

Forestry Expansion –
a study of technical, economic
and ecological factors
British Forestry in 1990

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Forestry Commission

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THE LONG DECLINE

Pliny, who sailed round Britain with the Roman fleet, described the northern part of these islands as being 'a land of clouds and rain, of bogs and morasses, with a great extent of forest'. The forests he saw were somewhat species-poor variants of both the northern temperate broadleaved forest and the northern coniferous forest, two forest zones that stretch in great adjacent irregular belts round the globe. By 1773, however, Samuel Johnson was to complain that Judas would not have found a tree in Scotland on which to hang himself. Between these two dates, and in the Highlands for some decades afterwards, the history is one of a continuing decline in forest cover.

The coniferous forests seen by Pliny were restricted to northern, upland or very infertile sites, whereas the lowlands and river valleys were occupied by mixed broadleaved forests within which, particularly in northern regions, would be found isolated stems or stands of Scots pine. Although the British broadleaved forests were very poor in shrub and herbaceous species when compared with equivalents in Europe, Asia and North America, the tree layer contained representatives of most of the genera found elsewhere. Oak, ash and elm were common everywhere, lime, rowan and whitebeam were locally important as were alder and hazel where drainage was poor or rainfall high. Birch was found at altitude or on sandy soils, particularly at the intergrade between the broadleaved and coniferous forests and again at the tree line. Relatively poorly represented were the poplars, excluding aspen, cherries and, in particular, the maples, while beech was restricted to the south-east of England.

By contrast, the British variant of the coniferous forest was limited to a single tree species, Scots pine (the only other conifers native to Britain are yew and juniper). The spruces and larches so common elsewhere had not returned after the ice age (although Norway spruce was certainly present before the ice age) and similarly the high sub-alpine association of spruce and fir was totally absent. It can be speculated that in the uplands, or on northern aspects on poor soils, there was a cyclical succession, fire and wind-blow permitting, of pine followed by birch and then heather and so back to pine, the open

heather replacing the spruce that is found in this succession in other regions. In the extreme north, or at altitude, it seems likely that birch dominated with pine being relatively infrequent.

These forests were the home of deer, wild pig, squirrels, wolf, badger, beaver and so on, many of which were hunted by the first humans to inhabit the area after the retreat of the ice. Soon, however, there was a move from a hunter gatherer life-style to shifting agriculture. Such agriculture tended to be concentrated on infertile freely draining soils, such as those of the Downs or along the Moray Firth, where trees were small, and so easily felled, drainage good and the light soils were readily cultivated by primitive implements. Fertility, of course, was dependent upon the organic matter that had accumulated under the forest and on the ash produced by the burning of the trees. This fertility was short lived and soon the farmer would move on allowing the forest to reinvade behind him. Such agriculture was still being practised in Finland as recently as the closing years of the last century. Although primitive this is a sophisticated agricultural system that need not be exploitive and is ecologically stable, provided that human populations are not so large that the cycle becomes too rapid to enable sites to recover their fertility before they are again cleared.

Primitive agriculture, based on shifting cultivation, is unlikely to have been a major factor leading to the destruction of British forests. Rather this was to accelerate with the development of settled agriculture entailing permanent cultivation of the fertile soils of the lowlands and river valleys. With growing population, and the advent of improved iron tools, clearance of the lowlands would have been fairly rapid. As populations rose so too did the demand for the products of the forest, notably firewood (often as charcoal) but also building material and animal fodder. Such harvesting of forest products would probably change the character of the forest but not lead to its destruction. If a forest is to become permanently cleared natural regeneration must be prevented, or the naturally regenerated seedlings consistently destroyed, over such a prolonged period that those trees that may act as a seed source die from old age. The agencies that lead to such destruction, other than permanent cultivation, are fire and grazing.

Fire may have been used in many upland forests to displace game or improve grazing and, it is said, to destroy the natural cover for the wolf. From an early date the sheiling system (from Norse words meaning temporary shelter) was probably much used, domestic animals being taken to the forests for summer grazing when the cleared lower ground was given over to the production of arable crops and winter feed. This system is still in use in Alpine regions to this day. Continued heavy grazing, whether fire is used or not, effectively prevents the regeneration of the forest which grows old and dies, to leave open moorland and heathland upon which, in our maritime climate, peat frequently develops.

Thus, by the middle ages much of the lowlands of Britain had been cleared for agriculture and the forests on the lower slopes and foothills were degenerating, largely because of grazing. Over subsequent centuries there was increasing demand for wood as fuel for industries such as dye works, glass works and production of sea salt; to which has to be added the demands of the growing urban population for firewood and charcoal and, of course, the increasing demands for ship building and iron smelting. None of these demands entail

destruction of the forest unless, as so often happened, grazing animals were introduced into the cleared areas. A classic example is the destruction of the mixed broadleaved forests in western Scotland where the charcoal burners supplying the local iron works (displaced to Scotland by laws preventing their operation in England) were followed by shepherds.

The forests of the Scottish Highlands alone survived into the eighteenth century on any scale. These, however, were to fall prey to full scale industrial exploitation with the opening of this region after the Jacobite rebellions. During this period the rivers Spey, Dee and Tay saw timber floating to rival the more well known examples of North America and Tasmania. Where landowners felt sufficient concern over their woods to restrict grazing the forests returned. Elsewhere clearance was greeted as the opportunity to expand sheep grazing.

GROWING CONCERN

Clearance of forests for agriculture is a necessary consequence of a growing population. In the United Kingdom, however, there was always land that could be under trees. Even such a populated country as Japan retains to this day 67% of its land area under forest. Britain's forests, therefore, largely disappeared through a lack of concerted effort to conserve them (it is no accident that a senior administrator in many forest departments is still called Conservator). From a very early stage, however, voices have been raised to protest at forest destruction and the consequent loss of a productive resource. The French saw the problem and acted. Colbert commissioned an inventory of the Royal forests of France in 1660 and then in 1669 had enacted an ordinance that laid the basis for effective forest administration and conservation. Similarly the Germans felt concern and created, through planting and management, many of the forests we see there today, in the process laying the foundation of modern forest science. In the United Kingdom, with our tradition of overseas trade, voices of protest were rather more muted except when our ability to import seemed to be threatened by external factors, in particular if the threat was directed at our wooden navy.

Pepys expressed concern as Secretary to the Admiralty and, in 1662, John Evelyn addressed the Royal Society 'Upon the occasion of certain quairies propounded to that Illustrious Assembly by the Honourable the Principle Officers and Commissioners of the Navy'. In this he discussed ways of ensuring forest growth, including the principle of sustained yield, for naval purposes. Two years later he published his famous *Silva, or a Discourse on Forest Trees* that was to remain in print, including revisions, for 161 years.

The troubles of the seventeenth century did lead to an interest among some landowners in the rehabilitation and establishment of woodlands. Official interest seemed to respond only to wars and the consequent need for naval timber. The Seven Years War (1756-63) was followed by a flurry of planting. There was further anxiety after the loss of the American colonies leading to the Commissioners of the Land Revenue being appointed to investigate the state of the old Royal forests (originally created and preserved for hunting) from which much of the naval oak was derived. In their report of 1792 they described the administration of these forests as 'a perpetual struggle of jarring

interests' and recommended that the Government plant 70,000 acres (28 000 ha). Little action resulted until the Napoleonic War when not only did Britain suffer from a lack of indigenous timber resource but, through the influence of Napoleon, was also denied imports from Russia, Sweden, and the USA.

In certain respects modern British plantation forestry dates to the period during and after the Napoleonic Wars. Many large landowners started planting, some initially using prisoners of war, and this was the start of the period when landed gentry vied with each other to establish arboreta and import exotic tree species. The great plant collectors such as Douglas (Douglas fir), Menzies (*Pseudotsuza menziesii*) and Fraser (*Abies fraseri*) were active and introduced many now important exotic species to Britain, e.g. Douglas fir in 1827, Sitka spruce in 1831 and grand fir in 1832. Furthermore, in 1810 the Government established the Commission of Woods and Forests to manage the Forest and Land Revenues of the Crown.

