

## Chapter (non-refereed)

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# Opportunities for vegetation management in plantation forests

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## Summary

Vegetation of upland forests is mostly found in the unplanted parts. There are few truly woodland species even under trees. Ferns, grasses, sedges and rushes predominate. In lowland areas there is more bramble; woody plants are far more vigorous. People certainly value wild vegetation in woodland, and complain if they see too much bare ground. Vegetation provides variety of colour and height. Rare plants are found chiefly in the lowlands, with dune forests pre-eminent. One management option is introduction of species, but is rarely justifiable, except for native trees and shrubs. The general environment of the forest can be improved by increasing the amount of ground vegetation. Whole-tree harvesting is advantageous in this respect, as are pines and larches. Scrub should be tolerated along roads and streams; but open areas, which may require mowing, are equally valuable. Roads should be allowed to become grassy where not in heavy use.

## 1 Introduction

### 1.1 Vegetation and habitat

Vegetation, for the purposes of this paper, is defined as wild vegetation. In strict logic, a crop of trees is vegetation; but crops are managed quite differently from other vegetation. Plantations of uneconomic broadleaves are also not considered to be vegetation, although their self-sown or suckering progeny are.

Wild vegetation varies greatly according to the habitat in which it is found. In a production forest, the main vegetation habitats are forests blocks, rides, stream-sides, road verges and road surfaces. There are always other unplanted habitats, such as quarries, rock outcrops and the vicinity of buildings.

Sceptics and green activists often say that there is no vegetation in forest blocks. If the crop is unthinned Sitka spruce (*Picea sitchensis*) older than 15 years, then the sceptics are right. Careful searching will, in fact, always reveal a few patches of greenery; but, except for finding out what may increase later, there is little point in looking for vegetation under unthinned spruce. Even bracken (*Pteridium aquilinum*) is killed. The chief survivor is bilberry (*Vaccinium myrtillus*). After thinning, there is always some invasion of rosette-forming ferns, though not of bracken. Heavily thinned spruce (*Picea* spp.) on favourable sites does eventually develop typical woodland ground vegetation; but, on most sites, the crop is felled or blown down before this development can happen.

Thus, the least favourable type of silviculture for vegetation is short-rotation Sitka spruce in the uplands. There is a period of only 15 out of 55 years during which non-crop plants can thrive. Heavy deposition of brash may shorten this period still further.

At the other extreme are pine (*Pinus* spp.) and larch (*Larix* spp.) grown on fertile lowland or semi-upland sites. Typically, the vegetation under mature crops is bracken and bramble (*Rubus fruticosus*) in the field layer, with a storey of bird-sown woody plants such as elder (*Sambucus nigra*) and rowan (*Sorbus aucuparia*). Here, we can indeed look for vegetation to manage. It will rapidly become dense when the trees are felled, and may compete with the next crop. Only during the rather brief thicket stage is it temporarily in abeyance.

Unplanted ground is always vegetated. Here, the main ecological characteristic of the forest environment is the low intensity of mammalian grazing. There is also appreciable shading along roads and rides when the trees are mature. In the absence of much grazing, small plants are rapidly crowded out, and there is a general ecological succession towards tussock grasses, ericoid shrubs, thorny scrub and seral woodland.

### 1.2 Species of the forest

Many plant species that are found in woodland are not specifically woodland plants. The vascular plants of Cwm Ddu in Beddgelert Forest number only 47 species (Table 1); bryophytes are more numerous. Of 12 grasses, only creeping soft-grass (*Holcus mollis*) is at all a woodland plant. It is also frequent on moorland. There are 9 sedges (*Carex* spp.) and rushes (*Juncus* spp.); none is a woodland plant, in the sense that it normally grows in shade, or is more likely to be found in a wood than elsewhere. Of the 12 herbs, only rosebay willowherb (*Chamerion angustifolium*) and foxglove (*Digitalis purpurea*) are woodland plants. The 5 ferns (which do not include bracken) are all strongly favoured by woodland. All the woody plants, except heather (*Calluna vulgaris*) and gorse (*Ulex europaeus*), are characteristic of woodland.

