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(Photo E. Prusa)

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Front cover: *Tetrao urogallus*
(Photo W. Lapinski)
Back cover: *Clematis vitalba*
(Photo G. Lacoumette)

Captions to colour illustrations p. 16-17
1. *Anemone nemorosa*
(Photo Pierre Pilloud - JACANA)
2. Willow catkins (Photo G. Lacoumette)
3. *Viburnum opulus*
(Photo G. Lacoumette)
4. *Glis glis* (Photo K. Lampe)
5. Ivy on a poplar
(Photo G. Lacoumette)
6. *Lenzites tricolor*
(Photo Brian Hawkes - JACANA)

Naturoopa

No. 43 - 1983

Editorial	G. Haiden	3
The forest, an integral part of our environment	K. Zukrigl	4
Multiple roles	H. Leibundgut	7
Leisure and relaxation	U. Ammer	9
Virgin forests	P. W. Jokinen	12
Acid rain	F. Andersson	14
Danger! Fire!	R. Véléz	19
The green mantle of Europe: forestry policies	J. Guillard	20
Around towns	B. Anko	24
Exploitation versus conservation	F. Clauser	26
Forest and game	Office National de la Chasse	29

Our forests

We are all familiar with "the forest", if only through fairytales and fables—the big forest where the wild animals roam, where people pick berries and mushrooms, and where the woodcutters go for wood.

Everywhere in Europe the forest, like the rest of the natural environment, is not what it was. It has been felled, burnt, used to build our ancestors' homes and the ships which sailed off to discover another world—from which species new to Europe were then imported.

Today, not only in Europe but over the whole surface of the planet, forests are increasingly threatened and their protection is becoming ever more urgent. As well as their influence on climate, their part in regenerating air and soil and their effects on water, our forests are still a

source of timber and are also of growing importance for recreation. In addition they are home to numerous species of plants and animals.

The forest which so vividly displays the changing seasons faces innumerable threats. Foremost among the evils of our industrial age are transfrontier air pollution and acid rain. But in spite of their extremely harmful effects, the optimist is in duty bound to see their positive side: they do at least provide dramatic proof of the vital need for immediate international and intergovernmental co-operation.

Announcing the Council of Europe's campaign on "The Water's Edge", that vulnerable zone between land and water, the next issue of *Naturoopa* will be devoted to aquatic birds.

H.H.H.

The growing awareness of their forests and woodlands which Europeans have shown in recent years is a very welcome—albeit extremely tardy—development. The advanced civilisations of the pre-industrial era damaged the forest, and in some regions destroyed them by ruthlessly plundering this storehouse of natural resources: but the civilisations of technical progress and industrialisation, despite all their scientific knowledge have not acted more intelligently.

By over-exploiting the forests of the Mediterranean regions the Phoenicians, Romans and Venetians laid waste whole tracts of countryside. Huge areas that were once fertile land are now karst or steppe. Medieval Europe was not much better, nor is our "knowledgeable" modern age.

When an "Imperial Forests Act" containing strict prohibitions on tree felling was passed 130 years ago under the Austro-Hungarian monarchy, the first important step was taken towards safeguarding our forests from despoliation. Today, when the preservation of our existing forests and woodlands has long since been placed beyond doubt—or ought to have been—other dangers are coming to the fore. They include damage by wild animals, a shrinking range of species and, not least, dangers from industry: dangers which are sometimes exaggerated but which have unquestionably reached a level where they must be taken very seriously. One problem is that of polluted air, harming vegetation in the form of acid rain.

Europe's forests now represent no more than 5.2 % of the total land area; and the fact is that, when their influence on hydrology, climate and oxygen is borne in mind, that is really none too much. In some regions the absence of forests gives rise to serious problems; but efforts to grow trees on marginal agricultural land, for example, give some reason to hope that our total forest area may be

improved despite felling losses. We are still a long way, however, from solving the problem of pollution.

Although the Final Act of the 1975 Conference on Security and Co-operation in Europe included an entire chapter on nature conservation and pollution across frontiers, little more than lip service has been paid to it so far. Most countries have not even ratified the 1979 Convention on Long-Range Transboundary Air Pollution, let alone enacted legislation.



In consequence, measures of the kind taken by Austria, for instance, remain only partly effective. As long ago as 1975—the year of the Helsinki Conference—Austria passed a new forestry act in which a whole chapter was given over to this problem. An implementing order containing precise definitions of pollutant combinations was issued, and measurement and monitoring facilities were established. These legally binding regulations require firms to make technical modifications at emission points

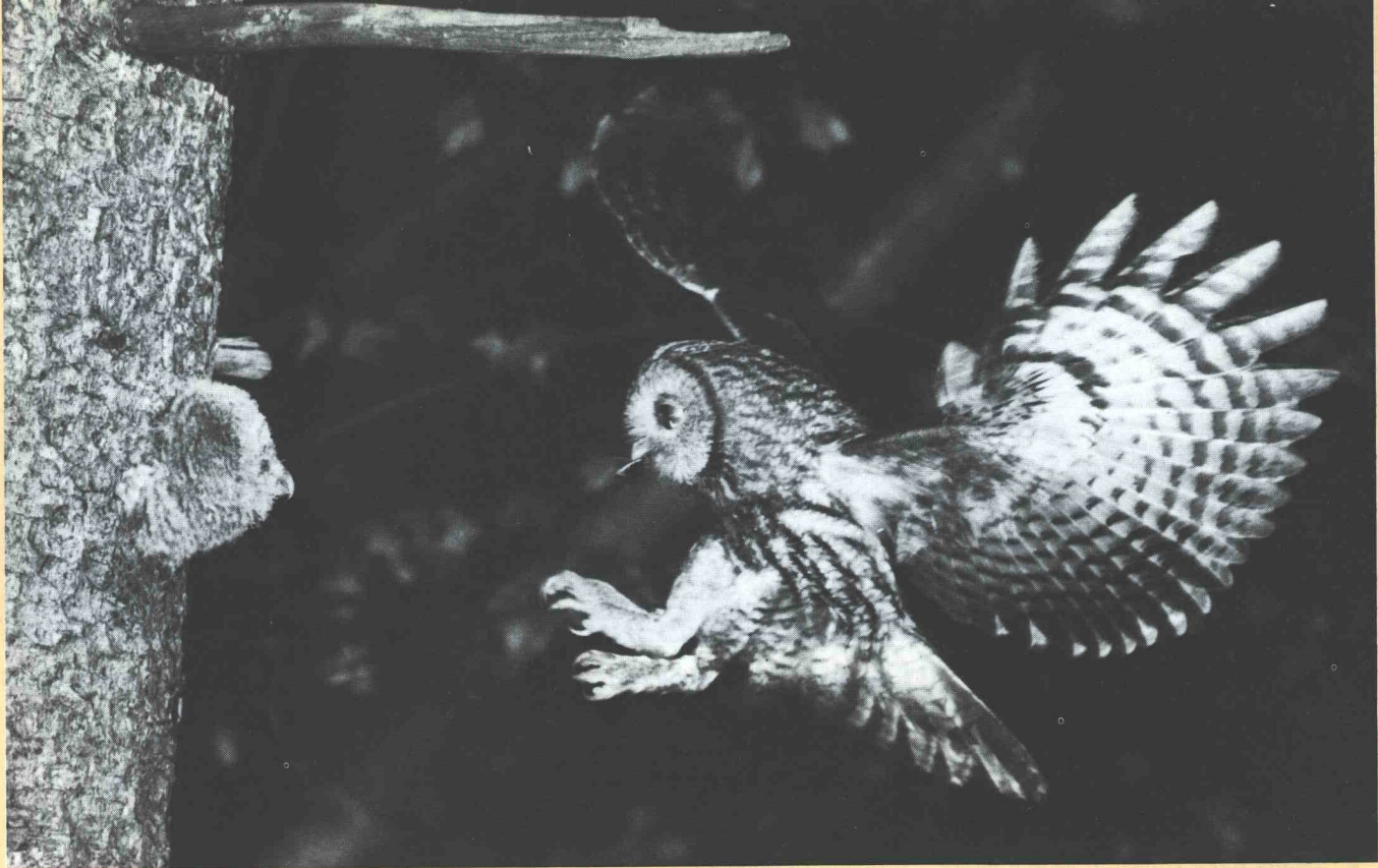
such that pollutant discharges are kept within prescribed limits. So we certainly have machinery that can be used to combat man-made environmental pollution; even so, it is inadequate in the case of the Austrian forests, simply because there are no frontier controls in the atmosphere.

Yet if we do not succeed in devising standard rules applicable to the whole of Europe in the foreseeable future, Europe runs the risk of encountering similar landscape and environment problems to those observed in many Third World countries.

As long as pollution levels and damage to the forests are merely "documented" by way of estimated values, as long as individual countries specify different legal limits and no serious attempt is made to arrive at a universally acceptable compromise between the needs of the forest and those of civilisation, all professions of concern for the environment are no more effective than the cry "Stop thief!"

It is certainly tempting to use the economic crisis as an excuse; on closer inspection, however, it is not tenable. Apart from the fact that an economic boom period is not universally regarded as the right time either, we have almost no option but to act now, without delay. We ought to accept in good time—and it is already very late in the day—that protection of the environment is not "free" and that conserving our forests is an investment which will pay returns. Protection of the environment is a life-preserving challenge to our age of science and technology, and to the economy, and a priority task for those who shoulder political responsibility. It is not just our own generation that needs constant, healthy forest landscapes: we have a duty to safeguard the forests for our children and our children's children.

Günther Haiden
Bundesminister für
Land- und Forstwirtschaft
Austria



Strix aluco (Photo W. Lapinski)

The forest, an integral part of our environment

Kurt Zukrigl

In our temperate regions forest is the predominant form of climax vegetation. Under natural conditions, a good 95 % of central Europe below the alpine tree line would be forest; even large tracts of the Hungarian puszta and the karst landscapes of the Mediterranean region would, except in certain areas of extreme conditions be covered with forest.

The history of human civilisation is the history of how the forests were driven back and transformed. For thousands of years human beings looked on the impenetrable forest as a hostile and mysterious entity. Forests had to be cleared for pasture and ploughland in order to meet their vital needs. The unfathomable is readily interpreted as the home either of gods or of ghosts and demons and so the mystery of the forest is reflected in numerous works, from the Romans' description of the forests of Germania to our own myths and folktales.

The fear and hostility which the forest once inspired in the European mind have long since turned to deep affection. But something of the mystery remains, so that in today's civilised world many people feel at ease only in forests which are looked after and made accessible for human use.

In many places the area under forest had already reached its minimum several centuries ago. Today it is in precisely those countries where the destruction of the forest was most far-reaching, such as

the Mediterranean countries and the Netherlands, that awareness of the forest's importance for people is most acute and that the greatest effort is being made to re-establish woodland. Even in comparatively wooded countries such as Austria and the Federal Republic of Germany, the afforested area is continuing to increase, although the fragmentation of woodland and to some extent also its ecological quality is worsening. In fact woodland is still being lost around the densely populated areas where it is most necessary and increasing in regions which already have more than their fair share of forest, as marginally productive agricultural land is afforested and as woodland recolonises disused pasture. As a result the landscape may become more monotonous, and from time to time even the environmental protection lobby campaigns against afforestation in order to retain certain anthropogenic landscape features such as dry grasslands and heaths.

The "forest" concept

Although the word "forest" conveys a clear idea to every one of us it is not easy to define. There are so many ways of looking at it, ranging from the concept of "an area devoted to timber production"—the definition used in old forestry laws—by way of an aesthetic and recreational experience to today's concept of

the ecosystem as the interplay of all living creatures within a given area amongst themselves and with the inorganic environment.

In forestry the two extremes are represented by Pressler, the "rationalist forester" of the 19th century who saw the forest simply as a timber production unit which could be measured and optimised mathematically, and by Möller, the father of the concept of the forest as a stable community who went as far as to consider the forest itself as an organism. The 1975 Austrian Forestry Act defines the forest in terms of its functions (section 1): according to this a forest is an area containing trees of the species listed in the appendix to the Act and which fulfils at least one of the "forest functions", namely production, protection, environmental well-being and recreation. ("Environmental well-being" means the effects of the forest on the environment, particularly as regards climate and water, purification and renewal of air and water, and noise reduction.) Nor should the forest's true protective function as shelter for many plants and animals be forgotten.

The term "forest" evokes firstly a physiological concept: a formation of trees, ie woody plants forming trunks of at least 5 m in height, sufficiently close together to cover a certain minimum (approximately one-third) of the area, which must itself be a certain minimum size sufficient to allow the development of a microclimate of its own—less windy, with less

extreme temperatures and higher air humidity. Too small an area would be too strongly influenced by the surroundings. Consequently, an isolated group of trees or a windbreak is not forest in the ecological sense.

