anderson-Bickley,
Ross Preston**

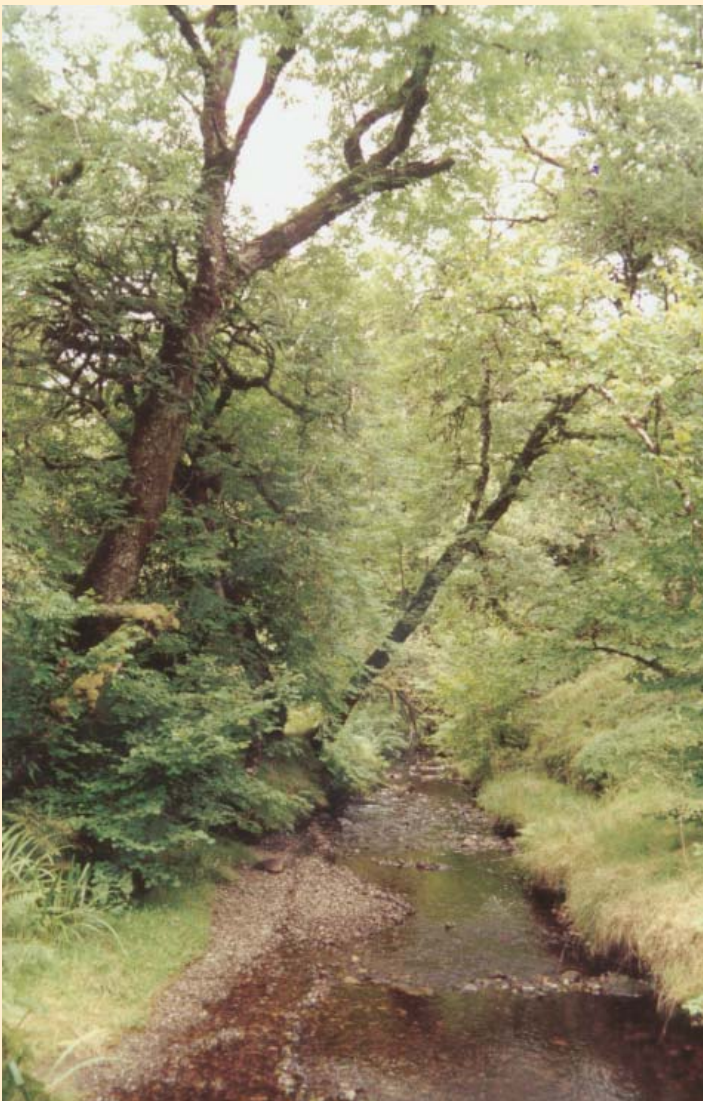
This oak-dominated wood was long treated as coppice, but from 1958 onwards a substantial portion was under-planted with conifers. The untouched minority portion was scheduled as an SSSI, and from 1984 onwards conifers were progressively removed from the rest. Samples of both the SSSI and the formerly under-planted oakwood were fenced against deer, including a small felling coupe. Conifer removal has progressed to the point where most of the conifers have been removed, leaving scattered blocks that will eventually be removed. Recent felling has not been confined to conifers: in some compartments, mature oaks have also been felled. The wood has wider significance as one of the first in which a native woodland restoration programme was started, and for the comprehensive set of monitoring plots established at the outset (*Kirby and May 1989*).

Outside the stands where conifers were felled to waste, and now form almost impenetrable mixtures of dead conifers, dense ground vegetation and scattered regeneration, the predominant impression is that the wood has rapidly reverted to oak woodland, with little immediate sign of the 25-30 years of conifer occupation. Regeneration under shade tends to be dominated by rowan, and in clearings by birch, but there is a reasonable stock of oak saplings on ride margins and in clearings. The impact of herbivores and shade is clear from the abundant seedling and stump regeneration within enclosed clearings, but even here regeneration is patchy and open ground remains.

- Phase 1 of the restoration has almost been completed: (i) the wood is predominantly native, and (ii) experience has been gained about how it responds to different treatments. The long-term treatment of the native stands (phase 2) needs to be decided
- Whilst we are sure that the prevailing oak monoculture is a product of past management, we do not know what composition and structure would be found if

the wood were natural. A reasonable assumption would be that oak would be a component of mixed broadleaved woodland (rowan, holly, hazel, oak and birch) on the drier soils, but in the flushes and base-rich valleys it would be a small minority amongst ash, hazel, alder, wych elm and willows. From the nature conservation standpoint, mixed stands would be preferable to continued oak dominance.

