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The importance of research in temperate forests

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1 Introduction

Why should we continue to do research in the temperate forests of the world? Many of the temperate forests exist in some of the wealthiest countries in the world, and there are long traditions of forest research in such countries. We might reasonably assume, therefore, that most of the important problems of forest ecology and management have already been solved, leaving very little that still needs to be done. It is true, of course, that large areas of temperate forest also exist in countries which have less well-developed economies, or which experienced long periods of economic or social disturbance. In such countries, forest research, with its long timescale for experiments and surveys, has been difficult, if not impossible, and it is only recently that many such countries have been able to establish forest research institutes, or even to survey the forest lands which may themselves have been devastated by warfare or by ill-advised utilization. In such situations, can we simply transfer some of the knowledge gained by those countries with long traditions of forest research?

The dependence on past research stressed above is only possible if we can assume that the influences on temperate forest have changed relatively little during the last century. In fact, of course, there are many negative influences on temperate forests and woodlands which have operated over the last 100 years, and which, if anything, have increased during the last 30 years. Perhaps the most important of these influences is the wholesale clearance of woodland for agriculture, urban expansion, industrial sites, and communications (roads, power lines, railways, etc). In many areas, land which even in recent history carried temperate woodland has been cleared for agriculture, often pushing the woodland remnants back on to the poorer land unsuitable for agriculture, and probably also unsuitable for the growth of high-quality timber. Where forest lands have been retained, such forests have often been subjected to overcutting or selective fellings, removing the more valuable species, but leaving damaged or poor growth of the less useful timber trees.

On such forest land as has been left after conversion to agriculture or other uses, and on areas brought back into forest, sometimes many years after they were originally felled, man has introduced fast-growing exotic species as alternatives to the often slower-growing native species, thus changing the composition of the forests. The redevelopment of a forest ecosystem is a slow process, especially where the species introduced to improve the rates of growth or

the value of the timber for particular purposes do not have their full complement of associated organisms, such as mycorrhizas, from their original habitats. Many of the present-day temperate forests consist of species which have yet to establish an ecological balance with their environment, so that outbreaks of pests or diseases may be more difficult to control or predict.

Changes in land ownership and management, especially through traditional forms of inheritance, have also led to the fragmentation of temperate forest lands in many countries. The effects of such fragmentation have not been widely studied, but are clearly also influenced by hunting practices and sporting interests, and by the harvesting of plants and animals for medicinal or decorative purposes, in addition to their use as foods. In recent years, the marked growth of interest in wildlife conservation has also had a profound effect on forest lands, not merely on nature reserves and in national parks, but also in the more extensive areas of commercial and recreation woodlands. Thus, while the growth of timber and wood fibre may remain the primary purpose of temperate woodland, the management of the woodland for such purposes has to be modified to accommodate other interests and values.

Finally, and for many countries most importantly, temperate forests have shown themselves to be sensitive to many of the pollutants which have become an apparently essential part of our economic life. In many industrialized countries, the effects of acidic inputs to the atmosphere, from power stations driven by fossil fuels, from industrial plants, and from motor vehicles, are currently causing particular concern. We now talk of 'forest decline', a phrase unheard of until quite recently. In the search for increasingly rapid growth in an attempt to beat the disadvantages of the long rotations of the discounting techniques of the economists' models, the use of greater quantities of nitrates in agriculture and forestry may have particularly unfortunate effects on the quality of future water supplies. Our use of pesticides and herbicides to control pests and diseases is often careless and uncontrolled, with results that were not foreseen at the time of application. We know very little about the possible effects of radionuclides released into the atmosphere by nuclear reactors, reprocessing plants or by accidents like Chernobyl.

All of these influences on temperate forest involve a wide range of scientific disciplines and expertise. In no sense can forest research be regarded as a narrow

academic topic, fit only to be pursued in isolation from the wider biological, ecological and environmental issues, as well as the economic and social factors that impinge on those issues. Forests, whether in the temperate or tropical regions of the world, play an essential role in the biosphere. If most attention has been given recently to the problems of tropical forest, for example in the Man and the Biosphere Programme of UNESCO, because of the rapid disappearance of that biome, we should not allow ourselves to be deluded into thinking that the problems of temperate woodland are trivial by comparison. For both temperate and tropical forests, the timescale necessary for scientific research into long-lived organisms like trees imposes a difficulty that can only be overcome by equally long-term planning and financial support.

2 Resource conservation

The rational development of a strategy for research and management of temperate forest, as for the other major biomes, requires a set of clear objectives for the future. Fortunately, we need look no further than the World Conservation Strategy (Allen 1980) for objectives that give a sharp focus for our present and future research. This strategy defines 3 main areas of activity.

- i. Maintaining essential ecological processes and life-support systems. The essential ecological processes range from global phenomena, such as the cycling of oxygen and carbon, to local ones such as the production and dispersal of seed by trees and other forest plants. In between these 2 extremes, there are many other processes essential for the survival of the forest, notably soil formation, the cycling of nutrients, and vegetation succession following the clearance of forest or damage by fire. All of these processes are part of the complex system of plants, animals, micro-organisms and the non-living components of the forest ecosystem, and our understanding of this ecosystem is essential for the survival and wise management of our forest resources.
- ii. Preserving genetic diversity. The range of genetic variation present in the temperate forest ecosystem includes all of the species, subspecies, varieties, strains and forms of plants, animals and micro-organisms. We need to keep the widest possible range of this variation to sustain and improve timber and fibre production, through breeding programmes for forest crops and forage plants, as well as for plants that have medicinal or decorative uses. The preservation of genetic diversity is a vital form of insurance, and an investment against harmful environmental change. It requires the prevention of the extinction of species and the preservation of as much of the variation within species as possible. Many species are highly variable, occurring in many different forms, and the continuing availability of

these different forms is important. Research is necessary, therefore, to characterize variability and to find ways in which that variability can be preserved in living plants and animals.