With the possible exception of holly (*Ilex aquifolium*), bramble and willowherb, all of which have excellent dispersal, the Beddgelert flowering plants would all have been present in the basin before afforestation. One of the ferns, scaly male-fern (*Dryopteris pseudo-mas*), may perhaps have been absent; the rest would certainly have occurred in small quantity on steep banks. Thus, afforestation has resulted in little immigration of new species to the site. Small plants,

Table 1. Vascular plants of Cwm Ddu, Beddgelert Forest

WOODY PLANTS		
<i>Betula pendula</i>	Birch	Scattered seedlings
<i>Calluna vulgaris</i>	Heather	Scattered seedlings
<i>Ilex aquifolium</i>	Holly	Scattered seedlings under spruce
<i>Picea sitchensis</i>	Sitka spruce	Much natural regeneration
<i>Rubus fruticosus</i>	Bramble	Scattered plants, not abundant
<i>Salix cinerea</i>	Sallow	Scattered seedlings
<i>Sorbus aucuparia</i>	Rowan	Scattered plants
<i>Ulex gallii</i>	Gorse	Steep south-facing slope; some adults, much regeneration from buried seed after clearfelling
<i>Vaccinium myrtillus</i>	Bilberry	Very common under trées
GRASSES		
<i>Agrostis capillaris</i>	Common bent	Abundant, especially soon after clearfelling
<i>A. vinealis</i>	Brown bent	Abundant but less than <i>A. capillaris</i>
<i>Anthoxanthum odoratum</i>	Sweet vernal-grass	Common, especially on verges
<i>Deschampsia cespitosa</i>	Tufted hair-grass	Common and locally abundant
<i>D. flexuosa</i>	Wavy hair-grass	Abundant after clearfelling
<i>Festuca ovina</i>	Sheep's fescue	Frequent in clearcuts
<i>F. vivipara</i>	Viviparous fescue	One plant found in a clearcut
<i>Holcus lanatus</i>	Yorkshire fog	Widespread in grassy places
<i>H. mollis</i>	Creeping soft-grass	Very locally abundant, mainly reliant on vegetative spread
<i>Molinia caerulea</i>	Purple moor-grass	Frequent
<i>Nardus stricta</i>	Mat-grass	Scattered individuals
<i>Poa annua</i>	Annual meadow-grass	Common on roads, rare elsewhere
SEDGES AND RUSHES		
<i>Carex binervis</i>	Green-ribbed sedge	Abundant regeneration from buried seed
<i>C. echinata</i>	Star sedge	Frequent, especially in moister places
<i>C. ovalis</i>	Oval sedge	Scattered regeneration from buried seed
<i>C. pilulifera</i>	Pill sedge	Frequent
<i>Eriophorum vaginatum</i>	Hare's-tail cotton-grass	Germinating from buried seed, scarce
<i>Juncus bulbosus</i>	Bulbous sedge	Frequent in wetter places
<i>J. effusus</i>	Soft rush	Abundant in grassy places
<i>J. squarrosus</i>	Heath rush	Frequent regeneration from buried seed
<i>Luzula multiflora</i>	Heath woodrush	Very scarce
HERBS		
<i>Cardamine flexuosa</i>	Wood bittercress	Roadside ditch in one place
<i>Cerastium fontanum</i>	Common mouse-ear	Roadsides
<i>Chamerion angustifolium</i>	Rosebay willowherb	Frequent, not abundant
<i>Digitalis purpurea</i>	Foxglove	Frequent, especially by roads
<i>Epilobium brunescens</i>	New Zealand willowherb	By road
<i>Galium saxatile</i>	Heath bedstraw	Abundant in grassy places
<i>Montia fontana</i>	Blinks	Roadsides and damp old quarry floor
<i>Potentilla erecta</i>	Tormentil	Scattered in grassy places
<i>Rumex acetosella</i>	Sheep's sorrel	Abundant on bare ground
<i>Sagina procumbens</i>	Common pearlwort	Roadside and ditches
<i>Stellaria alsine</i>	Bog stitchwort	Wet roadside
<i>Veronica serpyllifolia</i>	Thyme-leaved speedwell	Roadside
FERNS		
<i>Athyrium filix-femina</i>	Common lady-fern	Scattered in basin
<i>Blechnum spicant</i>	Hard fern	Frequent throughout plantations
<i>Dryopteris pseudomas</i>	Scaly male-fern	Scattered
<i>D. dilatata</i>	Broad buckler-fern	Abundant
<i>D. filix-mas</i>	Common male fern	Scattered

such as sundew (*Drosera* spp.) and bog asphodel (*Narthecium ossifragum*), would doubtless have been present in flushes before afforestation, and have now gone.

