CONSERVATION OF VEGETATION*

BRENDA FRICK, Department of Biology, University of Regina,
Regina, Saskatchewan, S4S 0A2.

Conservation has been defined in many ways. Two basic dichotomies exist based largely on the questions on "why" and "how". The first lies between what has loosely been termed "resource management", on the one hand and "the ecological approach" on the other. Resource management assumes that certain species, populations or ecosystems are of value to man — hence the term "resource". The emphasis is on conservation for utilization. Man is to be the beneficiary. The ecological approach finds nature valued in and of itself, independent of its value as a human resource, and seeks a position above trade-off for human benefit. Here the emphasis lies on conservation for the benefit of the entity conserved.[16]

The second major dichotomy is centered on whether biotic systems can or ought to be preserved in a static condition, much as a building can be preserved. Where preservation is the goal, systems are managed so that changes within the system (no matter what the causes) are minimized. This is often difficult, as preservation efforts themselves may result in changes. Where change is acknowledged as intrinsic to living systems, the general goal is to ensure that nothing in the existing system is permanently lost as a result of man's activity.[28]

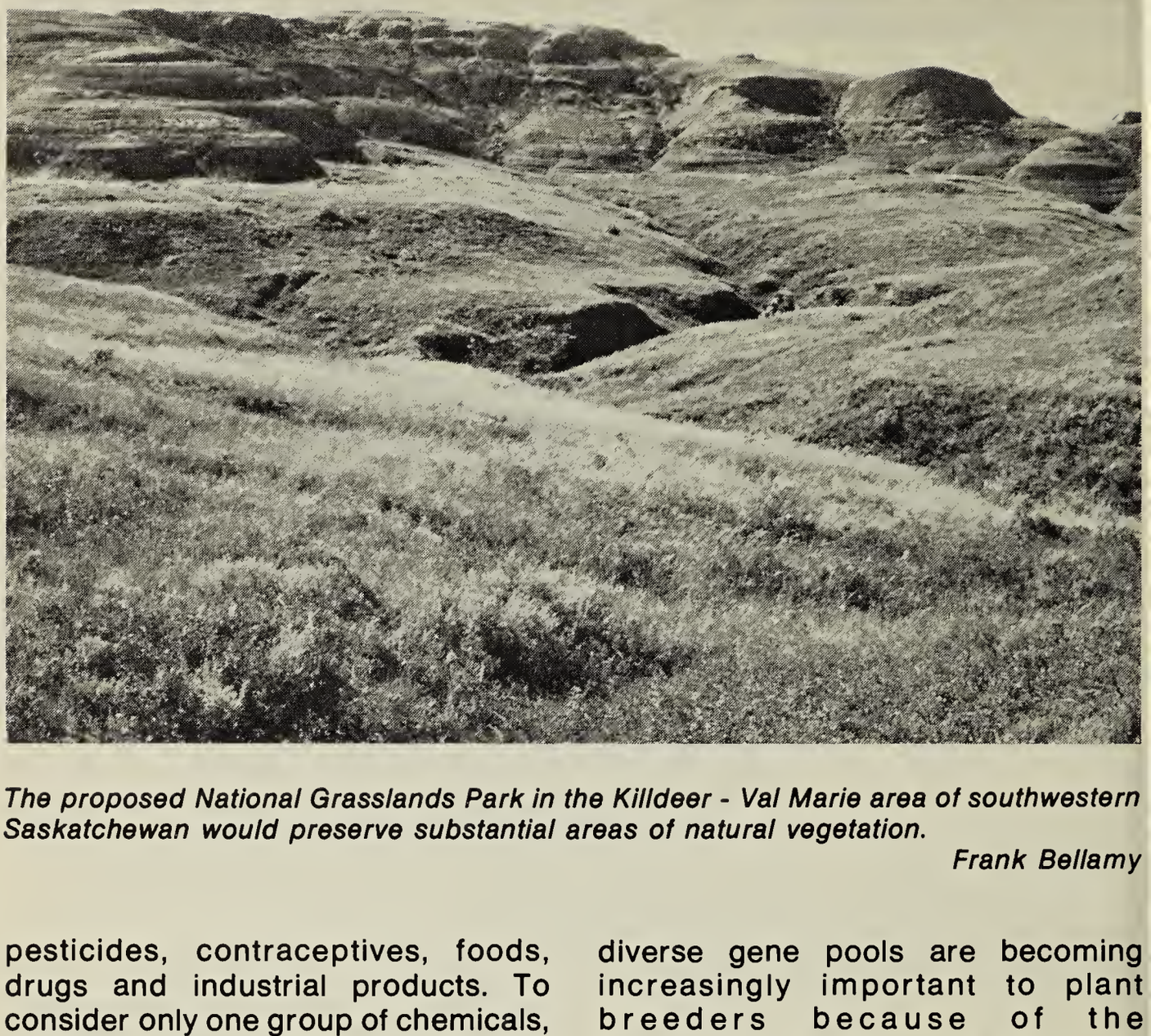
For the purpose of this paper, I will define conservation, ideally, as the maintenance of biota in its naturally dynamic state, for its own intrinsic value. As well as truly natural vegetation, I will include near- and semi-natural vegetation as the objects of conservation. These I will define as self-reproducing aggregations of native plant species. For those interested primarily in animals I will simply stress that for conservation of animals in anything close to a natural state there must first be the conservation of the native vegetation.