- Long-term management may best be designed round two main zones, minimum intervention stands and semi-commercial managed stands. The former would form coherent blocks concentrated on existing mature stands and diverse composition associated with valleys.
- The managed zone would take the form of oak-birch stands in which felling and thinning is planned to generate a variety of structures and a normal age-distribution. This would not only yield utilisable timber, but it would help to diversify the inherited mature oak monocultures and facilitate the development of some large trees in the managed zone. Immediate actions in this direction would include (i) thinning retained oak high forest irregularly, (ii) thinning or respacing regeneration stands to favour oak, and (iii) thinning stump regrowth to favour best stems.
- There seems to be a lack of local markets for native timber. The priority, as at Loch Lomond, may now be to develop native timber utilisation, rather than continued conifer removal.
- Non-native trees seemed to be rare, though the provenance of the oak is uncertain. As a compact, ancient woodland in surroundings controlled by FE, the preferred policy would be to eliminate and exclude such species.
- The Kirby-May plots represent a comprehensive baseline for monitoring native woodland recovery, which cannot realistically be repeated in many other sites. It would be valuable to repeat this record at no more than ten-yearly intervals, and publish the findings. Associated contemporary whole-wood records of flora and bryophytes may also form a repeatable baseline.



Above: Regeneration coupe cut and deer fenced in 1984 showing natural regeneration of birch, rowan and oak. Most oak stools produced regrowth. Oak seedlings were enclosed in tree shelters. Dalavich oakwood Lochaweside, 1992 (Alan Stevenson)

Far left: Streamside ash and oak at Dalavich which escaped the last coppice operation in the 1800s. the riparian woodland is thus distinct in composition and structure and is an important refuge for mature habitats. Dalavich oakwood, Lochaweside, 2001 (George Peterken)

Left: Tubed oak seedling. Dalavich oakwood, Lochaweside, 2001 (George Peterken)

Glen Loy, Lochaber

David Whitaker

This includes a particularly interesting native pinewood, which became an ecological reserve in the late 1930s, shortly after acquisition by the FC, and thus appreciably predates the more famous FC ecological reserves in Lady Park Wood (1944) and Black Wood of Rannoch (1948). The core pinewood was fenced and various regeneration experiments were undertaken (see main report).

Today, the pinewood is a substantial block of old-growth pine containing a wide range of size/age classes and including a substantial admixture of birch dating mainly from after 1933. There has been only limited recent regeneration of pine within the wood, but groups have developed on the margins. The older pines can be roughly resolved into generations of about 300-350 years and about 250 years. Some of the oldest pines had regenerated on tip-up mounds, clearly

indicating a natural origin, but most had wide crowns that appeared to have formed in fairly open conditions. The pine woodland actually extends beyond the old FC boundary. The rest of the woodland has recently been acquired, along with some intervening moorland. This will serve as a useful extension to the existing woodland and allow space for expansion by natural regeneration.

Glen Loy also contains much mature broadleaved woodland. This lies principally along the river as a wide riparian woodland strip, but it extends well into the lower reaches of the pine woodland. This woodland comprises riparian alder-bird cherry-hazel woodland, mature oak-birch woodland along the floodplain, and mature oak-birch-pine woodland on knolls in the lower edge of the pinewood. Some woodland has been referred to NVC W9, which is unusual in close proximity to pine woodland. Most oaks appeared to be closer to *Q. petraea*. Those by the pine wood included several pollards and stubs, which appeared to be associated with the remains of a farmstead. The alder-hazel also appeared to have been coppiced. Down the valley there is a separate oak wood, which is being linked to the riparian broadleaved woodland by felling intervening conifer plantations.

The interior of an old pinewood stand showing a range of age classes.
Glen Loy, Lochaber, 2001
(George Peterken)





The majority of the forested ground remains under commercial plantations managed on a 50 year rotation. Within this, the native woodland takes the form of large blocks linked by a riparian strip of mature broadleaves. In addition, there are Scots pine plantations formed from local stock, that will be retained. Broadleaves have been retained when plantations on lower slopes have been harvested.