Cwm Ddu is on a peaty podzol and the flora is small. For comparison, a single quadrat on brown earth in a

clearfelled part of Gwydyr Forest contained 32 kinds of vascular plants; a square kilometre in Clocaenog Forest contained 108 vascular plants; and from 42 sampling stations in Newborough Forest, 160 vascular plants were recorded. At Newborough, the crop was pine, and a distinctively woodland flora was beginning to develop 30 years after planting, including rosebay

willowherb, foxglove, creeping soft-grass, red campion (*Silene dioica*), white bryony (*Bryonia dioica*), black bryony (*Tamus communis*), wood sage (*Teucrium scorodonia*), dune helleborine (*Epipactis dunensis*), common twayblade (*Listera ovata*), honeysuckle (*Lonicera periclymenum*), ivy (*Hedera helix*) and elder. The majority of the non-woodland plants were common species of wayside and dune.

### 1.3 Structure of forest vegetation

In an upland forest such as Beddgelert, the structure of the ground vegetation is simple. In forest blocks, there is abundant grass, rush and sedge during the later part of the light phase between clearfelling and canopy closure. Woody plants are poorly represented unless there is nearby standing birch (*Betula* spp.), which seeds itself abundantly into clearcuts. Bramble and rosebay willowherb do not flourish. The only colourful herbs of any note are bedstraw (*Galium* spp.) and foxglove, with just a smattering of tormentil (*Potentilla erecta*).

In the lowland parts of Gwydyr Forest, by contrast, there are always nearby broadleaved trees. In the quadrat mentioned above, there was no ground vegetation when the Douglas fir (*Pseudotsuga menziesii*) crop was still standing. Five years after clearfelling, it was dominated by bramble, gorse, birch and willowherb, which formed a tangle so dense that walking was difficult.

Duneland is an exception to the general trend towards complex structure in the lowlands. In Newborough Forest, planted blocks on young dunes are very poor in species, and are notable chiefly for their abundance of moss, with scattered dewberry (*Rubus caesius*) and willowherb. As the dunes get older, the soil gradually becomes more fertile, and lime is leached out. At this stage, the ground becomes suitable for bramble; ferns become more prominent; and there are the beginnings of a woody understorey.

The same general structure is found on verges of forest roads. These are heathy, grassy or mossy in the uplands, brambly in the acid lowlands, often with much bracken, and grassy or mossy in young duneland.

## 2 Influence and value of vegetation

### 2.1 Effects of vegetation

One effect of vegetation is to suppress growth of young trees. In the uplands, the main weed problem is perhaps natural regeneration of Sitka spruce. I do not know whether heather presents a serious second-rotation weed problem anywhere in upland Wales. Much of the area was grassy before afforestation, so that the overall quantity of heather is quite small. On brown earth soils, bramble and bracken can create difficulties if replanting is delayed. Although bracken often delays the invasion of broadleaved trees on unforested ground, it is regarded by Brown (1975) as a

relatively friendly species, which may benefit young transplants by suppressing other competitors such as grasses.

After clearfelling, ground vegetation takes up nutrients from the soil, and certainly has the effect of reducing nitrogen losses. Phosphorus is much less soluble, and is unlikely to be lost even without vegetation. Whether potential nitrogen losses are ever likely to represent a significant economic loss in the British climate is an open question. Certainly, no-one has yet recommended sowing grass seed at clearfelling in order to get a quicker rate of greening up. In the United States, grass is sometimes sown after forest fires to reduce erosion; but not, so far as I know, to retain nutrients.

Vegetation has a major influence on animals, by providing food and shelter. The effect of the crop cycle on birds is now relatively well documented (Bibby *et al.* 1985). Thomson (1986a) demonstrated a rapid increase of field voles (*Microtus agrestis*) following clearfelling in Beddgelert Forest, doubtless in response to an increase in ground vegetation, even though greenery formed less than 50% of their diet (Thomson 1986b). Being sheltered from predators by brash, they could perhaps forage more widely than in grassland, and reached an estimated density of 31 animals per hectare when ground vegetation was still sparse.

In the lowlands, the vegetation of rides and verges sustains viable populations of numerous invertebrates. Butterflies are the most valued, and require chiefly shelter, warmth and the right food plants.