The demand for staff to create and manage these new plantations was leading to an embryonic forestry profession. This was based largely on apprenticeship training, primarily on Scottish estates, but increasingly the ambitious students were going to the well-established forestry education centres in Germany and France. In 1854 the Scottish Arboricultural Society, now the Royal Scottish Forestry Society, was formed and the English equivalent followed in 1882, both aiming to represent the working forester, the forest owner and the interested public. An early, and very active, member of the Scottish Society was Sir Walter Scott who has been credited with persuading foresters to replace the ancient name of Scotch fir with the botanically more correct, if less romantic, Scots pine.

In 1884 the International Forestry Exhibition was held in Edinburgh with the purpose of informing the public and raising money to stimulate forestry education. Although successful in the former objective it was only partly so in the latter. In many respects this exhibition came too late, for the great interest in forestry that had characterised the start of the nineteenth century had already evaporated; a consequence perhaps of prolonged peace, the advent of the iron ship (following the Battle of Hampton Roads in the American Civil War), free trade, a wide-flung empire and the fashion, lead by Queen Victoria, to acquire upland estates for recreation and sport rather than for income generation. During the period *ca.* 1870 to 1920 many forests suffered from neglect or total absence of management.

Although landowners seemed to have lost interest there were still many expressions of concern, particularly from the fledgling forestry profession. In 1884 John Croumbie Brown published a detailed and closely reasoned argument advocating an effective forest policy, improved forest management and access to training. Government report then followed upon Government report. In 1885 a Commons Select Committee recommended the creation of a Forestry Board within the new Department of Agriculture, and the establishment of schools and examinations in forestry. These conclusions were endorsed in 1903 by a Departmental Committee of the Board of Agriculture appointed to enquire into British Forestry. This committee, under the chairmanship of Ronald Munro-Ferguson, pointed out, *inter alia*, that 'timber of the kind and quality imported in such large quantities from the Baltic and similar temperate

regions can be grown as well here as anywhere', that 'there is in these islands a very large area of waste, heather and rough pasture or land out of cultivation, amounting in all to 21 million acres (8.5 million ha), on a large proportion of which afforestation could profitably be undertaken', and that 'the world is rapidly approaching a shortage, if not actual dearth, in its supply of coniferous timber, which constitutes between 80 and 90 per cent of the total British imports'. Note that strategic factors were not raised by this committee. The answer they proposed lay not in 'urging the Government to embark forthwith upon any general scheme of State Forests' but rather in education, encouraging local authorities to afforest water catchment areas under their control and, perhaps the most significant practical recommendation, to adjust the disincentive to continuing forest management consequent on the levy of estate duty on timber. This problem was tackled by Lloyd George a few years later when, in his budgets of 1909 and 1912, he effectively allowed the postponement of payment of estate duty to the time of normal felling, so removing the incentive for the then common habit of premature felling either to avoid subsequent tax liability or to enable payment immediately of the tax demands on immature trees.

In 1907 there was sufficient public concern for an Afforestation Conference to be held in London at which the association for Municipal Councils argued for the employment opportunities a major afforestation scheme would generate. Government was to respond in the following year by giving to the Royal Commission on Coast Erosion, originally established in 1906, the further reference to consider 'whether in connection with reclaimed lands or otherwise it is desirable to make an experiment in afforestation as a means of increasing employment during periods of depression in the labour market, and if so by what authority and under what conditions the experiment should be conducted'. Although at first sight it might seem strange that a committee considering coast erosion should be considered for this task, it reflects the fact that on the continent, particularly in the Landes region of France, tree planting had been highly developed as a means of preventing coastal erosion. The members of this committee, who included H Rider Haggard, were fortunate in having available to them the 1908 report by the Department of Agriculture and Technical Instruction for Ireland on Irish Forestry. In this it was estimated that the proportion of forest land in the various countries comprising the Union at that time was 5.3% in England, 4.6% in Scotland, 3.9% in Wales and 1.5% in Ireland (by 1988 the forest area in the United Kingdom as a whole had risen to 10%).

The Departmental Committee recommended that Ireland required 1 million acres (400 000 ha) of woodland, seven tenths of which would have to be created from bare land. They suggested that private owners be encouraged to plant five of these tenths and that a state forest service be established to plant the remaining two tenths. This same solution was picked up in the 1909 report of the Committee on Coast Erosion who argued that sustained yield for the United Kingdom would require an annual afforestation of 150,000 acres (66 000 ha) which should be brought about by establishing a state service equipped with powers of compulsory purchase and funded by an interest free loan from the Treasury. Professor M L Anderson, in his history of Scottish forestry, summarised the response in these words: 'The grandiose and irresponsible proposals of the Coast Erosion Committee aroused considerable apprehension, distrust and alarm amongst persons in Scotland knowledgeable in forestry, and especially amongst owners of land and other land users'. It can be presumed that the Treasury's response to the proposal of free loans was something more than apprehension.

There followed Committees appointed in 1912 both for Scotland and for England and Wales. Indeed, between 1850 and 1913 six Royal Commissions, Select Committees or Departmental Committees had been appointed to consider various aspects of forestry and no governmental action had resulted, other than adjustments to estate duty. As Sir William Schlich wrote 'too much talking and too little action demonstration areas and Schools of Forestry are all very well but they will not materially increase the timber supply of the country'.

ACTION AT LAST

The First World War concentrated the Government's mind wonderfully on the poor state of forestry in the United Kingdom. Initially there was little difficulty in maintaining imports but the German U-boats were rapidly establishing an effective blockade. By 1916 timber imports had fallen to 65% of the pre-war level and in the following year more than three and a half million tons of shipping was sunk. Much of the imported timber was destined for the mines, as Britain's war effort was fuelled by coal. Lloyd George is reported to have said that we more nearly lost the war for lack of timber than for lack of food. One response was to intensify the harvesting of the limited forests within the country and although this was controlled, first by the Home-Grown Timber Committee and then by the Directorate of Timber Supplies, great damage was exacted on Britain's forest with little or no official help being given to ensure the regeneration of the areas felled.

As early as July 1916 it was obvious that a changed forestry policy would be needed after the war. In that month a Forestry Sub-Committee of the Reconstruction Committee was appointed, under the Chairmanship of the Right Hon. F. D. Acland M.P., to 'consider and report on the best means of conserving and developing the woodland and forestry resources of the United Kingdom, having regard to the experience gained during the war'. The resulting report, dated May 1917, led to the creation of the Forestry Commission in 1919 and the, albeit fitful, start of the modern era.

Being the direct result of wartime difficulties the Acland report emphasised that the United Kingdom could not run the risk of future wars without safeguarding supplies of timber. They recommended that we should aim to be independent of imported timber for 3 years in an emergency which, they calculated, entailed afforesting a further 1,770,000 acres (700 000 ha) as well as bringing existing forests under effective management. Many of the other points they raised closely mirrored those of the 1903 report. They again expressed concern over Britain's future ability to import the timber we require, bearing in mind that most came 'from virgin forests in foreign countries, which are steadily being depleted'. Should this depletion continue unchecked, they suggested, 'it is inevitable that provision should be made within the British Isles on a far greater scale than is here proposed for purposes of defence'. Like the 1903 report, Acland pointed out both that the United Kingdom could grow the timber of comparable quality to that being imported and that there was land available. Indeed, they suggested that two million acres (0.8 million ha) of rough grazing could be afforested without decreasing the home production of meat by more than 0.7%. Unlike the 1903 report, however, Acland came forward with positive suggestions as to how to achieve these aims, suggestions that resembled, but were more realistic than, those put forward by the Coast

Erosion Committee in 1909. Thus, a centralised forest authority should be established, with money from Treasury and powers of compulsory purchase, and that this authority should not only engage in afforestation itself but should also pay 'limited grants' for replanting and afforestation to public bodies or private individuals.