The essential characteristics of forest are, then, a certain minimum surface area and density, the presence of trees, a microclimate within the wood and soil with a high humus content exceeded only by that of bogs. Further features are a characteristic flora adapted to the microclimate within the forest, particularly the degree of shade, and a characteristic fauna including soil organisms.

A complicated ecosystem

The forest is the most complicated ecosystem known to us. Innumerable organisms of all levels of organisation live close together and interact. Though in terms of numbers trees account for only a very small proportion of these organisms, they nevertheless have the greatest effect on the ecosystem. It is the primary producers, the autotrophic plants, which dominate. They are arranged in several layers. There may be several tree layers, the highest sometimes over 50 m high in the remaining vestiges of primeval forest, one or two shrub layers, a herb layer which is often itself subdivided, and a moss layer. These layers combine to create the characteristic structures of the various forest types. Each has a slightly different microclimate. Lianas and epiphytes, of small importance in European forests, serve to link the various layers. Less well-known is the "underground forest" formed of root systems of varying depths depending on plant species and soil conditions.

All this provides a rich feast for heterotrophic organisms, the most varied animals and chlorophyll-less plants; the big herbivores, the ungulates, are the most noticeable but the least important in the ecosystem, though admittedly too many of them can cause a great deal of damage. Waste matter is broken down and transformed by such organisms as worms and arthropods and eventually decomposed by the reducers, which are above all bacteria and fungi, into its simple inorganic components. These small creatures are essential to the life of the forest which would otherwise choke in its own waste. In many communities, particularly in forests with high soil acidity, symbiosis, the mutually beneficial association of different organisms, plays an important role, as in the case of mycorrhiza, the association of tree roots with specific fungi for the nourishment of the forest trees. Predators and parasites fill other ecological niches. Humanity itself is both a part of this cycle and outside

it with its extensive capacity for consciously influencing or even destroying the ecosystem.

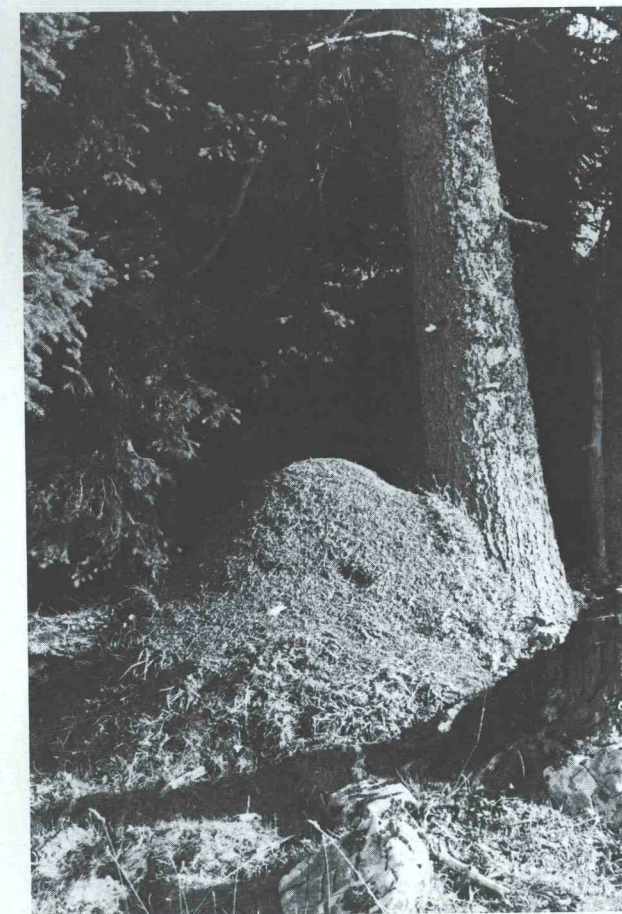
Forest ecosystems are characterised by a considerable accumulation of biomass, approximately 500 tonnes per hectare dry weight of living and dead organic matter in German forests under management. These values are considerably higher in primeval forests. The investment in the gigantic tree trunks of the primeval forest is obviously beneficial to the stability of the system which is far more resistant to storms, for example, than economically managed woodland where the tree trunks are comparatively thin.

Forest ecosystems have been functioning for thousands of years with virtually no external input apart from solar energy

and water. The forest itself plays a part in the water cycle. Nothing is lost. Waste is broken down by soil organisms into valuable manure and simultaneously serves to maintain a favourable soil structure.

The forest is frequently held up as a symbol of continuous growth. But it is not the whole system which is growing, only certain components of it which grow at the expense of others. For example, young trees grow in gaps left by the death of old trees, or created by gales or snow; stronger individuals hold back weaker ones and outgrow them. In the long term the amount of new growth in a primeval forest is equivalent to the amount of decay. The continuous growth of our economically managed forests is due simply to the fact that timber is continually felled and never reaches maturity.

Formica lugubris (Photo D. Cherix)



Wood ants are of valuable help to the forester by:

- safeguarding the health of our forests;
- improving soil quality;
- dispersing plant species by gathering seeds;
- increasing the quantity of forest honeydew

Nor does the forest suffer from any energy problems, except in the coldest extremes of its range. Only a very small proportion (around 2%) of the sun's energy is used to construct organic matter in the process known as assimilation. The greatest proportion of useable solar energy serves to evaporate water and maintain the circulation of sap, for which there is usually too much rather than too little energy available, so that transpiration has to be regulated by closing the stomata.

The forest is living proof that the only policy with any long-term chance of success will be one which emphasises balance with natural resources and attempts to maintain cycles of growth and decay. Sooner or later our economy which is still founded on growth, which squanders raw materials and energy and generates vast amounts of waste, will have to recognise the force of this example.

Influence of climate

When we talk about "the forest" we are in fact talking very much in the abstract. The different types of forest are at least as varied as the tree species which compose them. After all, forests grow over a very wide area. As far as Europe is concerned, it is virtually only in the east of the continent that the climate is too dry for forest growth. The only other factors limiting forest growth relate to soil characteristics: inadequate water-holding capacity, shallowness and porosity. Excess water is a fairly local problem around areas of water and bogs. Woodland flourishes best in a temperate and relatively damp climate and it is to this more suitable climate, rather than to better woodland management, that we owe the relatively high proportion of forest in central as compared to southern Europe. Furthermore, as far as soil chemistry is concerned, practically all the European soil types with the exception of salty soil are suited to forest. The most vivid natural limits to forest growth are the alpine and polar treelines, primarily determined by inadequate heat in summer and the shortness of the growing season.

Every part of this varied range has its own specially adapted type of woodland. Admittedly every stand has its own individual character resulting from environmental influences, historical development and the consequent conditions of colonisation and competition. Nevertheless over and over again similar areas are found to have similar combinations of species, thus making it possible to distinguish forest communities by their characteristic combinations of species,

specific structure and similar dynamics, rather than by the whole ecosystem which is far harder to study. Once such forest communities have been studied and a certain amount of research undertaken into their environmental requirements it becomes possible to draw conclusions about the sites where particular communities occur.

The first factor determining which forest communities will occur in a given site is regional climate, followed by soil or the parent rock from which it is formed. It is well known that in very broad terms Europe divides into the Mediterranean sclerophyllous regions adapted to dry summers, the temperate zone of deciduous broad-leaved woodland and the coniferous forests of the mountains and the north, where the climate is continental and winters are cold. A mixed forest region forms the transition in upland areas.

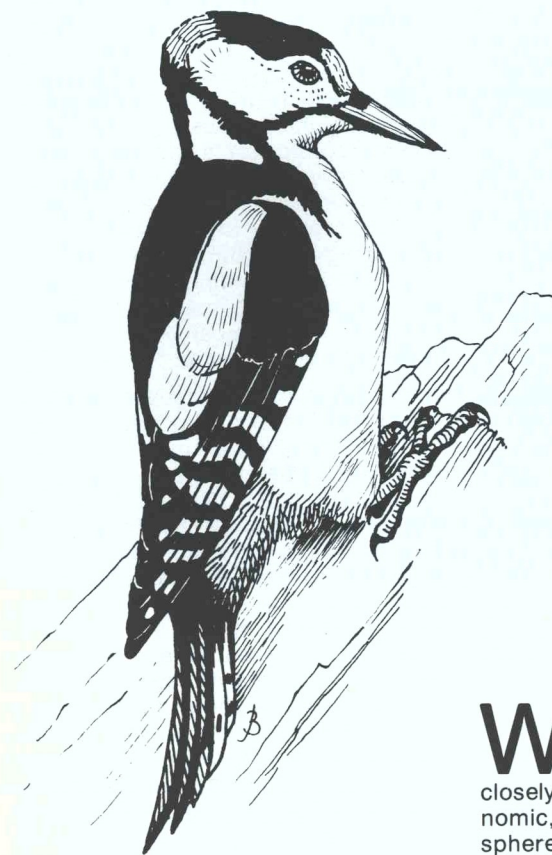
Nothing is permanent in forest ecosystems any more than it is elsewhere in nature. Environmental changes set in motion changes towards a new balance with the new environmental conditions. Thus for example a fall in the groundwater level may turn fen woodland into dry forest, as the species characteristic of damp conditions die out and are replaced by other kinds. However, as long as external conditions remain more or less stable the forest itself, once it has reached the climax vegetation for its particular site, will remain in a state of dynamic equilibrium, in which fluctuations of greater or smaller amplitude occur either side of a condition of equilibrium. The scale of the fluctuations depends upon the stability of the biotope and the site. As a general rule diversity of life forms and species enhances stability but is not a precondition for this. In extreme sites where relatively few species can flourish, as in the sub-alpine fir forests, it is perfectly possible for forests with a very limited number of species to be stable.

The reactions of various woodland types to management measures are as varied as their structure. It follows that experience with one type of woodland should not be transferred uncritically to other forest ecosystems. Ability to resist environmental damage also varies and here the forest has a new and important function as an environmental indicator. The decay and death of the forest as a result of air pollution is a vividly dramatic process, so immediately apparent that we may hope it will have a greater impact than scientific findings not directly accessible to the average citizen and persuade our society to change its present course by taking drastic measures to protect the environment and by rethinking our whole economic policy.

K.Z.

Multiple roles

Hans Leibundgut



Dendrocopos major (Drawing NCC)

Wherever the land is under cultivation, the historical development of the forest and its roles is closely linked to changes in the economic, technological, social and cultural spheres. Since the time when woodland, timber and other forest products were available in lavish abundance and human onslaughts on the environment were virtually unknown, practices such as wholesale clearing and exploitation, and a conception of forestry as an activity geared solely to the needs of timber production, have in a relatively short period of population growth, of transition from an agrarian to an industrial landscape and of economic expansion, caused increasing importance to be attached to the value of the forest as a resource and a catalyst. True, every stage of this development is still discernible: some woodland areas continue to be used simply for picking and gleaning, while others are ruthlessly exploited; in some, wood production is on the agricultural model with wide area harvesting and monocultural plantations, while others are husbanded in such a way as to keep them close to the natural state. It is clear, however, that as the cultural and social development of humanity pursues its course, so the forest is expected to assume more and more new roles; and most of these roles are rapidly gaining in importance.

A supply source with an economic function

In its role as supply source, the forest is mainly required to produce timber for

use as a building material, a fuel, a working medium and an industrial raw material. World timber demand is steadily increasing and to this day continues to be supplied to a very large extent by relentless deforestation in developing countries. To gain an idea of the volume of timber consumed every year, it is sufficient to imagine a tree-trunk 50 centimetres in diameter stretching two hundred times around the Earth's circumference. It would be possible, by making forests sufficiently accessible and practising careful husbandry, to produce this amount of wood without difficulty on a continuous and permanent basis. Trees, incidentally, can be grown and harvested with minimum energy consumption and little or no environmental impact.

The profits to be derived from forestry may well appear modest in comparison with those from agriculture or indeed industry. For many a mountain locality, however, forestry is the best and surest source of revenue. Moreover, in forestry, wages account for more than three-quarters of total costs, and represent a sorely-needed supplementary income for many smallholders and miners. Also, as a producer of timber, the forest provides manual workers of every description with indirect earnings by keeping the wood-processing industries regularly supplied.

Other forest products, like rubber, dyes, tannin, bark, cork, wild fruit, berries, mushrooms and game, do of course have a large part to play, but are on the whole less profitable than wood-based products.

Yet another important aspect of the forest's role as a source of supply lies in its ability to keep springs regularly replenished with wholesome drinking water and to maintain groundwater purity.