### 2.2 Value of vegetation

Through its effect on crops, soils and animals, forest vegetation has value, sometimes negative, to many people. It also has value in its own right. Almost all of us will agree that a forest without wild vegetation would be a dreary prospect. Indeed, one of the delights of forest landscapes compared with those of intensive agriculture is the abundance of wild plants.

It is pertinent to enquire what we value most in such landscapes. As with all aesthetic questions, people's responses will differ in detail. Let me list some of the things that I like to see in vegetation: accents of colour, variety in height, vistas into enclosed worlds, and a sense of the abundance and force of nature. Smells are also to be valued, but the best ones are normally produced by the crop itself.

Colour accents can be produced by flowers, foliage, and, in a few species such as Japanese larch (*Larix kaempferi*), by twigs. It is a sad fact that British flowers are really less colourful than those of many other countries, as a result of our dull, moist summers. Colourful flowers are an advertisement to pollinating insects, and are most effective on still days in bright sunshine. Thus, our forests lack many of the pretty

herbs that one can see in Sweden and Switzerland. In Beddgelert Forest, we have to make do with foxglove, willowherb, bedstraw, tormentil, and little else. Heather, especially bell heather (*Erica cinerea*), and gorse are major contributors of colour elsewhere. Only in the warmest lowlands are verges adorned with really abundant herbs. Even there, some of the most beautiful effects, such as viper's bugloss (*Echium vulgare*) and evening primrose (*Oenothera erythrosepala*) along roads in Newborough Forest, are achieved by deliberate cultivation.

If floral colour is generally poor in the uplands, foliage accents are often beautiful. Birch trees are perhaps the most generous contributors, providing brilliant pale greens in spring and fine yellows in autumn. Rowan and holly berries are almost as good. Even bracken is a fine sight in autumn, commemorated as 'goch' in countless Welsh place names.

Vegetation does not always provide variety in height; there may be little except grass and sedge. However, woody plants such as bramble, broom (*Sarothamnus scoparius*) and willow (*Salix cinerea*) always provide interesting height contrasts. This is especially true if they are arranged like a good shrub border, with the taller elements at the back, and herbaceous plants in front.

Vistas into enclosed worlds are not entirely the result of vegetation. No doubt speleologists also delight in such sights. Nevertheless, small clearings among tall forest, gaps in high banks of bushes, sunny verges alongside twisting forest roads, mossy ravines with rushing water, and well-illuminated ferny undergrowths beneath widely spaced columns of trees are just the sort of scenes that are most pleasant to meet in forest country. It is their enclosure that makes them delightful, and their vegetation is an essential part of their attraction.

A sense of the abundance and force of nature is provided by carpets of herbaceous plants and thickets of young trees. On the whole-tree harvested plots where I have studied vegetation for many years in Beddgelert Forest, there was in 1986 a splendid display of flowering wavy hair-grass (*Deschampsia flexuosa*). Waving in the wind, the ripe grass flowers were almost like a cereal crop in appearance, only more elegant. Likewise, in Newborough Forest, a sheet of wild pansies (*Viola tricolor*) flowering on ground from which turf had been stripped in an unplanted dune slack created a remarkable visual effect. Young broadleaved trees regenerating vigorously into forest clearcuts are certainly pleasing to the layman's eye, even if they spell future weeding for the forester.

In addition to its aesthetic value, which is great, vegetation also has some value as a product. Brambles yield blackberries, at least when they get plenty of

sun; bilberries are best where grazing is light, as along roads in Clocaenog Forest; raspberries (*Rubus idaeus*) are pleasant to find, if rarely numerous; some woodlands produce moss for lining baskets; and edible fungi are cherished by some enthusiasts. Yet, although these products are not negligible, they are small in value compared with aesthetic and animal products of forests.

### 2.3 Nature conservation

In production forests, nature conservation is necessarily not the main objective. Indeed, there is generally little vegetation that is of special value. Most conservationists prefer fragments of the past that carry a long history, such as peat bogs and ancient woodland. These are, so to speak, ancient monuments. If they are turned over to production forestry, then the link with the past is cut, and they become modern ecosystems. When some of our production forests have themselves seen a long history, then they too will come to acquire features that are interesting to conservationists.