The consequent Forestry Act received Royal Assent on 19th August, 1919, and so was born the Forestry Commission, an organisation that was given, as is usual in most countries, the dual role of forest authority and state forest enterprise. The ethic was very much one of establishing a strategic resource to ensure Britain's survival through any future blockade. This was to remain the central plank of Britain's forest policy for the next forty years. With hindsight it now seems that this imperative probably engendered a rather excessive 'War Office mentality' in the drive to get trees on the ground, a drive, however, that was a direct response to the urging of successive governments in their time.

The early staff of the Forestry Commission were pioneers in many ways. They were faced with a monumental task, not the least aspect being the sheer technical difficulties of afforesting the poor quality of ground likely to become available. Space does not permit tracing the history of research and trials that led to the successful modification and adaptation of lowland silvicultural techniques to the point where effective afforestation could be ensured on peats and acid heathlands. The task must have seemed so daunting that only a firm belief in the value of what they were doing, and faith in their own abilities, could have kept these early forest pioneers going. It was certainly not the availability of resource that ensured success for from the outset the Forestry Commission's funding was vulnerable to political vascillations. Indeed, in 1931 the Committee on National Expenditure recommended that the Forestry Commission should cease acquiring land, a proposal that was only modified after vociferous objections from many quarters.

By the onset of the second World War the Forestry Commission had acquired 977,000 acres (400 000 ha) but most of the forests on this area were still too young to contribute timber. Supplies would again have to come from private forests but, unfortunately, the policy to rehabilitate the forests devastated in the First World War had not been a conspicuous success. The Forestry Act of 1919 required that grants to private owners be repaid with interest so uptake had been negligible. In 1923 the law was modified to enable payment of direct grants (£4.40 per ha for conifer planting and £8.80 per ha for broadleaves) but payments under this scheme were severely curtailed during the financial stringencies of the 1930s. In consequence we entered the Second World War with the damage of the First World War as yet unrepaired.

Again the stringencies of war prompted a review of forest policy. In 1943 the Forestry Commissioners published a document 'Post-War Forest Policy'. The Commissioners reiterated the need for a strategic forest reserve and suggested an objective of 5 million acres (2 million ha) of effective forest of which 3 million acres (1.2 million ha) had still to be created. This total should be achieved by the end of the sixth decade after the war (i.e. 2005) and would entail both state planting and increased encouragement for private planting. An important recommendation was for the introduction of a 'Dedication scheme' whereby in return for a private owner dedicating land to timber production the state would pay planting and management grants. The condition for such grants were to be that timber production should be the main object and that forest and

financial management should be of adequate standard. The Commissioners also recommended the retention of the wartime system of felling licences. Both the grants and felling licences were designed to ensure the retention and maintenance of an adequate strategic reserve of timber. These proposals were accepted and incorporated into the 1947 Forestry Act.

WINDS OF CHANGE

In the 1950s the decision was taken to base Britain's defence on the nuclear deterrent. It was clear that Britain's forest policy now had to be rethought. The most significant contribution to the ensuing debate was the 1957 report from the National Resources (Technical) Committee, chaired by Sir Solly Zuckerman, on 'Forestry, Agricultural and Marginal Land'. Having pointed out that in an age of nuclear weapons 'it is very doubtful whether the time factor would permit reserves of standing timber to aid us in the prosecution of hostilities', the report went on to state 'It is difficult to believe that the continually increasing demand for timber and other produce can fail to be associated with an increase in costs and priceswe may therefore conclude that there is probably a stronger economic reason now than there has been hitherto for the investment in the planting of trees'. Essentially a return to the justification on which the 1903 report of the Departmental Committee of the Board of Agriculture based its proposals. This justification had also appeared as a subsidiary aspect in the Acland Report of 1917, and again in the Post-War Forest Policy document of 1943, which stated that 'it is only common prudence' to ensure a reasonable home production of probable peacetime needs.

In considering the use of marginal land the Zuckerman Committee suggested that generally forestry showed a slight advantage over agriculture, both in terms of return on invested capital and import saving. They also concluded with the remarkably modern sentiment that the solution to the effective use of marginal land lay in the integration of forestry and agriculture. This latter point was quickly overlooked in the noise of the ensuing verbal battle between agriculturalists (particularly representatives of sheep farmers) and foresters. The government then announced in 1958 that 'in light of current conditions - strategic, economic, agricultural and social' they would carry on more or less as before.

The one solution, however, that was not really available was to carry on with the ethic of the late forties and early fifties. If the establishment of a strategic timber resource was no longer the overwhelming objective then some consideration had to be given to the costs of achieving, and the weight to be given, to the other, ever present, objectives of managing a forest. No forest should be managed to a single objective for they can all simultaneously provide a range of products and services. The function of the manager is to balance these (optimise) within the constraints of the received policy. The commonest product is timber, but there may be others such as foliage, berries etc., while the service functions include provision of shelter and habitats, protection of soil and water, provision of recreation facilities (walking, orienteering, hunting, rallying etc) and general amenity and landscaping aspects. Indeed, the Post-War Forest Policy document stated 'it is necessary to reconcile the claims of amenity and economic utilisation; if they are kept

in watertight compartments there will not be enough land to go round', and urged that due attention be paid to amenity and recreation facilities.

This aspect, however, was not to appear very strongly in the immediate post-war policy statements. In the absence of a well formulated national policy the manager of both private and state forests in the 1960s was left with very little guidance. Worse, he was working to constraints of a different era. Thus, the manager of state forests was not empowered to spend money on non-productive functions whereas the grants given to private foresters specified that timber production be the primary aim. Furthermore, Treasury orthodoxy was constantly hammering in the need for high financial return from state investment, without making any particular allowance for the problem of, and imponderable benefits from, forest investment. No doubt a further problem lay in the minds of men, for some senior managers in state and private forestry had had to fight for, and had become so immured in, the strategic ethic that they found modification difficult.

Looking back it was a time when change was demanded by the public and by the forestry profession but institutionally change was difficult to achieve. An increasingly affluent and mobile public was seeking the recreational benefits of forests and the Countryside Acts of 1967 and 1968 gave the Forestry Commission, for the first time, specific powers to provide facilities for such recreation. The Commissioners, themselves, stated that this was 'an important landmark in progress towards the realisation of multiple-use forests in Great Britain'.

There was, however, no let up from Treasury. In December 1971 the forestry ministers announced that they were to review various aspects of forest policy, including the return on public money invested in forestry, a review that was to relate to both the public and private sectors and which would include cost-benefit studies. The latter study had, in fact, been under progress for some time and was published in 1972. The broad objective was to clarify what the nation was getting in return for the low financial rates of profit being achieved by the Forestry Commission. It was intended to be a contribution to, and not the essence of, the ministerial review of forest policy. Of course, the strategic objective had again to be dismissed. However, more of a surprise to foresters of the time, was the rejection of the import saving aspect on the grounds that it was incompatible with the general aim of reducing trade barriers and the specific UK policy of encouraging exports. There is now no argument over this matter for it is clear that the import substitution argument has no economic substance since it denies the doctrine of comparative advantage and the gains from trade. Nevertheless, attempts to invoke this justification were to continue for some time yet.

The findings of the 1972 Treasury report could be summarised as (1) that there was no value in import saving as such, (2) that the recreational value of Britain's forests was low but real and (3) that forestry showed a greater return and produced more jobs per hectare than did hill sheep farming but at a greater cost to the Exchequer. The report recommended that in future forestry, to obtain the desired financial yields, should concentrate on good land, shorten rotations and invest less at the establishment phase. The latter two points militated against any moves to increase diversity and so improve the landscaping and conservation value of our forests. Indeed, this report might be

regarded as at least retarding, and probably reversing for some time, the move towards the application of an effective multi-objective forest policy.