For many localities and owners of woodland estates, the forest represents a substantial source of economic prosperity, chiefly valuable for constituting a buffer stock which they can conveniently augment to some degree by planting more densely or deplete by stepping up consumption. Somewhat in the manner of an interest-bearing equalisation fund, the forest's reliable reserves help to defray major building expenses and the like, and make good diminishing returns and losses of all kinds.

Health and recreation

A further fact to mention is that in many areas, an abundance of woodland contributes to the development of tourism and holiday-making, for the forest's ability to provide health-giving recreation is seen more and more as a factor in curing a variety of physiological disorders.

These properties of the forest are closely associated with its ability to abate the unhealthy and destructive effects of emissions from built-up areas, industrial estates and motorways. In addition to the opportunity afforded for breathing air that is relatively unpolluted, the features chiefly appreciated as beneficial to health are balanced humidity and temperature, silence, subdued light, the changing woodland scene and the freedom to move without constraint and enjoy the natural environment.

All of these features have made the forest a favourite leisure resource for people living nearby. As the changes in our residential environment grow more aggressive and unpleasant, so the attraction exerted by those natural landscape features which have managed to remain largely intact becomes stronger. Parks, sports grounds, recreation areas, indoor swimming pools, botanical gardens and zoos are no substitute for the experience of nature which a forest has to offer. All those, and they are legion, who have no homes or gardens of their own regard the forest in quite a special way as "theirs", a space in which they can move freely, rest when they wish and generally please themselves. As early as 1912, a provision was incorporated in the Swiss Civil Code to the effect that everyone in the locality is free to enter the forest and pick wild berries, mushrooms and the like: this was a far-sighted move to establish one of the forest's important social functions, and there is no doubt that it was a major factor in enabling the people of Switzerland to develop the right attitude to their forests.

The forest offers a natural protection

The forest's intrinsic ability to ward off environmental hazards was the subject of considerable research at a very early stage. It has been established that trees can prevent, or at any rate greatly diminish, soil erosion and the risk of earth movements, keep water discharges under control, reduce wind speed and provide extensive defence against the occurrence of avalanches.

Forests have numerous accessory roles as well, not least that of nature conservation. In cultivated regions, the only places—except for natural forests—where free-ranging animals and plant life can survive in the wild are moors and wet meadows that have escaped drainage projects, a few lakeside and riverbank habitats and areas of unproductive wasteland. It may therefore be that the only way to keep the encroaching impoverishment of the entire living world at least partially at bay, apart from setting up nature reserves, is to direct forest management towards the preservation of wildlife communities.

One under-utilised feature of woodland is the opportunity it provides for scientific research, especially in ecology. All woodland, especially undisturbed primeval forest (commercial forest acreage too, if

close to the natural state) constitutes an extraordinary multifarious and complex pattern in which inanimate matter and living communities interact, and so offers the best possible terrain for investigating complicated functional interrelationships. At a time when our living environment seems to be losing its capacity for correcting imbalances and the warning signs of ecological disaster are starting to appear, the need for such research appears more urgent than ever. The longevity of forest trees means that by examining their stumps and measuring the width of the annual rings, we can acquire a unique insight into climatic changes and atmospheric conditions over hundreds of years.

No overall evaluation of the forest's many direct and indirect roles and influences can be made, partly because most of them cannot be expressed in numerical terms, and partly because the significance of each may vary from one place or one period of time to another. What is not in doubt, however, is that their importance is growing, and that from being a mere source of supply and profit, the forest is now seen as a multipurpose resource and catalytic agent. Provided due deference is shown to the ways of nature, these conceptions of forestry practice needs not conflict. The purpose of forestry today is not just to produce timber efficiently, but to enrich our lives. H.L.



(Photo G. Lacoumette)

The first person to draw attention not only to the importance of the forest for climate, soil and water, and the "social situation of peoples" but also to its beneficial effects for society was Alexandre Moreau de Jonnes, a high-ranking French officer and official in the Trade Ministry, in a prize-winning essay of 1825 which was very unusual for its time and was highly regarded throughout Europe. Some years later Wilhelm Heinrich Riehl (1857) took up the same idea and praised forests as places in which one "can enjoy personal freedom and wander this way and that as one chooses".

In spite of these promising beginnings, the systematic development of forests for recreation remained an exception, being restricted above all to the areas around health resorts and tourist centres. Until halfway through the present century there was still a belief that the requirements of forest recreation could be met at practically no cost, simply as a sort of by-product of timber production.

Things changed very abruptly in the early sixties: leisure time grew as working hours become shorter and car ownership increased population mobility; it became possible to make day trips or go for a weekend into forest areas, which were unprepared for this influx of visitors. Last but not least, changes in living and working conditions rapidly pushed up the demand for access to natural surround-

ings to counter-balance the effects of urbanisation, population concentration and automation.

How did owners and forestry commissioners respond to the challenge?

It is fair to reply that their reaction was spontaneous and positive. The managers, above all of publicly owned forests but also of the larger privately owned woodlands, accepted responsibilities which were—at least in scale—unprecedented. With the deliberate opening up of forests to the public for recreation—something which did not come automatically in all European countries—it was only a few years before virtually all the major forested areas affected by this new form of leisure activity acquired a basic, not to say generous, provision of car parks, footpaths, grassy recreation areas, picnic areas and shelters. Further development brought children's playgrounds, nature trails, keep-fit trails, game enclosures and other visitor attractions and was accompanied by feverish research activity into the sociological implications of forests: efforts were made to discover people's recreational wants and expectations, the amenities which best satisfy them, how long people spend in forest areas, what tree species—or types of woodland—they prefer, and in general what the ideal forest for recreation is.

During this period a wealth of models for assessing the recreational value of countryside and forest were designed, discussed and applied.

This positive attitude on the part of forest owners and administrators not only included a willingness to finance amenities and maintenance, largely from public funds though also from private sources; it also demanded a readiness to forego possible additional income, eg by renouncing opportunities for rationalisation and mechanisation through the selection of particular tree species, timber felling or cultivation methods in deference to the visitors' wishes. At the same time increasing visitor numbers led to more forest fires, disturbance of game and indirectly, as game was forced out of the most heavily frequented areas, to increased damage to plants in the less accessible areas of the wood from gnawing and bark stripping.

What has been the net result?

Today when we stand back and try to look objectively at this phase, we have to admit that there were virtually no earlier models or experience to serve as a basis for "fitting out" recreational forest areas, and also that developments were influenced at least in part by the attitudes and wishes of the towns and villages which, consciously or unconsciously, hoped that by developing the recreational potential of forests within easy



Mixed hardwood forest, Rhine valley (Photo ONF - Ludmann)

reach it would be possible to counter-balance the decline in the quality of urban life.

Without resorting to the dreadful expression "forest fixtures and fittings", one still has to admit—and today many forestry administrations take this view themselves—that opening up woods and providing recreational amenities has sometimes been too much of a good thing: not all the children's playgrounds were necessary and a lot of sometimes costly apparatus could well have been left out without the children missing it; nor would the health of the community have suffered if half the woodland keep-fit trails, particularly in rural areas, had never been built; admittedly there would have been far fewer opportunities for civic pomp at inauguration ceremonies and the boom in the sales of matching his-and-hers jogging outfits would never have happened. All this by way of saying that leisure has developed into a major economic force with its own laws and that the choice of leisure activities is increasingly something decreed by fashion: what other explanation is there for the successive vogues in winter sports, from downhill skiing via cross-country skiing to the latest, ski-touring? It is typical that a special outfit is required for each one. In many instances therefore it was quite impossible to deny the existence of fashion trends without losing sight of the needs of forestry policy.

This short analysis may have been somewhat too critical, but it is certain that in developing the recreational potential of our forests in the sixties and seventies we

(Photo G. Lacoumette)



(Photo Immendingen)

paid too little attention to their natural potential and too much to development and equipment. There are two aspects to this:

1. At times we should have given more careful consideration to the question of what the forest ecosystem can bear, and we should have realised clearly that certain biotopes can tolerate only very slight (peripheral) disturbance or none at all. The recreation models mentioned above told us which landscapes and forests were beautiful and best suited to recreational purposes, but often (unconsciously) concealed the fact that they were simultaneously the natural areas most in need of environmental protection

or most sensitive to ecological change. In other words they are areas which cannot cope with the mass influx of leisure seekers without essential components—plant life, animals, water quality—of the system being disturbed, impaired or irretrievably lost.

For recreation is only one of the forest's contributions to well-being. This has become particularly clear in mountain regions where never-ending development projects—construction of roads, cable railways, ski-lifts and pistes—have in places dangerously reduced the actual and potential protective capacity of the forests.

2. At times we should perhaps have laid greater store by the total contribution of the forest in all its variety than by recreational amenities alone. New discoveries in research on recreational forests and the findings of experienced observers show that much of what Heinrich von Salisch advocated as long ago as 1885 in his theories on forest aesthetics still holds good. The forest makes its impact through the mood it evokes by a multitude of sensations, sights, smells and sounds, and by the accidental or deliberate (or improved) grouping and succession of stands and individual trees, glades and clearings. Perhaps we have not given enough attention to the fact that in order to play children often need no more than a meadow, soft sandy soil or a stream which they can dam, and that in our "built environment" the forest is the only place left where such games are possible!

What conclusions can we draw?

Certainly it is neither possible nor necessary to prescribe universally valid solutions or guidelines. In the same way that the choice of economic goals and forestry methods will depend upon each



(Photo G. Lacoumette)

individual case, the approach adopted towards forest recreation areas must also be considered in the light of specific requirements and the spatial situation overall. Nonetheless it is I think permissible to draw a few conclusions from the experience of recent decades.

— The most important principle is that forests must remain out of bounds to all motor vehicles. This is the only hope of preserving one of the most valuable components of recreation, tranquillity.

— Parking areas are needed; common sense decrees that they should be designed to cope with an average demand rather than with a peak which occurs only once a year. The choice of sites for parking areas or of access routes to them from public highways often determines the visitor pressure to which areas of forest will be subject.

— Development of and access to woodland complexes must be adapted to the capacity of forest biotopes. Today we have more and better information about the existence and sensitivity of particular biotopes; we know too that visitor pressure falls rapidly with distance from parking areas and that the state of forest paths also exerts a selective influence. The construction and improvement of forestry tracks should also be seen in this light.

— Trails, paths, picnic areas and shelters are the most important amenities in forest recreation. Close attention should be paid to the signposting, layout and equipment of these various facilities since good planning can enhance the recreation experience as well as taking the pressure off vulnerable areas.

— Particular care (as well as a critical approach) is called for in planning children's playgrounds. Often children will need no more encouragement to play than access to a suitable area (forest meadow, small expanse of water, land along a riverbank) possibly provided with a basic level of equipment.

— As a matter of principle all amenities should be made of wood, not only because wood is a warm and relatively cheap form of building material, but also because its naturally limited life-span means that less successful items of equipment can be unobtrusively withdrawn.

— All our concern for providing facilities should not blind us to the fact that it is the forest itself which attracts visitors. Our attempts to develop woodland for recreation should therefore begin with forestry management and with the planning of the forest edge. We might sum it all up by saying that the greater the beauty, variety and romantic and emotional appeal of the forest, the less it has need of extraneous items of equipment and the more experience, pleasure and relaxation it can give.

Virgin forests

Paavo W. Jokinen

By wilderness areas this article means those forest areas that have stayed in their natural condition. The growing stock there is usually untouched. Those practising a natural livelihood, such as reindeer husbandry, and hikers ever increasing in number, are the main users of those forests which have remained as nature has shaped them for centuries.

The landscape

In botanical geography, Scandinavia is part of the northern coniferous zone extending over the whole of Eurasia, from the Pacific to the Atlantic Ocean and the climate and soil vary considerably.

This being the case, the eastern part has totally different tree species from the western. In those parts of the coniferous zone where Finland lies, the main tree species are Scots pine (*Pinus silvestris*) and Norway spruce (*Picea abies*). The most important deciduous species is birch (*Betula*).

The tree species also vary biologically. Birch is clearly a pioneer tree species which is the first to take over an open area. Later the area turns into a pine or spruce stand. Pine thrives on dryish or dry mineral soils, because with its root structure it can get the required water

from deep under the ground. Pine is also partly a pioneer tree species, while spruce is, above all, a species of moist soils. Being a species with shallow roots, it can get the water it needs. Spruce, compared with pine, tolerates more shadow. Thus, wherever there is sufficient moisture, it finds its way into a pine stand and takes over the site of this species. On peatland the choice of tree species depends on factors of quality, mineral content, acidity and water economy of the soil.

Forest fires have hindered the total take-over by spruce in wilderness areas. In their natural state, Finland's forests have been burnt at least once during the last one or two centuries. To these burnt-over areas the pioneer tree species come first. Only in the northernmost parts have forest fires not been able to affect the development of the forests greatly. The site is so moist that only during summers, when the precipitations are exceptionally low, may the soil get so dry that burning and the spreading of fire are possible.