- How should the native pinewood be treated? It has an excellent diverse and mature structure with groups of younger trees on the margin and small mires that appear to be fairly resistant to tree invasion. Given the history of wood-pasturage apparent in the form of the oldest pines and the associated oaks, there is a case for some pasturage, which might help the oak to regenerate (It has not regenerated for a very long time). In terms of my recent report to English Nature, this would be a Minimum Intervention (Wood-pasture) reserve (Peterken G.F. 2000).
- The pine plantations outside the reserve appear to be intermixed with commercial spruce plantations. Even though they are of local provenance, there seems no reason why these should not be harvested, though it would be worth considering natural regeneration under a shelterwood as a means of restocking.

- Although this is an early ecological reserve, there appear to be few records of early conditions. A search for old photos in FCHQ revealed nothing. Even the modern compartment database does not identify ecological records (which include a recent age structure study). In the light of the modern FE interest in ecological reserves, I would have thought that every effort would be made to collect old records, expand and archive modern records, and generally publicise the early FC interest in this aspect of forestry.

Groups of oak on streamside knolls on the lower edge of old growth pinewood. Pollard, stub and maiden oaks are all present. Glen Loy, Lochaber, 2001 (George Peterken)

Glengarry, Lochaber

Malcolm Wield, Sandra Paul, George MacLarty

A large, but extremely battered pinewood, this is the scene of a major restoration project. The natural woodland appears to have been mainly pine-birch, but with patches of oak, tracts of birch-juniper, and strips of alder along watercourses. Treeless mires ran along valleys. Above, the woodland runs into moorland, and below it is penetrated by patches of farmland with associated hazel coppice and parkland oak. Before FC acquired it, the pinewood had been extensively felled and burned. After FC acquisition, most of the ground was planted with spruce, and latterly the mires were planted with Lodgepole pine. Conifer afforestation extended the forest upwards. Lower ground was truncated by a rise in water levels when Loch Garry was incorporated in a hydro-electricity scheme.

Restoration started in 1985 when Norway spruce were removed from under a stand of mature oak, and this stand has now regenerated

abundantly with birch. It has continued with the removal of planted conifers from a huge swathe of forest mainly at middle and lower altitudes. During this process, any Scots pine have been retained, including both old trees that pre-dated the planting and self-sown younger trees that grew with the plantation. The current result is an open landscape, with scattered old and younger pine, and limited groups of old pine that escaped most of the effects of planting. At the same time, Lodgepole pine has been removed from the mires. The response has been a very substantial regeneration of birch on the drier ground, and rapid restoration of mire vegetation in the valleys. Some plantations that are earmarked for restoration to native woodland remain, but felling has been so extensive that these tend to take the form of blocks in a matrix of felled and native woodland. The upper levels, being both younger and beyond the original woodland boundary, will be retained as commercial plantations.

The native woodland in prospect will thus take the form of very extensive tracts of young birch-dominated woodland with an irregular scatter of older pine of various ages running 'horizontally' within a narrow altitudinal range. It will also include 'vertical' components in the form of riparian belts of native woodland along the main watercourses and a 30-40ha tract of open mature pinewood, which was never planted, that has acted as a 'deer downfall'.

- The most immediate impact of the site is the vast extent of the restoration exercise, which is on a scale rarely attempted in Britain. The implication, however, is that the huge even-aged plantations will be followed by a huge even-aged native woodland unless something is done to change the course of development. In ecological terms, the whole process is

Groups of self sown native pine which regenerated within a matrix of planted conifers during the 1930s following removal of spruce in the 1990s. Glengarry, 2001 (George Peterken)



Glengarry valley mire restoration with Ben Tee in the background. The mire was drained and planted with lodgepole pine in 1964 and 'felled to recycle' in the late 1990s. Future work required includes removal of regenerating lodgepole pine, drain blockage and cattle grazing to encourage diversity of ground vegetation. Glengarry, 2001 (George Peterken)





The core of the 1300 ha Glengarry restoration area: foreground copious birch regeneration following removal of spruce in 1996; middle distance recently felled area with timber stacks and old native pine retained during the plantation phase; extreme left has self sown pine cleared of spruce.
Glengarry, 2001 (George Peterken)

roughly analogous to a massive fire, so the extensive even-agedness in prospect could be construed as near-natural.

