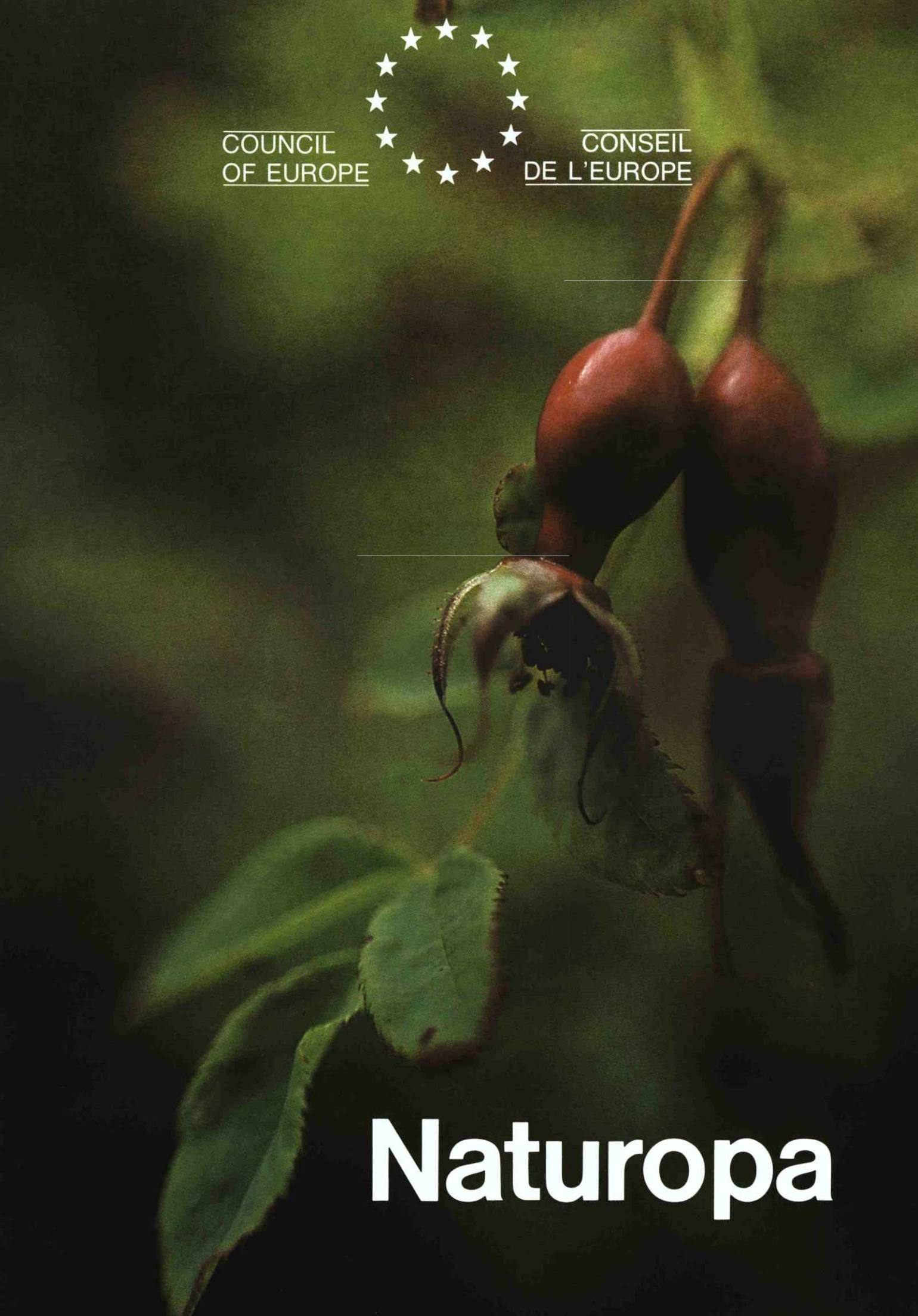
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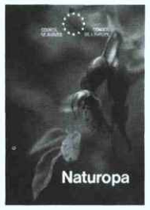

european information centre for nature conservation

The symbol for the Council of Europe's nature conservation activities.
It will also illustrate the Centre's campaign on the conservation of wild flora and fauna and natural habitats, which will be launched in 1979.

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Naturopa **No. 31 – 1978**

We keep an eye open!

This column is not meant to become one where *Naturopa's* editors cast a gloomy look at "our ever deteriorating environment, a world where only rats, algae and we ourselves may survive if we don't pay attention".

On the contrary, in this note we want to tell the world that the Council of Europe, with almost thirty years of intergovernmental experience to draw on, strives for all its worth to solve these – and other – problems. A top level committee draws up our programme, and expert committees carry it out. This means co-operation, often necessitating picking a tortuous path between a variety of conflicting interests, and thus the work may sometimes be long and tedious. But it is the results that count in the end. At this very moment, for instance, the Council of Europe is thrashing out an international convention that will become a protective umbrella for Europe's wild flora and fauna.

Nevertheless, we do point out in this issue that Europe's vegetation: the wild, living plants and trees, mosses, algae, fungi and shrubs, needs our urgent attention. Here too, our way of life, our casualness and thoughtlessness are creating a situation to which we must now react. Some of Europe's finest specialists on the subject have summarised the situation and advise us what to do.

The back cover announces *Naturopa's* next issue. – Hunting and shooting in today's Europe, our game and its habitat – a theme which occupies and preoccupies many of us.

H. H. H.

(Photo Ch. Marchal)

Editorial

The publication of the 286-page List of rare, threatened and endemic plants in Europe *(Council of Europe Nature and Environment Series 14, 1977) represents an important achievement, and one of which the many European botanists who voluntarily collaborated in its formulation may feel justly proud. The urgency and gravity of the problems facing plant conservation in Europe are, however, such that we cannot afford to be complacent. The "List" is not an end in itself, but merely a tool to be used by and with governments and private organisations and individuals to plan practical action.*

Its compilation is a co-operative project of experts from the Flora Europaea *team and conservation organisations in different European countries, by the Council of Europe, especially through its* ad hoc *working party set up in 1974, and by the newly-formed office of the Threatened Plants Committee of the International Union for the Conservation of Nature and Natural Resources, housed at the Royal Botanic Gardens, Kew. From the latest analysis of the completed* Flora Europaea, *including the as yet unpublished final volume (Webb, 1978), we can say that there are in Europe about 11 500 different species of flowering plants and ferns, of which about 3 500 are endemic, i.e. occur nowhere outside Europe. The List contains about 2 100 species which are rare or threatened on a European scale, two thirds (1 400) of which are known to be rare or threatened on a world scale.*

We should therefore be specially concerned about the fate of approximately one in every five vascular plants in Europe. Moreover, about 100 species are given the IUCN category "endangered" – plants which are in danger of total extinction and whose survival is unlikely if the casual factors continue to operate – and these are a matter of urgent concern for the conservation organisations in those European countries in which they are still to be found.

The listing of narrowly endemic species, i.e. those occurring in only one (European) country, enables us to see immediately a most significant fact – namely, that the flora of northern and central Europe are relatively poor in endemic species, whilst those of the Mediterranean countries are very rich. Greece (including Crete and the Aegean) is not much more than half the size of Great Britain, yet there are 676 Greek endemics compared with 15 in the British list! It is clear that, whatever co-operative effort we devise to protect the threatened flora of Europe, by far the greatest part of that effort should go into safeguarding the habitats of rare and local species in the countries of southern Europe. Much more international support is needed for the creation and effective maintenance of nature reserves and protected areas in the Mediterranean countries, and with it must go more scientific research into the rare Mediterranean plants and the vegetation in which they grow. In this connection the initiative of the recently-formed Organisation for the Phyto-taxonomic Investigation of the Mediterranean Area (OPTIMA) in setting up a Conservation Commission is greatly to be welcomed. Space does not permit a more detailed analysis here, and in any case other contributors to this special issue will be covering particular concerns, but one other generalisation is important. The List enables us to say something at least about the kinds of species which are or were widespread in Europe (and may even extend outside Europe) but which seem to be declining simultaneously in many countries. There are in fact two very obvious groups: species of arable and disturbed ground (often called "weeds" though many have no agricultural importance), and species of wetland and freshwater habitats. In both these cases, changes in agricultural methods and land use policies are responsible for the decline, and both groups need special attention and concern.

I want to conclude by listing what we, as conservationists concerned to protect the flora and vegetation of Europe, must see as urgent tasks. Now that we have the basic floristic information we must:

1. urge the organisations responsible for nature conservation in our own countries to give priority to the protection of those rare and threatened species listed as still occurring within their country by the creation of nature reserves, the enactment of appropriate legislation, the education of public opinion, and in any other way;

2. support the efforts of international bodies to continue the effective co-operation demonstrated in the production of this List, and in particular the scientific co-operation necessary to refine and enlarge our knowledge of the ecology of rare species in their natural habitats, so that we know how to protect them;

3. press for rapid progress towards a system of effective nature reserves for Europe which contain within them as many as possible of the listed rare and threatened species. It is essential to remember that we can ultimately only protect species by protecting the habitats in which they occur.

S. M. Walters

Forest fires, often started by arsonists or mentally deranged persons, cause heavy damage to flora and fauna
(Photo Ministry of Agriculture, France)

Where have all the flowers gone?

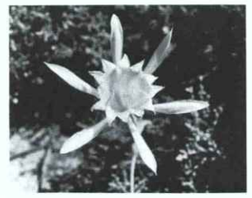
Pierre Broussalis

Upsetting the natural balance

The vital role of plants in the life cycle is common knowledge today: practically the only direct consumers of solar energy, they produce food not only for themselves but for all other living creatures; the food is then consumed directly by herbivores or indirectly by the animals which prey on them. On the survival of plants therefore depends the continuation of life on earth, a fact that man was quick to grasp and which led him to invent agriculture as a means of procuring sufficient quantities of vegetable matter without exhausting natural reserves: probably the first time the principles of conservation were ever applied. Mother Nature maintained the balance in more brutal fashion by allowing carnivorous predators to destroy surplus herbivores.

At least that was the case until fairly recently. Sadly, human activity has, as we are only too well aware, gradually altered this state of affairs and upset nature's delicate balance; over the past few decades human interference has reached such a pitch that it can fairly be described as a disastrous trend.

Thus arose the problem of the protection of nature generally and most recently of the protection of plants. All over the world, individuals and organisations are



fighting to preserve our natural heritage by trying to limit the damaging effects of human activity. We have nevertheless to bear in mind that, however destructive its effect on the environment, this same activity has enabled man to improve his living conditions to an extraordinary degree; and, as a result, many people would consider the activity in question anything but damaging. Even within Europe, conservation of the environment is viewed differently in the rich countries of the north and the poorer countries of the south. The crux of the problem lies in the difficulty of finding solutions appropriate to both objectives.

But why protect wild growing plants at all? The reasons — moral, practical, aesthetic and sentimental — have been expounded many a time and it would be pointless to repeat them here. Perhaps it is above all awareness of the fact that life on earth is a complex whole in which all beings interact with each other to maintain the balance necessary for survival which carries most weight today. Perhaps aesthetic and sentimental considerations, which have always attracted artists, poets and ordinary folk, continue to exert their influence, and for many people it is inconceivable that certain flowers should disappear for ever from the face of the earth.

Why are plants threatened with extinction? The reasons are many and varied: the *List of rare, threatened and endemic plants in Europe*, published by the Council of Europe's Committee for the Conservation of Nature and Natural Resources, mentions no less than twenty-three for the countries of our continent. It will suffice here to point out the main ones: industrialisation and urbanisation, road-building, development of the tourist industry, land drainage, the use of weedkillers and other chemical products, the grazing of animals, collection for horticultural or botanical purposes, the fact that some species are by nature rare. It is understandable that the threats differ from country to country. In the densely populated and heavily industrialised countries of northern Europe they derive mainly from urbanisation, industrialisation, various construction processes such as roads, dams, land drainage and outdoor tourism. In the countries of the south it is the grazing of animals, forest and scrubland fires, land clearance and the trade in certain plants which are probably the most important factors. In Greece the collection of endemic and other rare plants by professional and amateur botanists and other plant-lovers has assumed epidemic proportions.

The problems of conservation

It is not easy to protect plants from all dangers. Thus, it is impossible, without running the risk of political, perhaps social and certainly economic repercussions, simply to pass a law putting a stop to urbanisation, industrialisation, the development of tourism and even animal grazing in some countries. It is far easier to protect animal species — mammals and birds — though this too poses many problems. Laws or regulations can be made prohibiting, for instance, the hunting of bears and wild goat (ibex) throughout the year. Regulations of this kind are easily understood both by those whose job it is to look after game and by the public, and enforcing them, even incompletely, has a positive influence on the conservation of fauna. The situation as regards flora is more complicated; plants tend to be much less well known than animals, and there is a far greater number of species. It is also easier to pick a plant than it is to kill an animal. And, generally speaking, the average person is better able to understand the need to protect an animal, which he considers a living creature, than a plant. It is therefore apparent that protection of flora requires very detailed study of the subject-matter, if it is to produce constructive results and not just measures of theoretical interest.

In the developed countries attempts are being made to reduce the damaging effects of all industrial, commercial or tourist enterprises, etc., by requiring that a project's technical dossier be accompanied by a file on its environmental consequences. This is an interesting development which could do much to reduce air and water pollution but which cannot always ensure actual conservation of threatened plant species. It is not easy, for example, to convince the public or relevant authorities — at a time of energy crisis — that a hydro-electric dam should not be built because it might cause the destruction of a plant species whose sole virtue often lies only in its rarity value. The persistence with which certain well-intentioned individuals and groups pursue such objectives, whatever the cost, may even provoke what can only be described as a negative reaction from a public not always adequately informed or ready to agree to all the demands of environmental experts. Education has a decisive part to play here, and it is to this that the main activities of organisations for the protection of nature should be devoted.

Similar problems arise in the comparatively less developed countries of southern Europe which are doing their utmost to catch up. In these countries it is difficult to place obstacles in the way of industrialisation, the development of tourism or any other project liable to boost the economy. When every effort is being made to stop the exodus from the villages, there is little sense in banning the grazing of goats and sheep which often constitutes the only means of support of mountain people. Nonetheless, spectacular results can be achieved when the population is made aware of certain problems. In Greece the construction of cement factories and shipyards was halted as a result of pressure exerted by the population which did not wish to see parts of the coastline polluted by those installations. And an earlier attempt to reduce the number of goats proved very successful.

Educating people in the value of their floral heritage and the need to conserve it should start with school and be continued without a break by the press, radio, television, tourist clubs, etc. Unfortunately, because of the difficult times in which we live, it is not always feasible to draw up such ambitious programmes, since other urgent problems claim the attention of both governments and people. Here too organisations for the protection of nature have an important part to play.

What sort of protection?

In the face of all these difficulties the idea of overall protection of plants has to be abandoned, and we have to be satisfied with saving those which have or are soon likely to become very rare and those which grow in very exposed places and so need to be protected in one way or another.

The best method of ensuring the survival of a species is to conserve it in its natural habitat. Priority should therefore be given to establishing parks or nature reserves. However, setting up such parks or reserves and maintaining them, especially when they are intended for plants, is not an easy thing in every country. Furthermore, it is impossible to establish reserves for all threatened species and it is, in any case, difficult to protect plants effectively. We should bear in mind that these reserves have a magnetic attraction for all kinds of botanists, naturalists and other nature-lovers whose intentions are not always consistent with the concept of conservation. Moreover, experts do not always agree on the setting up of such reserves, for the protection they offer, removed from man and his domestic animals, may result in changes in the ecosystem and so encourage new plants to establish themselves at the expense of those they were supposed to protect.

Consequently, almost all over the world the only method of protecting plants anything like effectively is to make it illegal to collect them. This involves drawing up a list of plants deemed to be threatened with extinction or with becoming dangerously rare. Compiling a list of this kind is not easy, particularly in countries with a wealth of flora like Greece and Spain; and besides, experts do not agree on which species are in need of protection. This task was greatly facilitated by the aforesaid publication of the *List of rare, threatened and endemic plants in Europe* compiled with the help of the IUCN and the Royal Botanical Gardens, Kew. Experts everywhere can learn from this gen-

Where have all the flowers gone?

eral list which species are threatened locally and what measures should be taken to conserve them.

Publishing a list of threatened, and thus obviously protected plants does not automatically guarantee their conservation. The laws prohibiting collection of these plants vary from country to country, and in a number of European countries the legislation is simply not adequate. Some countries absolutely prohibit collection of listed plants. Others allow it only for holders of a special permit. Others still, whose legislation is more recent, have alighted on a more flexible formula and drawn up three lists: the first covers threatened species which are fully protected, both the parts above and below ground; the second covers plants whose parts below ground only are protected; the third covers plants which may not be collected or pulled up for commercial purposes. It would be best if a single formula were established for all European countries.

A charming but nevertheless alarming spectacle! Goats and sheep can be a real danger to plant cover
(Photos J. L. S. Dubois – Explorer)

These solutions have both their advantages and their disadvantages, some of which should be mentioned here. The existence of legislation makes every collector face up to his responsibilities. No longer can anyone resort to the excuse of an absence of restrictions. There is always the possibility of inflicting a punishment in case of infringement, and this may deter some people. However, including a plant in a list of rare species lends it prestige and publicises it, thus bringing it to the attention of the public with who knows what result. Furthermore, enforcement of these regulations continues to pose problems. No policeman, forester or village constable can be expected to have sufficient botanical knowledge to recognise unhesitatingly the plants referred to in the various lists, even if there are pictures to illustrate them. In some southern European countries wide-ranging mountainous regions are only rarely patrolled by officers of the law. Besides, how can a check be kept on holders of special collection permits?