Nowadays the intensified control of forest fires, with the aid of permanent control points (towers) and regular, continuous aerial control, restrains the starting of large forest fires. Changes in the ecology of the natural forests therefore occur very slowly, according to nature's own condi-

tions. In old forests the changes are induced by the dying of old stands that have stopped growing, still further aided by insect and fungus damage. Also storms may be a cause of damage, and all these factors together will further the regeneration of natural forests. Although the formation of a new forest is slow, the age of the growing stock in wilderness areas may fluctuate greatly. The share of the seedling and young stands is, however, small, most of the growing stock being near its biological maximum age: the pine stands 300 to 500 years and the spruce 200 to 400 years old.

Protection of the wilderness

When we think about a country such as Finland, whose economy, to a large extent, is dependent on the practice of forestry and forest industries, one can justify the question of whether it is reasonable to keep the natural forests of the wilderness in a virgin state. The systematic use of these forests, by following correct silvicultural methods, would apparently increase the output of raw material considerably. One should, however, know that the majority of the wilderness areas proper lie in northern Finland, close to the timber line. There, the regeneration of the forest is slow and the annual increment small (circa 1 m³ per

hectare per year). Even with the best silvicultural procedures, we cannot make up for the basic factors of climate and soil. Also, it should be mentioned that pine seeds from this area have a good germination capacity only once every ten to fifteen years. The result of this efficient forest utilisation might be the dropping of the timber line and desolation of the soil.

Protective forests

To stop the dropping of the timber line, we have in Finland a protective forest Act that was issued in 1922. This Act gives the government the right to forbid, at the proposition of the National Board of Forestry, the free use of forests for other than household purposes in the protective forest area. For other kinds of cutting, an approved plan and permission from the authorities is required. In the most sensitive parts, the right to take household wood may also be restricted or totally forbidden. The geographical border of the protective forest area crosses Finland, starting south of the 68th latitude and extending, with the exception of small commercial forests, over the northernmost region of the country. The total of protective forests represents 2.2 million hectares. The protective forest area can duly be called wilderness area, even if it is not totally "virgin".

Exceptions to this area are the summit zones of the protective forests, ie areas more than 300 metres above sea level, where the use of forests is forbidden by the National Board of Forestry. This area exceeds one million hectares, which is about half the total area of protective forests. As far as the growing stock and the original landscape are concerned, this can be considered genuine wilderness.

Management

Finland is a forested country where forestry is being promoted in many ways, and thus the utilisation of forests is intensive. It is therefore important that such areas where the original landscape and the whole biotope are at their best, be left outside commercial activities. A sufficient number of these areas should be put under protection but this cannot be achieved without special legislation. In Finland we fortunately still have some natural forests, even real wilderness areas which we have been able to turn into protected zones. These are either strict nature reserves (a total of 20) or national parks (22). The strict nature reserves are intended especially for research and education and access to them requires a permit, thus securing the virgin state of the landscape. The national parks, on the other hand, as natural

scenery, help to increase interest in nature and recreation in open-air surroundings. They have been equipped with trail networks and special places for making camp fires. Taking wood is not allowed in order to keep the wilderness conditions as natural as possible; thus firewood is delivered by the park wardens from outside the park.

Wilderness areas have been supplemented by peatland protection zones. Peatlands are part of the original landscape and the purpose of their protection is mainly to guarantee the existence of versatile swamp vegetation and bird fauna, rich in species, by habitat protection. These peatland protected areas also have a statutory basis.

The extent of statutory protected areas established or being established in Finland is circa 1.5 million hectares. This figure includes circa 141,000 hectares of strict nature reserves and circa 600,000 hectares of national parks.

It should be mentioned that the National Board of Forestry—which administers state-owned land and water areas (8.4 million hectares) and manages, protects and utilises its forests with the aim of a rising timber yield and an economically favourable return—has, by its own decision, protected largish areas or single stands representative of the original untouched nature to serve as examples of genuine wilderness landscape. All kinds of activity will be kept out of these areas, which represent a total of circa 15,000 hectares.

To guarantee the balance of nature

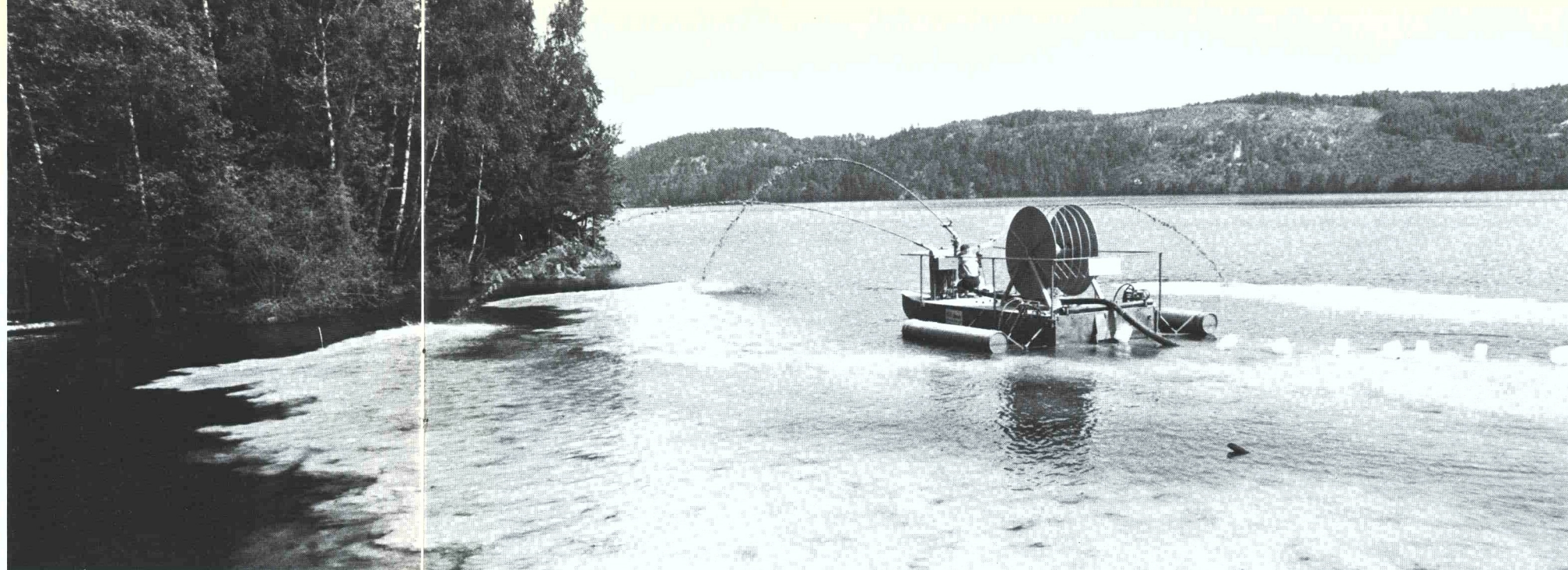
Wilderness areas with forests that have been formed naturally in the course of time are an example of how nature is able to protect itself and its existence. Only man can, by his interventions, bring about catastrophes disturbing the balance of nature. The most alarming example of this is the present systematic devastation of the tropical rain forests. In the northern coniferous zone, even severe cuttings may not result in corresponding extensive desolation, because of the soil structure and the climate. The disappearance of virgin forests implies, above all, a gap in the range of different forest types, whose regeneration by cultivated forestry is not possible. The impression is the same as when a building with cultural and historical value is replaced by a construction with modern lines. The preservation of natural forests, even only as an example for future generations, may not be an unjustified demand. Let us give the wilderness a chance to live. P.W.J.



Virgin forest - the oldest trees are more than 500 years old (Photos R. Kalliola)

Acid rain

Folke Andersson



Lime is sprayed to combat the acidification of lakes (Photo G. Svensson)

Over the last 20 years growing concern has been apparent for the effects of air pollution on the European as well as the world's forests. It started with the UN Conference on the Human Environment in Stockholm 1972, when a case study on "Air pollution across national boundaries—The impact of sulphur on air and precipitation" was presented. The study mainly dealt with the Swedish situation with increasing material damage by corrosion, effects on human health, increasing number of lakes becoming acidified, and also dealing with possible effects on soils and forest growth.

During the last five years new alarming reports have come from Central Europe in connection with the occurrence of dying forests.

In June 1982 the Swedish Government arranged a Ministerial Conference devoted to the "Acidification of the Environment". The aim was to commemorate the 1972 conference and to stimulate international collaboration and ratification of the 1979 Geneva Convention on measures against air pollution within the ECE countries. A report from the 1982 Stockholm Conference is available—"Acidification today and tomorrow". It deals with a scientific and political description of the acid rain issue followed by a presentation of the present and future acidification situation particularly from a Swedish point of view. The last section deals with possible measures to stop the acidification.

The Ministerial Conference was preceded by two expert meetings dealing with ecological effects of acid deposition and strategies to control emissions of sulphur and nitrogen oxides. This description of acid rain and its effects on European forests is mainly based on the findings of these expert meetings.



Acid deposition - effects on forests

To understand the effects of acid rain on forests we need to know the different forms of air pollutants and their way of affecting the forests. We cannot limit our interest and discussion only to acid compounds in the rain, but must also include other compounds which are the origin of acid or acidifying components in the ecosystems.

With acidification we mean an increase of the amount of hydrogen ions (measured as lower pH-value or higher acidity). The story of acidification begins as soon as vegetation starts to colonise bare soils. The present situation with an increased man-made acidification can be traced back to the times when we started to burn organic materials containing sulphur in a more regular fashion. This is most pronounced as a consequence of the start of industrialisation during the 18th century.

In its most accelerated form it occurs after the 1950s with increasing burning of oil containing varying sulphur levels. Today we calculate that, on a European scale, of the sulphur coming to the surface of land and water, 50 % originates from oil-fired, 40 % from coal-fired and 10 % from other industrial processes.

The combustion of organic material containing sulphur means production of gaseous sulphur dioxide, which in the atmosphere will be transformed to sulphuric acid. In the rain it will be dissolved into hydrogen (H^+) and sulphate (SO_4^{2-}) ions. During the combustion nitrogen oxides will also be formed, which are transformed into nitric acid and in the rain water dissolved into hydrogen and nitrate (NO_3^-) ions. Today approximately one third of the acidity in precipitation is derived from nitric acid. The dissolved pollutants are brought to the forest as wet

deposition. Acid or acidifying compounds in the form of gases as well as particles (especially heavy metals) are transported to forests as dry deposition. The dry deposited materials are usually transported over shorter distances.

Direct and indirect effects

Gases like sulphur dioxide have direct effects on organisms and material. Plant leaves take up the gas and at high concentration photosynthesis is disturbed or disrupted.

Acidification effects are usually considered to be of an indirect nature. Incoming acidity to the forest will affect the soil chemistry and also the soil biology. Changes in availability of nutrients will occur and at higher levels of acidity toxic elements may be liberated and brought into circulation. The acidification effects depend then on two factors, viz. the magnitude of wet and dry deposition and the natural, inherent sensitivity of the soil and the water to acidification. Other effects appear, however, where there is the most unfavourable combination of deposition and soils; thus effects can occur both in the immediate vicinity of an emission source and at hundreds to thousands of kilometres from it.

We can say that the direct effects or damage will affect leaves and trunks of trees. The indirect effects will affect the root environment as well as release of nutrients, which in turn will affect the growth of the forest. This means that acidification can be discussed in terms of nutrition of the forests as well as toxicity which is a threat to the flora and fauna.

What is the situation of the European forest today?

With this background on air pollutants, their deposition and ways of affecting the forest, we will now examine two cases:

- the Central European case, with very high levels of sulphur and nitrogen deposition, and
- the South Scandinavian case, with less, but considerable deposition of sulphur and nitrogen.

With these two cases we have then a better possibility of understanding the present and future effects of air pollutants on our forests.

The Central European case

Central Europe has a deposition of 30-60 kg sulphur per ha per year and 15-30 kg nitrogen per ha per year or more. The contribution of dry deposition is high. Today one million hectares of dying forests are reported, especially of white fir and Norway spruce. Damage to beech forests has also been reported.

Even if all details are not yet proved, it is obvious that one important impact on the forest is through the direct effects of sulphur dioxide, nitrogen oxides and the occurrence of ozone, which can damage leaves and their photosynthetic machinery.

It has been found that levels of sulphur dioxide causing a reduction in tree growth are lower than previously estimated. Today growth decreases can be expected at yearly mean concentrations of 25-50 μg sulphur dioxide per m^3 . These concentrations now prevail over large areas of Europe. Damage also seems to occur at lower concentrations when

oxides of sulphur and nitrogen occur together as well as combined with ozone.