Conservation of Species

Conservation of wild plant species is important for a number of reasons. It has been argued, and I believe rightly so, that all species have an innate right to exist, quite apart from their worth to man. Never-the-less, the question is often asked — "What good is conservation to me?" This may be answered practically or at least more egocentricly. Wild plant species have many profound benefits to offer man. The first is the heightened sense of psychological well-being many people find when surrounded by natural vegetation. This is apparent both in the number of people who flock to national, provincial and city parks and in the proliferation of greenery in the urban environment.

Wild plants constitute a reservoir of untapped chemicals which man may find useful in the development of

*An expanded version of this paper was given as a seminar to the University of Regina Biology Department on 30 April 1980. I would like to thank Dr. G. F. Ledingham and Mrs. Jackie Prescott for helping transform the seminar to written form.



The proposed National Grasslands Park in the Killdeer - Val Marie area of southwestern Saskatchewan would preserve substantial areas of natural vegetation.

Frank Bellamy

pesticides, contraceptives, foods, drugs and industrial products. To consider only one group of chemicals, by 1976, over 1,000 alkaloid forms had been extracted from plants. Some of these are likely to prove active against several forms of tumorous cancer, others are used to treat leukemia, and others are used for cardiac problems and for hypertension. Yet only about 2% of plant species have been examined for such chemicals.[22] Over 10% of plants screened by the National Cancer Institute in the United States showed promise of rendering cancer-relieving drugs.[23]

Wild species which are closely related or ancestral to present crop species are especially important to man as they comprise a genetic reservoir, essential to long-term success in plant breeding. Large and diverse gene pools are becoming increasingly important to plant breeders because of the everchanging demands of the future. Genetic manipulation alone is not sufficient to meet these demands as it would be difficult if not impossible to construct desired phenotypes with no model or description.[11]

Wild plant species are also indirectly beneficial to man in that they provide the habitat and the food for many animal species which man deems desirable.

A final and major selling point for the conservation of plant species rests in the lack of knowledge that we have about basically all wild plant species. We just don't know if a plant we drive to extinction today might not have proved invaluable to us tomorrow, had we preserved it. Even with the wonders of our technology, extinction remains final.[10]

Conservation of Ecosystems

Not only is it important to conserve wild plant species; it is important to conserve plant communities, vegetations, and entire ecosystems. In essence, conserving ecosystems is the only satisfactory method of conserving species if genetic variation is to be maintained.[1]

The entire biosphere, including man, is dependent on energy fixation by various vegetation types. Man needs not only energy from his crops, but energy tied up currently in forest products, historically in fossil fuels and so on. Cultivation contributes only about 5% of the net global primary production. Other vegetation types, notably the tropical forest at about 29% and marine flora at 32%, make more substantial contributions to the annual fixation of energy.[34]