It is clear that the protection of a country's flora is not an easy problem to resolve satisfactorily. Nonetheless, as this issue becomes more and more pressing, measures, though in themselves imperfect, must be taken by all European countries to protect their floral heritage. The various difficulties described above were mentioned to demonstrate the complexity of the problem and the need to make a detailed study of its different aspects. The difficulties should in no way discourage those who lead the movement nor delay the necessary measures. The Committee for the Conservation of Nature and Natural Resources of the Council of Europe should press ahead determinedly with its efforts to promote, particularly in those countries where nothing has yet been done, the requisite legislation, the establishment of nature reserves and the education of the public.

P. B.

No biotope no protection

Victor Westhoff

Diversity and limits of the flora protection system

The alarming increase in the impoverishment of European flora and vegetation can, in principle, lead to four different approaches which attempt to counteract it:

1. the preservation of species;
2. the use of botanical gardens as refuges for species;
3. education;
4. the conservation of habitats.

The rapid and accelerating changes in European land use during the last century, due to technical innovations as well as to population pressure and increasing outdoor activities, have brought about a situation in which only approach number 4 can be considered a proper, though not an adequate answer to the problem.

Measures for the protection of species have been enacted by legislation in many European countries. Such laws and bylaws, however, have a limited value; they aim to prohibit, partially or totally, the picking, destruction, etc. of rare plant species, but they do not have the power to prevent habitat destruction. This can lead to the absurd situation where a child may be prosecuted for picking gentians or orchids, while the entire population of the same gentians or orchids, on the same site, is legally destroyed by bulldozers for land reclamation. In practice, such species–preserving laws or bylaws are only effective in the case of plant species which are destroyed wholesale by commercial exploitation, e.g. for gardening or pharmaceutical purposes.

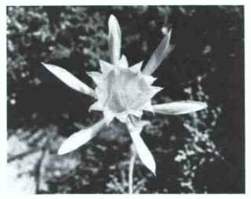
Botanical gardens undoubtedly have a specific responsibility to preserve species which otherwise would be exterminated. However, the survival of a plant species for the garden only is a poor substitute for the preservation of wildlife. Moreover, only a restricted number of species can be preserved in gardens, many rare and sensitive, "stenoecous" species will not survive there. A third restriction is the vulnerability of this way of creating sanctuaries: it is entirely dependent on intensive care in a well-to-do society. Last but not least, it is hardly possible to maintain plant communities in botanical gardens. Some simple pioneer ecosystems, characteristic of dynamic or disturbed habitats, can be created artificially, e.g. eutrophic pools and reed-swamps, or road verges, but it is impossible to create all kinds of secondary and climax ecosystems in which the web of life is much more complicated and in which historical factors form a major part. Man cannot, however, deliberately reconstruct such biotic communities (e. g. bogs, grasslands on chalk, alluvial forests and other complicated stable environments) in a botanical garden.

The third answer, education, is likewise insufficient. As stated by Norman Moore in *Naturopa* No. 27 (1977), "despite a very real and desirable shift in opinion. . . there is little evidence that education can produce the changes quickly enough to conserve wildlife; the economic and fiscal forces which operate in the opposite direction are too strong. Something more than education is required." This "something more" then has to be found in habitat preservation.

A major problem in habitat preservation is an adequate understanding of man's role in changing the face of the earth. As early as 1946 Edward Graham *(Natural Principles of Land Use)* proclaimed that such understanding should be the paramount preoccupation of nature conservationists.

Human influence: an essential parameter

Perhaps the most important new view of nature conservation in the past forty years is the better understanding of the role of man himself. Until a quarter of a century ago, nature preservation meant that man



must be kept out. Human influence was considered undesirable interference; nature should be left to look after itself. In western European countries this viewpoint is nowadays considered romantic and out of date. Ecological research has scientifically shown what field practitioners had already discovered long ago: that man and his impact are part of the ecosystem and they are not necessarily undesirable or even harmful.

The aim of nature conservation is, and should be, to preserve as many species of living organisms as possible; to maintain variety. In principle, the extent of human influence is not the only criterion of the value of a wildlife area. Biotic communities are controlled by a web of integrated environmental factors, and human influence is a part of the ecosystem, just as climate, bedrock and soil.

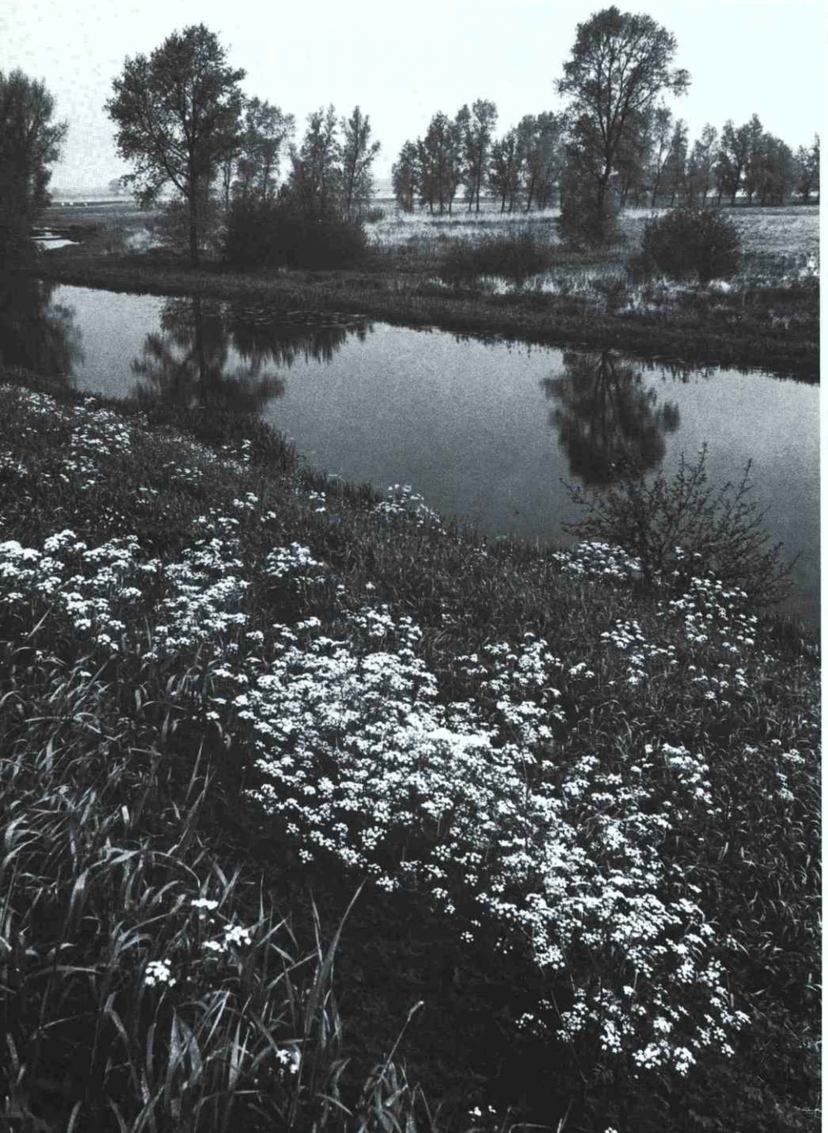
Vegetation studies have shown that a large number of biotic communities would not be able to persist or even to exist without major human impact. Nevertheless, many of them require conservation, particularly the semi-natural ones. Nature does not need to be defended against man as such, but against the deterioration caused by modern technical production and cultivation methods. Those modern methods reduce the variety of environmental sites, greatly diminishing the original richness of flora and fauna. They aim at the maintenance of only a restricted number of cultivated species.

Contrary to this process and in reaction to it, nature conservation wants to maintain and increase environmental variety. It tries to achieve this, in the first place, by creating nature reserves through purchasing the territory and, in the second place, by managing them properly. Selection and management have to be based on a study of the impact of man on the ecosystem, and of the successional changes which may occur.

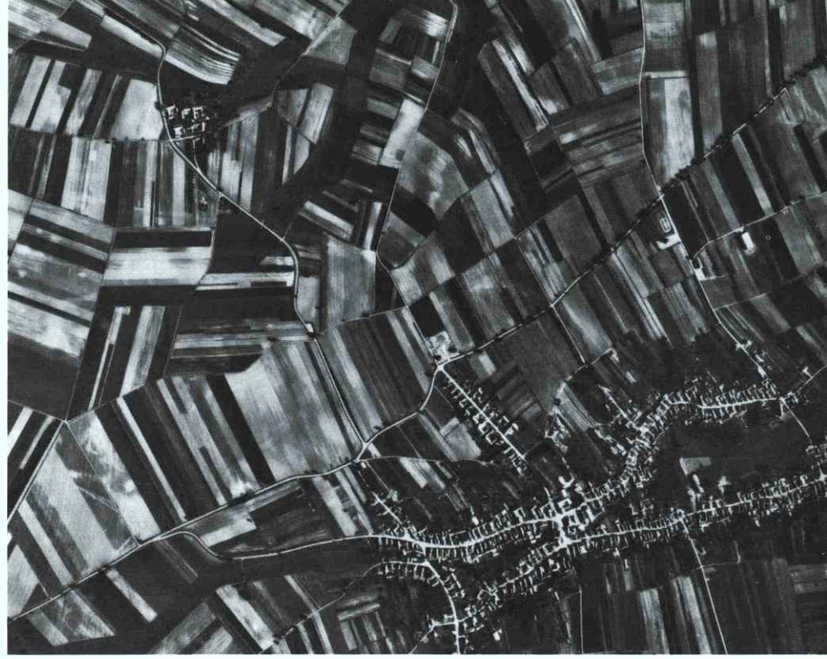
The next step in conservation ecology was to define and classify the different levels of human impact on the landscape and biotic communities. Four categories have been distinguished, based on ecological, floristic and vegetational criteria: the natural, subnatural, semi-natural and cultural ecosystems.

It should be stressed that from the Middle Ages until the first half of the twentieth century, semi-natural ecosystems predominated in western and central Europe. They covered a much larger surface than either the subnatural or the cultivated ecosystems. Human influence was positive rather than negative: its effect was more enriching than impoverishing. Differentiation outweighed standardisation.

Major landscape units differed from each other because of their isolation as well as their physiographical conditions. Their specific character may be compared to that of regional costumes, dialects and the way of life of their human inhabitants. On a smaller scale, interaction between man and his environment led to forms of land use which increased variation within the biosphere and thereby stabilised it. Only during the last decades has stabilisation been replaced by disturbance, continuity by discontinuity. Our ancestors always carried out the same practices on a certain site, but on every site the action was different (stability in time, diversity in space). The present generation, on the contrary, changes its methods all the time but carries out a similar action overall, regardless of the character of the site (instability in time, uniformity in space). This technical revolution has been disastrous for the richness and diversity of flora. In the Netherlands, maps showing the "naturalness" of vegetation, i.e. the rate of human impact on it (*abgeleitete Vegetationskarten mit Bezug auf den Natürlichkeitsgrad der Landschaft*) have been made for today's situation and extrapolated for the year 1900.



Man's interference is not necessarily bad, as witness the example of the Netherlands with its rich flora and fauna (Photo Jan van de Kam)



Man's impact! (Near Wissembourg, France)
(Photo National Geographic Institute, Copyright IGN No. 99–2415 of 20 July 1978)

The impact of man results in a certain amount of human environmental dynamics, added to the amount of natural dynamics which is characteristic of the ecosystem of that specific site. The amount of environmental Dynamics Added by Man (DAM) is zero in a natural ecosystem, greatest in a cultivated one.

Natural (including subnatural) ecosystems can be listed in the order of the amount of environmental dynamics characteristic of them. Ombrotrophic peat bogs and oligotrophic woodlands represent the lowest degree, salt marshes and estuaries the highest.

Within this range, the sites are more susceptible to disturbance by DAM as they are less dynamic themselves.

For efficient management of nature reserves

On the basis of these experiences and the theory derived from them, the "outward" and "inward" management of nature reserves are established. Outward management (external regulations) aims at isolating the reserve against disturbance from outside as well as at counteracting the effect of such disturbance; inward management (internal regulations) deals with the techniques to be applied within the reserve in order to maintain its characteristic ecosystems. Whereas outward management means limiting permitted human influence, inward management is conditioned by the required minimum of human influence. Outward management is mainly prohibiting the input (influx) of minerals (e.g. nutrients); inward management deals with furthering the output (removal) of minerals (e.g. nutrients).

Outward management has to prevent or counteract disturbances such as pollution, eutrophication, use and misuse of biocides, damage caused by intensive recreation and, last but not least, lowering of the water table by agricultural techniques used in adjoining territories. One possible measure is the planting of shelterbelts to prevent agricultural nutrients being blown by the wind. Inward management deals mainly with semi-natural ecosystems such as moorland, sedge swamp and chalk grasslands. It is aimed at the maintenance of the internal web of life of the site under consideration. This implies that those human activities essential for the existence of the communities within a site should go on at their own rhythm and in their own way, just as they have been for many generations. Consequently, in many cases traditional agricultural methods must be maintained. If this is not possible for technical reasons, we have to take measures simulating the former agricultural practice and coming as near to it as possible. The techniques to be applied can be listed in the following order: excavating, turf-cutting, ploughing, treading, grazing, burning, mowing, chopping, no action at all. In this sequence the rate of DAM decreases. The impact of DAM is strongest in the first three actions: they imply a direct influence on soil conditions ("spade effect"). It is weaker in the remaining ones, implying an indirect influence on soil conditions ("axe effect").

Nature conservation must be a national aim

Finally we must stress that it will not be possible to preserve all plant species and communities in nature reserves, even in the ideal situation of enough representative reserves being established, with enough money and man-power to manage them properly. Even then reserves would not suffice. The long-established, historical, agrarian landscapes with their small-scale diversity are indispensable for the maintenance of much of the European flora and vegetation. The main reason is that many species require larger or more "sophisticated" environmental dynamics than they will find in nature reserves. On the other hand, they cannot stand the disturbances of modern farming techniques. Such species find their habitats in extensively, more or less irregularly cultivated farmland, uncropped (ruderal) habitats on the farm or on the verges of irregularly trodden pathways ("off the beaten track"), or again in the fringes of woodland.

Total polarisation of agriculture and conservation would, therefore, be disastrous for the preservation of plant species and communities. A solution can only be found by a mixture of measures, as was clearly stated by Norman Moore (*op. cit.*). Most important will be the development of a national land use strategy, which would state explicitly that the conservation of nature and landscape, as well as food and timber production are national aims. V. W.

Forests or just trees?

Roland Carbiener

European forests: an economic, natural and cultural heritage

After south-east Asia, Europe as a whole has the highest population density in the world. In the present context of an economy tending to institutionalise wastage, this population is too high for the natural resources – both the non-renewable ones, into which considerable inroads have been made and the renewable ones, which are often over-exploited (Gruhl, 1975).

Despite this handicap, thanks to the considerable diversity of its relief and climate, and thanks also to the inherited balance between farming, forestry and grazing created by its very old agrarian-based civilisation (a balance that has now been disturbed), Europe has been able to preserve an adequate (apart from local exceptions) forest cover.