- The poor state of many of the old pines is a concern. This results from heavy competition from planted stock, and also perhaps from the shock of sudden exposure or a rise in watertables. If the restoration is analogous to a large fire, that hypothetical fire was intense.
- Most of the regeneration is birch, Scots pine being very limited. Some Scots pine have been experimentally mound-planted to adjust the balance.
- Lodgepole pine, Norway and Sitka spruce are also regenerating. These are unlikely to make up a large portion of the regenerating woodland, but Norway spruce presumably has the capacity to regenerate under birch shade and would be at risk of increasing eventually. A decision will be needed on whether to accept or eliminate these species, though with commercial plantations nearby upslope, there will always be a need for vigilance.
- There is a case for retaining for a decade or so the remaining blocks of plantations that will eventually be replaced by native woodland, so that there is a wider range of ages in successor stands. However, since this would presumably increase the proportion of non-native conifers in the regenerating stands, long-term stand diversity might be better sought by management of birch.
- Management of the new native stands has yet to be decided. There is a case for harvesting a substantial fraction if a market can be developed for birch. This would help



Old pine killed during the spruce rotation but retained as deadwood habitat. Retained pole stage native pine regeneration in the background.
Glengarry, 2001 (George Peterken)

to break up the extensive even-agedness and maintain open spaces. The same applies to new pine stands, and the denser portions of the post-acquisition pine generation.

- Nevertheless, given the long history of mature pine removal, the need for many decades will be to retain all mature pine individuals and groups, and to allow snags to remain until they fall. A pattern of blocks of mature pine woodland treated as minimum intervention in a matrix of younger, mostly managed stands, appears to be the best solution. In the managed stands, better pines would be retained as a shelterwood and kept through the next rotation, both as seed sources and as a means of rebuilding mature habitats.
- Having freed the mires from Lodgepole pine, there may be a need to block some drains to facilitate recovery of wetland species. Grazing would help encourage plant diversity.
- There is evidently some prospect of using the forest as an extensive wood-pasture with Highland cattle. This would have many ecological benefits in mire recovery and maintaining structural diversity in regenerating woodland.

Knockie, Loch Ness side

Malcolm Wield, Sandra Paul, George MacLarty

This site was viewed only from the far side of the Great Glen, but it illustrates some useful points. The FE restoration site is a substantial stretch of valley side lying between two birch woods, both of which are SSSIs. The restoration land is separated from Loch Ness by a fringe of birch woodland that links the two SSSIs.

Mature conifer plantations have been felled to the point where the remaining unfelled plantations stand as isolated blocks in a matrix of felled woodland. Birch is likely to be the main regenerating species, though bracken is vigorous and may suppress regeneration in patches. Thus, once regeneration is under way, the two SSSI birch woods will be linked by young birch.

- There is a case for delaying the final removal of conifers for a decade or so. This would ensure that, when they are eventually removed, the native woodland that develops will have a range of age classes. Isolated blocks of conifers would not impair the newly achieved links between existing birch woodlands, though they might provide seed sources for regeneration in the felled areas. Delay might also allow a better price to be obtained eventually.
- With the need to suppress bracken and to ensure that the new woodland has some open space habitats, there is a case for running some Highland cattle in the new woodland, always assuming this is practicable.

The east shore of Loch Ness prior to the removal (in 2001) of small areas of conifers which intruded into an extensive area of mainly birch woodland most of which forms a SSSI. Knockie Forest, 1990s, (Alan Stevenson)



Glen Moriston

Malcolm Wield, Sandra Paul, George MacLarty

Two native pinewood sites were visited, Bhlaraidh and Inverwick Forest. The former took the form of groves, groups and isolated pines into which spruce was planted in the 1950s. Some birch came up with the crop, but little pine. The crop was felled in 1996, since when FE has been waiting for natural regeneration. Unfortunately, there was a poor response, perhaps associated with the conditions of the shooting tenancy. However, there are now many 1 and 2 year-old birch on the ground and a light scatter of Scots pine close to seed trees, so the prospects are improving. The prospect now is for a birch-dominated woodland to develop with an admixture of pine and rowan. Western hemlock is also regenerating copiously, and will need to be removed.

Inverwick Forest covers 672 ha, all of which will be restored to native woodland. Currently it contains a mature native pinewood remnant associated with CHF (Lodgepole pine, Norway spruce, western hemlock) dating from the 1950s and 1980s. The pines are mostly slim trees in dense groups with no 'grannies'. Until recently there was little open space or diversity of stand structure, but a large swathe has lately been clear felled. An enclosure containing sapling birch and rowan demonstrates the impact of deer on regeneration, but the cleared plantations will provide an opening for deer control.