Natural vegetation is also important in its stabilizing effects. Vegetation acts as a sink for low concentrations of air pollutants. Vegetation is essential in the cycling of nutrients and other elements, and greatly influences local climate.[26]

The loss of natural vegetation, then, results in a loss of a buffering and stabilizing influence. Thus the remaining biota become less capable of recuperating from man's disruptions.[6]

Obstructions to Conservation

The route of conservation is not always easy; a number of factors act as obstructions. Probably the most noticeable is that of increasing human population. More people require more space, exploit more resources and produce more wastes. When human populations were small, people could walk away from their ecological mistakes by emigrating to virgin territory. The population explosion and the apparent finiteness of the world mean this is no longer possible. Increasing population is possible only with increasing technology. Technological destruction of the environment increases even in excess of population growth. The advances in our technology which have given us many benefits, such as increased food production, have also given us the power and the potential for devastating impact on the entire world, including natural systems.[24 32]

Another obstruction to conservation is ignorance. Ignorance both of the need for conservation and of the scale of destruction occurring. Compounding this problem is the frequent separation of the people who benefit from ecosystem destruction and those people who suffer because of it. A prime example of this is the exploitation of natural resources of third world — particularly tropical — countries by the superpowers. Few people in the exploiting country confront the damage and thus realize the true cost of the tropical export.[22]

A far more complex issue, tied in with ignorance, is the question of attitude. Indifference to the need of conservation was summed up in 1966 by a Californian senator with regard to California's giant redwood forests. "A tree is a tree. If you've seen one, you've seen them all."[16]

Economic attitudes create problems for conservation, particularly in the context of resource management. Here the conflict is often between short- and long-term benefits. Ecosystem protection offers very large potential long-term benefits. These benefits extend over a long time and are spread over a great many beneficiaries. This diffusion, however, makes the benefits less perceptible. The short-term benefits of ecosystem destruction are immediate, and concentrated among

a limited number of beneficiaries. This renders them more appreciable. Thus conservation is not always advocated even though the total benefits resulting from protection are far greater than the benefits from destruction of an ecosystem.[22]

Integral to this discussion is the philosophy of natural vegetation as common property — common not only among all people today but common to us and to all future generations. Because these things belong to everyone, they belong to no one, and no one is responsible for their wise treatment. In this case, misuse, for individual gain is bound to occur, as each individual pays only his proportion of the damage, whereas the benefit of misuse goes solely to the misuser. Degradation of vegetation then occurs, as more individuals realize their advantage at the expense of the general public.[22]

Humanitarian gain as well as selfish gain can be obstructive to conservation. The short-term benefits of vegetation destruction include such things as production of temporarily arable land in a world where many starve. The technology that pollutes and destroys vegetations may raise its masters from subsistence to financial security. However, methods which rely on depletion and destruction give only transitory benefits, which end when the vegetation or land are depleted and destroyed.

A further complication arises in the way man views nature. In many allegedly primitive peoples, certain aspects of nature were seen as sacred, and this resulted in a very effective conservation of at least those areas or species. Even in our culture, nature is acknowledged as an ultimate form of beauty. However, our culture is largely dominated by the philosophy of man's dominion over the earth. Nature must be subdued so that man's mastery may be displayed. As long as nature is viewed as separate from man, and as existing solely for his use or abuse, conservation will be unlikely. This view of nature is deeply entrenched in the powerful societies of the world today.[28]

Man's Influence on Vegetation

Current estimates of the number of plant species facing extinction range from around 20,000.[22] Myers estimates that the world is currently losing one species per day; will lose 24 species a day by the end of the decade; and will lose 137 species per day by the end of the century.[23] While admittedly, species extinctions occur naturally, in the absence of man, man has greatly accelerated this rate. Even during the great dying of the dinosaurs, the average dinosaur extinction rate was about one species per thousand years.[22, 23]

As a species, man had little impact on the world he lived in until relatively recent times. This changed dramatically with the discovery of fire, agriculture, and domestication of animals, in conjunction with increasing population. Man's impact increased again in the 1600's with the Industrial Revolution.[27]