The levels of nitrogen oxides in the air are at present increasing, which also will favour the formation of ozone, a problem which will be accentuated in the future.

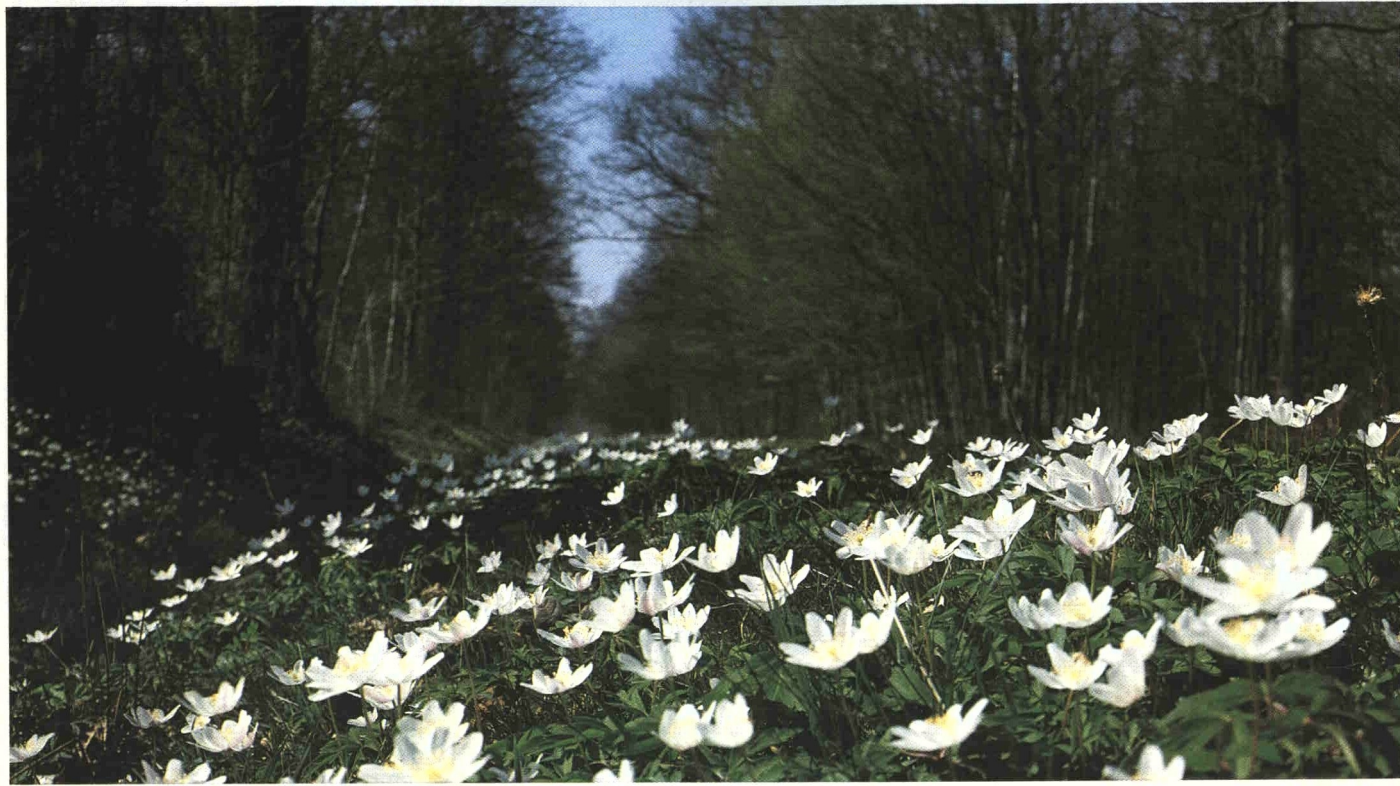
There are also changes occurring in the soil as a consequence of deposition of acid compounds, especially hydrogen ions, sulphate and nitrate ions. These are responsible for exchange of other cations in the soil and the transfer of cations from the soil to ground and surface water. In particular, forests on sandy and silty soils are subject to soil acidification. Soil acidification is probably a widespread phenomenon. In some areas aluminium and heavy metals will be mobilised with consequent toxic effects on organisms.

Wind-exposed areas at higher altitudes in central Germany also receive higher amounts of acid by droplets from fog-clouds, which will increase the losses through leaching of the essential elements for the buffering of the soil like calcium and magnesium.

So far no good evidence exists that acid rain and its indirect effects alone have decreased forest growth. The reason for this is the counteracting and fertilising effect of the nitrogen, which in higher amounts is transported to the forests with the polluted rain.

Possible negative effects on soil acidification of the acid precipitation may be concealed by the growth stimulating deposition of nitrogen. Also, potassium and magnesium are increasingly subject to leaching from the soil as a consequence of the continued deposition of acid compounds. This situation has been confirmed for areas of poor forest soils in central Europe.

The forest



1

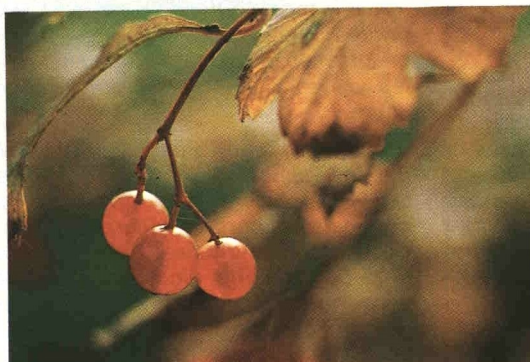


4

A living entity in continuous development, where life and death are always close to each other and maintain a fragile and complex balance.



2



3



5



6

It is hypothesized that trees with an ample supply of nitrogen may experience a situation with an impaired root development and a lessened ability to build up protective compounds to prevent insect and pathogen attacks. In general, increased sensitivity of forests develops in areas with high deposition of nitrogen.

The same phenomenon holds for damage caused by acid mist on leaves as well as possible toxicity damage to roots and mycorrhiza caused by aluminium and heavy metals released through soil acidification.

Even if drastic changes have been observed in Central European forests and possible explanations exist, more research is still required to evaluate this new hypothesis. However, it is quite obvious that an accumulated deposition of air pollutants including heavy metals over hundreds of years has reached a stage where the forest is affected.

The South Scandinavian case

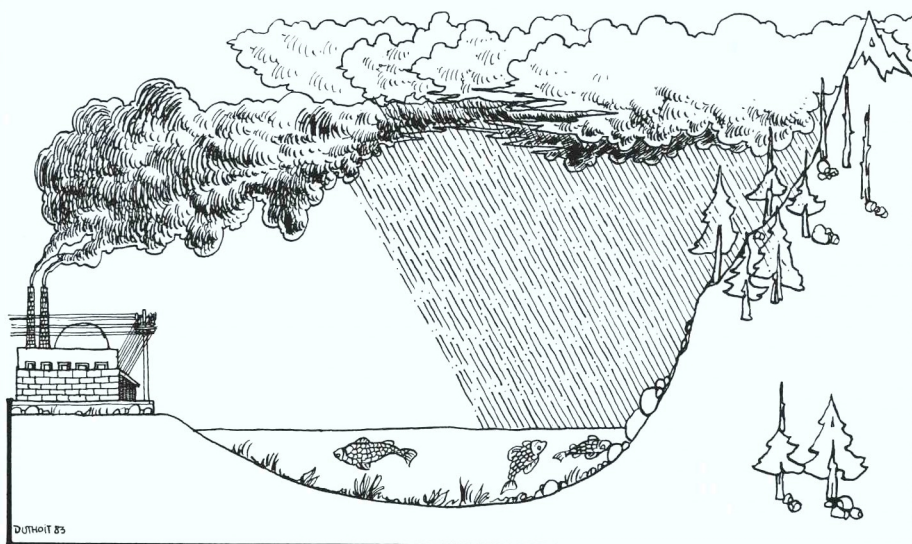
South Scandinavia receives 10-35 kg sulphur per ha per year and 5-15 kg nitrogen

per ha per year. Compared to Central Europe the dry deposition is smaller, but high compared to the earlier situation of a pristine environment.

Direct effect seems to be limited to areas around emitting sources and indirect effects of the acid deposition will be dominant on a regional scale.

The forest has so far not shown any sign of decrease in production or growth, rather the contrary. This can be explained by the increasing deposition of nitrogen. As recorded in Central Europe, we can now expect on better soils a situation where a continued fall-out of nitrogen will not cause any increase in growth because other elements will become limiting. We should then expect more stressed and vulnerable forests.

A continued fall-out of sulphate and nitrate ions in deposition will lead to a continuous loss of elements such as calcium, magnesium and potassium. Ground water and lake water in areas with high deposition and coarse soils will show high contents of aluminium and heavy metal—a mirror of changes in the soil.



(Drawing F. Duthoit)

Strategies to control acid rain

The only reasonable way to reduce damage by acid deposition is to reduce pollution at the source. Countermeasures like the liming of lakes and land can in no way be considered as solutions. They serve rather as an "aspirin" or as temporary remedies.

The 1982 Stockholm Conference found that a deposition of sulphur of less than 0.5 gr per m² per year was thought at present not to create severe damage to lakes of high sensitivity. This corresponds to a deposition level of 3 to 8 times less than the present one in South Scandinavia. Any decreases in deposition of acidifying substances will bring improvements not only to sensitive aquatic ecosystems, but also to forest soils.

Most countries have agreed in principle to the idea of the ECE Geneva Convention of 1979 to reduce emissions into the air, but there is a long way to go before this is achieved on a satisfactory scale. Clear goals have first to be established for acceptable emissions of sulphur and nitrogen.

Energy conservation, when economically attractive, has a large potential for reducing energy demand and thereby emissions. Today there are also techniques and technologies available for the control of sulphur and nitrogen oxides emissions. Developments are leading to improvement in existing technologies and development of new ones. This is expected to continue, but only gradually, so we cannot justify delaying the use of available techniques.

The present development of pollution damage within Central Europe, including acid rain, has again clearly shown that effective counter-measures have to be taken in order not only to improve the situation of today but also for the future. It is in everyone's interest to protect a living and healthy Nature. F.A.

Danger! Fire!

Ricardo Vélez

Forest fires are the most serious cause of the destruction of the natural environment in countries bordering the Mediterranean. Spain, because of ecological and demographic factors, is the worst sufferer in this part of the world.

The underlying reasons

The reasons which underlie the problem include:

- the generally poor fire resistance of Mediterranean species of plants and trees, not only in natural formations but also in the areas that have been reforested over the last 50 years (over 2.5 million hectares);
- the high population density, which rises even higher in the summer when the tourists arrive;
- the rural population's lack of consideration for woodlands, because of the low short-term economic return they offer;
- the increasing incidence of deliberate fire-raising, which is a reflection of the world-wide increase in crime;
- the adverse effects of the climate, with longer and longer droughts and extremely hot summers.

The consequences are enormous areas devastated by fire, which destroyed 100,000 hectares each year from 1978 to 1981; there were more than 10,000 fires in 1981 alone. The damage amounts to more than 6,000 million pesetas annually in primary products (wood, cork, resin, fruit, pasture), and nearly 20,000 millions are lost indirectly as vegetation ceases to protect the soil and regulate water, as the quality of forest areas set aside for recreation deteriorates, and as firms are faced with the difficulty of scarcer timber—not to mention the loss of human life (100 deaths since 1961).

In an effort to tackle this serious and on-going danger, ICONA (National Institute for Nature Conservation, under the aegis of the Ministry of Agriculture, Fisheries and Food) has launched a forest fire prevention and control pro-

gramme in accordance with Act No. 81/1968 on forest fires, and this programme has assumed sizeable dimensions in recent years.

The implementation of the programme is assisted by the actual structure of the Institute itself, which covers the whole country with its provincial offices and manages publicly owned woodland through its staff of foresters, and is therefore able to intervene at any point in the nation's forests. However, some of its activities are organised centrally for reasons of efficiency and because of the country-wide scope of the work.



Although the Institute is mainly responsible for publicly owned woodland, it has also been necessary to provide substantial fire-fighting resources to deal with privately owned forests, bearing in mind that the destructive effects of fires have damaging repercussions on resources of value to the community as a whole, such as water, soil and supplies of wood, a raw material in which Spain is far from self-sufficient.

The ICONA programme

The programme comprises:

1. Prevention

- General education and public relations campaigns designed to inculcate patterns of behaviour among both children and adults which will prevent fires from being started.
- Preventive forestry work in the form of fire-breaks, which make it less likely that a fire will spread and which also make it easier for fire-fighting equipment to get close to the fire.
- Studies and experiments aimed at developing our understanding of the phenomenon of fire and improving technique for dealing with it.