- There is an obvious lesson in the need for deer control. This suggests that wood-pasture systems in restoration projects will have to be carefully controlled, and that the introduction of pasturage may have to be delayed for a few years until natural regeneration is well established.
- The western hemlock will have to be rigorously removed before it becomes more firmly entrenched. It probably has the capacity to regenerate in the shade of any native stands. This emphasises the need to treat each alien species on its merits, Rhododendron and western hemlock being the two that must be eliminated.



Western hemlock regenerating in a native pinewood from which plantation conifers have been removed.

Bhlaraidh, Glenmoriston, 2001
(George Peterken)

Glen Affric

Malcolm Wield, Sandra Paul, George MacLarty

This large holding (14,535 ha) contains one of the largest and finest native pinewoods, and carries a multitude of designations. Substantial tracts of mature pine woodland occupy both sides of the valley, but also include significant stands of broadleaves, including mature oaks. Much of the ground was planted with spruce in the 1960s, but this has now been extensively cleared, leaving the mature pine and the younger pine that came up with the plantations. The older pines thus emerge after no more than 30-35 years encased in plantations, and in fact most are in reasonably good condition. Scots pine plantations were also established in the 1960s, but these are known from the 'compartment record' to be of local origin and will be retained. The forest now consists of large blocks and groups of mature pine that were not directly affected by planting, large clear cuts that will regenerate naturally, plantations, some of which are locally native Scots pine, patches of broadleaved woodland, and open moorland.

The restoration process has generated a

debate on the relative importance of deer and tree regeneration. The Strathglass Community Development Group (CDG) emphasises the importance of deer stalking to the local economy, and criticises fencing and the reduction in deer populations. They take the view that 'deer stalking is the major commercial activity in Upper Strathglass and as such must be given priority in considerations of overall land use' and fear that 'the FE tree planting/regeneration programme seems at the moment to exclude deer from its wildlife conservation policy and seems to take precedence over all other matters'. In striking a balance FE has taken into account the long years when the deer did take precedence over trees and regeneration. As *Finlay MacRae* (1980) recalled, when FC took over 'the woodland was progressing rapidly towards complete degeneration and eventual extinction' due to red deer and presumably sheep.

- Here again the rapid restoration from plantation to native woodland is likely to generate a very extensive even-aged component of the new woodland, mitigated mainly by a scatter of Scots pine inherited from before and during the plantation period. There will be a need to generate new young stands steadily through the 21st century to maintain large-scale diversity.
- At this scale there is every opportunity to design the forest as a mosaic of minimum intervention and managed stands. There

Western Glen Affric and Loch Affric showing the scale and diversity of the native woodland. (George Peterken, 2001)





seems no reason why this should not yield moderate amounts of pine and birch timber in future, especially as this will help to diversify large-scale stand structure.

- The managed stands could well include a variety of treatments, from group felling and restocking, through shelterwood regeneration to clear cuts. This could be initiated in the Scots pine plantations of c 30-40 years, and in fact an area has been treated to produce a mosaic of thinned stands, open ground and unthinned stands

on a 50m scale with the support of funding from the Millennium Forest for Scotland.

- The value of good records is illustrated here. The old compartment records, kept at the Fort Augustus office, confirmed that the planted pines were from local stock, and this has made a material difference to the planning for the new objectives.
- Evidently there is no soil map of the forest, nor is a MLURI map of potential natural woodland available. Both would help form a basis for zoning the new woodland.

Western Glen Affric and Loch Affric showing recovery of ground flora and some regeneration of pine, birch and juniper following enclosure by a deer fence in 1995. (Alan Stevenson, 2002)



Far left: South shore of Loch Affric looking north to Sgurr na Lapaich. The foreground was enclosed by a deer fence as part of an EU Life NATURE project in 1994. (Alan Stevenson 2001)



Left: Meallan, Glen Affric in 2001 showing plantation partially felled to 'recycle' in 1995 leaving old pine and attendant regeneration. (George Peterken, 2001)



Far left: The south side of Glen Affric showing regeneration dating from the 1960s and 1970s amongst old stands. 2001 (George Peterken)



Left: Doire Charnoch birch wood following removal of planted Sitka spruce and Lodgepole pine as part of the EU LIFE Nature/Millennium Forest for Scotland project. Western Glen Affric, 1991 (Alan Stevenson, 2001)