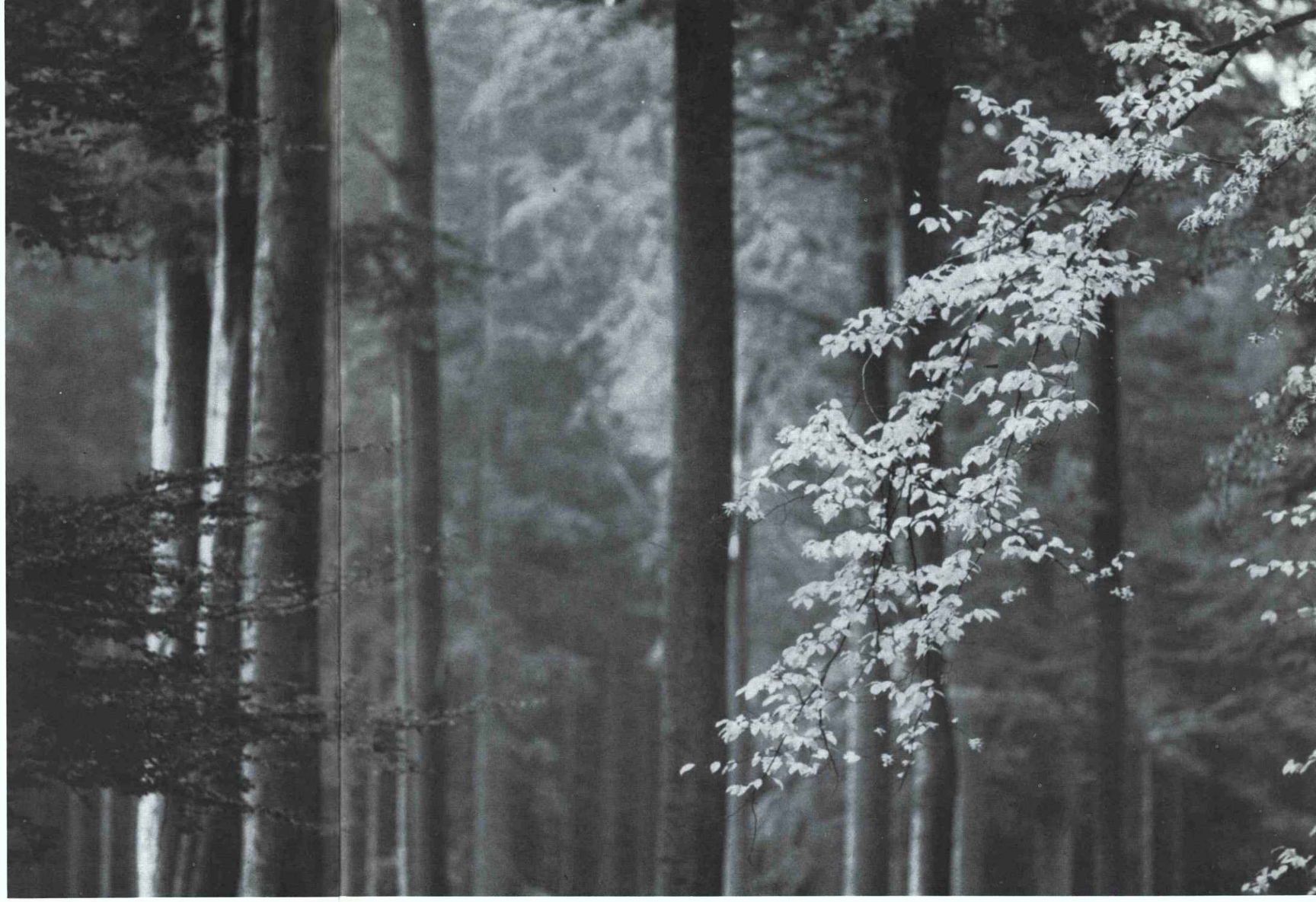
Our forests represent an increasingly valuable *potential of future renewable resources.* From the *economic* point of view alone, forests, as developed ecosystems (in the systemic sense of the term), have the great advantage over agricultural[1] ecosystems of converting, at no cost, solar energy into chemical energy, that is to say without human intervention, or, in the general case of exploited forests, at the price of comparatively small energy investments. Wood, a valuable raw material that can also be reprocessed, a major forest product, though not the only one, presents a marvellously ingenious and irreplaceable bio-chemical structure.

Furthermore, forests are the natural environments which on the whole have best retained the original natural balances. For this reason they probably have the largest number of non-economic values concentrated in them. These social values frequently conflict with the present trend towards sylvicultural "rationalisation" and this in turn leads to forests being replaced under the pressure of the short-term economic situation – calling for short-term profits – by uniform stands of young trees. These plantations, reduced to the state of "cellulose factories", are no longer forests but fields (of poplar, spruce or maple) where almost all the values specific to the usual forest environment are lost.

In *landscape heritage* forests are thus an integral part of the harmonious pattern composed by the most developed agro-sylvo-pastoral systems, in which Europe abounds. Each region has its own special character as regards forest composition, structure, balance and dynamics. Forests represent a *cultural value* thanks to the variety of their structures both in space (forest architecture) and in time (forest dynamics, history of forest massifs, human influences of the past, seasonal changes). The strong affective and aesthetic relationships thus created are acutely perceived by people with their roots in the soil. The *educational value* of the forests is being increasingly realised because of the necessary advent of ecological logic as a subject of study. It is at the level of forests (the real ones) that the complexity of an ecosystem is best able to be learnt and understood, and that the new systemic logic – including the concept of dynamic balance – can best be demonstrated. Moreover, in conjunction with the teaching of these *scientific concepts,* qualities of *sensitivity* – so neglected in education, with such disastrous social consequences – can be cultivated: sense of observation, aesthetic perception, opportunity for contact with many live animal and plant species. Real forests (not timber plantations) combine the greatest scientific, educational and cultural potential that can be offered by a natural environment.[2]

1. Agricultural ecosystems in the systemic sense are ecosystems kept at the very under-developed juvenile stage and so require constant supplies of energy from outside the system.

2. We shall not enter into the argument about what is "natural", with its denial of the part played by natural factors on the specious grounds of long-standing human influences. This superficial view is typical of people who know nothing about ecology.

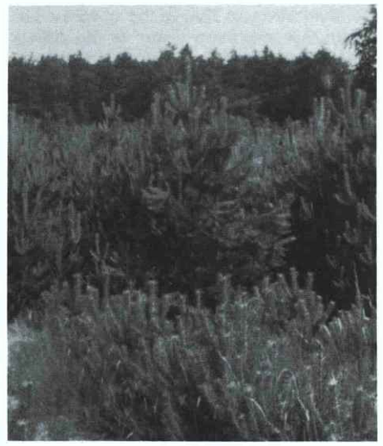


120-year-old beeches: rather too long term exploitation?
(Photo B. Winsmann)

One absolute rule: preserve diversity

The conservation problems raised by European forests are numerous. However, it seems possible to sum them all up in one absolute rule: *preserve diversity.*

The first urgent step to take would be to influence national forest policies in the direction of abandoning their pseudo-rationales induced by the short-term economic situation, in favour of keeping intact the long-term genetic and production potential of balanced forests, that is to say forests with a complex structure, rich in species and self-homeostatic. It may well be that the profound transformation of "needs" in the post-industrial economies (which hard facts will impose on us) will raise even the economic value of diversified ligneous products (each species having its own properties). This would simultaneously ensure the preservation of the multiple values concentrated in forests without affecting the production potential, provided always that production and yield are viewed from the only acceptable angle, not from that of short-term economic yield, that is to say the apparent yield per hectare, but from that of the real, systemic yield, by means, that is, of calculations and evaluations combining the energy input-output ratio, the maintenance of the production potential of the sub-strata (soils), the genetic maintenance of well-adapted populations, and the achievement of self-homeostatic structures (e.g. cultivated woods).



Only too often, conifer plantations provide the only reafforestation prospects in today's forestry policy (Photo H. U. Moosmayer)

But there is also another matter of urgency. European forests still in the quasi-primary state or, at least, very close to the climax or paraclimax, have become extremely rare and, in the last twenty years, many of those remaining have suffered from drastic exploitation. It is therefore urgent for European and national authorities to give priority to creating a *network of reserves* enjoying total protec-

tion, so as to preserve representative samples of various climatic or paraclimatic ecosystems in Europe (e.g. riparian forests, marsh forests, ravine forests). Some countries are ahead in this respect; others, like France, are noticeably backward.

It is only by this means that we shall be able to preserve for future generations examples of the most authentic (developed) forests. Scientific studies of their sylvigenesis[3] might be undertaken and their aesthetic qualities preserved, since developed forests are much more beautiful than forests grown for timber, which are usually uniform and monotonous. It is indeed regrettable that a hotchpotch of anti-scientific mythology about forests still persists. For example, there is the myth that a forest ecosystem left to itself would eventually degenerate into scrub (if not wasteland); and there is the myth of the impenetrable and unaesthetic character of climatic forests. One need only think of the splendour of the primary forests of the Dalmatian coast, of Romania, of Bielowiesza in Poland, or of the United States of America; all these countries already manage immense, totally protected forest reserves.

Another important objective is that of keeping *suburban forests* in as natural and diversified a state as possible, that is to say of giving priority to social objectives. Strasbourg is setting a particularly bad example in this respect, having converted – and persisting in doing so despite protests – much of the remaining suburban forests deriving from the original Rhine riparian forests of outstanding interest into plantations of trees of the same age and of one species, that is to say into cellulose factories of beech, sycamore, pine and ash of deplorable banality.

In conclusion, forest conservation is not, as in other cases of flora protection, a matter of preserving a collection of more or less rare species or fine flowers, but of *preserving the original structure and dynamics of each type of climatic forest.*

It is time now to give a more concrete idea of the natural heritage of European forests.

A whole made up of contrasts

The general characteristics may be summed up as follows:

There is a contrast between the diversity of types of ecosystems, reflecting the climatic diversity and the paucity of dendroflora of the ligneous species: (trees, shrubs), a legacy of the vicissitudes of bio-geographical history.

3. That is to say the natural cycle which automatically maintains the composition and structure of climatic forests.

Rare vestiges of primeval forests. Will they be the basis of a revival of our forests? (Urwald Rheinhardswald) (Photo B. Winsmann)

The diversity of forest climaxes

European forests are not, like those of Asia, divided simply into zones, that is to say according to the general climate resulting from the interaction of latitude and altitude. The oceanic influences combined with the interception of oceanic (or continental) air streams by very differently oriented mountain ranges considerably disturb the zonal structure and introduce original aspects due to the formation of a number of climatic sub-systems: regional and local climates. This situation is typical of the western seaboards of continents in the Northern hemisphere.

Thus, Europe, as the western facade of the Asian mega-continent, has a *particularly marked climatic diversity* in relation to its small area. The disturbance of the zonal distribution of climates by oceanic influences determines the existence of overlapping ecological gradations, that is to say continuous variations from west to east (gradually decreasing influence of ocean winds) and from north to south (according to the zone). The relief introduces a third variable, and when mountains lie directly across the path of the prevailing winds, they may cause considerable contrasts over short distances. An illustration of this is the contrast between the scrub sub-desert of the coasts of Madeira and the laurel-type forests rich in tertiary relicts endemic in the mountains of the island, or between some beech and pinewoods of the western ranges of Corsica (or the birch woods of the Col de Vergio) and the forests of *Pinus laricio* of the more sheltered higher Corsican mountains. Likewise, the sub-alpine beechwoods in the Vosges and the Massif Central and the beech and pinewoods of the peripheral ranges of the Alps contrast strangely with the forests of larch (*Larix europea*) and Siberian pine of the central Alps. Further north, similar contrasts can be found between the wet forests of pubescent birch and oak of the coastal ranges of southern Norway and the sub-oceanic forests of sylvester pines of the central massif (Rondane) only a few dozen kilometres away. Conversely, there is a similarity, despite the difference of latitude, between the eu-Atlantic oak forests of Portugal and those of Ireland (the strawberry tree – Arbutus – is to be found throughout this sector). Similarly, the extremely selective effect of Mediterranean climates (very hard on vegetation) explains the relative uniformity and the small number of species to be observed in the climax forests of the Mediterranean basin, namely the forests of evergreen oak.

Since geological and paleobotanical factors also have an effect on climatological data, it will be easily understood why, in the relatively restricted area of Europe, a particularly complex pattern of natural regions is to be found, each section of which corresponds to a combination of forest climaxes[4] and associated paraclimatic forests (e.g. riparian, ravine or marsh forests). Hence the wealth, bound up with this diversity of the natural heritages of Europe and the legacies of culture and landscape deriving from them.

It is this *original and unique diversity that must be protected* by setting up throughout Europe a dense network of preserved forests and by basing sylviculture for production on ecological criteria that take full account of social objectives. These objectives are comparatively easy to attain in Europe because European forests are of a relatively simple composition and structure compared with the structure of temperate forests in North America and Eastern Asia (e.g. Japan, Korea). Our forests are much poorer in ligneous species (trees and shrubs) than the forests in those countries. This is likely to simplify the problem of respecting ecological criteria in sylviculture production.

The relative paucity of the European dendroflora – its *causes and effects: simplicity of forest phytocenoses.*

If the phytosociological composition of a natural deciduous forest in the north east of the United States is compared with a similar forest in central Europe and a riparian forest of northern Japan or the Mississippi with the riparian forests of the middle Rhine or Danube – though these

4. Climaxes are the most developed stable ecosystems that a biotope can harbour.

are among the most remarkable in Europe – or again a mountain laurel forest in southern Japan with one in Madeira, the relative paucity of ligneous species in the European forests is only too apparent; frequently, the ecologically "vicarious" forests of the Far East or of America have twice the number of trees and shrubs (they are therefore much more developed, more highly evolved and richer in ecosystemic logic).[5]

Outside Europe, one is struck by the almost total absence of dominant species. And yet the genuses are frequently the same, but where in Europe one or two oaks, elms, cornels, or beeches, etc. are to be found in a given forest phytocenosis, three to four (or more) species of these genuses are to be found in America or in Japan.

This dwindling of the European dendroflora is due to the devastation of the tertiary flora of Europe by the successive waves of the great quaternary glaciations. Whereas in America and Japan, the temperate flora was able to retreat towards the south without major geographical obstacles (longitudinal disposition of the mountain ranges), in Europe the Alps and the Mediterranean acted as barriers and prevented access to adequate refuges. Furthermore, the gradual quaternary individualisation of the Mediterranean climate, very unfavourable to trees, replacing the very favourable original warm and temperate climate, did the rest.

This relative simplification had *important consequences.* The pitiless pressure of selection exerted on the European ligneous flora by these repeated vicissitudes led to the formation of particularly competitive species, such as the beech, the spruce and, to a lesser extent, the hornbeam and large-leafed European maples.[6]

These trees have eliminated many commensals and are the cause of a certain natural lack of diversity in the forest phytocenoses themselves. The predominance of the most competitive species thus explains why the structure of European forests is simpler, less stable, less balanced, from the start.

This fact helps to show how ready-made ideas about the natural structure of forests and the mythology already mentioned arose. It was long considered that the architectural model (ecologically) marginal and over-simplified, of beech or spruce forests was the "natural" forest model. These forests have little or no sub-layers of subordinate ligneous species and sometimes regenerate themselves by drastic means (dead wood). The "norm" of the "cathedral forest" is based on these exceptional cases.

A natural forest structure does not comprise dominant species (except in the marginal ecosystems of the sub-alpine altitudes and the Nordic zones): several species of large trees are to be found side by side. A natural structure comprises smaller ligneous species (lesser trees, shrubs) forming several "levels", and juxtaposes all the generations of all the species constituting the ecosystem in a constantly changing sylvigenetic pattern. Such forests are by far the most beautiful (cf. the beauty of a spring or autumn walk through the primary deciduous forests of America or Japan).

This heterogeneousness ensures a remarkable homeostasis, that is to say the perpetual renewal of the structure, of its species make-up, and of the soil fertility, unless climatic changes occur of the forest biocenosis.

5. According to this logic, diversity and complexity reflect an order of a higher kind concealed beneath an outward multiplicity, whereas simplified structures represent, despite appearances, disorder and instability.

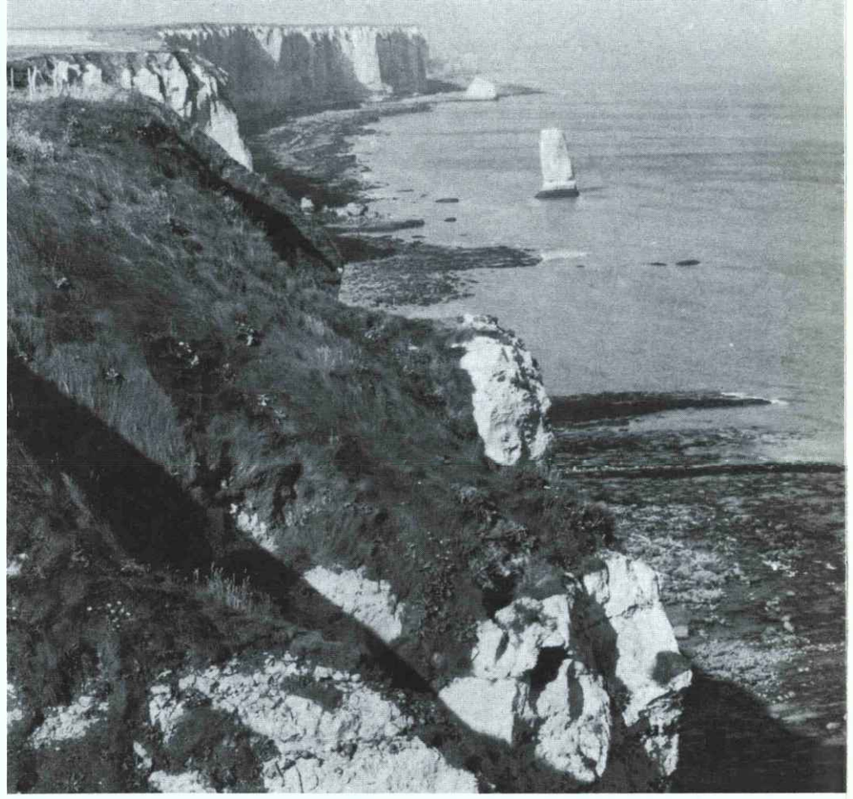
6. It is remarkable that the European species of the genuses *Acer, Tilia, Quercus, Fagus, Carpinus,* etc., are on the whole much more competitive than the corresponding American or Far Eastern species.

(Photo Ch. Cuny – Explorer)

Reconciling the objectives of production with those of ecology

That is the ideal forest ecology model, whether it be a matter of preservation in the form of a totally protected reserve, or of as close an imitation as possible in the productive forests of the future, by means of an ecological sylviculture, economical where technical aids are concerned but making generous use of human skills (and consequently offering employment). This would enable production objectives to be reconciled with social objectives, and the natural potential of fertility (directly correlated with diversity) would thereby be maintained in the long term. In Europe, precisely because of the greater simplicity of structure at the outset, ecological sylviculture will be less complicated and easier than in America or Japan! It is in Europe that it is easiest to reconcile the – legitimate – objectives of production with those of ecology. Let us make the most of it.