Today, man induced extinctions of plant species result primarily through destruction of habitat — both directly and indirectly. Favorable habitats are eliminated by fire, and by man's domestic plants and animals. Landscape alterations, such as the use of land for urban sprawl, constructing highways, draining marshes, bulldozing hills, strip mining, etc. greatly alter or consume habitats. The addition of chemicals such as air or water pollutants, pesticides and herbicides effect species directly, and thus alter community structure.[27]

Gladmar Park, Saskatoon, Saskatchewan *J. B. Gollop*

Man's increase in travel has also led to the extinction of plant species, by introducing exotics — both plant and animal — to new and unprepared areas. Introduced species are often freed from the predators, parasites and competitors which kept them in check in their native communities. Thus some are able to increase rapidly. This is to the detriment of native species if the introduction is a predator, parasite, disease organism, competitor or if the introduction alters the micro-environment in an unfavorable way.[27]

Removal of species can also lead to plant species extinction. Obvious examples are the harvest of timber from forest, and the picking of wild-flowers by nature enthusiasts and botanists. Also to be included here, however, are the loss of pollinator species and species which control plant pests. The following case of habitat loss is but one example of a widespread phenomenon. In 1831, the study site was a 36 square mile area of deciduous forest in Wisconsin. In 1954, more than 96% of the site had been cleared for agriculture. Less than 1% of the forest was left in a natural state. This was in the form of small, widely scattered patches. Agricultural expansion into prairie vegetation was even more extreme. Often only railroad right of ways remained native.[4]

In 1972, Dasmann considered the proportion of natural areas represented by some form of protection such as national parks and reserves. Biotic provinces are major

biotic units, generally accepted by biogeographers. An example might be the Canadian tundra, or the tallgrass prairies. Fully 1/3 of the world's biotic provinces were unprotected by parks or reserves, and a further 1/3 of the areas are only marginally represented by reserves. The new world tropics in particular were very poorly represented.[5]

It is important, however, to note that those areas in parks and reserves, are again, not entirely protected. A very striking example of this is Yosemite National Park, one of the oldest parks in the United States. Despite being in a national park, the Hetch-Hetchy River was dammed. The valley forest was cleared and flooded.[10]

In addition to such outright abuse, national parks in many cases suffer from dual but non-compatible roles. The Canadian National Parks Policy states that the objective of national parks is "protecting for all time, representative natural areas of Canadian significance." Similar policies exist as Provincial Parks Acts. However, national and provincial parks are often supported on the basis of the benefit they offer the public for recreation. The contradiction of these two goals is shown in the case of Ivy Green Provincial Park in British Columbia. According to the B.C. Park Act, this park was dedicated to preservation of the natural environment. The provincial government, in setting up the park installed campsites, toilets, trailer sani-stations, a paved parking lot, and a service yard and thus directly consumed 3/4 of the habitat in this park (which had statutory protection against impairment). This shows clearly the conflict between conservation for utilization and conservation for ecological reasons. The benefit of the user, not of the environment must have held the higher priority.[35]

Visitors to such parks are generally classed as non-consumptive, and it is assumed that their use of the park does not diminish its value. This may not be true. Park visitors are very effective garbage dispersal agents. Personnel of Algonquin Park in Ontario removed 53 tons of garbage from the interior canoe route in 1972 alone.[35] The garbage results in the concentration of wildlife, such as bears, in such areas and thus disturbs the ecosystem. The garbage and the toilet facilities provided result in nutrient enrichment, thus altering the composition of the vegetational community. Visitors to the park introduce exotic species and remove native species which have pretty flowers or would look nice in the garden. Even trampling can cause vegetation effects. It compacts the soil, which retards the growth and hinders germination. Trampling favors low, prostrate, plant species which regenerate rapidly, and hinders tall slow-growing species. This may encourage excessive population growth of weedy species.[29 35]

Examples of Urgency

I would like now to dwell on two specific areas in which conservation of natural vegetation is particularly urgent. The first is the area of agricultural relatives and ancestors. As previously mentioned, these species are particularly valuable to man as they act as genetic reservoirs for plant breeding.