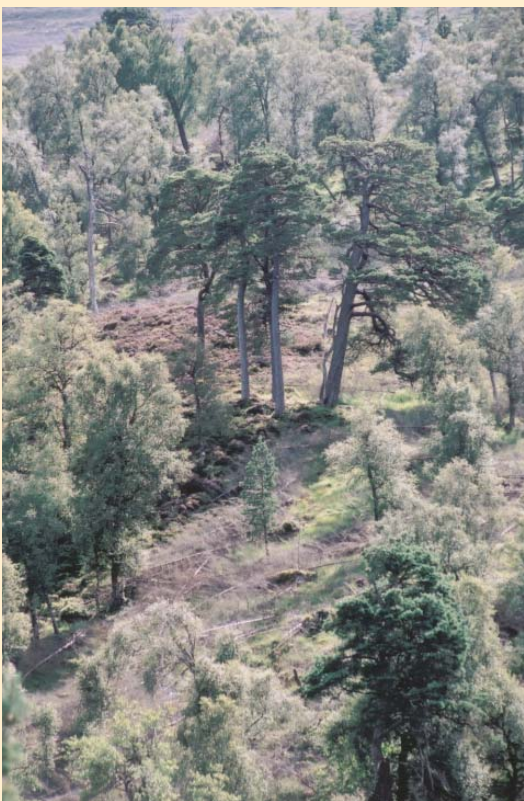


Top: Glen Cannich prior to the commencement of the Millennium Forest for Scotland Project which contributed to the removal of all of the 1960s plantations in the western part of the glen thus paving the way for an extension of the restoration area in the Beaully catchment.
1996 (Alan Stevenson)

Right: Old pine and birch retained following harvesting of Norway and Sitka spruce.
Guisachan, 2002 (Alan Stevenson)



Above and far right: Recent restoration by 'felling to recycle' (upper right) and harvesting (middle left). Remnant native woodland is present on the upper slopes and along the riverside, which has produced regeneration of pine and birch within the former plantation area.
Glen Cannich, 2002 (Alan Stevenson)



Right and far right: Spruce planted in the 1970s 'felled to recycle' in the late 1990s as part of the Millennium Forest for Scotland Project.
Cougie, 2002 (Alan Stevenson)



Far right: Area of plantation cleared the mid 1990s. Natural regeneration of birch and pine within the plantation were retained and now form a respectable native woodland.
Glen Cannich, 1999 (Alan Stevenson)

Glenmore Forest, Strathspey

David Jardine, Ken Sinclair, Jack Mackay,
Geoff Stone

During the 18th century this was described as the finest native pinewood in Scotland, but by 1978 the area of old-growth native pine stands within the forest fence (167 ha) was not much larger than the area of forest roads (129 ha) (Mowle 1979). This was one of three forests used as examples to illustrate a paper on large-scale forest management (Peterken *et al* 1992).

Glenmore Forest forms a link in a chain of forests in the Spey catchment that runs from Abernethy in the north, through Glenmore, Rothiemurchus, Inshriach and Glen Feshie. The FE holding comprised a fenced forest of 1718 ha in 1978, but it extends far onto higher ground. The fine old-growth pine stand of Ryvoan pass, was leased to the Scottish Wildlife Trust for many years, but FE took it back when the lease expired. By 1980, the bulk of the fenced forest comprised conifer plantations established from 1924 onwards. Within these plantations a scatter of old pines had been retained, and for many years significant tracts of valley mire remained unplanted, but in the 1960s Lodgepole pine was planted on the remaining mires.

During the last decade or so, this trend of events has been completely reversed. Huge tracts of plantation have been felled, leaving only the old Scots pine trees and groups, younger SP that came up with the plantations,

and the thin scatter of broadleaves, and this ground is being allowed to regenerate naturally. Mires have been opened up, and have revegetated strongly, though they remain semi-drained. Regeneration is not yet well-established: spruce are tending to regenerate with the native species, but they are being removed. Substantial Scots pine plantations dating back to the 1920s and later are being retained. At the same time, efforts have been initiated to extend the forest above the forest fence to form a more natural treeline, and this is helped by substantial regeneration of Scots pine on moorland above the Ryvoan old-growth and nearby plantations. Today, Scots pine is dominant in 55% of the ground.

The points made about management in the 1992 paper still seem apposite, and indeed are largely being implemented. [GFP is not claiming cause and effect!] Some points that arose during this brief visit are worth adding.