There followed extensive discussions with the forestry profession and the resulting ministerial statement of June 1972 was not as dismissive of forestry as the Treasury cost-benefit study might have indicated. The Government, in fact, concluded that the main justification for state planting was in sustaining the rural economy, especially in areas which might otherwise be threatened by depopulation. They announced a broadly unchanged planting target but, in so doing, accepted that forestry could not be costed on the same basis as other forms of investment and so introduced a target rate of return on capital of 3% per annum in real terms, making allowance where necessary for planting which is undertaken primarily for social reasons.

These were most important developments that were mirrored 2 years later (1974) by the introduction of a revised grant scheme for private forestry, the object of which was stated to be 'to secure sound forestry practice, effective integration with agriculture and environmental safeguards, together with such opportunities for recreation as may be appropriate'. Indeed, a grant recipient was now required, if requested, to negotiate an access agreement to his forest with the Local Authority. This is very much the era when public concern was focused on recreation. Conservation pressure had still to exert its full weight but even so the new scheme was to pay, for the first time since 1939, a larger grant for planting broadleaved trees than for coniferous trees. Already, however, Felling Licences were being seen more as a means of preserving habitats and landscapes than as a means of controlling timber exploitation.

To help focus discussion the Forestry Commission, in 1977, set up a group to review the wood production outlook in Great Britain. Projections of demand are fraught with problems involved in assumptions regarding population growth, changes in *per capita* income, resource substitution etc. Nevertheless, the group considered that in comparison with the 1972 consumption level worldwide requirement for roundwood would increase 83% by the year 2000 and 186% by 2025. Over these periods production in Britain would actually fall unless there was to be further substantial planting. They examined the consequences of further expansion of Britain's forest area by either 1 million or 1.8 million ha. Either scenario would ensure a continuing increase in domestic wood production until 2050, a policy of expansion that 'is technically feasible and appears to be a prudent investment'. In making this recommendation cognisance was taken of the impact on nature conservation, although it was pointed out that the effect on conservation was by no means entirely negative.

The demands that forest policy be modified to take more account of nature conservation, and to a lesser extent recreation, were to become increasingly vociferous from this time on. An effective counterweight, however, appeared in early 1980 when the Centre for Agricultural Strategy (CAS), an independent research unit on the campus of the University of Reading, issued its report No. 6, a *Strategy for the U.K. Forest Industry*. This forecast that a deficit in world timber supply could be expected and, in view of the fact that the countries of the European Community were only 60% self-sufficient in timber, urged that the UK Government stimulate further planting of perhaps as much as 2 million ha. Thus, CAS, in 1980, estimated that the United Kingdom, including Northern Ireland, could aim for a forest resource of 4 million ha, which compares

remarkably well with the figure of 3.6 million ha for Great Britain alone estimated by the Coast Erosion Committee in 1909. CAS gave consideration to the environmental consequences of their proposals urging (1) that there should be greater integration of farming and forestry, (2) that particular care be taken of wildlife habitats and (3) that the ratio of broadleaves to conifers should be shifted from 1:30 to 1:20.

Taken all in all this was a very bullish report for forestry and one that sought to give due weight to both production and to the service functions of conservation, recreation and amenity. It was not an official report but, together with the Forestry Commission's *Wood Production Outlook*, of 1977, undoubtedly contributed to the new Government's review of forestry, the conclusions of which were announced in December 1980. In this statement the Government accepted that the world's forests were likely to come under increasing pressure and that in this circumstance there was a need for Britain to assist in solving a global problem by producing a steadily increasing proportion of its requirements for timber from its own resources. New planting, the Government believed, should carry on at broadly the rate of the past 25 years but that the emphasis should shift to the private sector. In order to reduce public expenditure, and to rationalise its resource, the Forestry Commission was to be required to raise capital by selling some proportion of their estate (a new Act to permit this was passed in 1981), indeed a further programme of sales was announced as recently as 1989.

Another action by the new Government was the replacement, in 1984, of the old rather cumbersome grant system with the streamlined Forestry Grant Scheme. However, the conditions attached, and the distinction between broadleaves and conifers, remained as before, including the need for 'effective integration with agriculture', although precisely what was meant by this was never defined.

The position of Britain's declining broadleaved resource was now causing particular concern, especially among environmental organisations such as the Royal Society for the Protection of Birds (RSPB) and the Nature Conservancy Council (NCC). The Forestry Commission, together with the Institute of Chartered Foresters, responded by organising a special conference to discuss the situation and to consider appropriate remedies. In consequence a new and particularly generous grant scheme was introduced in 1985 specifically for the planting of crops of pure broadleaves. In addition the Forestry Commission announced that in future they were unlikely to approve applications for planting grants unless they included at least 5% of broadleaved species and that the grant schemes and felling licences would be used to ensure that no area of broadleaves was converted to some other crop, either of coniferous trees or agricultural. This package of measure was to become known as the Broadleaves Policy and, despite further changes in grants and taxation, the incentives remain to this day. A parallel development has been provision of enhanced grants to ensure the maintenance of our limited areas of native pinewoods, with a recent development being inducements to expand the area of such forest type.

Another important development in 1985 was the publication by Timber Growers United Kingdom of *The Forestry and Woodland Code*, aimed to guide and ensure that private forestry, in addition to aiming to be economically viable, should further effective conservation, be ecologically sustainable and in harmony with the balance of nature and be socially acceptable. The Forestry Commission has since stated that adherence to the

code is *sine qua non* for award of grant aid. More recently the Code has been amplified with the publication of a series of detailed guidelines, for example on landscaping, by the Forestry Commission.

Despite these moves, pressures against expansion of forestry on the grounds of nature conservation were to be intensified. In 1986 the NCC published a position paper entitled *Nature Conservation and Afforestation in Britain*. Although the Chairman of the NCC emphasised their belief that forestry and timber production were important for Britain the entire tenor of the document seemed to many to deny this. The debate between forestry and conservation was rapidly becoming polarised at the expense of developing the ideal of multiple-objective forestry. One, much neglected, document that went some way to redressing the balance was the report on Forestry by the UK Centre for Economic and Environmental Development (CEED), an independent organisation set up with the aim of monitoring the UK responses to the World Conservation Strategy. In their document CEED emphasised the important role of timber as a renewable and valuable industrial resource and the need for the United Kingdom to participate in ensuring the continuation of timber production into the future. However, it also emphasised the need to temper forestry expansion with due consideration of other requirements, including conservation and protection of water catchment schemes.

Hardly had this document been digested than there appeared, in December 1986, the National Audit Office's (NAO) *Review of Forestry Commission's Objectives and Achievements*. While generally complementing the Forestry Commission on its impressive past achievements it queried whether recent planting could achieve the 3% target set in 1972. Again, the strategic argument for forestry was rejected, as was the balance of payment argument. With regards to employment, which ministers had given as a main justification for forestry expansion, they suggested simply that because of the large increase in urban unemployment it could no longer be assumed that rural unemployment, which is expensive to correct, is the more important. However, they did agree that 'it would appear prudent to maintain an adequate reserve of commercial woodland in order to safeguard the nation's timber needs against over-dependence on foreign supplies'. To achieve this they echoed the 1972 cost-benefit study in suggesting that forestry investment should be concentrated on better quality land and they also queried whether the then available tax incentives and planting grants were 'matched by commensurate benefits in national economic terms'. While it is clear that the NAO report was to some extent based on faulty or poorly understood data (numbers employed in forestry, for example, were much underestimated) it did intensify the debate, a debate that is still continuing.

Since that time the tax incentives have been removed and grants increased, in consequence of which new planting has much reduced and industries based on home timber are beginning to fear for their future supplies. The planting grants under the newly introduced Woodland Grant Scheme no longer require that timber production be the main objective and insists on due consideration of landscape, conservation, recreation, access, maintenance of archaeological features and the safeguarding of water supplies. Further responses to conservation and amenity pressure include measures such as the newly introduced requirement for Environment Assessment statements on larger afforestation schemes and the expansion of Forest Nature Reserves and recreation facilities. Also some substance has been given to the plea to integrate farming and forestry

by the provision of special incentives to farmers to plant trees under the Farm Woodland Scheme. This latter scheme gives farmers who plant trees on arable land or improved grassland, in addition to the Forestry Commission planting grants, an annual grant designed to replace lost income until the trees reach the thinning stage, i.e. for 40 years in the case of oak and beech, 30 years for other hardwoods and 20 years for conifers.