The conservation of European forests, like the other problems of the conservation of the heritage of plant diversity, can only be conceived as the preservation both of milieux and of ecosystems. It is therefore urgent to set up a dense network of ecological forest reserves in every country. But in the case of forests exploited for their products, the very special problem of sylvicultural techniques must be reconsidered. We must prevent the disastrous effects of short-term profit-seeking which subjects forestry to the purely short-term, necessarily transitory (we are witnessing the beginning of the decline of technocratic structures) and false rationale of an economy-mindedness that crushes man. As distinct from all other types of action to save European flora where forests are concerned, their preservation as a whole is more important than the protection of rare plants. R. C.



The coastline of Europe: beaches, tides, cliffs, fjords. . ., but also tourism, buildings, pollution, industry (Photo J. M. Gehu)

80,000 kms of coastline

Jean-Marie Gehu

Rich and varied vegetation

A "promontory" continent, Europe has about 80 000 km of fairly rugged coastline spread over some 40° of latitude between the North Cape and Crete.

Its vascular flora (algae will not be dealt with here) is rich and varied. It comprises numerous specialised plant groups which together make up the coastal vegetation.

The great diversity of European maritime flora and vegetation is naturally due to several causes: the general climate varies from the Arctic to the Eastern Mediterranean type. Within each type of general climate, a multiplicity of topographical features combine to produce a whole range of local climates favourable to very different species. The geomorphological conditions are just as varied: elevated coasts (Scandinavia), subsiding coasts (the Netherlands, South-East England), coasts in process of erosion (limestone, chalk, granite, sandstone, shale, cliffs, etc.), sedimentary coasts of varying granulometry (off-shore bars of shingle or gravel, sand dunes, mud and sea-sand of estuaries and bays, etc.), and foster the development of the various plants associated with these types of station.

Reconstituted after the end of the Würm glaciation period in Northern Europe, the coastal flora has persisted in the Mediterranean and in the South West of the Iberian Peninsula and this explains its penetration into the present vegetation of the dunes, the cliffs and even the salty mudflats of temperate Atlantic Europe. Several halophile[1] plants, particularly the *Chenopodiaceae,* probably originated in the Eurasiatic or North-African salt steppes. The selective rigour of the maritime climate encourages the development of micro-species. Various ecotypes (e.g. prostrate forms) have thus made their appearance on many Atlantic headlands.

The traditional human influence, though not totally absent, has at least left less imprint on coastal vegetation than on the inland plains. It is along the edge of the sea, as in the high mountains, that the most "natural" vegetation in existence is to be found in our regions nowadays.

Each plant community on the coast is thus the local and original result of the history of the flora and of the conditions peculiar to a given station.

Along the coastline, these groups are usually arranged in narrow belts varying in breadth according to the distance from the sea-shore, and to the attenuation of the two predominating ecological factors which mark the boundary between marine and land life: salt and wind.

In their natural sequence, untouched by man, these specialised belts of vegetation always precede pre-forest or forest communities. The width of the belts depends on the strength of the direct or indirect marine influence (exposure, heights of tides, etc): broad around headlands and bays, they can narrow to be almost nil in protected rias.

It is convenient to divide them according to the main geomorphological categories of shores. Studies perpendicular or parallel to the different types of shore can be made of the various communities present on each.

In the perpendicular studies, each site will show a transect of associations gradually less halophile as they spread inland. In the parallel studies, each element in the transect will contain floristic substitutions depending on the latitude, the factor which creates the phenomena of geographical vicariousness.

Coasts in process of erosion

Generally speaking, erosion is associated with the appearance of cliffs. A good average example of a transect may be found in Northern Brittany, on the granite cliffs of the major promontories. At the base, where the cliff-face is still washed by waves during storms, only the halophile vegetation occurring in rock fissures is present in the form of *Crithmum maritimum, Spergularia rupicola, Limonium binervosum.* In shady crevices the fern *Asplenium marinum* will grow. A little higher up, where fine particles are able to accumulate, the wind-scorched blue-green *Festuca pruinosa* turf dotted with *Armeria maritima* and *Silene maritima* will be found.

Then, at the top of the cliff and on the plateau, there are the coastal heathlands with gorse and heather swept into strange ball-like shapes by the wind.

A heathland of European gorse (*Ulex europaeus*) in its prostrate maritime form usually precedes a heathland of Legall gorse (*Ulex gallii*).

In Southern Brittany, on Belle Ile, for example, the phenomena of vicariousness are clearly visible at each stage. In the *Crithmum* zone, more thermophile plants, like *Frankenia loevis,* appear. In the turf, the *Silene* are replaced by plants such as *Daucus gadeceauii* (endemic micro-species) and *Plantago carinata.* On the heathland, *Erica vagans* appears. Obviously, the thermophile elements die out towards the North. On the Scottish cliffs, among the Chasmophytes,[2] it is possible to see a combination of wide-ranging halophytes, such as *Armeria maritima,* with subalpine types like *Sedum roseum* or Nordic types like *Ligusticum scoticum,* whereas the turf contains a remarkable mixture of maritime plants, such as *Plantago maritima,* various nordic or alpine grasses such as *Oxytropis halleri,* Atlantic varieties such as *Scilla verna* and endemic plants like *Primula scotica.* The heathland, which retains its western tinge with *Erica cinerea,* becomes very nordic with the *Vaccinium* and *Empetrum.*

This phenomenon is accentuated in Iceland, where the basalt scree slopes bring together plants such as *Silene maritima* and various arctic alpine plants of the mountain scree class (*Thlaspietea*). The heathland is of the subarctic type, with *Calluna,* various *Vaccinium* and the dwarf birch.

Conversely, towards the South, in the Mediterranean region, the *Crithmum* zone is enhanced by numerous species of *Limonium,* but the turf disappears. The plateaux, as at Cape St Vincent, may be covered with ball-shaped thorny xerophytes (of North-African appearance and origin) like some *Astragalus.* In the Mediterranean, elements of the maquis and the garrigue frequently appear right at the edge of the cliff in unusual combinations.

The edaphic influence on cliff vegetation is clearly apparent if a transect of the Breton granite cliffs is compared with that of the chalk cliffs in upper Normandy. There, the vertical face is covered by the rosettes of the *Brassica oleracea,* whereas the *Festuca* turf includes various special ecotypes of species belonging to the genera *Trifolium, Picris, Vincetoxicum* and *Senecio.*

A grassy *Mesobromion* turf (with false brome-grass, orchids and various calcicolous species) replaces the heathland of heather and gorse.

In Brittany, the deposit of calciferous or limon sand on the granite allowed a special false brome-grass to grow and thickets of black thorn, European gorse, privet and elm to supplant the heath.

Sedimentary coasts

According to the granulometric dimensions of sediments, it is possible to distinguish three major types of sedimentary coasts:

— stretches of shingle and gravel;
— sand dunes;
— salt mud-flats.

Ridges of sand or shingle, by slowing down the outflow of water from the land, sometimes create conditions favourable to the formation inland of marshes and peat-bogs.

The protection of the saline meadows from the sea, whether naturally or by dykes, leads to the formation of polder zones with sub-maritime flora.

Shingle and gravel splits

Shingle, broken off from the cliffs, accumulated to form bars, spits, "fingers" or "comet tails" behind islets.

In temperate Europe the vegetation most typical of this environment is composed of sea-kale or *Crambe maritima.* Towards the West it may be associated with *Crithmum maritimum.* In the Baltic it is accompanied by *Elymus arenarius.* In England *Lathyrus maritimum,* a species of holarctic distribution, is also found, but everywhere else, from Denmark northwards, it it more often found in sand.

In the exceptional site of Dungeness (South-East England), zonation continues with an *Arrhenatherum* dominated by *Silene maritima,* then with a fruticetum in which an extraordinary semi-circular shaped variety of the common broom predominates. A few isolated residual clumps suggest a para-climax dominated by holly (*Ilex aquifolium*) in the station.

Dunes

The classic dune sequence in Western France commences above the beach with a disjointed line of annual, halonitrophile plants at the high-water mark (*Cakile maritima, Atriplex arenaria, Salsola kali*).

The embryonic dune is the home of the *Agropyrum junceum,* the white shifting dune, that of the sand reed, *Ammophila arenaria.*

In this zone there are remarkable phenomena of geographical vicariousness.

All around the North Sea (the Netherlands, Northern Germany) and in the Western Baltic, *Agropyrum* is associated with the Nordic grass *Elymus arenarius.* Farther East, on the Polish coast, it disappears and its place is taken by the sand reed at the top of the beach where the water is less saline. Conversely, towards the South West there appear in the embryonic dune more thermophile plants such as *Eryngium maritimum* (the blue thistle), *Euphorbia paralias* and *Calystegia soldanella* (dune bindweed).

In the Mediterranean the *Agropyrum,* in a different ecotype form, is combined with the grass *Sporobolus arenarius.*

The same vicariousness is observed in the sand reed zone, from the North to the Mediterranean, where it is illustrated by the Nordic *Elymo-Ammophiletum,*[3] the Western *Euphorbio-Ammophiletum,* the South-West *Iberian Othanto-Ammophiletum*[4] and the Mediterranean *Echinophoro-Ammophiletum.*[5]

In the North, for example, on the black basalt sands in Iceland and in Scandinavia, the *Ammophiletea* class no

Pancratium, too often sought and picked by tourists for its beauty and scent
(Photo John G. Walmsley)

1. Plants which flourish in, or tolerate a saline habitat.

2. Plants growing in rock fissures.

3. *Ammophila arenaria* or sand reed.
4. *Othanthus maritimus:* a compound with white, silvery pubescent leaves.
5. *Echinophora spinosissima:* Mediterranean umbellifer.

longer exists. It has been replaced by such nordic plants as *Honckenya peploides* and its associates *Lathyrus maritimus* and *Elymus arenarius*.

The phenomena of vicariousness occur much more quickly in inland dunes, where the features of the local climate are accentuated, particularly in the dry hollows between the dunes. On the Atlantic coast of France alone there are more than twenty plant groups of small-grass (frequently annual and minute) or bryo-lichen turf. The lichens and mosses gradually disappear from inland dunes towards the Mediterranean and their place is taken by sub-ligneus, chamaephytic plants such as the *Helichrysum stoechas,* and various species of *Artemisia, Ephedra distachya, Crucianella maritima* and the like.

Inland dunes also tend to produce trees when they are wide enough and do not suffer any damage by human beings or animals (rabbits for example).

Various types of fruticeta pave the way for forests, for example, from Scandinavia to Northern Holland: heathlands dominated by *Empetrum;* in East Manche: fruticeta dominated by elder, sea-buckthorn (*Hippophae rhamnoides*) and privet; in Charente Maritime: thickets of *Daphne gnidium* and *Ligustrum vulgare.*

The dune forest in East Manche is composed of birch, the one between the Loire and the Gironde of maritime pine and holly oaks, that of the Gascony heathlands of pines and cork oaks. The dune forest in the South-West of the Iberian Peninsula has juniper trees, such as *Juniperus lycia.*

Salt mud-flats

In temperate Europe, if one excludes the marine *Phanerogamia* (i. e. the *Zosterae,* replaced in the Mediterranean by *Posidoniae*), the colonisation of emergent mud-flats begins with the pioneer groups of annual saltworts, of which there are two species, one diploid, on the higher levels, the other, tetraploid, at the lower levels.

Various species of marsh grass, which stand upright, also frequently help to stabilise the salt mud-flats and to raise the level of salt meadows. Only *Spartina maritima,* of European origin, exists in the South-West. An American type has taken root in some sites: *Spartina alterniflora* (Basque country, French Finistère). *Spartina townsendii,* their allopolyploid,[6] is developing vigorously and rapidly.

In Northern Europe saltworts and marsh grasses are dying out because they cannot withstand frost.

Zonation continues with meadows dominated by *Puccinellia maritima* which is spreading, in various forms, from Portugal to Iceland and central Scandinavia. In the North other species of *Puccinellia (P. retroplex* and *P. phryganodes*) are taking over.

Next in the transect come the silvery meadows, with evergreen scrub dominated by *Halimione portulacoides.* These are the last emissaries towards the North of the perennial saltwort which inhabits the Mediterranean and Mediterranean-Atlantic brackish marshlands (Sansouires).

The zonation finishes with *Festuca* (*Festuca littoralis*) or couchgrass (*Agropyrum pungens*) dominated turf.

Some groups, very widely distributed (such as *Artemisietum maritimae* or *Juncetum gerardii*) in the Western Baltic or the North Sea, are becoming much more scarce, or even non-existent towards the Atlantic. Conversely, the thermophile associations of the perennial salt are dying out towards the North: the communities dominated by *Salicornia radicans* in the Cotentin and in South-East England, and those dominated by *Salicornia fruticosa* around Brest.

The topographical and edaphic conditions of the upper parts of the salt meadows ("schorre") can considerably accentuate diversity in the plant communities.

A position at the bottom of a depression is favourable to the development of *Plantagini – Limonietum* (floral facies of *Limonium vulgare*). The sandy sub-stratum is particularly suited to communities dominated by *Frankenia loevis* and *Limonium lychnidifolium.* Ground-water seepage encourages the growth of *Carex extensa, Scirpus maritimus. . .* There is not enough warmth on European mud-flats for the growth of woody, shrubby plants (of the mangrove type).

However, an American shrub of the family of compounds, *Baccharis halimifolia,* is becoming naturalised in the upper parts of salt meadows in South-West France.

Polders and the sub-coastal zones

These are interesting because they show the gradual continentalisation of the vegetation. The meadows of *Agropyro-Rumicion* in them are particularly interesting. Afforestation with elms has become possible.

Marshes and peat bogs in the hinterland

As in Picardy, these may have a rich flora of *Carex* and orchids.

In Holland it is possible to see remarkable instances of transition, from salt-meadow communities to marshy vegetation dominated by *Schoenus nigricans.*

A fragile and threatened treasure

As general and brief a paper as this is quite incapable of giving even an approximate idea of the extraordinary wealth and the immense floristic and phytocenotic diversity of the European coasts. A lengthy treatise would hardly suffice.

But it must be remembered that the biological wealth of the coastline is very fragile and highly vulnerable, much more so than that of many sensitive sites inland. This fragility is due to its being distributed in all its diversity, along a band which, though usually a few hundred or thousand metres – but never more than a few kilometres – in width, may sometimes be no broader than a few metres. Furthermore, each belt generally lives off those preceding or following it. The smallest human installation might do irreparable damage.

The causes of destruction are legion and have increased dramatically during the last twenty years. They range from the industrial-port occupation of the seashore to uncontrolled touristic development with the erection of "seafront" buildings and housing, together with the construction of dikes for agricultural purposes. The list of all the types of aggression against the sea coast is such that it alone would justify a special article.

Several European coastal species and phytocenoses are already threatened with destruction. On the salt mud-flats of the Brittany coast, now submerged by the oil pollution, there used to be two *Cochlearia-Plantaginetum* and *Cochlearia-Frankenietum* associations, endemic to North Finistère. It is too early yet to know whether they will survive. In many places on the Mediterranean coast, particularly in Spain and Italy, if not in France, it is already too late to study the dune vegetation. In the Biarritz area, a plant association behind the dunes is disappearing. A community dominated by the *Euphorbia peplis* on the shingle of the Brittany coast became extinct five years ago.

Measures for the protection of the European coastline, particularly in the Mediterranean and in the middle reaches of the Atlantic coast, must be speeded up and intensified without delay if real biological calamity is to be averted.

J.-M. G.

6. A hybrid which has become fertile by the doubling of chromosomes.

(Photo Suiss National Park)

Education and information

Jean-Jacques Symoens

Why educate?

In some regions of the world, especially those which are densely populated, where agriculture is intensive and where there is a high proportion of urban and industrialised areas, plant species are under a severe threat. Investigations carried out in several EEC countries have revealed a rapid and alarming decline of plant life. In Belgium, for example, out of some 1 300 plant species of the higher order (bracken and flowering plants), 59 have disappeared since 1850, 71 are threatened with extinction in the near future, and 151 others have become scarce in much of the country (Delvosalle and others, 1969).

The decline and disappearance of plant species are due chiefly to the destruction and alteration of wildlife habitats by felling and clearing, the extension of crop growing and the use of weedkillers, the disappearance of marshes and wetlands, water eutrophication and pollution, the clearing and straightening of waterways, the expansion of coniferous plantations, and the encroachment of urban and industrial areas, roads, port facilities, etc.

Once a plant community has been dismantled and the number of surviving members of the species diminished, overpicking adds to the threat and causes further regression of plant life. Herbalists, gardeners, flower sellers and ramblers may all be to blame for overpicking; so may some collectors of botanical items, although there is less evidence for this.

Conservation measures of various kinds are therefore essential if our natural plant life heritage is not to be impoverished still further; such measures range from the creation of reserves to the individual protection of certain threatened plants.

Regulations and education

Legislation of various kinds has been enacted in Europe to ban or restrict the picking of certain wild plants and to prevent their destruction.

The officials responsible for enforcing these laws cannot, of course, be expected to know enough about the prohibited species to exercise adequate supervision. Moreover, their task is made very difficult by the fact that wild plant communities are somewhat scattered.

In fact, these legal provisions should be regarded primarily as having an educational purpose. Their enactment is usually the occasion for the issue of brochures and posters informing the public that the natural plant heritage is protected by law and emphasising the value of that heritage. As J. Duvigneaud has said (1976), it is intended that these measures, being of an anti-demagogic nature, will make for greater discipline and foster a more respectful attitude towards nature.