- The danger of a rapid transformation is that the forest will have very extensive even-aged stands in the future. Having made an impact, and having reduced non-native plantations to patches within what will be a native matrix, there is a case for completing the conversion at a more measured pace in order to generate a wider age spread.
- The 50-70 year old Scots pine plantations represent an important bridge between the pre-plantation old-growth and the forthcoming stands succeeding the plantations. We discussed how these should be treated, and agreed that the priority was to (i) relieve old Scots pine within the stand from immediate crown competition, and (ii) thin in a pattern that would allow some



A view east over Glenmore towards Ryvoan pass (behind the old granny pine). All of this view is being restored to Caledonian pine forest as part of a major project, which commenced in 1991. (Laurie Campbell)

An example of old pine embedded within spruce plantations. As edge trees the pine crowns have largely survived the competition. Glenmore Forest Park, 2001 (George Peterken)



Below: Old growth pine (in the background) which was never converted to plantation with a 1930s spruce plantation (in the foreground) which has been harvested to reveal dead and damaged old pine. Ryvoan, Glenmore Forest Park, 2001 (George Peterken)

plantation Scots pine to develop large crowns quickly. Dead wood would also be increased if some thinnings were left on site.

they were removed by past managers. Birch, aspen, sallows and rowan seem appropriate, and should be allowed to recover. There is an analogy here with Scandinavian pine-spruce forests, from which broadleaves have been evicted by foresters and overgrazing, thereby endangering specialist species dependent upon aspen and other broadleaves.

- A substantial effort has been put into recording baselines for monitoring, which is admirable, and there are comprehensive monitoring plans in the Inshriach Plan. It



Above right: A recent spruce clearance that has revealed stunted pines on a small valley mire. The background shows an adjacent private lodgepole pine plantation which represents a threat to native woodland restoration. Another threat, spruce regeneration can be seen beside the forest road in the foreground. Glenmore Forest Park 2001 (George Peterken)



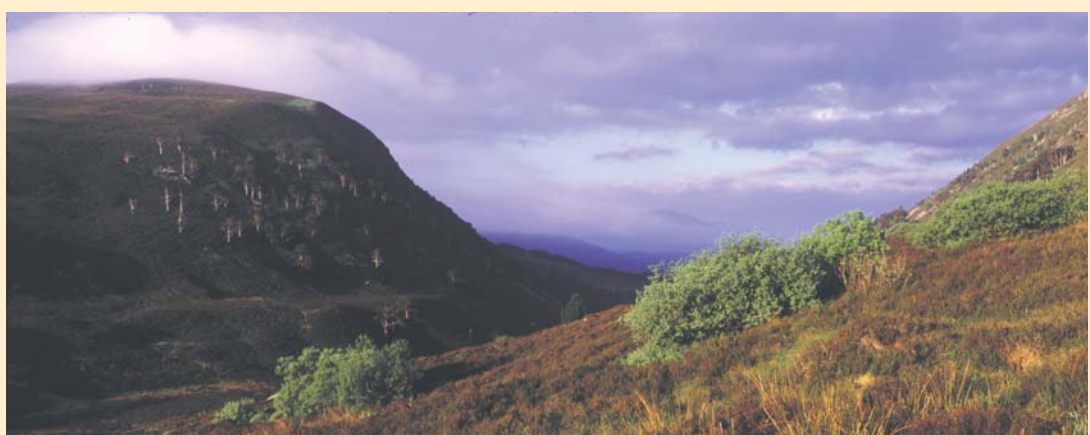
Above far right: Natural regeneration of Scots pine above the former plantation is tending to form a more natural treeline. Ryvoan, Glenmore Forest Park, 2001 (George Peterken)

- Old Scots pine within plantations have suffered high mortality, and many survivors have only small living crowns. These will be retained as snags and seed sources. Snags stand for at least 50 years and take longer to rot completely, but there is still likely to be a large-timber/dead-wood habitat bottleneck through the 21st century about which little can be done.
- There seems no reason why part of the forest should not be zoned for semi-commercial Scots pine timber production, regenerating eventually under a shelterwood of retained Scots pine. Access seems good, and harvesting will facilitate the development of a normal age-class distribution. The Cairngorms Partnership has recently published guidance on the growth of timber-quality pine (Worrell and Ross 2001).
- Glenmore always seems unusually deficient in native broadleaves, evidently because

would be interesting to repeat Alan Mowle's 1978 survey in both forests to demonstrate the extent of the transformation.