While continuing to respond to demands for more sensitive forestry the government remains committed to the expansion of the forest estate. To this end in 1989 the Secretary of State for Scotland announced a relaxation of the criteria for the release of agricultural land for planting so improving the potential supply of better land (in particular that falling within classes 3.2 and 4) for afforestation.

The winds of change are still blowing, and still often gusting in opposite directions. It is clear that the search for that effective balance of objectives that is called multiple-purpose forestry still goes on. It is also clear that the balance in Caithness must be notably different to that required for the Cotswolds, as it must be between the southern uplands and the south downs. An important development in this regard has been the production of 'Indicative Strategies' for forestry as part of the Structural Plans produced by Regional Authorities in Scotland. These plans indicate, in advance, the likely ease of achieving agreement for planting by dividing the regions into 'preferred areas', where subject to good practice forestry might be promoted, 'potential areas', which have one major strategic issue which requires special treatment in any forestry development and 'sensitive areas', where a combination of complex interrelated constraints means special study and particularly sensitive proposals. The indicative strategy is welcomed by the forestry industry for giving clear guidance and it also ensures that local authorities can, in relation to forestry, plan effectively rather than merely responding to proposals as they arise.

THE PRESENT POSITION

Although the planting programme was not very large in the years before the last war, thereafter, as a direct result of the report on Post War Forest Policy, the area planted has usually been in excess of 20 000 ha per annum (Figure 1). As a result woodlands, which accounted for only 5% of Britains land area in 1919, now cover 2.3 million ha representing 10% of the land area. Most of the expansion has been concentrated in the uplands, particularly of Scotland and Wales (Figure 2). This is a direct result of the policy pursued since 1919 that forestry should not occupy good agricultural ground. Indeed, before any planting grant application can be approved the agricultural departments (MAFF, SOAFD, WOAD) have first to affirm that the proposed changes in land use will not damage the agricultural viability either of the holding or the area. This restriction has proved to be something of a straightjacket controlling the pattern of forestry expansion, and remained so despite a relaxation of the criteria for release of agricultural ground announced in 1986. However, the further relaxation announced in 1989 appears to be greatly easing the situation.

It should be emphasised at this juncture the extent to which forestry development, and forest policy, is a consequence, even a by-product, of agricultural policy. Thus, while food production was the dominant factor in land-use policy forestry was consigned to

poorer ground unsuitable for all but the most extensive agricultural system, usually sheep farming. Now that land needs to be taken out of agricultural production good land can be planted. However, such planting will be limited to small areas on existing farm holdings, for which there are incentives under the Farm Woodland Scheme. More extensive planting on better quality land may well remain restricted so long as support for agriculture under the Common Agricultural Policy continues to keep land prices so high that returns cannot be expected from forest investment on such land. Meanwhile the Government has attempted to redress the balance by including a 'Better Land Supplement' with Woodland Grants when planting is to be on arable land or improved grasslands.

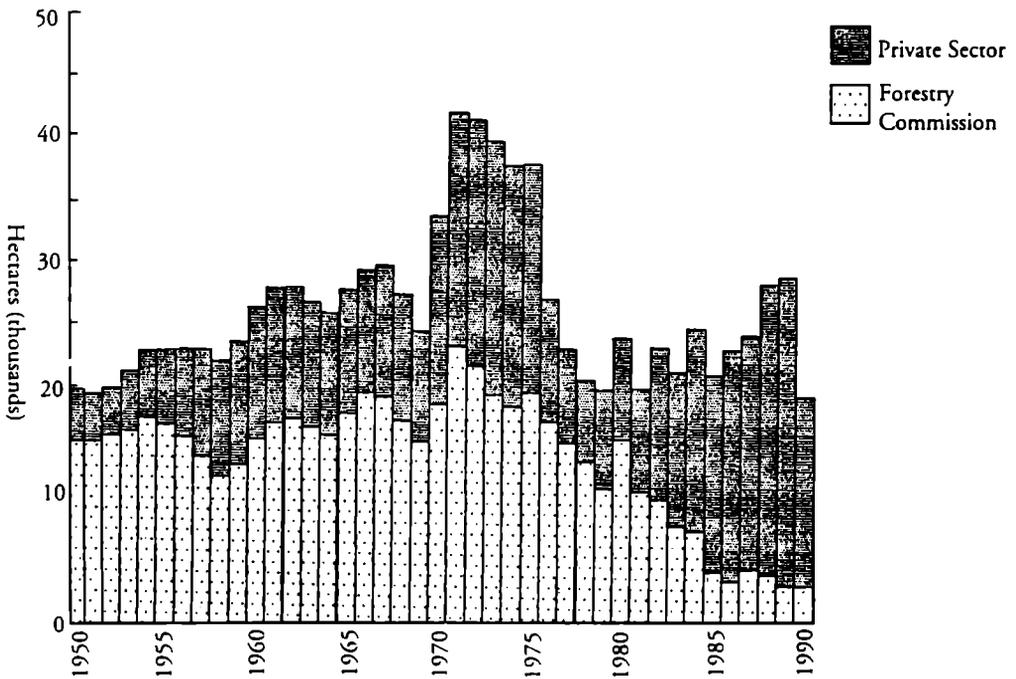


Figure 1 New Planting since 1950 (source, Forestry Commission).