2. Detection and alarm system

- A network of fixed and mobile fire-watching posts in the forests (1,366 in 1982) with radio link-ups so that fires can be spotted as soon as they start and the fire-fighting service mobilised immediately.
- A meteorological network which calculates the fire incidence and fire spread risk, so that the fire-fighting services can be alerted and deployed.

3. Fire-fighting

- A specialised service of trained and fully equipped fire-fighting teams (tools, extinguishers, motorised pumps and fire-fighting vehicles). There were 1,006 teams in 1982. Our aim is to have one team for every 10,000 hectares of forest area, so that the time-lag before a fire is tackled can be brought down to less than 30 minutes.
- Specially designed airborne equipment to assist fire-fighting services on the ground. At present we have twelve amphibious aircraft operating in conjunction with the Air Force. Ten land-based supply aircraft are also used on a contract basis to spray a mixture of water and fire retardants.

4. Training of staff and risk cover

- Practical and theoretical courses and equipment exercises in order to train personnel in prevention and fire-fighting techniques, in order to achieve greater efficiency and personal safety.
- Financial cover for the risks incurred by fire-fighting personnel and safety campaigns in order to prevent accidents.

5. Co-ordination

A policy of co-operation and co-ordination with various public bodies has been introduced with the aim of enhancing the impact of this programme. R.V.



Castor fiber, a great consumer of wood! (Photo W. Lapinski)

The green mantle of Europe: forestry policies

Joanny Guillard

If the world is seen from a satellite, Europe stands out clearly from the other continents. It has no huge, unbroken expanses of forest sparsely dotted with fields and villages, no uniform stretches of grassland, ice or desert; instead, a constant variety of landscapes, with woods and forests providing a background texture. Denser in some places, thinner in others, with their patchwork of form and colour, the forests of Europe everywhere add a special quality to our landscapes, which never fails to impress foreign visitors. Because forests are such a constant feature of our countryside, because wood and its by-products are so important to our national economies and in our daily lives and because trees and forests arouse very deep-seated individual and collective feelings in us, Europe has for a long time pursued very complex forestry policies.

Natural wealth

A closer look reveals an endless variety and wealth of detail in European forests. The alternating patches of spruce and Norway pine contrasting with the paler birch in Scandinavia, the light cork trees in Portugal, the dark areas of fir and the oak and beech woods display great ecological diversity. The slow progress of civilisation has gradually altered these ecosystems, in particular by grafting onto them very different systems of land tenure. In Scandinavia, large estates are owned by industrial concerns, while in regions which bear the stamp of the Napoleonic Civil Code private property has been fragmented by the laws of inheritance. The division of forests between the state and/or provinces, local authorities and individuals or families differs substantially from country to country. While there are no countries now where the total forest area is shrinking, there are some, like Spain, the United Kingdom and France where it has even grown considerably since the middle of the century.

In densely populated European countries, with big urban concentrations and a growing appetite for timber and wood products, forests have always played an important and clearly recognised role. They are generally subject to many powerful and sometimes conflicting constraints, so that the policies set up to ensure their preservation and turn this major natural resource to full economic and social advantage, though often long-established and possibly a little outdated, have always appeared extremely elaborate and complex compared with those of many other countries in the world.

Of course, being the product of different approaches and different types of experience and bearing as they do the imprint of the past and of major political movements, each of these policies is also a reflection of the ecological, economic and social conditions of a particular country. All European forestry policies, however, are based on four main objectives:

1. Producing as much high-quality timber as possible.
2. Conserving water, soil and climate by the simplest natural means.
3. Offering the public and in particular city-dwellers, the opportunities for recreation and leisure, even for fantasy, which they increasingly need.
4. Despite increasing simplification imposed by production targets, maintaining ecosystems which are as diversified and as stable as possible.

Depending on the relative importance of the timber industry in their economy, on the size of their urban populations, on



Reafforestation in Cyprus (Photo Ministry of Agriculture and Natural Resources, Cyprus)

their psycho-sociological attitude to the forest, and of course depending on the type of forests they have, individual countries may concentrate on one or two of these objectives, but the others will never be wholly disregarded.

In the last 20 years, although the public access and nature conservation aspects have tended to attract more attention, the production and general protection objectives have not been lost sight of on that account: quite the contrary.

A heritage to be managed

Although there is an awareness of the latent conflict between the private owner's pursuit of short-term benefits or even profit and ways of best serving the long-term general interest, none of the policies adopted by the 21 states has ever tried to resolve it by resorting to such drastic measures as the nationalisation of forests. On the contrary, in some degree or other, all countries help land owners to safeguard their forests and to improve their composition, management and output. This is achieved in various ways, by means of direct or indirect subsidies, support for groups, associations or co-operatives, tax concessions, public access, etc. In exchange, the owner's right to do as he pleases with his own property has been gradually eroded (through

regulations governing tree-felling, clearances and reafforestation, management methods, etc.).

Although in all these countries considerable technical, moral and financial support is given to agriculture to implement its sometimes ill-defined and often fluctuating policies, the financial assistance provided for Europe's forests is by no means of the same order, and at any rate seldom proportionate to the national territory concerned. The greatest effort tends to be made by authorities in countries with the largest wood industries and wood-related export trade.

Europe's enormous wood deficit has encouraged not only substantial internal trade but also a growing dependence on imports from other continents.

At the same time, the recent drop in wood prices in real terms and the rising costs of production and transport, despite increased mechanisation, have left producers in an increasingly difficult situation economically.

All too often, it is the wood industry which bears the brunt of the cost of preserving and maintaining the forest heritage. Societal obligations have grown steadily without communities making much effort to maintain ecosystems which they exploit sometimes to the point of degradation.

Generally speaking, the emphasis has been placed on softwood rather than hardwood forests in Europe. Except in a few cases, hardwood ecosystems have been rather neglected or even deliberately changed. Virtually everywhere there has been an overall process of ecological simplification, or even complete transformation, often through the introduction of exotic species such as *Pinus contorta* in Sweden and Scotland, or eucalyptus and *Pinus radiata* in the south, not to mention the large-scale invasion of the Douglas fir and Sitka spruce.

From north to south

Beneath their apparent diversity the forestry policies of European countries are in fact a model of continuity and remarkably similar. In some countries they are the responsibility of the Ministry of Agriculture, while in others they are operated by a more specialised body. They are reasonably effectively applied everywhere, partly thanks to the backing of a system of regulations and efficient administrative structures, and partly thanks to the devoted, not to say loving and even utterly dedicated efforts of forestry staff at all levels.

But there are still substantial problems which remain unresolved, and in particular three major threats hanging over most European forests.

In the south, fires resulting from a variety of causes destroy thousands of hectares of forest and scrub every year, spoiling a plant cover which is more vulnerable and more useful in the Mediterranean climate than anywhere else.

Air pollution of industrial and urban origin is a threat mainly to the forests of central and northern Europe; but it should be borne in mind that the answer to acid rain cannot be found in forestry policies alone and that action must be taken against the sources of pollution, however far away they may be situated.

In most parts of Europe, insufficient respect for natural equilibria, a love for wild animals and the popularity of hunting have led to increasing damage by game animals. The rising cost of protecting newly planted trees, the magnitude of the problems involved and the serious

dangers to the survival of forest ecosystems are major sources of concern in a great many regions.

A world model of management

On the whole, European forests constitute an exceptional world model of reasonably well-balanced long-term management of natural resources. They show that it is quite possible to provide simultaneously for such needs as a fair standard of protection of ecosystems, recreational and leisure amenities and remarkable landscapes, and substantial timber production. Needless to say, this result has been achieved at a certain cost, in terms of effort and a willingness to compromise, not always with success, and consciously or unconsciously to sacrifice one or other objective. Forestry authorities and policies have not hesitated to make changes, some radical and very visible, others discreet and gradual. On the credit side, the positive aspects include the general preservation of large areas of forests against destruction to make way for agriculture, urban growth or transport routes, continually improved recreational facilities, the institution of nature reserves and parks, and a high output of valuable timber.

In an affluent society in which economic growth was accompanied by an increasing consumption of natural resources, Europe might have been prepared to give priority to the ecological and social functions of forests, thanks to increasing imports of timber and energy. The question is, can such a policy still be maintained? The steady demand for wood products and energy, combined with economic difficulties and the need for international solidarity to cope with a hungry world market for wood and the depletion of the world's major forest reserves, have together given fresh impetus to the industrial production of timber in Europe.

The situation is far from ideal

Like the forester and forestry science, torn between ecology and economics, which are each in turn a target and a tool of management, European forestry policies have had to reconcile the contradictory—not to say conflicting—aims of our developed societies. Having long



We must prevent our forests from dying...
(Photo G. Svensson)

been looked upon as a source of products and energy and a reserve of land, Europe's green mantle, whose surface area is now fairly constant, still sets the basic pattern for our countryside. A lot of time will still be spent discussing, in the light of the prevailing economic and social situation and all too often with short-term considerations in mind, relatively minor issues such as the ideal proportions of hardwoods and softwoods, or whether to open roads for lumbering or paths for nature lovers. If the output of timber is increased in one area, entailing a greater or lesser degree of human intervention there, it will automatically be offset by reduced pressure in another area, where priority can be given to different objectives.

There is still plenty of room for improvement. In the first place, an attempt must be made to resolve the three major outstanding problems—forest fires, acid rain and damage by game animals. A considerable effort is needed in most countries to apply the results of research now advancing rapidly, to achieve a fuller understanding of the complexity of nature and to take this more into account in economic management.

European forestry policies are no longer and can no longer be (as they were for centuries) devised and implemented in splendid isolation. They cannot be decided without constant reference to agricultural, industrial and social policies, on which they are based and which set their limits. These other policies are always subject to change, often at fairly short notice, and are sometimes not explicitly stated in European countries, hence the endless conflicts with forestry policies, which are based on medium-term or even long-term considerations. Present European forestry policies may be criticised for being a product of history rather than of a clear vision of political forces; they may also be blamed for failing to take into account soon enough and fully enough the expression of non-commercial societal needs.

They cannot, on the other hand, be criticised for their continuity or their complexity. Even though gradual changes have taken place by a process of slow evolution, the policies are, whether one likes it or not, necessarily conditioned by long-term objectives and a deep-seated respect for delicate natural equilibria.

They cannot be decided entirely by the forestry authorities. It is essential that our increasingly urbanised societies, their democratic and political institutions and all the men and women of Europe should be increasingly involved in the development of forestry policy and concerned with its implementation.

Preservation means management

The double aim, on the one hand of producing timber, supplying industry and creating jobs, and on the other hand of preserving nature, the diversity of its component parts and their complex interrelations, lies at the heart of forestry policies, whose purpose is heritage conservation in the real sense of the word. This is the very basis of the management of forest ecosystems, which must be at the same time comprehensive and carefully oriented, sufficiently imaginative yet cautious. At stake is one of the most important of our natural resources, Europe's green mantle. It is a problem which faces our forestry experts continually, but which they should not and do not wish to tackle alone. Forestry policy, a problem which is as old and will last as long as our societies themselves, must allow for change while ensuring continuity, constantly safeguarding the future and essential values.

Under their seeming diversity, due to the ecological, economic and social differences between our 21 countries, European forestry policies are remarkably similar and coherent. In this respect they stand in marked contrast to the policies of many other regions of the world, or indeed to the absence of any declared policy, which results in the squandering of this prodigious natural resource.

No doubt much progress and a great deal of effort are needed in the way our forestry policies are decided and implemented. They have succeeded so far in safeguarding and enriching the green mantle of Europe and in managing a prime resource in what may be termed exemplary fashion (compared with so many cases of destruction and waste of the world's natural heritage). All of us must recognise the economic and social value of our forests if we are to make progress together.

J.G.

Around towns

Boštjan Anko

Seldom was there room for a full grown tree, let alone a forest, behind the walls of our medieval cities—yet their very existence was heavily dependent upon the surrounding forests. However, the dependence of these cities upon the forest and their attitude toward it, differed only slightly from that of a humble village—the only difference appeared to be in the scale of requirements and in the resulting influences upon the forest. As it grew in size and complexity, the medieval city as a relatively closed, simple system, expanded its boundaries. The former city forest largely lost its importance and fell victim to more profitable land uses, such as farming or simply construction. In this process the forest had literally been elbowed out of sight and figuratively also out of mind of the city dweller.

Thus the growing size and complexity of our cities brought about not only the changes in the physical landscape of their surroundings, but also in the city dweller's mental landscape which became bare of forests. The resulting alienation from the forest as a symbol of everything natural had to become unbearable to awaken us to recognition that the modern cities, too, need forests: not any longer for wood or animal grazing, but for a whole scope of new uses and functions our forefathers could hardly dream of.