If the vegetation of various forests is compared for nature conservation value, then dune forests must rank high, and Culbin Forest highest. Here, there is a remarkable selection of rare northern flowers, including the wintergreens, one-flowered wintergreen (*Moneses uniflora*), serrated wintergreen (*Orthilia secunda*) and common wintergreen (*Pyrola minor*), and the orchids, coralroot orchid (*Corallorhiza trifida*), creeping lady's-tresses (*Goodyera repens*) and lesser twayblade (*Listera cordata*). According to McCallum Webster (1977), they become abundant for a while, but, owing to thinning and felling of the pines, are never permanent.

This description emphasizes an important feature of production forests, which makes them a difficult habitat for some plant species, namely that they are constantly changing, and plants may lack a means of survival through the dark phase of the crop cycle. Forests are not permanent like grazed meadows. It is notable that both wintergreens and orchids are dispersed by minute dust seeds, and are dependent on mycorrhizal associations for survival. Here in Wales, two species, the common wintergreen and the round-leaved wintergreen (*P. rotundifolia*), have invaded Newborough Forest on Anglesey. The dune helleborine (*Epipactis dunensis*), possibly not present before afforestation, has now become abundant. These events have occurred in less than 40 years.

Another important feature of dune forests is that they are planted with pines. There is almost no opportunity for a good woodland flora to develop under spruce and fir (*Abies* spp.) in the uplands, because they are windthrown too soon. Indeed, so far the only colonists of note have been ferns, aided by their windblown spores. In principle, forest blocks with a short crop rotation ought to be a good habitat for flowering plants

with long survival of buried seed. For, if there is not too much brash, and if there is little vegetation on the forest floor at the time of clearfelling, then the floor makes a good seed bed. In Beddgelert Forest, foxgloves, sedges and rushes have benefited from this fact, most notably after whole-tree harvesting, but no formerly rare species have spread in clearfelled spruce forests. They show none of the propensity of dune pinewoods to develop a specialist flora.

The fact that forest blocks in spruce woods do not develop an interesting flora does not mean that areas of upland forest are lacking in interesting plant species. It does mean that such plants should be looked for in unplanted parts of the forest, or perhaps in parts that are reserved for larch, pine or broadleaves. Even in a dune forest such as Newborough, most of the interesting plants are found on verges or in unplanted dune slacks. Likewise, in Gwydyr Forest, old quarries and lead mines are valuable habitats, as are lake margins and crags.

I wish that I could say more about vegetation in relation to conservation of animals. The existence of scrubby areas with plenty of bramble must surely improve the habitat for many animals by providing cover and alternative sources of food. On the other hand, some small mammals can exist in the darkest spruce plantations, where vegetation other than moss is lacking. In unfelled parts of Beddgelert Forest, Thomson (1986a) found densities of 6 wood mice (*Apodemus sylvaticus*) and 16 bank voles (*Clethrionomys glareolus*) per hectare. These creatures lived chiefly on spruce seeds, with an admixture of some arthropods. In autumn, fungi formed a large part of their diet (Thomson 1986b). The existence of this alternative seasonal diet must be providential for these rodents, because the season of seedfall runs from October to April, but the main seedfall often does not start until December (Mair 1973).

### 3 Management

#### 3.1 Introduction of species

Foresters are no strangers to making species introductions, but often restrict themselves to crop species and a few ornamentals dotted along the forest edge. Newborough Forest was exceptional. Well over 100 species were deliberately introduced to the site, most of which failed immediately. Some, such as *Yucca gloriosa*, thrived where they were planted, but did not spread; this species is not truly naturalized nearer than northern Italy (Tutin *et al.* 1964–80). Of many herbs tried, white stonecrop (*Sedum album*) and evening primrose are now locally abundant, but most planted herbs died out. Broom (*Cytisus scoparius*) and Himalayan cotoneaster (*Cotoneaster simonsii*) have spread to a small extent, and may eventually become fully naturalized. Sea buckthorn (*Hippophae rhamnoides*) was introduced from south Wales, and has proved so successful that efforts are now being made to control it. It is a native British plant in its right habitat, regarded

by many as dangerously invasive. There is no reason to be too sentimental about our native flora; exotics may often be preferable.

In retrospect, it would probably have been better if nothing had been deliberately introduced to the Newborough dunes. Sea buckthorn is a threat to the nearby nature reserve. Likewise, in the uplands, foresters would be ill advised to plant rhododendron (*Rhododendron ponticum*) for ornament along verges. Species that are likely to invade nearby lands should be avoided.