- iii. Utilizing species, and the forest ecosystem as a whole, sustainably. The concept of sustainability is a simple one: we should utilize the species and the ecosystem at levels and in ways that allow them to go on renewing themselves for all practical purposes indefinitely. How to achieve sustainability is less easily defined because the difference between sustained use and exploitation leading to extinction is sometimes very small, particularly in ecosystems which suffer periodic fluctuations because of climate or succession. Research is therefore necessary to define the limits within which the exploitation of the forest resources can be permitted so as to ensure that the forest itself, and the many species making up that forest, will survive. Such research also has to be linked to the economic and social factors which govern the use of the forest and its resources.

In implementing such a strategy of research and management, it should be clear that the forest resources extend far beyond those of wood and wood fibre that are the more obvious products of forestry. They include fuelwood, often important to the local community, water, the food provided by forest animals and plants, the wildlife for which the forest provides the necessary habitat, and areas for recreation and visual amenity. In the pursuit of these resources and their continuing availability in the future, the interaction of policies and programmes for individual areas of forest with factors of ownership and with state policies for land use and the protection of resources will often impose critical constraints. To make matters even more complicated, these constraints may alter several times in a single rotation of the forest. Everyone engaged in forest research must, therefore, have a very clear idea of the objectives of that research so as to ensure its relevance against a changing political, social and economic background.

3 Research topics

Within the framework of the broad strategy outlined above, it is relatively easy to identify the individual research topics that will make up a programme of forest research. Beginning with the regeneration of existing forest as it reaches the end of its rotation, or the reforestation of land that has not carried forest, perhaps for many years, study of the early years of the growth of the forest stand, and the succession of forest types during the period of rapid growth and change, poses many practical problems in forest ecology and silviculture. Clear understanding of the processes of decomposition and nutrient cycling help in the unravelling of variations in productivity on different sites, or even in different parts of the same

site. From such knowledge of the potential and actual productivity, effective silvicultural management of the growing forest, from the closure of canopy to maturity, guides the development of the long-term resource.

Throughout the life of the forest, protection against pests and pathogens will often be necessary, especially where natural cycles of succession or development are controlled or inhibited in the interests of productivity. However, maintaining forest development in close harmony with the ecology of the area may do much to reduce the harmful effects of pests and diseases, partly by ensuring that the chain of predators and secondary consumers is kept intact, rather than being truncated. Effective forest research, therefore, requires knowledge about the whole of the forest ecosystem and not just about the trees which are the most obvious components of that ecosystem. The old English saying about not being able to 'see the wood for the trees' is especially relevant to research and management of temperate forest.

Once the forest has reached maturity, it has to be harvested, and, in temperate forest in particular, there is much research that still needs to be done to make the harvesting and extraction of timber from the forest less damaging to the forest ecosystem. The last few decades of cheap energy, in the form of oil, have placed an undue emphasis on large-scale clearances of forest as the most 'economic' form of harvesting. When the effects of loss of soil through erosion, compaction of soil by the use of heavy vehicles, and destruction of humus with burning are added to the negative side of the balance, however, it may be necessary for us to reconsider our harvesting and extraction practices, both in terms of scale and of methods. The felling of the forest and the extraction of the timber are not the end of the process, but the start of the process of forest renewal.

4 *The role of Changbai Mountain*

We are gathered together for this Symposium near a site which is perhaps unique. Not far from where we are now, the Changbai Mountain rises steeply from the surrounding plain, and, since 1702, the vegetation on that mountain has been disturbed only minimally. As we have seen, there is a complete succession of vegetation from bare rock at the summit, through alpine tundra and dwarf shrub communities, to *Betula*

(birch) woodland. From the *Betula* woodlands, the progression through various mixtures of conifers follows altitudinal zones marked by transitions within only a few metres. Finally, we emerge in the broad-leaved woodlands of the plains.

There can be few places in the world where all of these woodland types are in such close proximity and so undisturbed by man's activities or by the grazing of man's domestic animals. Changbai offers an opportunity for forest ecology, and for the study of the essential life-support systems of the different types of forest so that they can be compared and contrasted within a relatively narrow range of soil and site types. Some of this work has already been done, and has been described at this Symposium, but there remains much that can still be done, and we look forward to working with our Chinese colleagues on extensions of this work in the future. Those of us who are visitors to Changbai have been privileged to share these days with our hosts in this very special place.

It would also be appropriate, perhaps, to say something about the UNESCO Man and the Biosphere Programme, and its role in promoting this Symposium and the collaboration of scientists of many countries with their Chinese colleagues at Changbai. It was under the auspices of MAB that many of us first heard of Changbai, and were invited by the National Committee for MAB of the People's Republic of China to visit Beijing and the research sites of the MAB Programme in China. The general objective of the MAB Programme is to develop the basis within the natural and social sciences for the rational use and conservation of the resources of the biosphere, to predict the consequences of today's actions on tomorrow's world, and thereby to increase man's ability to manage efficiently the natural resources of the biosphere. This Symposium is an expression of those objectives, and it is heartening that, despite all the differences that divide the nations of the earth, the scientists participating in MAB can meet as colleagues intent on finding solutions to the ecological, social and economic problems which affect all of us on the planet Earth.

5 *Reference*

Allen, R. 1980. *How to save the world*. London: Kegan Paul.