The modern city needs a forest again—yet there is no room for it behind the "city walls". Flooded by the concrete tide, the fields, meadows, pastures as well as forests disappeared under the spreading cities in the name of—what? Modern man lives in the city and dreams of the forest. The few forest remnants in our cities and

their immediate surroundings that survived, more through sheer chance than a provident foresight, are too precious and we cannot afford to let this trend continue. At the same time the question arises: do we know enough about them to be able to protect and manage them accordingly?

Facets of suburban forests

The functions of forests in general can be divided into three main groups: productive, environmental and socio-cultural ones. The three groups differ among themselves considerably, with respect to the laws by which they are governed, with respect to the manner in which they can be expressed as well as regarding the number of beneficiaries.

The practice of multiple use forestry, now accepted in most countries, recognises the necessity of considering all the various forest functions in managing this resource. It is quite obvious that one cannot manage the same hectare of forest for all its possible functions at their maximum level at the same time. Some of them may even be incompatible—yet it is of absolute necessity to maintain the view of all the functions in every measure undertaken—to maintain sufficient flexibility for the functions to be able to respond to the demand for them in time. For these demands do change and there is no better example for this than the suburban forest itself.

Suburban forests are still productive, as they were in the Middle Ages, yet their productive functions are hardly considered in their contemporary management. More and more we realise that their

environmental and especially socio-cultural functions are of far greater significance.

Even though the term and practice of urban forestry are becoming more and more widespread and accepted, the definition of suburban forest seems to vary considerably from country to country, in accordance with natural, socio-economic and cultural specifics of a given region. We shall therefore attempt to describe suburban forest in general terms rather than to try to come up with yet another definition. The most important feature of such forest is its proximity to the urban centre. It depends on the natural conditions as well as on historic development of a given landscape. Under ideal circumstances such forests should be close enough to the urban settlement as to modify its physical environment (e.g. the climate) as well as to offer the whole scope of socio-cultural functions to the city dweller. The most fundamental difference between forests in general and urban forests seems to be in the sequence of importance of the groups of functions enumerated above. The least we can say is, that their order has been completely changed: socio-cultural functions assume the most important role, and are followed by environmental ones. The productive functions really assume the lowest priority—at least as far as the general public is concerned.



(Photo G. Lacoumette)

A bridge between town and nature

As such, suburban forests can be viewed not only as a substitute for forests in general but rather as a bridge between the man-made urban and natural forested landscape.

In what way does the suburban forest fulfill this role? Most people will agree that the recreational role is one of the most important functions of the suburban forests. Yet the structure and quality of recreational experience in it differs considerably from that in any other forest, where man searches for solitude and contact with unspoiled nature on longer, usually all-day trips.

As a rule, trips to suburban forest are shorter in duration yet more frequent. They constitute a brief, yet very intensive experience of forest as a contrast to the city. On such trips, people want to reinforce the idealised image of a forest—which the suburban forest in fact is. What is this image or rather, what do people expect from suburban forests? There seem to be just as many answers as there are visitors—yet there seem to be some common features we might discern in their answers: people want to feel the depth of the forest, its natural variety, the seasonal changes, they want to admire the twisted tree giants, they want to relax from the strict forms of the city architecture, they want to have a

breath of fresh air, etc. On the other hand the extent of the forest seems to be of lesser significance to them—only as far as it influences overcrowding. They do not search for absolute solitude and do not seem to mind the remote humming of the city—on the contrary: it only reinforces the feeling of "being somewhere else". They do not expect to see big game and are quite contented with seeing song birds or squirrels. In general: their expectations seem to be quite modest and relatively easy to satisfy. People appreciate, however, well maintained roads, benches, sign-posts, etc., they seem to have especially strong feelings regarding good visibility; there is a common belief, for example, that dense undergrowth tends to foster delinquency—they want to feel safe!

Education and nature conservation

Only two more of the several functions belonging to the socio-cultural ones should be mentioned in this connection: education and nature conservation. Most aspects of the suburban forest enumerated above stress an important point which should not be overlooked: they are centered on the city-man-forest relations which in a way reflect the degree to which such a man is alienated to the forest. He does not live with it—he only visits it and

he knows surprisingly little about it. The visit to the suburban forest appears to be more a flight from the city than a desire to come to know it. In the age of growing environmental awareness, it therefore seems that explaining the forest to the city dweller is becoming a cultural mission of the forestry as a profession. The person who understands the forest will not only enjoy it better but will also appreciate it more and, if necessary, defend it more successfully. Well designed, maintained and interpreted nature trails in suburban forests can work miracles in this respect.

For the more knowledgeable—not only for the scientists—the very proximity of suburban forest makes it an ideal place for nature conservation. Small parts of suburban forests may be ideally suited for this function, especially when there is a possibility of including a body of water, a marsh etc. Not only do such areas create the impression of pristine environment but they also offer a number of possibilities for amateur naturalist observations, school class research etc.

Management

Modern forest management requires (among other things) two views of the forest: the first is the somewhat traditional view of the forest from within, the second is that of the forest as an element of the landscape—a view from without the forest. Nowhere becomes the necessity of both views more apparent than in the case of the suburban forest. Most of its environmental functions can, in fact, be fully understood and properly interpreted only from this second perspective. Many people are aware of the beneficial effects forests have upon the climate, water run-off, soil protection etc. Nevertheless, only a professional can fully appreciate their extent, so these functions, too, have to be considered in management of suburban forests.

The suburban forest ought to be managed for many people and for many things. An important question arises in this respect, namely, to what extent should the forester be guided by public demands and to what extent should he guide them himself. The broad scope of rather elusive values and benefits the suburban forests offer, seems to make the traditional management for timber production rather simple: the traditional forester is not a sociologist, nor is he a psychologist, meteorologist, medical expert, hydrologist or landscape architect, and yet he is best equipped to manage, interpret and defend the forest as a living resource. It is quite obvious that managing suburban forests is becoming an interdisciplinary enterprise—with a single purpose: to enhance not the quantity, but rather the quality of our urban life. B.A.

Exploitation versus conservation



Tropical forests are also our responsibility (Photo Gebr. V. Dam)

Fabio Clauser

Using a forest means felling all or some of the trees in it, preparing the wood obtained from them and clearing away undergrowth. In this sense "using" means applying in practice the principles of forestry as a phase in the harvesting of the crop and, where only some of the trees are felled, as a means of shaping the forest. Obviously such operations affect the environment in various ways, depending on how they are carried out. The short- and long-term consequences in relation to the problems of protection may be broadly positive or broadly negative. The relations between

uses and protection accordingly constitute a special aspect—perhaps of major importance—of the larger subject embracing relations between forestry and nature protection, the latter being understood as environmental protection in the broad sense.

A possible balance

When approaching this particular topic it must be ascertained in advance whether it is possible to achieve a stable, harmonious balance between forestry and environmental protection, taking ac-

count of the continual, varied developments which the two concepts of forestry and nature protection are undergoing at the present time with the expansion of scientific knowledge and changing social conditions and needs. The question can immediately be answered in the affirmative: the most recent scientific discoveries in the sphere of forest ecology allow one to state that a relationship of this kind—a harmonious and lasting one—is certainly possible. It can be achieved by borrowing from the natural forest ecosystems their mechanisms of self-assertion, self-defence and self-preservation. The techniques of forestry, and therefore of utilisation, thus achieve their ends—expressed in the multiple functions of protection and production along with socio-cultural functions—in a process of rationalisation based on the automation of biological processes.

The felling of trees and the use of forests become a model of the social community formed by the trees in the sense of a functional structure. Through the selection carried out by felling, the flow of natural energy is directed towards the vehicles of functions and so towards those trees which best carry out automatically the manifold functions of the forest. So much so, that it can be said—using a rather evocative image—that the only energy that needs to be deliberately introduced into the system is that of the forester.

It should be added that in the varied dynamics of the different social conditions and types of forest to be found in Europe—from the northern conifer forests to the Mediterranean maquis—the resilience of forest ecosystems as regards their point of equilibrium with the environment is also such that a large measure of adaptability is possible to the various local requirements of the economy and environmental protection.

Although theoretical explanations of these possibilities have been offered only relatively recently, their practical implementation has been known about for some time. In this connection I should like here to mention one of the brilliant insights of the forestry inspector Michele Briani, who was trained at the Vienna School at the end of the nineteenth century. He did not leave any writings, but he left many fine forests. The rule to follow, he told me over 40 years ago when I was still a student, is that forests must be used in such a way that after felling you do not notice that it had taken place. Experience has amply demonstrated to me the validity of this.

The result is to guarantee the forest environment the best protection conditions compatible with timber production and to ensure that the latter benefits from the quantity/quality ratio most favourable to local or regional economies. Unfortunately, immediate results cannot be

secured everywhere, because in many cases results can be achieved only through gradual, long-term forestry work, which usually necessitates a temporary reduction of use in terms of quantity and quality.

But the important thing is to move in this direction knowing that according to this view a balance can be achieved in forest uses between wood consumers (timber and paper industries) and those who wish to protect nature (ecologists, Greens, etc.) in the most diversely organised kinds of society and forest environment.

Some clashes between conflicting interests

However, as is plain for all to see, this does not happen everywhere. In many cases, using the forest gives rise instead to clashes between conflicting interests. Simplifying a complex problem to the utmost, one can say that its complexity is due to the fact that alongside the ecological conception of forestry contained in the silvicultural theory being expounded here, there is another, opposing view based on the rationalisation not of biological processes but rather of the mechanical processes of production. In the place of an energy budget without any fixed time-limit it puts a strictly economic budget for the short term. The intellectual

energy required is no longer the forester's but that of the business manager employed to rationalise the use of machines for the cutting, preparing and haulage of wood.

Taking this tendency to its logical conclusion means:

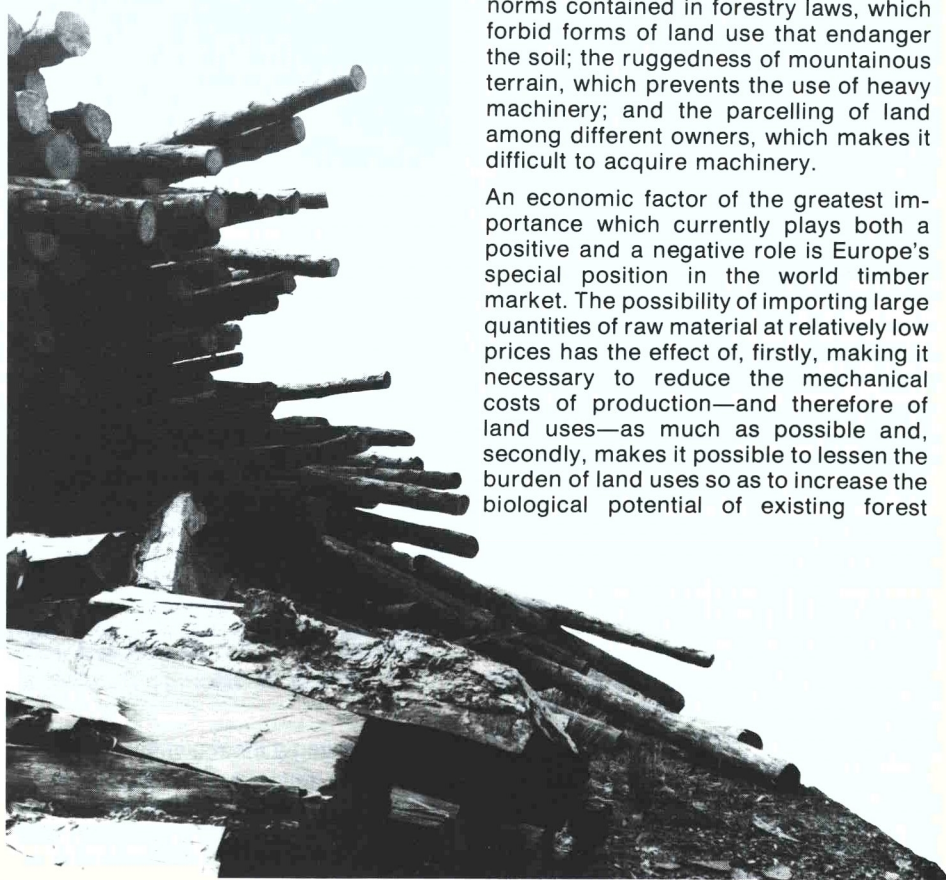
- clearing woods over a vast area in order to ensure minimum costs of mechanical processing with maximum concentration of raw material and

- promoting single-species cultivation or even, as is already technically possible with conifers, monoclonal cultivation, so as to obtain—through homogeneity of the raw material produced—maximum efficiency from the machines used for primary and secondary processing.