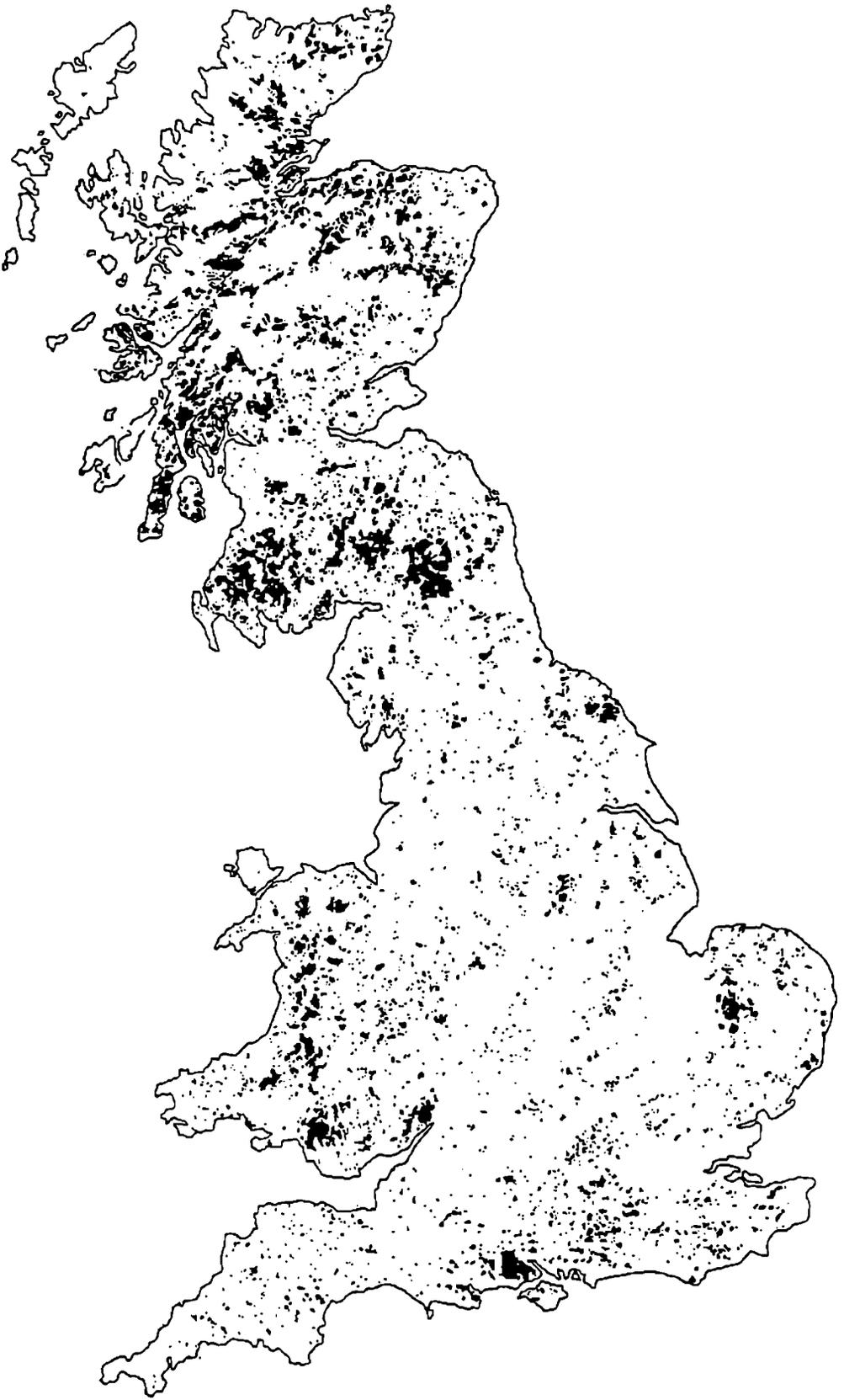


Figure 2 Map of Forestry Commission forests and of grant aided forests in Great Britain.

Restricting forestry to poorer land has inevitably limited species choice, with many broadleaved species being unsuitable for the sites available. However, it must be emphasised that the predominance of conifers in British Forestry (Figure 3) is largely in response to financial and marketing considerations. Spruces will mature in 50 years or less, oaks require more than 100 years. Naturally, if the capital invested is to attract interest, these differing rotation lengths have a profound effect on the decision of which species to plant. In addition, as the Acland Report pointed out in 1919, our imports of industrial timber at that time comprised 90% coniferous species. It remains true that industrial demand is predominantly for conifers. The eleven major pulp and board mills operating in the United Kingdom consume between them 3.3 million tonnes of coniferous timber annually and only 0.3 million tonnes of hardwood timber. Recent years have seen major new investment in pulp mills at Shotton (annual consumption of 550 000 tonnes) and at Irvine (200 000 tonnes), based entirely on coniferous timber, predominantly spruce, while conifers are also the basis for expansions of boardmills at Hexham, Inverness, Wrexham and elsewhere. These pulp and boardmills depend on wood waste and small round wood, the latter referring to the small sized trees removed in early thinnings and the small diameter upper sections of the larger trees harvested at later thinnings and at clearfelling. The profitability of forestry is very dependent on having a market for such material, even although the unit price is quite low. The larger logs, of course, go to sawmills to be converted to boards and posts suitable for joinery and other uses. Again, British sawmills are predominantly specialists in coniferous timber, reflecting the industrial demand for sawn softwoods. Furthermore, recent expansion and modernisation of these mills (there are now some highly advanced automated sawmills in the United Kingdom) is again focused on the softwood market.

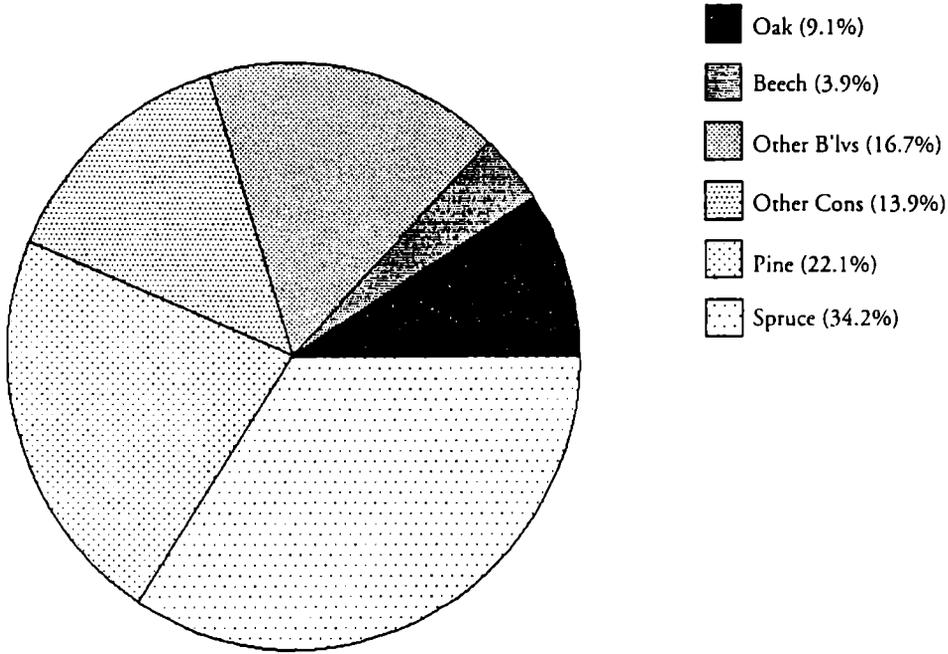


Figure 3 Species distribution in Great Britain, data from the Census of Woodlands 1980.

All this is not to suggest that Britain does not, or cannot, grow and process hardwood timber. At present a little more than half a million hectares of British woods are classified as broadleaved high forest or coppice, producing almost three-quarters of a million tonnes of timber per annum. Some small proportion of this is high quality decorative hardwoods that fetch extremely high prices, requiring specialist mills to process them. However, a regrettably high proportion of the harvest is sold as firewood or as pulpwood at a very low unit price. The current broadleaves policy is leading to an important increase in the area under broadleaves, but as many are being planted on sites that are very marginal for such species there is unlikely to be much impact on the quality hardwood market, rather the policy has to be justified in terms of landscaping and conservation unless new industries appear.

When calling for a determined forest policy the Acland Committee pointed to the very considerable costs of timber imports in the early years of this century. Imports have continued to increase (Table 1) and the 48.5 million m³ equivalent imported in 1988 cost £6.7 billion pounds in foreign exchange. Currently UK production is providing only 10.6% of our annual requirements (Table 1). However, because of the past pattern of planting (Figure 4) most of our forest estate is only now coming into the productive phase. In consequence a considerable increase in the home timber harvest will occur over the coming years (Figure 5). It is anticipated that the United Kingdom will eventually produce a quarter or more of its requirements for sawn timber, rather less for processed timber, and reach a level of self-sufficiency comparable to that of most of our European partners, this degree of self-sufficiency, however, will not be maintained unless there is further expansion of the forest estate.

The movement of forests into the production phase has profound implications for employment. It has often been overlooked that forests produce the raw material for downstream processing industries. The employment they create, therefore, is not limited to the growing phase but also encompasses harvesting, transporting, processing, conversion, marketing and so on. It has recently been estimated that total employment in forestry and in industries processing British wood is 55,500. Furthermore, despite the concentration and centralisation of certain modern processing industries, 80% of all forestry workers live within 20 miles of their place of work, so underlining the success of forestry in creating jobs in rural communities. Fortunately these jobs can be regarded as being fairly secure for the impact of increasing mechanisation and efficiency will be

Table 1 Volume of UK imports, production and apparent consumption of wood and wood products, in millions of cubic metres of wood, raw material equivalents (source: Forestry Commission)

<i>Calendar Year</i>	<i>Imports</i>					<i>UK Production</i>	<i>Apparent Consumption</i>
	<i>Wood</i>	<i>Pulp</i>	<i>Panel products</i>	<i>Paper</i>	<i>Total</i>		
1986	14.6	8.3	4.3	13.0	40.2	5.2	43.0
1987	19.1	8.5	4.5	15.4	47.6	5.4	49.9
1988	18.6	9.6	6.8	13.9	48.5	6.0	50.7