But legal provisions will remain largely a dead letter if they are not understood and accepted by the populations for whom they are intended. Their effectiveness will be blunted if the public does not give them its support or at least willingly comply with them. The law is ineffective without the consent of the majority. And there is no consent, and no co-operation, without education.

The application of educational methods to nature conservation is a long-term policy. But there is no reason to think that an educative campaign of this kind will not one day bear fruit, and examples are available to show that such campaigns succeed when properly managed. In the Netherlands, where nature could well have disappeared altogether under the impact of a dense working population, intensive farming, unrestricted roadbuilding and an expanding industry, the natural heritage is nevertheless being satisfactorily safeguarded. This is largely because P. G. van Tienhoven managed to pass on his enthusiasm for the cause to the *Vereniging tot Behoud van Natuurmonumenten* (association for the conservation of natural sites) which he founded in 1905 and which now has over 220 000 members. Through this association, he taught the entire Dutch nation to take an intelligent interest and pride in nature conservation. Once properly educated in this field, the people of the Netherlands eagerly supported the creation of private or state nature reserves: the country now comprises some 800 nature reserves covering 3.6% of the national territory, an appreciably higher percentage than in the neighbouring countries.

The younger generation as the chief target of environmental education

To have any chance of success, education must be spread widely. Adults are an important target, because it is on them that the immediate response to the new measures depends. But conservation of the natural environment is a notion that must be instilled in children especially, and from a very early age; this is because the aim is to fashion a new way of thinking, and as children are less set in their ways it is with them that the best results can be expected.

The principles of plant life conservation must be taught at all levels of traditional education.

From the moment he starts school, the child should receive object lessons that stimulate his interest in nature: every opportunity must be used to teach him to treat plants and animals with respect. Like their elders, children know what it is to make choices, that is to say to have likes and dislikes: but they discriminate without knowing it. The love of nature must therefore be fostered in children, without their knowledge as it were. This will require a certain skill in the way lessons involving plants and animals are presented. The decoration of classrooms is another way of bringing the child closer to nature. A careful study of sprouting plants may be a means of creating the first link between the natural environment and the adult of tomorrow. A love of nature will become part of the children's educational background, and they will come to treat the natural environment with the same respect as the property of other people or the community.

In secondary education, science classes provide opportunities for introducing remarks on nature conservation. The teacher responsible for character training, too, will show that respect for life is a precept of philosophical systems of the most varied kinds, and that virtually no moral code condones the gratuitous destruction of life.

At university level, even when no course on the conservation of natural resources figures explicitly on the curriculum, the concept can still find a logical place in traditional lectures on subjects such as botanical geography. Some universities, however, have recognised the usefulness of incorporating conservation courses in degree courses in biology, geography and economics, and in the training of agronomists, town planners and even teachers. The universities in Poland were the pioneers in this field, and the notions of nature conservation have been an integral part of the science degree course in Cracow since 1929, and in Poznan since 1933.

In addition, knowledge of and respect for plant life fit particularly well into forms of out-of-school education associated with open air school activities: scouting, tree planting and school forest maintenance, excursions and youth camps. What an opportunity for making young people, with their constant potential for enthusiasm, aware of the beauties of nature in the wild! Increasingly, these activities are being taken over by young people's associations.

Lastly, there must be some form of out-of-school activity designed for the education of the general public. All the information media must endeavour to familiarise the public with the principles and techniques of conservation applied by laboratories and experimental stations. All the means of persuasion (radio and television, films, exhibitions and newspapers) must be used to make the public co-operate in protecting the natural heritage.

Posters, leaflets, postcards and postage stamps depicting aspects of regional plant life may be used to elicit respect for the protected species. Postmarks too may be a useful means of circulating a slogan.

"The love of nature must be fostered in children" (Photo Swiss National Park)

Some ethical rules for botanists

Measures for the protection of plant life are in no way intended to prohibit the study of wild plant communities or the constitution of herbaria. From an educational standpoint, the herbarium is one of the best means of acquainting the beginner or the student with plants of various kinds. For the scientist wishing to study groups of difficult taxonomy or prepare valid phytogeographical documents, it is indispensable to compile collections for reference and assemble samples to authenticate floristic discoveries and descriptions of the plant cover.

However, the rules of reasonable ethics must be voluntarily accepted by naturalists, especially those who are responsible for organising educational excursions: such excursions involving large numbers of participants should be restricted to sites which do not contain rare species; students' herbaria should be limited to the most common species – which are also the most important to study; and the picking of species that have become very rare must be strictly limited or ruled out altogether. The Society for the exchange of vascular plants of Western Europe and the Mediterranean basin has itself stated in its rules that preference must be given to the distribution of critical plants over that of very rare plants, and that the large collections required for the exchange of herbarium material must in no way lead to the disappearance or impoverishment of precarious communities of rare plants.

In conclusion, the fact that certain plant species are becoming scarce means that the general public and all botanists must observe the laws and ethical rules designed to ensure the survival of those species. Adherence to these rules will be all the more effective once the protective measures receive the voluntary consensus of educated men, convinced of the inestimable value of wildlife as the irreplaceable natural heritage of each nation. To win over the citizens to this cause will be a step towards the necessary reconciliation of mankind and nature.

J. J. S.

(Photo J. M. Gehu)

Where there's a will there's a way

Eithor Einarsson

A vital part of our environment, plants are also some of the most beautiful organisms on earth. Their flowers in particular are admired and enjoyed by all. The sight of eroded or burnt terrain is proof enough that without plant-life our environment would lose much of its charm.

Vegetation is an essential natural resource, since green plants are producers in all ecosystems; both in water and on land, they produce the food on which all animals depend directly or indirectly and constitute man's most valuable food source. Moreover, they maintain the oxygen content of the atmosphere, essential to the respiratory systems of man and beast. It is therefore imperative that plant-life be protected, if only in our own interests!

Man and flora:

— We must learn to appreciate the beauty of flowers and plants and the importance of their role.

— Roads and pathways provide a means of traversing nature without harming the vegetation on which damage should not be inflicted needlessly. The more frequented the location (picnic areas, campsites, etc.), the more vital it is that these precautions be observed.

Total disappearance of the natural habitat (Saint-Jean-de-Monts, France) (Photo R. Lanaud – Explorer)

— Flowers, leaves and branches should be picked only if the species is very common locally. Flowers thrive and live longer in their natural environment in which, moreover, everyone is able to enjoy and admire them. We must not forget that flowers form the plant's reproductive organs and without them it cannot produce seeds.

— Whenever possible, we should avoid uprooting whole plants and refrain at all costs from interfering with rare species, many of which have become rare as a result of over-picking. If it is really necessary to obtain living matter (for cultivation for example), then it is better to collect seeds.

— Protected species (those which have been acknowledged to be rare!) must be respected without exception. The most insignificant are as valuable as the most beautiful of them and everyone must bear responsibility for their protection. The discovery of a new site or rare plant should not be publicised indiscriminately, for this might attract too many visitors and thus be detrimental.

— Nature reserves and other protected areas rely on the visitors they admit to respect their natural integrity and benefit from the visit. Observation of regulations is a fundamental rule of behaviour.

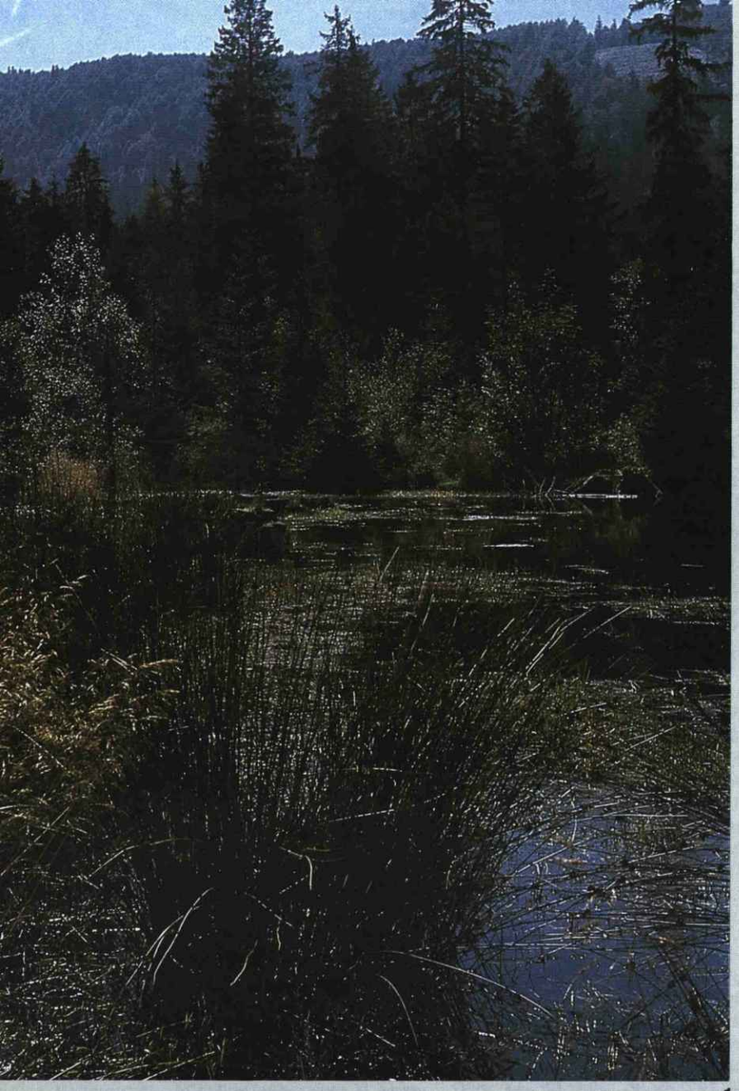
— It is essential to conserve the habitat of wild plants, that is the site and conditions in which they grow. Everything possible must be done, therefore, to see that a given site is not over-frequented, as this might prevent shoots from establishing themselves and prejudice their future growth.

— Some habitats are becoming rare, not because of damage caused by visitors, but because of the methods used to exploit them or the pollution to which they are subjected. Wetlands, which act as genuine buffers because they retain water in the rainy season and release it in time of drought, are disappearing as a result of the drainage of marshes and of land for cultivation. The plants and animals which used to reproduce there very rapidly are becoming rare or extinct, the groundwater level is falling, there is soil erosion. Protection of wetlands has now become an international obligation, since they present many important resources which are of prime importance in maintaining the balance of the biosphere.

— Fire poses another threat to vegetation, particularly inflammable when dry. Though for many years vegetation was deliberately set on fire to clear land for cultivation, such fires today are usually accidental or the result of negligence. Fire must be handled with extreme caution.

— Those who enjoy photographing plants must, like collectors, be patient and take pains to conserve nature so that others may hope to enjoy it after them.

E. E.



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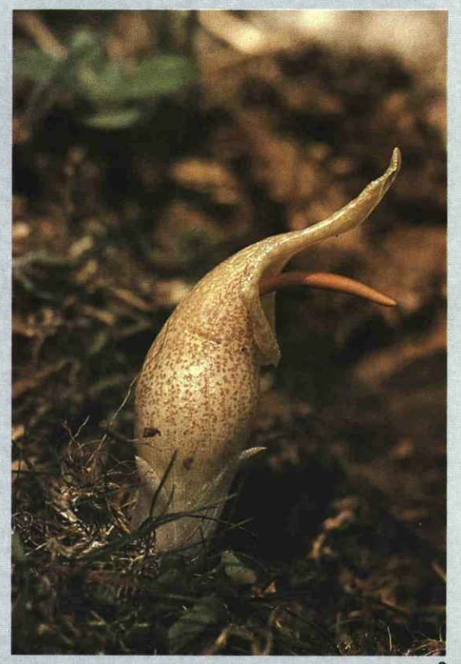

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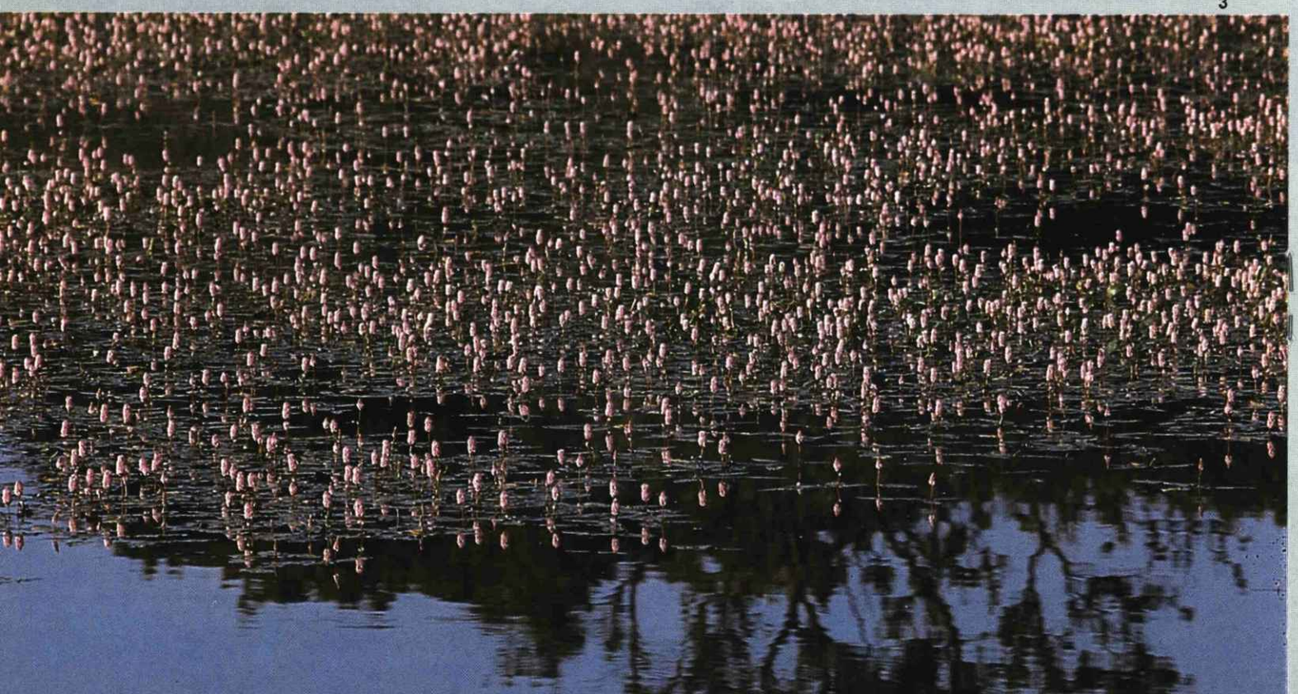

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Resolution (77) 6 on the conservation of rare and threatened plants in Europe

The Committee of Ministers,

Referring to Resolutions No. 2 of the European Ministerial Conferences on the Environment (Vienna 1973, Brussels 1976) on the protection of wildlife;

Having regard to the list of rare, threatened and endemic plants in Europe commissioned by the European Committee for the Conservation of Nature and Natural Resources;

Recalling that man and all animals are dependent for their survival on the plant kingdom;

Recognising that plants (species, subspecies, varieties, etc.) form a genetic resource of immeasurable value to mankind and that the economic potential of the plant kingdom is as yet only partly realised;

Recognising the scientific, educational, recreational, aesthetic, cultural and ethical value of plants to mankind;

Noting that the list includes some 1 400 species as rare and/or threatened in Europe, of which more than 100 are in imminent danger of extinction, and that the figure of 1 400 represents approximately one tenth of the total European flora;

Realising that once a species becomes extinct, it cannot be recreated by man, and hence that it is of the utmost importance to ensure the conservation of as many species as possible for the economic, scientific and cultural benefit of mankind;

Recommends that the governments of member states of the Council of Europe be guided in their policy in this matter by the principles set out below:

1. Ensure adequate legal protection for all plants identified as endangered in the above-mentioned list with provision for licences to be issued for approved collection purposes;

2. Provide minimum legal protection for all plants against depredations not yet covered by law;

3. Institute or complete national surveys of plants that are rare or threatened within their boundaries for appropriate dissemination and publication. Such surveys should:

a. include plants that are rare or threatened only in particular countries and therefore not included in the list;

b. identify the principal threats to plants so listed;

c. specify the action needed to ensure their survival;

4. Establish nature reserves and designate areas in which vegetation and flora are protected by law and stimulate the setting up of nature reserves by private bodies, with the long-term aim of ensuring that all species on the list can be found in such areas and in so doing contribute to the establishment of the European network of biogenetic reserves which was the subject of Resolution (76) 17;

5. Incorporate safeguards in future planning strategies to protect all species on the list, as the major threat to many plants is created by changing patterns of land use;

6. Stimulate, undertake and co-ordinate through competent organisations multidisciplinary research at national or international level, with particular emphasis on bringing together information on plants found in more than one country with a view to:

a. extending and improving knowledge about the flora of those areas in Europe that are still insufficiently known botanically, so as to be able to make constructive proposals for conservation and planning purposes;

b. promoting studies on the habitat, autoecology and population biology of each plant on the list to provide the information needed from which integrated conservation management plans can be formulated;

c. promoting studies on the dynamics and ecology of the vegetation types in which the plants on the list occur;

7. Give appropriate support to scientifically based botanical gardens so that they have the facilities they need to propagate and grow the plants on the list and to distribute propagating material to other institutions and where appropriate reintroduce plants to the wild, with the aim of reducing the pressure on wild plant populations and at the same time drawing attention to the aesthetic, cultural and scientific importance of these plants;

8. Ratify for their states, if they have not already done so, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, opened for signature in Washington on 3 March 1973;

9. Acknowledge that the plant kingdom is a dynamic system and needs to be monitored at stated intervals so that the list can be revised regularly;

10. Prepare and disseminate codes of conduct on rare and threatened plants;

11. Disseminate general information on the need to protect plants and on the protective measures set out in the European committee's list.