The environmental impact may then be massive, ranging from extreme aesthetic impoverishment of the landscape to extreme biological and genetic impoverishment of the ecosystems. Since the latter radically affects the animal sector of the ecosystem, it necessitates in its turn increasingly frequent use of pesticides and fertilisers, which may be highly contaminating. If the area of the land subject to such forms of forest use were to exceed the critical amount, a chain reaction could be triggered off, with unforeseeable but assuredly serious consequences.

There are, however, objective obstacles to such an undesirable trend of development. These include land-conservation norms contained in forestry laws, which forbid forms of land use that endanger the soil; the ruggedness of mountainous terrain, which prevents the use of heavy machinery; and the parcelling of land among different owners, which makes it difficult to acquire machinery.

An economic factor of the greatest importance which currently plays both a positive and a negative role is Europe's special position in the world timber market. The possibility of importing large quantities of raw material at relatively low prices has the effect of, firstly, making it necessary to reduce the mechanical costs of production—and therefore of land uses—as much as possible and, secondly, makes it possible to lessen the burden of land uses so as to increase the biological potential of existing forest



resources by making use of existing stock and by extending the area of forest. Thus for the time being, European forests are among the privileged parts of the earth, with statistics showing progressive improvement in forest resources in terms both of density of stock and of area, apart from various outbreaks of blight—particularly among silver firs—apparently due to atmospheric pollution.

Necessity of regional plans

What, then, should concern us in the land-use sector from the point of view of environment protection? At least two things seem to me to be of the greatest importance. First of all it must be remembered that while an improvement in the situation as regards forests may be observed in Europe, in tropical countries, on the contrary, catastrophic destruction is taking place in order to supply industry and/or to meet the elementary subsistence needs of the population. On the planetary scale, therefore, there is an imbalance in the uses of forests which is indefensible both from the environmental and from the social point of view, and ultimately this cannot leave European forests and society unaffected.

Secondly, we must bear in mind that the improvement in the European situation in relation to the use of forests is not wholly the result of deliberate forestry policy; it therefore has no solid rational basis which could be taken as a guide for all long-term forestry planning on ecological principles. Rather, it has been accidental in nature: it is the natural consequence, on the one hand, of mechanisation difficulties and, on the other, of the destruction of the great equatorial forests and the depletion of the enormous reserves of wood in previously unused territories of Asian Russia and South America.

So much so that the authors of many studies and documents on forestry policy complain of a degree of under-utilisation of forests, albeit only regionally.

In Italy, to take an example which comes readily to mind, there are those who wring their hands because timber woods are maturing without being used.

But the environmental danger, as I hope to have made clear, is certainly not that of under-utilisation but something quite different, and if it is not actually imminent, it is nonetheless potential—the probability of its becoming manifest being in direct proportion to the precariousness of the world market and to the insubstantiality of a forestry policy currently based more on territorial considerations than on environmental ones and shaped more by chance than by rationality.

Expressed in these terms, the problem of the relations between uses and environ-

mental protection makes clear, I think, the need to propose regional development plans for forest resources on the basis of the ecological theory I set out at the beginning.

The great adaptability of forest ecosystems makes it possible among other things to offer flexible alternatives to the mechanical development of production—many improvements in mechanical production are possible and desirable, alongside improvements in biological production. The latter alone, however, must take precedence when fundamental management choices are being made.



The difficulties arise at this point—from the usual conflict between short-term and long-term interests and between private and public interests. Everything comes back to fundamental political choices.

In this connection I agree with those who see as the determining rational factor underlying every political choice, not the validity of a scientific theory but the probability of the political success of the decision-making body. I therefore believe that it is pointless to try to demonstrate to decision-makers in forestry policy the scope for the long-term eco-

nomie success of a method of using forests which complies with strictly ecological criteria and therefore respects the natural environment to the maximum.

It is more likely that it is these prospects of immediately obtainable environmental benefits which will offer some chance of success, since such benefits are eagerly sought after by major social groups.

In a world which daily laments the energy crisis, although it has accumulated and continues to accumulate in its arsenals of war more energy than is needed for the destruction of life on this planet, the attempt to have some positive influence on the environmental conservation of

forests by rationalising their utilisation on ecological bases is a bold venture which may bring a smile to people's lips.

But there is an Italian proverb which says there is no harm in trying. Maybe it is appropriate here too. The certain knowledge that environmental conservation is compatible with the economic exploitation of forests—albeit on certain conditions—and the tendency in ever larger social groups to attach growing importance to environmental problems may help us to face this difficult undertaking and give us hope for some probability of success.

F.C.



Forest and game

Office National de la Chasse
(Hunting State Agency)

An environment's territorial capacity for any one species or group of species is among the expressions many of us would find it hard to define.

This recent concept in fact incorporates two ideas:

- the biological capacity for a given species is equivalent to the maximum density level at which the population can thrive while remaining in balance with the biocenosis, despite a possible drop in productivity. The biologically sustainable density is in fact not always economically sustainable, particularly when the environment as modified by man is such that the presence of animals endangers the economic viability of productive activities;

- the economic capacity of an area is equivalent to the maximum density which the land can sustain at the end of winter while maintaining the essential balance, that is to say, without danger of intolerable damage to forestry or agricultural productivity: this is commonly referred to as the balance of forest and game.

This territorial capacity is not easily defined since, although it is inseparable from the biotope, it is also inseparable from the population's internal structure (breakdown according to sex, age group, etc.). Moreover, where there is inter-specific competition (eg the presence of both red deer and roe deer) it can only be defined for all the competing species together.

The types of damage caused to the forest environment by large lowland ungulates when they exceed the territorial capacity are well known: damage due to browsing (nibbling of branch tips and terminal buds, bark stripping, etc.), and damage due to behaviour (scraping during the rut and fraying periods).

These are the most spectacular results of the over-abundance of ungulates in a particular forest environment. However, just as significant is the regular over-cropping of the most favoured plants, which can cause them to disappear and can upset the general floristic balance in favour of other less popular species. Raspberries, whitebeam and, to a lesser extent, bilberries can thus disappear from environments which are over-browsed by stags and hinds. The impact of an excessive ungulate population is therefore not only economic but also ecological. For example, red deer and capercaillie can compete for the available supply of bilberries and other berries.

The balance of forest and game: a difficult concept to grasp

Forests have two main types of function:

- a general utility function which is difficult to quantify (soil protection, leisure and recreation, etc.);
- a production function, which is easier

to assess (products in the form of timber and game).

Thus hunters see the forest as principally the place where red deer, roe deer and wild boar are found; for town dwellers, it is a place for weekend recreation; for phytosociologists, it is an environment composed of varied floristic stages (herbaceous, shrub, arborescent, etc.) whose components are adapted to the local soil, climate and topography. Finally, foresters see the forest as all these things, but above all as stands of trees that have to be replanted, thinned out, felled for timber when they reach maturity, and so on.

So the balance of forest and game can be defined as the consensus which results from weighing up against each other different points of view that are sometimes complementary and sometimes in conflict.

They complement each other because they concern different links in a biological chain to which both hunters and foresters belong.

They conflict when one interest dominates the others, eg overabundance or extension of a species due solely to the actions of hunters; planning for forestry alone, excluding herbivorous ungulates, as decided by the foresters.

The forces at work are not equal, since large game animals cannot exist in our countries without forest cover. In any

case, wildlife has to adapt to vegetation and to a certain extent the hunter must bow to the forester.

But how can the point of equilibrium be defined?

The excessive damage done by animals to young plants (by browsing) or to sapling plantations (by bark stripping) is often the first alarm signal for foresters, whose main responsibility is to renew the existing stands of trees. Since there is as yet no accurate and flexible method for assessing damage done to forests, particularly those undergoing natural regeneration, estimates are often subjective and personal. The balance has often already been destroyed when unacceptable damage begins to appear.

By applying sophisticated phytoecological techniques, it is possible to calculate the point at which the deterioration of flora (including non-productive flora) starts; this point represents the beginning of the imbalance.

The first approach is more pragmatic and more or less subjective according to the aims; the second, based on the use of plant life by ungulates, is more objective and certainly more accurate than the first so long as the structure of the forest environment is itself in equilibrium (a balanced pattern of species of different age groups, for example).

To conclude, the forest and the large game animals in it may be said to be in balance when an ecologically adapted forest can renew itself without the need systematically to resort to temporary local or general protection. Different studies lead us to suppose that the point of imbalance appears above 26 roe-deer units per 100 ha (or 4 red deer + 9 roe deer) in the richest forests, and that a figure of 10 roe-deer units should not be exceeded in the poorest ones.

Effect of forestry activities on game

Often, where large animals are relatively numerous, they are not directly responsible for the critical situation we are facing.

The choice of species and the forestry management system influence the availability of food; abandoning the coppice or coppice-with-standards system leads to a significant drop in the food value of the trees—dense plantations of spruce or Douglas fir devoid of undergrowth are veritable deserts for hunters. Increasing the size of forest sectors alters the spatial distribution of food and thus leads to a concentration of animals, thus increasing the danger of damage. Opening up new roads is admittedly beneficial because of the herbaceous and shrubby vegetation which develops alongside the roadside

verges, but the fact that the forest becomes busier can be harmful at certain critical times: the stag's rut, the calving season, etc. The effect of certain types of maintenance and other forestry work is also significant. For instance, while the present-day practice of chemical control is not directly harmful to game, it certainly reduces available food supplies (by eliminating brambles).

Reducing the imbalance : measures to be taken

Remedying the imbalance requires the application of various measures:

- Reducing the population and restoring a sexual and structural balance are often priorities.
- An effort should then be made to improve the conditions in which the animals live.

Forestry practices must be thought out afresh in terms of their impact on game (size of regeneration areas, severity of thinning). Specific game planning could be envisaged (setting aside meadows and food areas). Provision of fodder should be limited in time and space and take place only when it is particularly hard for the animals to survive (prolonged snow cover).

- Finally, public access to the forest should be organised in such a way as to minimise disturbance to the animals (zoning of activities, prohibitions on access).

All these measures can only be effective if applied simultaneously to an area within which the ungulate population can live all year round. Co-ordination of activities at this level is absolutely essential, since a priority measure should be to standardise the animals' living conditions to some extent. Furthermore, results are never immediate: recent studies show, for example, that restoring degraded plant life is a very slow process.

Until the middle of this century, the method of managing broad-leaved lowland forests (coppice or coppice-with-standards) met the food and shelter requirements of most species of large game animals in France. The self-sufficient family farms which lay on the outskirts of our forests could tolerate the existence of these species.

Nowadays, the development of intensive forestry and agricultural methods has totally changed the picture. In the future, if the populations of large game animals are to be maintained, not to say increased, then all the problems connected with their presence against a background of forestry and farming must be assessed and taken into account.

O.N.C.

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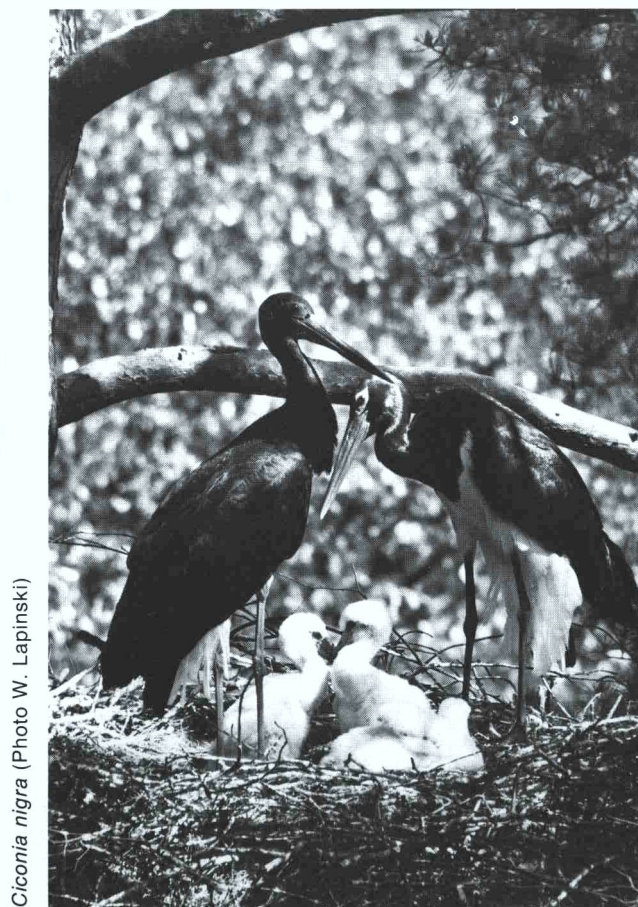
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Ciconia nigra (Photo W. Lapinski)

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