Unlike wild plant species, cultivated monoculture crops are notoriously lacking in genetic variability. This uniformity makes them highly susceptible to biotic attack. The Irish potato blight of 1840 resulted in the death of 2 million people, and the exodus of many more.[20] This example

highlights the vulnerability of monoculture crops and points to the need for plant breeding which incorporates the resistance of wild species into crop varieties.

The widely acclaimed Green Revolution was based on plant breeding. New "miracle" strains of grain were introduced, that with irrigation and heavy treatments of fertilizer and pesticides gave tremendous yields. Extensive areas were planted to those strains at the expense of countless local varieties. Although there is much controversy, these strains appear to have greatly increased world food production, particularly in third world countries. Unfortunately for the Green Revolution, money for irrigation, fertilizer and pesticides upon which these miracle grains depend, is hard to come by in these countries. Without them the new grains offer much less advantage.[25]

The extreme danger of programs like the Green Revolution, however, lies in the tremendous loss of diversity which results when countless local varieties are supplanted by the wonder strain. Of course, this increases vulnerability, but the irretrievable loss of local varieties may have more long-lasting effects.[20 25 31]

The wild relatives of crop plants are often found in natural populations in regions where the related crop is grown, especially near places of origin. They are also found as weeds within the crop. If outcrossing is possible this results in a natural exchange of genetic information, and in hybrids. Often the hybrids show advantageous traits in this natural breeding program. Thus, again a great potential is available to man in the form of these weeds.[12] Because they are weeds, however, a concentrated effort is made to eliminate them. The Agriculture Canada research station at Regina was established in part, to eliminate wild mustard. Some strains of the weed have now become important in plant breeding programs aimed at developing atricine resistance in rape.[15]

Another area in which conservation is urgent, is the tropical rain forest. Scientists warn that the rain forests are endangered, non-renewable and within years of non-existence.[2 13 17] Tropical vegetations are extremely vulnerable. The tree species have large, usually poorly dispersing seed. This seed is usually non-dormant. Thus, when the vegetation of an area is destroyed, re-establishment of the primary tree species can only occur by slow invasion from adjacent areas. When large areas are cleared the distance from source to sink can be prohibitive.[13] The rain forest has a very high species diversity: 100 - 200 tree species per hectare[8 26]; 40 - 50% of all plant and animal species.[23] This means that individuals of the same species are often widely separated. Thus, when an area is disturbed, few species are within dispersal range.[13] The nature of tropical soils may also create problems. Where vegetation is cut and burned, rains can quickly wash away much of the shallow soil. The aluminum and iron in the soil make it susceptible to excessive hardening when exposed. This results in hardpan which cannot be revegetated in any reasonable length of time.[8]

Much of the loss of the tropical rain forests is at the hands of foreign exploiters. In the tropical Americas cattle production is a major factor. Virgin forest is cleared, burned, and seeded to grass. For a time it can produce cattle, but inevitably the productivity declines rapidly. Then it may be sold to the native farmer who uses it until all fertility is exhausted.[6]

In Central America, in 1976, 2/3 of the natural forest had been cleared for planted pasture and for beef production. In the Amazon Basin, 100,000 km² are cleared per year for cattle production. Costa Rica serves as an example of exploitation. An increase in beef production of 92% was associated with a decrease in local beef consumption of 26%. Most of the extra output was exported to the United States.[22]

Logging is another major factor in S.E. Asia. Three million hectares of forest are cleared for lumber annually.[22] In the Amazon, an American entrepreneur has cleared native forest and planted 250,000 acres with three tree species, grown as monoculture crops.[18] Developing countries encourage such exploitation as it assists trade earnings and brings immediate economic development.

Tragedies of the tropics such as the intentional defoliation of extensive areas of southeast Asia further decrease the likelihood that it can be saved. Yet the very nature of tropical rain forests which render them so vulnerable also render them so valuable. We do not even know the scientific and ecological significance of the tropical rain forests as reservoirs of genetic material. However, as major areas of forest their contribution to biosphere stability must be great and in a finite world where man is an increasingly efficient destabilizer of environment, this may become increasingly important.[6]

Conservation: How?