Captions to colour illustrations

1. *Lispach Peat-Bog*
   (Photo Ch. Graff)
2. *Biarum Davisii*
   (Photo P. Broussalis)
3. *Potamogeton L.*
   (Photo H. Veiller – Explorer)
4. *Paeonia Mascula*
   (Photo P. Broussalis)
5. *Gentiana Verna*
   (Photo B. Josedupont – Jacana)
6. *Crataegus Monogyana Jacq*
   (Photo C. Nardin – Jacana)
7. *Drosera*
   (Photo Ch. Marchal)
8. *Peziza Auranthia*
   (Photo Ph. Summ – Jacana)

Symbol of the purity of the peaks – Edelweiss (Photo Varin-Visage – Jacana)

Mountain flora

A rupture of nature

Hans Pitschmann

Alpine vegetation and its history

To understand contemporary alpine vegetation it is essential to look at the changes which have taken place in the course of the earth's history. The Alps are young mountains; they only began to rise during the Tertiary, 70 million years ago, and are still rising today. The gradual deterioration of the climate during the range's formative period ultimately led to the glaciation of Scandinavia and the Alps (Ice Ages). Because of this the subtropical flora which still populated the southern fringe of the Alps at the end of the Tertiary (about two million years ago) was totally

destroyed, for example, the bald cypress (*Taxodium*) and giant sequoia (*Sequoiadendron*) survive only in North America, while the tulip tree (*Liriodendron*) and magnolias are native today only in the Far East and North America. A small number of highly resistant species managed to hold out, on the western, southern and eastern fringes of the region of alpine glaciation, within the unfrozen "refuge massifs", and a few species with unusually high resistance to cold even survived on the summits emerging from the glaciers in the very heart of the range.

During the Ice Ages, glaciers alternately advanced and withdrew and there were corresponding long periods of cold and warmth. In the warmer interglacial periods some ice-free areas were re-colonised by species which had survived in regions nearby. With the advance of the Scandinavian glaciers, plants from the boreal regions were also driven towards the Alps and mingled with alpine strains; and since the end of the last Ice Age, only 20 000 years ago, many alien species have immigrated from the summits of the Altai, Siberia and the Mediterranean basin. Arctic species, for example, include the different members of the osier family, mountain avens (*Dryas*) and the saxifrages; Siberian species are the Cembran pine (*Pinus cembra*), Edelweiss (*Leontopodium alpinum*), alpine aster (*Aster alpinus*) and saussurea (*Saussurea alpina*). From the Mediterranean basin came the erica, globularia, violet (*Viola*), rockrose (*Helianthemum*), houseleek (*Sempervivum*), daphne (*Daphne*) and many *Ranunculaceae* and *Cruciferae,* together with species of pinks, *Compositae* and most of the lilies.

A tiered and contrasted vegetation

As one moves higher in the mountains, the climate becomes harsher and there is an increase of radiation, rainfall and, above all, the length of time the snow remains on the ground; the "productive period" of plants is correspondingly reduced. Along with the climate, the vegetation is also radically transformed from one altitude-band to another. The outer slopes of the Alps are damper and cooler, with an even, "oceanic" climate, whereas their inner slopes are warmer and dryer and show more marked differences in temperature ("continental" climate). Here are found the rich valleys of the inner Alps (such as the Drave, Vintschgau, Valais, Aosta, Durance and Maurienne) with large expanses of pine forests. The beech and fir, together with the yew (*Taxus*) and holly (*Ilex aquifolium*) are the typical trees of the approaches to the Alps, while the upper forest zone is composed of beech or spruce in the peripheral Alps, Cembran pine and larch in the central Alps, and *Pinus uncinata* and larch in the south-western Alps.

At the lowest levels of the coastal Alps and in the region of the Lago del Garda, where winters are mild and damp and summers dry, the Alps are still part of the forever verdant Mediterranean zone, with the holm oak (*Quercus ilex*), olive, strawberry tree (*Arbutus unedo*) and Aleppo pine (*Pinus halepensis,* coastal Alps). The Mediterranean zone is followed by the deciduous (sub-Mediterranean) zone, with white oak (*Quercus pubescens*), European hop hornbeam (*Ostrya carpinifolia*), manna ash (*Fraxinus ornus*), hackberry (*Celtis australis*), turpentine tree (*Pistacia terebinthus*), smoke tree (*Cotinus cog-*

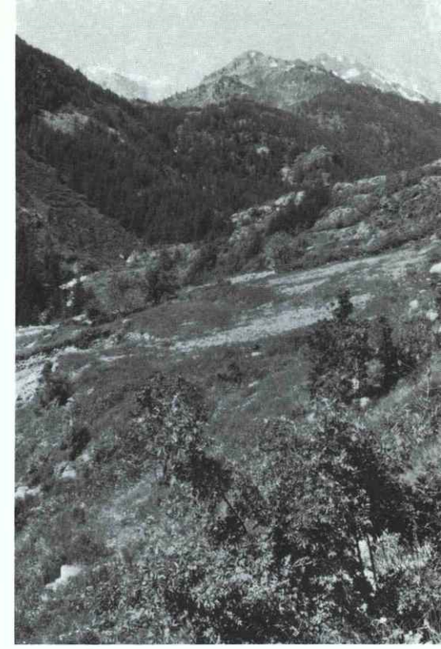
Mountain tourism has become an industry and is completely changing the landscape
(Photo Pitschmann)

gygria), St Lucie's cherry (*Prunus malaheb*) and bladder senna (*Colutea arborescens*). In the hill belt the main growth is mixed deciduous forests, with sessile and English oak (*Quercus petraea* and *robur*), lime tree (*Tilia*), ash (*Fraxinus*) and hornbeam (*Carpinus*). Higher up comes the mountain belt with forests of beech and fir on the outward-facing slopes, and spruce and pine in the central Alps. The sub-alpine zone is characterised by the predominance of the Cembran pine, larch and spruce, and the calcareous mountains mainly by vast forests of Swiss mountain pine (*Pinus mugo*). Above the treeline begins the alpine region itself, in which no trees grow and plant distribution is determined solely by microclimates. Most often the first level is occupied by heathlands covered with dwarfed bushes: on the cooler shaded slopes alpenroses (*Rhododendron ferrugineum*) grow alongside various berry-bearing bushes (*Vaccinium, Empetrum*), while on sunny and hence warm and dry slopes *Arbutus uva-ursi* and dwarf junipers (*Juniperus nana*) are found. Then come the meadows and grasslands, at around 2 400 metres. In depressions where the snow lies for eight to ten months, societies of plants can be found which are remarkable for their extra-zonal character, with the least willow (*Salix herbacea*), mountain sorrel (*Oxyria digyna*), dwarf cudweed (*Gnaphalium supinum*) and *Sibbaldia procumbens,* among others. Above the continuous pastureland, around 2 700–3 000 metres, the surface vegetation becomes increasingly sparse; only in sheltered areas can pulviniform plants (saxifrage species, *Androsace glacialis*) still develop. Mosses and lichens prevail near the summits, next to rare petal-bearing species such as the *Ranunculus glacialis,* which is met at the very highest altitudes in the Alps.

Apart from low temperatures and powerful radiation, the most important ecological factor in high mountains is wind, which spreads the snow over the asperities of the terrain, bares spines and peaks, builds cornices and fills depressions which sometimes do not thaw from one year to the next; and no higher plant can live unless the ground beneath it is snowfree at least two months each year.

Man and his disruptive action

Human colonising activity in the Alps goes far back in history. Forests were cleared to make grazing and cropland, but only as required for subsistence by the peasants. People did not always show great discernment or understanding of Nature, no doubt: the charcoal strata found so extensively in the soil (e.g. in the valleys of the central and southern Alps) show proof of forest clearing by burning in the distant past. Since the earliest times, too, all the valleys in which mining



Irreplaceable natural landscape
(Photo Pujebet – Explorer)

activities were carried on have been destroyed by fire; precious species such as the oak and beech have disappeared and been replaced by the unassuming birch and pine. In dry years (such as 1921, 1933 and 1947) the forest preserves and dwarf pine stands have been the victims of fires caused by negligence. Reafforestation, especially in calcareous and dolomitic terrain, is a very slow process and there are great technical difficulties. Nevertheless, it has produced good results in many parts of the Alps. In recent centuries the growing density of colonisation of the alpine valleys has driven a great many plants and animals out of their hereditary habitats and exterminated many as well. In the last few years, many wetlands (grasslands and marshes) have been dried to increase the amount of arable land, and have thus been deprived of their natural vegetation. Such action is justifiable in some places, but it should not lead as it already has in many places to the extermination of the last meadow thicket and the filling-in of the last marsh. As a result, irreplaceable natural landscapes and their wealth of life have been destroyed forever.

In recent decades the greatest threat to the native alpine landscape has been the effects of tourism and more intensive exploitation of energy. This is why the major alpine states have set up nature reserves and enacted nature protection laws. The Swiss National Park in the upper Engadine and the Italian Gran Paradiso National Park are the foremost illustrations. The Austrian federated states have also created smaller nature reserves. There are still obstacles to overcome before a national park for the whole of Austria can be instituted, although serious efforts have been made for many years. In this connection, mention must be made of the Austrian Alpine Association, which promoted, beginning in 1969, a popular demand for the creation of a Hohe Tauern national park. In 1971 an agreement was concluded between the Tyrol, Salzburg and Kärnten Länder to set up such a park, but thus far nothing has materialised. In 1977 the association transformed its own capital of land, over 320 km² in the centre of the future natural park, into the Hohe Tauern reserve of the Austrian Alpine Association. This should ensure the region's protection against future interference.

The lasting conservation of the alpine flora and fauna and their communities is possible only in reserves possessing a sufficiently large area, protected from disruptive incursions and under permanent supervision. For the largest and most precious protected areas, which are of national and international as well as local interest, measures should be adopted befitting their value, by competent specialists (ecologists), but such measures must not, of course, be detrimental to the vital interests of the native populations. However, there must be a change of attitudes and this will be a long process, leading not to uncontrolled short-term and therefore improvident exploitation through over-building of hotels and funicular railways, but to the protection of the natural space and its use within reasonable limits, for in this way it will last longer and be more fruitful in the end.

The greatest danger to the forests, but also to ground above the treeline, lies in the uncontrolled development of ski-slopes, which have reached alarming proportions in many parts of the Alps. In Austria some 30 000 hectares of ski-slope are now in use and the number of funiculars and ski-lifts has tripled in fifteen years. In the Tyrol alone, 600 hectares of forest have been sacrificed to make runs in the last hundred years. Forest clearing produces significant disruptions in microclimates and the water equilibrium of the soil. Unplanted land, especially in heavy rainfall, cannot retain as much water and there has been a sharp increase in erosion. Because of the intensity of the traffic, ski equipment and the edges of the skis themselves do serious damage on "natural runs", to dwarf bushes and the grass cover, whose regeneration at high altitude is extremely difficult and slow. As a result, every newly built ski-run must be artificially planted to reduce the damage; but this is an extremely difficult undertaking because it is almost impossible to find the right kind of seed on the market.

For many alpine valleys the serious question has already arisen as to whether total clearing will yield the desired results in the long run. The "consumers" of the alpine landscape, mostly city-dwellers racked by noise and exhaust fumes, are seeking increasingly for rest rather than agitation during their holidays, which is all to the honour of the "quality of the landscape". But nowadays the landscape to which these words are applied is no longer really intact. To encourage the nature protection movement with the greatest possible determination will be one of the major duties of the Council of Europe.

H. P.

Light gives life

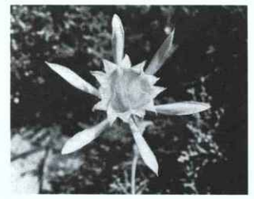
Søren Wium-Andersen and Claus Helweg Ovesen

Lakes and watercourses are perhaps the most important nature types in Europe and provide habitats for much of the European flora and fauna. The vegetation consists of three main parts: vegetation on the banks (such as reeds, alder swamps, willows, etc.), benthic vegetation, and the planktonic vegetation of microscopic algae floating in the open water. The two latter groups make up the underwater vegetation, having the whole thallus or the leaves under – or in some cases on – the surface of the water. Most freshwater fauna use the underwater vegetation as a substratum and many food-chains in freshwater start with the plankton algae. It is eaten by small crustaceans and other zooplankton, which again are eaten by smaller fishes and water insects. These provide food for larger fishes and fish-eating birds, which in turn are eaten by birds of prey of lakes and freshwaters, such as the marsh harrier and the osprey. In the water the bigger plants are the home of most molluscs, insects and freshwater fishes. Reeds and swamps are important as shelter and nesting places for most of the water birds and other wetland species.

Plants in water vegetation

The underwater vegetation consists of two main groups of plants: flowering plants and algae. In Europe, apart from a few free-floating species, we find the first group only on sandy or muddy bottoms,

Drainage and pollution seriously impoverish aquatic flora
(Photo B. Thomas – Explorer)



whereas algae are found in all sorts of freshwater habitats, and are the only group of plants in the phytoplankton.

Among both the higher water plants and the algae there are a number of characteristic life-forms. Most are rooted in the bottom with the leaves in the water, while the flowers are usually above the surface.

To this group belong important genuses such as *Potamogeton* (with a large number of species), *Myriophyllum, Batrachium* (some species with floating leaves) and *Helodea,* all species which are important members of the underwater vegetation in most European lakes.

In lakes with water poor in nutrients – the oligotrophic lakes – the bottom is covered by plants with short stiff leaves in a rosette – the isoetides. The best known is *Lobelia,* with beautiful white flowers above the water surface. Some water plants are free-floating, though sometimes starting as seedlings rooted in the bottom. Important genuses are *Lemna, Hydrocharis, Utricularia* and *Stratiotes; Cerathopyllum* is found up-rooted, but continues growing very well in this state. Finally, a well-known group of higher water plants are those with leaves floating on the surface and the stem rooted in the bottom. Important genuses are *Nymphaea* and Nuphar and the species *Polygonum amphibium* and *Potamogeton natans.* Plants of this type often form a special vegetation belt in lakes, outside the reed swamp. A few underwater species occur only in running water, e.g. *Oenanthe fluviatilis.* Another widely distributed reed plant which is common in running water is *Sparganium,* which is able to grow there but not to produce flowering shoots.

Freshwater algae are either unicellular – those in the phytoplankton nearly all belong to that group – or multicellular, forming either threads or crusts. A very special group are the *Charophyta,* which are ecologically parallel to the higher water plants, being fastened by root-like shoots to the soft bottom. Otherwise, multicellular algae is mainly found attached to stones, wood or higher water plants, and some species form blankets on sandy or muddy bottoms. The algal flora is very sensitive to pollution and changes very much from the clean lakes and watercourse, with crusts of green algae and the few, interesting freshwater red algae, to the dull blue-green algae and diatoms of many European waters.

Disturbances of the ecosystem

Aquatic flora has been threatened for many years. The number of lakes and waterlogged areas has been reduced, and the surface level of lakes and ponds is now nearly constant throughout the year. This has proved necessary because the surrounding areas are used as farmlands, meadows and pasture. As a result, many of the species belonging to occasionally flooded shores are now very rare. The disappearance of these plants can be explained not only by a more or less constant water level, but also because of increasing eutrophication which has changed shore vegetation from a very specialised type with several species able to withstand flooding to a more luxurious single culture of reeds. These have replaced the former shore vegetation around many lakes. So what? most people ask. Is it just that a few species of interest only to specialists have disappeared? No. It is more than that. It is a sign to us all that part of an ecosystem has changed more or less irreversibly.

This happens not only to shore plants but to all the underwater vegetation in our lakes, when the load of nutrients to a lake rises above a certain level. When this happens the phytoplankton takes over and the underwater vegetation is covered with thick mats of small algae. These two factors have destroyed the underwater vegetation. This picture is more or less constant in many European lakes. Fifty to a hundred years ago, the lake bottoms were covered with plants down to a depth of 4-6 metres, occasionally deeper, in a system in which each species was growing at a special depth. When eutrophication increased, the different species tried to avoid being over-shadowed by plankton by growing closer to the surface of the water. But at last the dense mats of blue-green algae would kill the last species and then the most interesting fish, from an angler's point of view, would also disappear. Not because of a few plants disappearing, of course, but because of the change in the ecosystem which was signalled by the changes in the plants.

Underwater vegetation and water quality

It is obvious from the above that the higher plants work as monitors measuring the quality of water in the lake. By using these monitors, it has been possible to see a more or less identical change in all lakes which have been affected by sewage. It has even been possible, in a single lake in Denmark, to show that not only underwater vegetation but also reed-beds along the shore were reduced by eutrophication. The name of the lake is Bastrup and it was studied as early as 1912. At that time, a map was drawn showing the distribution of the reeds, and the maximum depth of water along the edge of the reed-bed was measured. In 1973 the same process was carried out, demonstrating that the area covered with reeds was reduced by 60%. The water depth at the edge of the vegetation was reduced from 1.7 to 1.1 metres. This reduction was correlated with heavy pollution of the lake.