- Large though it is, Glenmore is still subject to influences from neighbouring forests. Perhaps the greatest point of concern seen was the Lodgepole pine in Rothiemurchus that stands next to the Glenmore boundary.
- The whole belt of forests from Abernethy to Glen Feshie is now likely to be treated as native woodland. This is one of the few places where a forested National Park on a North American scale is attainable in GB. Settlement patterns probably preclude a 'Yellowstone' approach to management – which includes allowing almost free rein to natural fires – but the same general effect can be generated by zones of Minimum Intervention and zones of shelterwood-based utilisation of native trees, combined with retention and restoration of mires.

Right: The strategic link between Glenmore and Abernethy forests is now starting to show signs of woodland regeneration. (Niall Benvie)



Darrochwids Project, Huntly

Norman Davidson, Alan Stevenson

This comprises 500ha of afforestation with native woodland on farmland on the margins of a 5000ha plantation forest. The district is, like the North York Moors, characterised by the juxtaposition of intensive farming and conifer afforestation on moorland. The scheme represents not only a major transformation of the ground to be afforested, but a significant change in the environment of the existing plantations, which are almost entirely conifer-dominated, first rotation stands devoid of native species.

streamsides, and established secondary woods of sycamore and spruce. The soils and flora have been thoroughly surveyed.

This is an extremely ambitious project, and not just because it is large. The aim is to create native woodland with its associated biodiversity almost from scratch, and with only limited indications of the nature of former natural woodland in the district. The development of the 20th century conifer plantations into worthwhile wildlife habitats with some uncommon species demonstrates what is possible with 'passive' restoration, but in the present instance there are plans (if funded) for introduction of ground flora, epiflora and saproxylic species. The project is largely supported by the Scottish Forestry Alliance funded by BP, to whom it represents substantial carbon sequestration.

- The native tree species that seem worth planting include alder, ash, aspen, birches, hawthorn, hazel, oaks, rowan, whitebeam

*Coyachie farm which comprises mainly pasture and conifer shelterbelts which will be the subject of a 300ha new native woodland project. The project will contribute towards the development of an extensive habitat network in the adjacent 5000 ha Clashindarroch forest (in the background).
(George Peterken, 2001)*



The new woodland falls into three blocks, one of which is over 300ha. This large block is distributed around a long valley, from which there will be a phased withdrawal of farming. Much of the land is under ley grassland, and this includes the floodplain, but the land has several features that will bring an inheritance of more natural vegetation to the new woodland, including mature birch woodland, semi-natural grassland on banks, partially wooded

and wych elm, in various combinations of mixed deciduous woodland. Ash was growing well in nearby field margins on somewhat lower ground. Large wych elm beside a stream appeared to be free of Dutch elm disease.

- On a secondary, isolated site like this, one could afford a liberal interpretation of 'native' to include sycamore.



The Darrochwoods Project launch day at Coynachie farm showing areas of native woodland, and conifer afforestation. The whole valley will be the subject of a native woodland project supported by the Scottish Forest Alliance funded by BP.
(Alan Stevenson, 2002)



- The old birch Wood of Drumferge had been heavily grazed, but it included some hazel. This is best treated as ancient semi-natural woodland, i.e., no enrichment planting, at least initially.
- The small patches of semi-natural grassland appeared to have a moderately rich meadow flora. It would be important to maintain these as sources of diversity for open space habitats elsewhere within the scheme.
- The woodland flora on the ground is inevitably limited, but included *Chrysosplenium oppositifolium*, *Viola riviniana*, and *Luzula pilosa* close to a stream. It would be worth taking advice on likely natural colonisation and need/opportunities for introducing a woodland flora.
- It would be worth looking at 19th century OS maps, which may give some insight into vegetation that preceded the intensive farming.
- The large site represents an opportunity for a large, wood-pasture, native woodland. The land is fertile and would afford good pasturage. The ground vegetation of new woodland on fertilized soils will need some disturbance and suppression if it is not to develop into a 500ha nettle bed. Continued pasturage would help maintain existing semi-natural grassland.
- Irrespective of whether pasturage forms part of the operation, the best approach seems likely to be based on planting most of the existing intensive farmland, but leaving existing semi-natural woodland and grassland unplanted. Open spaces along riparian corridors and flush zones would be desirable.
- It would be valuable to maintain from the outset a comprehensive record of the progress of the project and the ecological development of the new habitats. There is very little research data on new woodland development in Scotland, save for the Rum project, which is of course on quite different ground - moorland in an oceanic climate.