On the other hand, there can be no objection to introducing plants that are already present in the vicinity, provided that they have a valuable contribution to make. On the barer uplands, deliberate planting of birch and rowan should enable populations of these trees to increase more quickly, so that they should soon become a permanent part of the forest scene. Why wait? They would get there in the end.

Likewise, if a woodland flora is urgently desired in a new forest, there should be no objection to introducing local species that are thought suitable. Purists will object, saying that species should be allowed to find their own way in over the course of time. However, it is absurd to regard all forestry plantations as experiments in island biogeography. If a species is really needed, then it should be brought in, but let us be clear about what we want.

#### 3.2 Crop management

In the present state of knowledge, it is difficult to be sure about long-term effects of crop regimes on vegetation. The first rotation is only the beginning. Ellenberg (1978) says that, in central Europe, it generally takes 3 rotations of pine forest before a woodland flora is properly developed, but that with spruce only one rotation is necessary. Certainly, spruce in Britain has the effect of killing out the existing ground vegetation more effectively than pine during the thicket stage; but, with our short rotations, spruce forest scarcely develops any flora at all.

To promote woodland plants, some areas permanently devoted to species other than spruce can help to act as a reservoir. In valley bottoms, spruce grown on long rotations with heavy thinning may also be a possibility. But we should remember that, in the western uplands, even the native woodland flora is poor. Western forests may be beautiful, but they will not develop a rich, specifically woodland, flora except on dry soils in the lowlands.

Not only are species other than Sitka spruce likely to be more favourable for the woodland flora, but they also produce less brash, so that there is more open ground to support vegetation regrowth after clearfelling. Even more effective at opening up ground is whole-tree harvesting. Observations in Beddgelert

Forest suggest that whole-tree removal results in about 5 years' advancement of the greening-up process. The forest floor under larch is already green by the time the crop is felled, and the amount of brash is small. A similar or even larger advancement of the greening process may result.

If the 'light window' between rotations is 15 years, and if it takes about 2 years to green up with whole-tree harvesting (Hill *et al.* 1984), then this gives 13 green years with whole-tree harvesting, as opposed to only 8 years if the brash is left on the ground. In walking about a normal forest, the difference will be substantial, with perhaps 60% more vegetation found in clearcuts from larch and whole-tree harvesting than after brashy Sitka spruce.

The size and arrangement of felling coupes must also have some effect on the vegetation within them. Invasion of plants from outside is not negligible, especially of trees such as birch and willow. Most plants, however, have poor dispersal, over only a few metres, so that edge effects are small. True woodland plants with poor dispersal are the most likely to benefit from small felling coupes. On the other hand, wintergreens and orchids are well dispersed by small seeds, and are probably indifferent as to coupe size.

### 3.3 Vegetation management

The most ambitious form of vegetation management, now being implemented in Beddgelert Forest, is the designation of parts of the area to 'permanent forest structure'. Here, the rotational clearfelling regime will be abandoned, and the forest will be allowed to regenerate naturally. There can be no doubt that this practice will create visual interest, though because of the general floristic poverty of western woodland, the ground flora will not necessarily develop any intrinsic conservation value.

Less ambitious but also achieving good visual effects is to tolerate scrub along roads and streams, and not to 'clean' planted crops too assiduously. These relatively lax management practices will surely lead to a great enhancement of the visual interest of forests, by providing the colour accents and height variation that strictly regimented verges and forest blocks lack.

Another form of laxity that certainly creates attractive vegetation for the visitor is reduced attention to road

maintenance. Grassy roads are really very pleasant, but are often eliminated by frequent regrading. Clearly, roads should not be so bad as to damage the vehicles that drive along them, but, from the point of view of vegetation, they are better with a minimum of maintenance.

On roads, maintenance is normally frequent enough to suppress woody vegetation and coarse grasses. On verges, however, mowing may be necessary to suppress scrub. Wide mown verges are a special and interesting type of habitat. They encourage flowering herbs and thereby promote a valuable element of colour. In Newborough Forest, not only mowing but also cultivation is used to sustain diversity.

Rivers and streams perhaps present more of a problem than roads, in that, if left unmanaged, their banks will all become scrubby. Their plant life is certainly diminished if there is uniform shade along them. Also, intermittently grassy streamsides are more pleasing to the eye than totally scrubby ones. Both here and on roads, zones of scrub suppression should help to avoid the impression that the forest is closing in on the visitor from all sides.

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