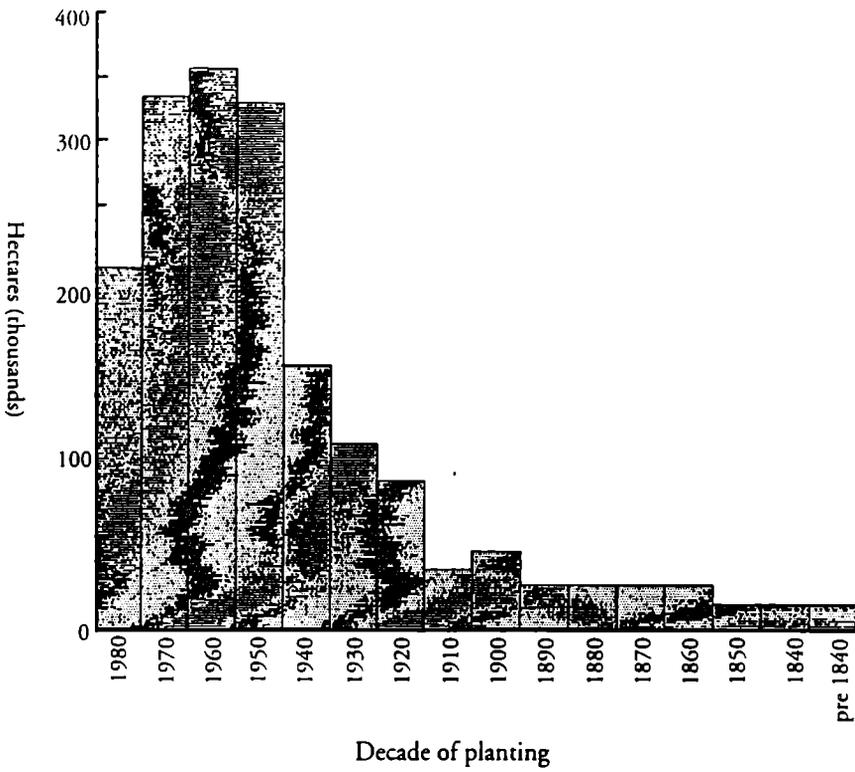


Figure 4 Age profile of forests in Britain (source: Forestry Commission).

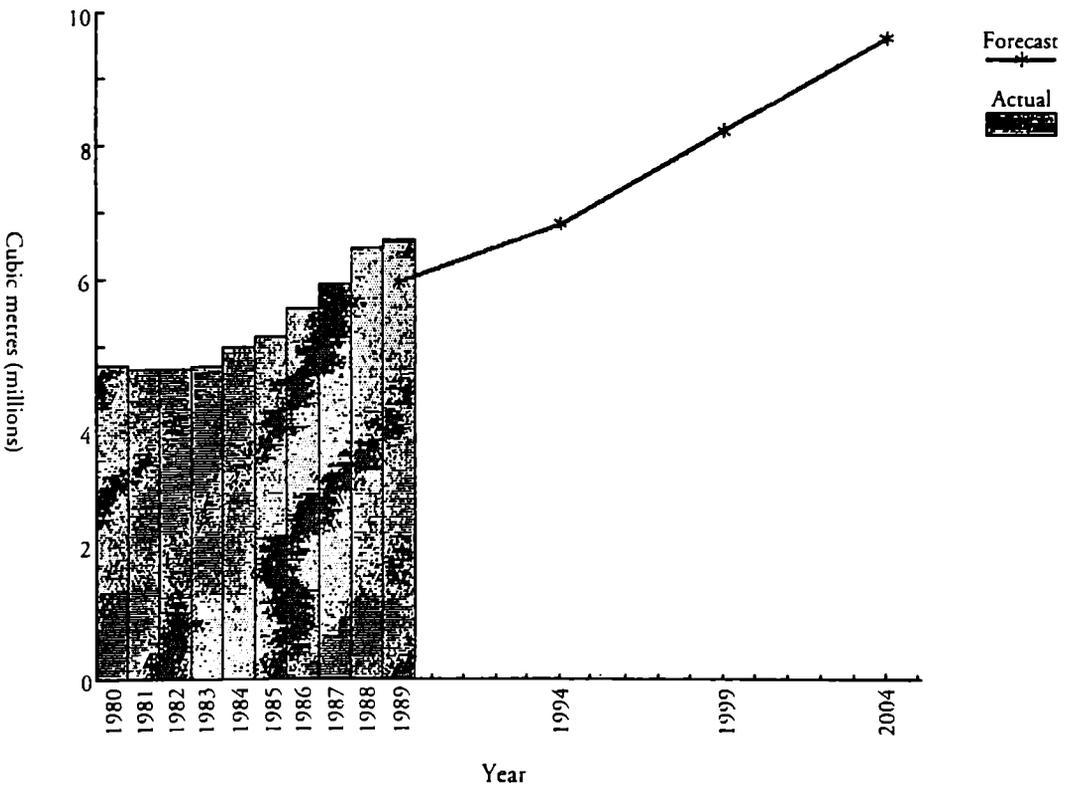


Figure 5 Trend in timber production for British forests, with projections to 2004 (source: Forestry Commission).

compensated by the marked rise in the amount of timber to be harvested and processed (and the consequent rise in area of ground to be replanted). What can be anticipated is an increasing tendency to use contract labour so allowing the development of specialist teams well supplied with appropriate equipment.

The increasing conservation and recreation demands being placed on Britain's forests was traced in the previous section. Appreciating that they were managing areas of particular natural beauty the Forestry Commission first established forest parks as early as 1935 and these were to increase in number to 11, to which must be added the New Forest which has a unique status although it is managed as a forest park. Then in 1989 46 Forest Nature Reserves were declared covering a wide range of sites including an otter sanctuary. In both the parks and the reserves management is particularly sympathetic to amenity and conservation requirements.

By and large, access to Britain's forests on foot is unrestricted. As already mentioned, the 1967 and 1968 Countryside Acts granted the Forestry Commission the freedom to invest in recreation facilities. There followed the welcome establishment of prepared walks, campsites and caravan sites and holiday homes for rent in the forest. By 1988 the Forestry Commission was managing 32 camping and caravan sites, 646 picnic sites, 709 forest walks and forest nature trails, 19 visitor centres, 21 arboreta, 10 forest drives and 194 forest cabins and holiday houses.

Particularly exciting are the newly announced proposals for a Central Scotland forest and for 11 community woodlands around English cities. These represent new forests in areas of high population where the requirement for the sorts of recreation forests can provide is particularly acute. It is noticeable that the announcements of both the Scottish and the English plans emphasised, the multiple-objective/purpose role of such forests, including production as well as recreation, conservation and landscaping.

Conservation, like recreation, is now receiving increasing attention when designing and managing forests. Indeed, conservation and landscape plans are now a *sine qua non* if grant aid approval is to be gained for any significant planting programme. The design of landscape as an artistic endeavour and like all such is open to individual interpretation and is subject to differing perceptions. Indeed, a recent survey commissioned by the Scottish Forestry Trust showed that the mass of the public are not nearly as anti-conifer as the media, reporting pressure groups, would suggest. It is also not widely appreciated how difficult it is to get agreement on many conservation issues (the Swedes and Austrians are concerned at the effect tree felling may have on their eagle populations while British conservationists are concerned at the effect tree planting may have on our eagles). Judgements on issues of conservation are often value-laden, the scientific base for them to be otherwise is simply not available. However, some general principles are clear and are being espoused. In particular, forests are being designed, or modified, to ensure diversity of species and structure so offering a diversity of adjacent habitats.

THE HESITANT WAY FORWARD

Britain imports 90% of its timber requirements. The 12 countries of the European Communities together import about half their timber requirements. The Commission of

the European Communities in their *Community Strategy and Action Programme for the Forestry Sector*, published in 1988, pointed out that despite the production shortfall the forests of the Community are still under-exploited. In this programme the Commission put forward 8 aims that together projected the value of forests not just for timber but also for management for multiple use. In particular they pointed to the need to afforest agricultural land and to develop forests in those rural areas hardest hit by the crisis in agriculture. This need has prompted the introduction of the Farm Woodland Scheme in Britain. However, much yet needs to be done on the formulation and implementation of forest policies for the Community and for Britain.