Quantitative changes in vegetation in lakes have been very difficult to record until now. Usually the old map material available is of a very low standard, because it was difficult to measure the size and coverage of the reed-beds. Today vegetation can be recorded fast and efficiently by remote sensing on false colour films. If possible, pictures should be taken in stereopairs[1] on a scale of 1:5 000 or 1:10 000. It would then be very easy in the future to compare the new pictures with the old ones and to record the differences. If possible this method should be used, together with the earlier more qualitative recordings of species. It has already been used extensively in Sweden and Denmark, and we believe that with this type of date recording it will be much easier in future to argue with the decision-makers.

Acidification

Until now we have dealt with only one aspect of the human impact on the ecosystem, eutrophication. However, another serious problem which influences the aquatic flora is acidification. This was recognised ten to fifteen years ago, and lakes on a hard bed-rock are especially threatened. In hundreds of lakes in Norway and Sweden, it has been possible to show a decrease in pH of 1 or 2. The pH in some of the lakes is now down to 3.5-4. As a result, the vegetation dominated by higher plants such as *Lobelia dortmanna* and *Littorella uniflora* has changed to one dominated by water-mosses. Fish, especially trout, disappeared at the same time and the recreation value of the lakes decreased. Also in Denmark, a decrease in pH has been shown in some of the soft water lakes. Annual precipitation on these lakes is only 60 cm. This shows how

1. This method consists in taking two photographs of the same place simultaneously, but from a slightly different angle. The two pictures projected together will result in a single three-dimensional one.

Light gives life

serious the problem with acid rain is today and it must be expected to influence ecosystems other than aquatic ones in the near future.

Man — another danger

The use of the lakes for swimming and water skiing will also harm the vegetation. Big stretches of the reed-beds are cut down when people want easy access to the lake shore and when they want to moor their motor boats. Birds depending on extensive reed-beds disappear. Swimmers also destroy the vegetation in the lakes most attractive for swimming. These have low productivity and very high water quality, without reeds along the shores. The bottoms are covered with isoetids which are not able to withstand traffic, even light traffic. The plants are destroyed and vegetation-free areas result. Either because of these changes in the vegetation or because of pollution connected with the use of the area as a recreation centre, the character of the lake alters, water quality decreases and the phytoplankton takes over.

European co-operation: a means to protect aquatic flora

On the Council of Europe's list of rare and threatened plants, a number of water plants are mentioned. These will presumably be protected later by the signing and ratification of the draft Convention on the Protection of Wildlife. Another important initiative was the European Water Charter, because the best way of protecting underwater vegetation is to protect the water where it grows. Finally the 1976-77 Wetlands Campaign increased public awareness of the importance of protecting all kinds of wetlands. S. W.-A. and C. H. O.

The Council of Europe wetlands campaign has contributed to a better understanding of these problems
(Photo G. Tenton)

When fields and pastures disappear, the forest returns (Photo Dierschke)

Monotony!

Harmut Dierschke

The grassland vegetation of Central Europe witnesses to human activity

Grassland biomes (meadows, pastures and rough grass) are a familiar sight in Central Europe and form an irreplaceable component of the variegated landscape that we have made. They bear witness to the many changes that man has made in the natural plant cover and they often show us, in juxtaposition, successive phases in agricultural land use. Grassland, with its wealth of plants and plant communities, forms one of the most important growing areas for floral and other vegetation.

The transformation and rationalisation of agriculture today are a growing threat to large stretches of grassland, which are thus becoming one of the most urgent problem areas in the conservation of nature and the countryside.

Grassland biomes, with their abundance of grasses and herbs, were an unusual feature in the plant cover of Central Europe in its natural state, which was predominantly wooded. Grassland plants could not develop and survive for any length of time except in places where extreme ecological conditions made woodland impossible. Such conditions were to be found mainly along the sea coasts and in mountain areas, but small isolated patches could also occur anywhere on the wet or dry borders of woodland. However, those biomes had little in common with the grassland vegetation prevailing today, which has gradually developed over the last two or three thousand years under the influence of man. First, large swathes were cleared through the woods by forest pastures, fire and felling, so that species requiring much light were able to spread at the expense of woodland plants. Since the Middle Ages, large areas suitable for grasslands have been created through systematic clearance and drainage.

Most species of plants already occurred in open forests, glades and natural grassland, but the type and extent of anthropozoogenic influences and local conditions determined the development of completely new combinations of species suited to cultivation cycles, which finally led to the grassland biomes that are so widespread today. The types of vegetation which have emerged in less than a thousand years under pressure from mowing and grazing often react with much greater sensitivity to the existing changeable environmental conditions than the woodland which grew previously. Woodland associations, relatively small in number, have been replaced by a multiplicity of grassland biomes which are of great significance for scientific theory and practice in that they provide sensitive indicators of a locality's potential, being often much more unstable than woods and likely to change quickly if the landscape is interfered with.

Although grassland has been constantly exposed to change by man ever since it came into existence, for a long time the wide range of soils, from wet to dry and from rich to poor, and the amplitude of situations from warm to cool, have produced a variety of growing conditions balanced by a correspondingly large number of grassland biomes. The recent progressive elimination of local differences, which in many cases has occurred only in the last twenty to thirty years, has produced an increasing standardisation and impoverishment of our grasslands. Nevertheless, enough places still remain where plant communities which were formerly widespread have survived. Today, however, many of these are threatened, as areas which are unproductive or difficult to work are afforested or neglected.

Intensive floristic and phyto-sociological research in Central Europe, often related to practical problems, has led to a thorough knowledge of grassland vegetation.

Monotony!

Grassland vegetation in its different aspects

Phyto-sociological subdivision and classification make it possible to present the enormous variety in a clear synoptic form. Biomes can be classified according to the principal factors of their habitat and the extent of human influence. The following categories can be distinguished:

Extensively used rough grass and rough pasture

Mostly unfertilised low-yield grassland with many different species, mown once or used for pasturage.

The quality of the soil allows us to differentiate:

● *Plant communities on ground which is dry or intermittently dry with a poor supply of nutritive elements.* They are mainly found in low-lying and hilly areas with little rainfall. There are also small patches in localised dry habitats. A wide variety of species is found in many different combinations, including predominantly pasture land (especially for sheep) and in some places meadows which produce one crop of litter annually. In places with extreme conditions there may also be some natural vegetation, mostly unused.

— Biomes on ground rich in bases (*Festuco-Brometea*): still frequently found in small areas, they are mostly unused today. There are climatic differentiations of biomes into sub-continental (*Festucetalia vallesiacae*) and sub-Atlantic-sub-Mediterranean (*Brometalia erecti*).

— Biomes on ground poor in bases and often sandy (*Festucosedetalia*): today they mostly occur in small, rare patches remaining especially in low-lying sandy areas.

● *Plant communities on ground poor in bases* but with a better water supply. These consist mainly of extensive pastureland for cattle and sheep but in some cases of meadows yielding one annual crop of hay.

Matweed and rough grass (*Nardetalia*): they are often rich in species and sometimes spread over wide areas at higher altitudes with sufficient to plentiful rainfall; found only in small depleted patches in low-lying areas.

● *Plant communities on ground which is wet or intermittently moist,* consisting chiefly of meadows producing one crop of litter annually, but in some cases also natural, and often unused.

— In this category, we can find marshy meadows with common sedge (*Caricetea nigrae*): narrow to wide range of species of short plants with a high proportion of "acid" grasses and some natural unused grass and marshes. Relics of this type of vegetation are mostly found only in small patches at all altitudes from lowland to high mountain on wet ground, sometimes with many springs and often moorland.

— Marshy meadows with tufted sedge (*Magnocaricion*): mostly dense crops of tufted sedge with few other species. Formerly found in all lowlands as meadows producing litter, today they are encountered with any frequency only in eastern Central Europe.

— Litter meadows with purple-moor grass (*Molinion*): meadows with a wide variety of tall, dense species, with a high percentage of late herbaceous plants which are encouraged by mowing towards the end of the growing season. This was formerly a widespread form of meadow in lowlands which were moist or intermittently moist, but today it is rare and found mostly in the foothills of the Alps.

(The natural, little-used alpine grasses, *Caricetea curvulae* and *Seslerietea* will not be discussed here.)

Besides extensively used rough grass and rough pasture, there are meadows for fodder and pastures which are intensively used and cultivated and highly productive, having from average to small number of species. From these come two or more crops of hay or intensive pasture, organic and mineral fertilisers being employed. Widespread in Central Europe (grassland in the narrower sense), they are divided into:

● *Plant communities on ground which is moist or somewhere between intermittently moist and occasionally wet.* They include:

— Moist meadows with marsh-marigold (*Calthion*), which are meadows yielding two crops of hay, with dense, tall vegetation often comprising a large number of herbaceous species, widespread and with marked floristic differentiation.

— Water meadows with marsh-foxtail (*Agropyro-rumicion*): today decreasing rapidly, they consist of grass and meadows with a large proportion of low, creeping plants and are found in hollows which are periodically flooded or on river banks in extensive lowlands.

● *Plant communities on fresh soils with a plentiful water supply throughout the year.* They include:

— Fresh meadows with false oat-grass (*Arrhenatherion*): very dense, tall vegetation in highly productive meadows yielding two or more crops of hay and found in lowland and hill areas. It is the most recent type occurring in Central Europe and now the most widespread. Although with little differentiation of biomes, it is however likely to present slight floristic variations caused by regional climate.

— Fresh meadows with yellow oat-grass (*Polygono-Trisetion*): These are meadows with a wide variety of species growing to different heights and yielding mostly only one crop of hay. They occur in mountain areas.

— Intensive meadows with dog's tail (*Cynosurion*): Widespread mainly in lowlands and hill areas, they consist of a small variety of species, with little differentiation, often uniform and greatly affected by being eaten and trampled.

Extensively used meadows and grass areas in coastal regions, with good growing properties produced by natural silt fertilisation.

— Salt meadows with thrift (*Armerion-maritimae*): dense crops with an average number of species, a large percentage of which are halophilic plants, growing in land in front of dykes where there is periodic salt-water flooding. Formed through mowing and grazing from natural biomes free of woodlands, and today greatly reduced by the building of dykes.

Impoverishment and standardisation of grassland vegetation

As the list shows, grassland communities are varied and differ from place to place, but this heterogeneity is increasingly threatened, especially in recent times. Although in the course of many centuries man has created the prerequisites for a very varied plant cover, unlike the natural landscape, now he is concerned with large-scale farming with the greatest possible efficiency. Many small pockets sheltering plant communities which have been rare from time immemorial are disappearing. The use of areas which cannot be farmed intensively is being abandoned.

For these reasons, many grassland plants today belong to species which are threatened with extinction or drastic decline. Of the 822 ferns and flowering plants included in the *Red Data Book,* 240, or 29% belong to the various grassland communities, mostly extensively used crops in extreme habitats.

Decline and extinction threaten not only individual species, but whole plant biomes, as is forcefully demonstrated, for example, by a study in the sandy Ems valley (Meisel and von Hübschmann 1975) where, within barely twenty years, eleven grassland communities completely disappeared from a 50-hectare area which underwent consolidation. A small section was replaced by pastures containing a meagre variety of species but the major part by arable land. Only forty out of almost a hundred species of grassland plants remained.

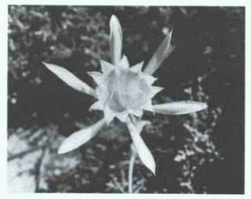
It is possible to list a large number of factors which lead, or have led, to the rapid impoverishment of our cultivated land. In most cases, plants indicating poor or moist soil are giving way to fodder crops with a high nutritive value, and one result of this is a shift from the dominance of herbs to that of grass. Usually several of the following measures produce a combined effect:

● *Transformation of communities containing a wide variety of species into highly productive grassland crops with few species, no radical changes taking place in the habitat.* This result is obtained from:

— the transition from extensive pasture to intensive pasture with crop rotation,

— the substantial use of mineral fertilisers,

In Europe, water meadows and flooded woodlands have almost disappeared
(Photo P. Sigwalt)



Monotony!

— the changeover from pure grazing pastures to a combination of mowing and grazing,

— the conversion from meadows producing one or two crops of hay annually to meadows which are mowed several times,

— the replacement of multi-species by new crops with a small number of rapidly growing high-grade green foods which are often ploughed up and replanted at short intervals, in some cases alternating with arable crops,

— the change from hay-making to silage with early first mowing,

— the use of modern machinery (crops mown close to the ground),

— the amalgamation of small plots to form large usable areas.

● *The replacement of communities containing a large number of species in moist to wet ground by more productive crops with fewer species* after soil improvement plays a great part in the modification of grassland vegetation. This change consists of:

— regulation of watercourses and installation of new drainage systems,

— building of high dykes to prevent flooding,

— new cultivation of moorland areas previously used only extensively.

● *The complete destruction of grassland vegetation.* This comes from the conversion of moist grassland into arable land, after deep ploughing and thorough drainage, or from the conversion of fresh meadows and pastures into arable land, with the addition of other factors such as:

— top-soiling of moist areas,

— afforestation of grassland areas, mostly with spruce, pine, poplar or alder,

— extension or establishment of housing areas, industrial sites, communication routes, rubbish tips, etc.

● *The abandonment of previous grassland farming in marginal areas, small residual pockets or remote mountain areas,* sometimes accompanied by migration of the rural population or their employment in other occupations. This abandonment explains too the disappearance of grassland vegetation.

Over a long period of time, the abandonment of hay meadows and pastureland leads to a reversion to woodland. The manner and speed of change in fallow land depend mainly on local conditions, the structure, the combination of species and previous use. In general, the plant population changes its structure in the first few years, as particularly vigorous species become dominant. The number of species is usually reduced at the expense of the smaller plants.

A distinction may be drawn between the following patterns of development:

1. Fallow land in moist and wet localities changes to give a smaller number of species of tall herbaceous plants and grasses peculiar to meadows, which, after a few years, form stable populations. Dense growth and abundant production of litter prevent the appearance of woody plants.

2. Fallow land changes with the immigration of ruderal plants, often nitrophilous, not found in meadows. In some cases the result is extremely stable, with tall plant formations, combined with a very slow infiltration of woody plants.

3. Fallow land changes, with the immigration and spread of woody plants, to form a grass and bush mosaic in which the grassland gradually decreases.

4. Fallow land changes with the decline of vigorous species when areas which are naturally poor are no longer fertilised. The spread of plants indicating poor soil can lead, at least for a while, to an increase in the number of species.

Farmers as stewards of the landscape

The delicate balance of grassland biomes is easily upset by local changes, with the result that the population is rapidly transformed. In many cases, it is the plants that are most valuable from the floristic point of view which disappear first, being sensitive indicators. Nevertheless, some isolated positive trends are to be observed in fallow land. A further example of this is furnished by observations of semi-dry grassland (Künkele, 1977), which indicate that orchids spread in areas which are no longer used.

The present trends towards an increase in agricultural production cannot of course be halted, but this does not rule out preserving small areas in every cultivated landscape for less intensive use and for service as refuges for rare plants and plant communities and the associated fauna. The multiplicity of species which could be conserved in some such areas would not only improve the regenerative power of a landscape but would increase its human recreational value. In all landscape planning, and land consolidation in particular, care must be taken to provide a sufficient number of such refuge areas of an adequate size. In many cases it is not enough to leave such patches to their own natural development. Steps must be taken to ensure that grasslands continue to be used in their accustomed manner. When the measures are applied, therefore, certain parts of the landscape should be set aside and complete laying fallow avoided.

The conservation of a varied cultivated landscape is in many cases a financial problem. In times of agricultural overproduction and increasing unemployment, it seems appropriate to ask whether some of the large agricultural subsidies and some of the cost of major improvement projects would not be better spent if specific assistance were given to farmers in suitable areas who are prepared to use their land in the traditional way. This means that more funds should be made available for farmers as stewards of the landscape. Such plans must be adapted to phyto-sociological and ecological conditions and can therefore be worked out only with the advice and under the supervision of experts.

In many regions it is indeed rather late, but not too late, to direct the development of our cultivated landscape into reasonable channels. This requires the co-operation of scientists, technicians and politicians, supported by a public with a growing awareness of the environment. There are many signs of a positive trend in that direction.

H. D.

(Photo Ch. Michel – Explorer)

Trends in legislation

Patricia Bugnot

The different methods of protection

The need to use legal instruments to protect flora made itself felt at a very early stage. Thus, at the end of the 19th century, collection of the edelweiss was prohibited in Salzburg, Austria.

Since that time, the damage inflicted on the plant world has steadily increased. Three contemporary phenomena share much responsibility for this state of affairs. The development of mass tourism has opened up an ever-increasing number of previously inaccessible sites and thus contributed to their destruction. The urban explosion and, in addition, the development of rural housing and the boom in second homes have encroached dangerously on areas previously unexposed to such onslaughts. Lastly, the growing requirements of the trade in wild flowers and plants have made it hard for certain species to survive.

Some states realised early on that it was necessary to enact legislation for the protection of threatened species. This is true of the Austrian provinces and indeed of Iceland which, as long ago as 1956, passed a Nature Conservation Act. Other countries followed in the 1960s, but real awareness at both national and international level may be said to have dawned only in the 1970s, when various initiatives were taken with regard to the law.