Even if conservation is given a high priority, sufficient to overcome all mentioned obstacles, a major concern would remain. How can vegetation be conserved? This depends, of course, both on the objectives of conservation and on the vegetation itself. A vegetation which has been truly unaffected by man can obviously best be conserved, as natural, by a continuation of non-disturbance. This vegetational situation, however, must be extremely rare. According to Duffy and Watt, "at present there is no part of the earth's surface, land or water, entirely free from the effects of man's activities. Because of man's pervasive influence, no area can be completely isolated from his direct and indirect influence."[9]

Where alleged natural areas have been maintained by a long history of man's disturbance, conservation efforts must not ignore this effect. In the absence of all human interference, the desirable vegetation may sometimes disappear.[3 7 33]

One of man's most long-term disturbances to vegetation is through the use of fire. Admittedly fires occur naturally, but man has increased their frequency and directed their progress. Much of the world's great grasslands may have resulted from the fire-drive hunting methods of man during the Pleistocene.[27] African tropical savanna and Mediterranean chaparral are probably fire climaxes and thus were created and maintained by man's activity.[7] The grasslands of the arid and semiarid southern United States had been maintained by the burning practices of aboriginal people.[14]

Whether man has been the prime agent or not, many vegetational communities have developed in the presence of occasional or even frequent fire. Inclusion of such areas in various protected states, has in many cases resulted in their protection from the fire that they are adapted to.

In Cypress Hills Provincial Park, fire protection may have severely limited the reproduction of lodgepole pine

A prairie fire *J. B. Gollop*

but not of white spruce. This would result in a change in the character of the park.

In Alberta, fire management plans are being determined for provincial parks. These plans involve the determination of frequency, size and severity of natural and historic fire. The effect of fire on the vegetation, soil, air, water and wildlife are evaluated, as well as the behavior of fire under different conditions. From this data base a fire use policy is established which determines if naturally occurring fires should be allowed to proceed, and if prescribed burning is necessary. Miller found that in some Alberta parks, fire did less damage to vegetation than fire prevention techniques such as fire lines and fire roads.[21]

Another major effect of man on vegetation which is of historic duration is that of grazing domestic animals. Grazing, particularly in conjunction with fire, has been used (intentionally or otherwise) to decimate forests. Sheep and goats are particularly effective in reducing the regenerative abilities of trees and shrubs. Most grazers graze preferentially on more palatable species. This, of course, alters the competitive ability of forage species in a grazed community. Continued assault on desired species results in a decrease of their vegetative vigor and frequency of flowering. This in turn, results in their scarcity or even elimination from the community. By elimination of successively less palatable species, overgrazing greatly alters community structure.

Again, as with fire, sudden cessation of grazing may alter community structure. The effect of grazing is dependent on the relationship of herbivore and

vegetation, and in the nature of the vegetation to be grazed.[30] Where many species graze an area, vast number of herbivores can be maintained without prohibitive grazing pressure. Because the various herbivores have different preferences, no forage species is sought to extinction.[19]

A final form of conservation which I want to just briefly mention is that of reducing the impact of man's disturbance. This area is becoming more important as we try to come to grips with the conflict between development and conservation. Environmental study at the planning stages of disruptive projects is a major step forward in correcting attitudes which limit conservation efforts. Reclamation efforts are also important. It is, of course, best to find ways to avoid damaging the environment. This may not always be possible, but ways should be sought to minimize damage if it must occur.

Summary

Conservation of vegetation is important for the well-being of the biosphere, and for the continuance and quality of human life. Conservation needs are truly urgent. Ideal conservation methods must consider the recent impact of man on the vegetation to be conserved.

Woodwell stated that "human-induced biotic impoverishment, in magnitude and potential effects on the biosphere is equivalent to the other great biotic revolutions of geological time — the evolution of aerobic respiration, the appearance of the angiosperms and the splitting and fusion of molecules."[36] Myers sets a similar tone: "The outburst of extinctions now underway . . . represents the greatest debacle since life emerged on earth some 3.6 billion years ago."[23] These may seem overstated, but they describe an important problem: one which we must come to grips with, soon.

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