Britain's forest policy has undergone changes and shifts in emphasis and has been subject to a number of sharp shocks. Yet, through the 70 years since the establishment of the Forestry Commission there has been a certain continuity and consistency of purpose. Planting has continued, except during the war years, and this has been backed by the necessary research into techniques of silviculture and management to ensure success on the relatively inhospitable ground made available to foresters. Only since 1988, with concern about the over production of food, has official blessing, and aid, been given to the planting of good land. What is the future likely to be, and what are the pressures that will mould it? These will be discussed in the following papers but perhaps some superficial speculation can be permitted by way of introduction.

Continuation of forest expansion, if it continues at all, will depend on the public perception of the balance between the disadvantages associated with a change in land use and the production and service benefits created by the new forest. The nature of any forest then created will depend on the balance between these perceived production and service benefits. The weighting to be given to production and service will vary with location, although the response to such geographical variations may remain institutionally limited (the new community forests are a good example of how the balance can be deliberately tilted to reflect regional needs).

Already forests are being much modified to ensure conservation of faunal, floral, physiographic and archaeological features. Interestingly, it is often found that the necessary modifications can serve more than one function; for example, leaving an archaeological site unplanted may provide a deer lawn, will increase habitat diversity and can create a feature with both landscape and recreational interest. The design of forests to optimise these factors is one of the great challenges facing management.

Such developments, however, do not obviate the need for the United Kingdom to address its position as a major importer of timber that is capable of producing at least some portion of its own supply. We know that some sources of supply, particularly from natural forests, are unlikely to be in a position to expand. Meanwhile, consumption everywhere is increasing. Consumption per capita in the developed countries of the world averages about one and a quarter cubic metres roundwood equivalent per year, whereas in the developing countries it is only half a cubic metre, with 90% of this being as firewood. The opportunities for replacing firewood is limited (almost half the wood cut world-wide goes as firewood) and the demand is increasing with the rapidly increasing population of many countries. Furthermore, with rising affluence and expectations in the developing countries the consumption per head is increasing. The saving grace is the rate at which around the world new forest plantations are being

created and are coming into production. If the envisaged rate of plantation expansion is realised the world should avoid the often feared timber famine. However, this does require that all those countries that have the land and opportunity to create new plantations should attempt to do so. In this regard Britain, with its relatively high growth rates, is particularly well placed.

In the United Kingdom there is a forest industry, based largely on coniferous timber, and we have the potential to expand our forest area. Such an expansion could be regarded either as prudent planning against future long-term shortages or as a response to the moral problem of continuing to rely on imports from areas likely to be desperately short of timber themselves. Expansion, however, must take cognisance of public pressure for improved amenity, recreation and conservation by appropriate design and choice of species. Modifications to meet such demands entail a cost, if the modifications are pronounced the public must be prepared to shoulder the cost.

SELECTED BIBLIOGRAPHY

- ANDERSON, M.L. (1967). *A history of Scottish forestry, Vols 1 and 2*. Nelson, London.
- ANON (1903). *British forestry, report of the departmental committee appointed by the Board of Agriculture*. Cd 1319. HMSO, London.
- ANON (1908). *Report of the departmental committee on Irish forestry*. Department of Agriculture and Technical Instruction for Ireland. Cd 4027. HMSO, Dublin.
- ANON (1909). *Second report (on afforestation) of the Royal Commission on Coast Erosion*. Cd 4460. HMSO, Dublin.
- ANON (1918). *Final report of the forestry sub-committee of the Reconstruction Committee*. Ministry of Reconstruction. Cd 8881. HMSO, London.
- ANON (1921-1938 and 1945-1966). *Annual reports of the Forestry Commissioners*. HMSO, London.
- ANON (1967-1989). *Forestry Commission annual report and accounts*. HMSO, London and Edinburgh.
- ANON (1957). *Forestry Agriculture and Marginal Land*. A Report by the National Resources (Technical) Committee Office of the Lord President of the Council. HMSO London.
- ANON (1966). *Leisure in the countryside, England and Wales*. Cmnd 2928, HMSO, London.
- ANON (1967). *Countryside (Scotland) Bill (as amended in committee)*. HMSO, London.
- ANON (1989). *Caithness and Sutherland HRC working party. Summary report and land-use strategy*. Highland Regional Council. Inverness.
- BROWN, J.C. (1884). *Introduction to the studies of modern forest economy*. Oliver and Boyd, Edinburgh.
- CENTRE FOR AGRICULTURAL STRATEGY (1980). *Strategy for the UK forestry industry*. CAS Report No. 6. Centre for Agricultural Strategy, Reading.
- COSLA (1986). *Forestry in Scotland: planning the way ahead*. Convention of Scottish Local Authorities, Edinburgh.
- DENNE, T., BOWN, M.J.D. and ABEL, J.A. (1986). *Forestry: Britains Growing Resource*. UK Centre for Economic and Environmental Development (CEED), London.
- EVANS, J. (1987). Conflict in the countryside, the pressure on British forestry and the land use option. Unpub. *Honours Thesis*, Department of Forestry, University of Aberdeen.

**'FORESTRY EXPANSION: A STUDY OF TECHNICAL,
ECONOMIC AND ECOLOGICAL FACTORS'**

This is one of a series of papers which form part of a study to consider the scale, location and nature of forestry expansion in Britain.

The Forestry Commission invited fourteen specialist authors, including economists, foresters, ecologists and biological scientists to write about current knowledge and to assess the main factors bearing on decisions about the future direction of forestry expansion. It is intended that the papers will form the basis for future discussions of the location and type of forestry that will best meet the demands of society for wood products, jobs, recreation, amenity, wildlife conservation, carbon storage and the other uses and public benefits supplied by the country's forests.

Published by the Forestry Commission on 19th July, 1991.

The full list of papers is as follows:

<u>Occasional Paper No</u>	<u>Title</u>	<u>Author</u>
33	Introduction	Professor Ian Cunningham, Macaulay Land Use Research Institute
34	British Forestry in 1990	Hugh Miller, University of Aberdeen
35	International Environmental Impacts: Acid Rain and the Greenhouse Effect	Melvyn Cannell and John Cape, Institute of Terrestrial Ecology
36	The Long Term Global Demand for and Supply of Wood	Mike Arnold, Oxford Forestry Institute
37	UK Demand for and Supply of Wood and Wood Products	Adrian Whiteman, Forestry Commission
38	Development of the British Wood Processing Industries	Iain McNicoll and Peter McGregor, University of Strathclyde and Bill Mutch, Consultant
39	The Demand for Forests for Recreation	John Benson and Ken Willis, University of Newcastle
40	Forests as Wildlife Habitat	John Good, Ian Newton, John Miles, Rob Marrs and John Nicholas Greatorex-Davies, Institute of Terrestrial Ecology
41	Forestry and the Conservation and Enhancement of Landscape	Duncan Campbell and Roddie Fairley, Countryside Commission for Scotland
42	The Impacts on Water Quality and Quantity	Mike Horning and John Adamson, Institute of Terrestrial Ecology
43	Sporting Recreational Use of Land	James McGilvray and Roger Perman, University of Strathclyde
44	The Agricultural Demand for Land: Its Availability and Cost for Forestry	David Harvey, University of Newcastle
45	Forestry in the Rural Economy	John Strak and Chris Mackel, Consultants
46	New Planting Methods, Costs and Returns	Jim Dewar, Forestry Commission
47	Assessing the Returns to the Economy and to Society from Investments in Forestry	David Pearce, University College London

The summary document is free; each of the 14 papers is available at £2.00 (including postage) and the full set is priced at £25.00 (including postage) from: Publications, Forestry Commission, Alice Holt Lodge, Wrecclesham, Farnham, Surrey GU10 4LH, Tel: 0420 22255 .