What are the instruments of this new protection policy? This is the question to which the following paragraphs will attempt to supply some sort of answer.

At national level

We should begin by pointing out that rules for the protection of the flora are enacted at very many different levels.

In many cases the structure of a state accounts for regulations of this kind being made at decentralised level. In Germany and Austria, protection of the flora and vegetation is the responsibility of the *Länder* and provinces respectively. Italy has no national legislation for the protection of wild plant species (nor indeed have many other countries) except for legislation regulating the collection of truffles and plants of medicinal value. Nonetheless, protection is provided locally by the regions, which are relatively autonomous.

Another frequent explanation of the fragmentary nature of the regulations is the great variety of habitat to be found in Italy and elsewhere, so that it would be too complicated and vast a task to attempt to provide detailed protection at national level geared to all local conditions. Regulations are therefore made by the region, the canton or even the municipality.

Occasionally several levels of protection overlap. Such is the case in Switzerland and the Federal Republic of Germany where federal legislation on nature conservation exists alongside the regulations issued by the cantons and *Länder.*

Similarly, a number of different bodies are empowered to enact the legislation according protection. Usually, it is the parliament which is competent, and is indeed the source of numerous nature conservation acts being adopted in an increasing number of countries.

However, provisions on nature conservation are sometimes to be found in other, more general legislation, such as the Irish Local Government (Planning and Development) Act, 1965.

There is, nevertheless, a growing trend towards specific legislative activity on the subject, as is borne out by the increasing number of ministries of the environment and other ministries concerned with the quality of life included in the structure of governments.

Furthermore, a number of mixed bodies, such as the Nature Conservation Councils in Iceland and Great Britain, have fairly extensive statutory powers in this respect, being able to decide what protection is to be accorded to a particular threatened species.

At international level

Attention must be drawn first and foremost to the research carried out in 1973 at the request of the Council of Europe's European Committee for the Conservation of Nature and Natural Resources, by the Threatened Plants Committee of the International Union for the Conservation of Nature. The research involved drawing up a *List of rare, threatened and endemic plants in Europe,* which provides an excellent reference document for botanists and other scientists, but could also be used as a basis for the preparation of legal instruments for conservation. With this in mind, the Committee of Ministers of the Council of Europe adopted Resolution (77) 6 on the conservation of rare and threatened plants in Europe which refers to Resolutions No. 2 of the European Ministerial Conferences on the Environment in Vienna, 1973, and Bruxelles, 1976.

The resolution notes the legal instruments capable of providing Europe's threatened flora and plant life with effective protection and recommends, among others, that governments:

"— ensure adequate legal protection for all plants identified as endangered . . . ;

— provide minimum legal protection for all plants against depredations not yet covered by law . . .;

— establish nature reserves and designate areas in which vegetation and flora are protected by law . . . ;

— incorporate safeguards in future planning strategies to protect all species on the list, as the major threat to many plants is created by changing patterns of land use;

— ratify . . . the Convention on International Trade in Endangered Species of Wild Fauna and Flora, opened for signature in Washington on 3 March 1973."

(In Europe, only Finland, the German Democratic Republic, the Federal Republic of Germany, Norway, Switzerland and the United Kingdom had ratified the convention in 1977.)

Partial or full protection

How far can the member states be said to be implementing these recommendations? In other words, what legal measures are being employed by the states to protect the threatened flora?

The most direct form of protection consists of making specific provision in law for the threatened plant or plants, by establishing a set of rules that are more or less binding, depending on the degree of protection required.

There are two types of protection:

— the most severely threatened species, usually those about to become extinct, will be given "absolute" or "full" protection;

— species which are threatened in the longer term will be given "partial" or "relative" protection.

If a plant belongs to the first category, it may not be removed either in part or in whole. Both the parts below ground (roots and root stock) and the parts above ground (branches, flowers, leaves, stalk, fruit, etc.) are protected. Not only is it forbidden to destroy any of these parts but also to transplant the species, that is remove it from its natural habitat. In this case, the plant is therefore protected from damage to any part of it.

The second type of protection, the so-called "partial" protection, covers only the parts below ground which ensure that the plant will survive and continue to propagate even if the parts above ground are collected.

(Photo Ministry of Agriculture, France)
From indifference. . .

. . .to awareness
(Poster designed by the Regional Technical Services of Isère, France)
(Photos Cadel, Hayon, Maquet, Noailles, Ruffier-Lanche, Sigg – Publisher AREP, 38509 Voiron)

It is nonetheless clear that, though such collection may be permitted, it must be kept within certain limits. Intensive, let alone excessive collection would also have a destructive effect on the species concerned in the longer or medium term.

Restrictions on collection of above-ground parts vary enormously from one country to another; collection may be subject to prior authorisation, or restricted in terms of quantity. For example, collection of a certain number of flowers of a species may be permitted, or of a certain number of "flowering spikes" or of "flower bearing stems" or "as many flower bearing stems as may be held in the hand". Then there is the restriction which refers to a "bunch . . . the total size of which must not exceed 2 cm in diameter", and plants which may be cut provided that at least two leaves are left with the undisturbed basal part of the plant.

It should be noted that the owner of the land on which the protected plants grow is not always subject to these restrictions (in Italy and the United Kingdom, for example); furthermore, exceptions may be made "in the interests of science".

These two types of protection may be accompanied by additional regulations on the marketing of plants which might be prohibited. Such a ban is superfluous in respect of plants which enjoy total protection; unjustified possession of these may, however, be forbidden.

In the case of plants accorded relative protection, however, there could also be a ban on offering them for sale, buying or peddling them, collection being then permitted only for personal use. By way of exception, threatened plants may be used for commercial purposes if they have originated from propagated stock in a nursery or garden (Netherlands) or certified cultivated stock (Italy), in which case a certificate of origin is required.

All these measures, then, are designed to protect threatened species, that is species entered on a special list according to country or regions and sites within states.

The need for overall protection

Protection may often come too late, however, or be too fragmentary. The ideal would be not to have any threatened species, in other words, to put a stop to all phenomena which destroy the flora, whatever their source.

In the first instance, the most extreme, but at the same time simplest solution, in theory at least, would be to protect the whole of the flora, both species that are threatened and wild species which propagate abundantly.

In Great Britain, wild flowers are deemed to belong to the owner of the land on which they grow, so that to remove them comes within the provisions of the Theft Act, is tantamount to theft and hence punishable as such. But the aim here is the protection of private property rather than the protection of the flora in general. In the Federal Republic of Germany, the *Länder* have produced legislation designed to ensure the protection of wild plants, persons infringing it being liable to a fine of not more than DM 1 000. Two of the Italian provinces (Bolzano and Trento) protect all herbaceous and shrubby species which grow naturally.

Protection of the biotope and the establishment of parks and nature reserves

A much more usual form of protection, and one that would seem to be favoured by both public and legislature, involves the establishment of protected sites, reserves and natural parks. Initially, protection of a species was ensured within existing geographical and administrative areas (municipality, province, canton, region, etc.). The reason for this may be protection of one or more threatened species occurring with particular frequency in the location concerned, which may extend over a greater or lesser area. Protection may thus be accorded to one individual tree of special interest or to a whole site (for example, a valley, river banks, etc.) or it may take in a reserve or park.

Increasingly, however, in these two latter cases (park or reserve) the aim is more than just protection of one or more selected species which are deemed to be threatened. These species are in need of something more than haphazard protection, and must be able to develop in a general environment suited to them.

It has accordingly become apparent that the biotope, the natural environment of the plant in question, needs to be protected, thus including the whole of the site. In Finland, legislation on nature conservation distinguishes between "general nature reserves" in which all natural phenomena are protected and to which the public has limited access, as they are there primarily for scientific research, and "special nature reserves" in which protection is accorded to a number of selected species.

The next step was to try to conserve the whole site or region, that is the flora and plant life and also fauna, landscapes and geological formations . . . nor is man himself excluded from this type of protection. Reserves have also been set up which embrace the habitat and local crafts, as in the case of the *Parc Naturel Régional des Vosges du Nord* in France, which combines ninety-three municipalities in a joint association for management of the common heritage.

In Denmark, the 1969 Nature Act extends the scope of "protected areas", since they are intended both to conserve nature and to provide the public with natural and recreational areas, in an attempt to foster harmony between man and his natural environment.

Protection but also prevention

It soon becomes clear, however, that establishing parks and reserves must not be the only measure to protect the flora. In the first place, it is not always easy to set up and manage these parks in practice; and, furthermore, though the establishment of protected areas where man is admitted only as a visitor is in itself desirable, it is also necessary to protect the flora and nature wherever man carries out his daily activities, in areas where the threat of destruction is at its greatest. It is through agriculture, industrialisation and urbanisation that man causes the greatest damage to the flora and these therefore are the areas in which legislation is required.

As yet very few countries have considered it necessary to undertake preliminary studies on the impact of the processes involved in urbanisation.

In Ireland, land-owners and the relevant ministries may conclude an agreement whereby use of the land shall not be detrimental to nature or to the task of protecting it. The planning authorities are consulted before any measure for the protection of a threatened area is enacted.

Danish legislation makes it possible to ban the use of all land which might run counter to existing plans for nature conservation.

It is Swedish and above all French legislation which provide for protection of the environment in the face of any changes in land use.

In France the 10 July 1976 Act states that development work and projects undertaken by a public authority or requiring authorisation or approval and documents relating to town planning must respect the environment; studies made before work is begun on a development or construction project, which, because of its size or effect on the natural environment, may damage the latter, must include an impact study so that an assessment can be made of its likely consequences.

Municipalities also buy up land which is then designated a land reserve not available for development.

The above would appear to be effective methods of protecting the flora generally in those areas where it is most severely threatened. Parks and reserves continue to provide the best means of protecting a threatened species by conserving the biotope and promoting scientific research. It is equally important that protected areas be established to act as "open-air museums", places where man can relax and enjoy his leisure.

However, these different means, such as impact studies, are an attempt to combat the harmful effects of industrialisation and urbanisation, while the parks contribute above all to limiting the amount of damage caused by tourism.

Problems of application

It remains to be seen whether all these methods will prove effective in practice; it is not enough to enact a regulation, however binding, without the means to ensure that it is observed. With the exception of the legislation on town planning and construction which can be enforced by withholding building permits, it is still difficult to apply a law protecting a threatened species or to penalise infringements effectively.

Banning the trade in certain species may occasion controls and penalties, but not all threatened species are perforce commercially exploited. Moreover, it is not easy to punish those who collect or destroy flowers, for even if a system of fines is provided, it is difficult to catch offenders in the act, and in some cases the ban is not coupled with any sanction.

It is therefore vital that people be educated and informed about nature conservation.

Indeed, it is futile to draw up a list of threatened plants, unless the public at large realises that protection exists and is taught to recognise the protected species.

Education in this context should therefore stress two essential points:

— the importance of publicising the legislation governing the protection of the flora and the identity of the threatened species;

— the public spirit which must compensate for the shortcomings of legislation abounding in good intentions but still struggling to assert itself.

P. B.

The traditional role of botanical gardens is to protect species and educate the public
(Photo Geneva Botanical Gardens, Geneva)

Why and wherefore of botanical gardens

Ruggiero Tomaselli

A twofold task: protection and information

Botanical parks and gardens are of immense value, not only for scientific and educational reasons, but also for their role in the conservation and protection of rare, endemic or threatened species.

Particularly valuable are those botanical parks and gardens located in regions where the species in question exist in the wild, and it is desirable for such specimens to be presented to the public with notices explaining their scientific importance and the reasons for according them complete protection. In this way, visitors can be made aware of the problem and taught to respect the plants they find during their rambles in the neighbourhood; in this way gardens and parks will not only provide material for scientific research without impoverishing the natural environment; they will also help to remove one of the dangers to which the protected species are subject, namely the danger of being picked by tourists who are ill-informed and therefore insensitive; they will help to substitute intelligent tourism for casual tourism.

Ecological education will thus be achieved from two angles: knowledge of the reasons for protection, and recognition of "scientific" tourism.

Numerous botanical gardens attached to universities or scientific and cultural institutions belonging to local authorities or private organisations are already designed for the conservation of rare, endemic or threatened species so that they can be used for scientific research, while performing an important educational function. Ideally, however, in addition to the species itself, it should be possible to show its habitat, or at least a sample of its habitat if it covers too wide a geographical area; it is for this reason that habitat portions are artificially reconstituted in botanical gardens situated some distance from the places where the species in question originate.

This technique is undoubtedly helpful in all respects, but it would be even more effective and interesting to develop those gardens which are already, as I have said, close to the natural environments themselves, to create new gardens in carefully chosen places, to provide them with signposted footpaths, explanatory notices, protective systems, etc. so that they can fulfil their educational function properly without any harm whatsoever being done to natural life.

In addition to traditional botanical gardens, therefore, institutions of a new type should be created.

A new formula: garden-reserves

The problem was studied in depth at an informal meeting which took place from 16 to 19 October 1977 at Nevegal, near Belluno, not far from the alpine botanical garden of the Belluno Pre-Alps. This garden is the property of the Department of Italian State Forests and has already been converted into a garden-reserve. The meeting, which was arranged, under the auspices of the Council of Europe, by the Directorate General of Mountain and Forest Economy of the Italian Ministry of Agriculture and Forestry, and the University of Pavia, concentrated particularly on the situation of mountain regions, especially alpine regions, where there are found numerous endemic and threatened species to which initiatives of this kind could well give priority. Clearly, the arguments put forward by the botanists on this occasion are applicable to any other geographical region or natural habitat. After taking note of the activities and recommendations of the Council of Europe (in particular Resolution (76) 17 of the Committee of Ministers on the European network of biogenetic reserves), the European Charters on soil, water and mountain regions, and the Charter on forests prepared by the "Euroforesta" organisation, and all documents relating to flora and fauna published by the European Committee for the Conservation of Nature and Natural Resources, the participants agreed that these special botanical gardens would be called "garden-reserves"; their scope was defined, and guidelines established for their constitution and management. The proceedings of the meeting were recorded as follows in the final report:

"Preamble

The various activities the alpine gardens in existence so far are mainly concerned with:

— compiling local or regional taxa;
— collecting species from various origins, European or extra-European;
— collections relevant to regional biocenoses ;
— specialised collections relating to medicinal plants, or to those of industrial or economic interest.

The organisation and classification of such collections may be systematical, geographical or ecological, or may be used for demonstration purposes.

The proposal is that a special structure should be developed within the European network of biogenetic reserves, namely alpine garden-reserves.

Definition

Apart from traditional alpine gardens, the alpine garden-reserves are special *Horti botanici* for ensuring the cultivation and conservation of plants and components of phytocenoses living in undisturbed ecological conditions in the upper mountains. These conditions are to be considered either in altitude (i.e. mountain ranges such as the Alps or the Pyrenees) or in latitude (e.g. Scandinavia, Iceland).

Objectives

The objectives should conform to Resolution (76) 17 on a European network of biogenetic reserves.

In particular, the objectives should be:

the protection of biocenoses and the conservation of their diversity, thus ensuring ecological equilibrium;

the maintenance of specific entities or threatened biocenotic units;

the harvesting, cultivation and propagation of the other taxa in the region where the garden is situated;

if necessary, the reintroduction of regional species which have disappeared locally.

Other objectives are also to be promoted:

— scientific research,
— development of scientific tourism and meeting requirements,
— the didactic function,
— the pedagogical function.

Guidelines on constitution and management

The planning, administration and management of alpine garden-reserves must be entrusted to scientifically competent institutions or foundations.

The garden-reserves must represent as varied as possible a natural area in the region concerned.

The area should be defined so as to include a sample of typical biocenoses of each region in which the garden-reserves are situated, or correspond to a specific ecological entity. It should include a special enclosure where regional species may be cultivated and propagated.

As far as possible, the garden-reserve should be surrounded by a protecting area in which human activity must be

compatible with the conservation of the species in the garden-reserve.

Special measures and means must be envisaged so as to guarantee the perpetuity of the alpine garden-reserves as is the case of traditional alpine gardens. Furthermore, management must comply with Principle No. 6 of Resolution (76) 17 of the Council of Europe and with the objectives mentioned above."

The garden-reserves could be arranged differently according to their location: for example, those on the edges of national parks and major nature reserves could each include a sector for harvesting the park's species, which would be presented in beds in the traditional manner, coupled with a sector in which the most important species would be wholly in their characteristic environment, that is to say in association with the plants that accompany them in the wild: in other sizeable areas, possibly some distance from the parks or nature reserves, the species of a whole, unified ecological habitat would be assembled, such as a range of mountains, a series of peat bogs, heathlands, etc. Ideally, garden-reserves should be arranged in easily accessible locations and comprise some of the natural associations of the zone which develop in varied habitats (for example, escarpments, pastures, copses); but they would be side-by-side, making it easier to organise planned visits with one-way trails and relevant scientific explanations.

It must not be forgotten that a ban on picking the protected species could be detrimental to ancient local customs, especially with regard to their use as pharmaceuticals, foodstuffs, cosmetics, etc.

The garden-reserve could therefore be combined with an experimental growing and production area for these species, so as to reconcile respect for the natural environment with the necessary utilisation of the plants. Plantations of wormwood, *Arnica montana, Gentiana lutea,* etc. could possibly serve as examples.

R. T.

Where the habitat cannot be protected, the garden-reserve comes into its own (Gladiolus palustris) (Photo P. Sigwalt)

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(Photo J. P. Champroux – Jacana)

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