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REGENERATION PROBLEMS OF THE TROPICAL RAIN FOREST

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In this presentation I will be talking of the evergreen rain forest of tropical lowlands. It is important to mention this because frequently there is a generalization of the term to ecosystems of very diverse nature.

The tropical zone is covered by a great diversity of ecosystems which have attracted the attention of naturalists for a long time. This area has been the center of many fundamental advances in the biological sciences. The most outstanding biologist of all times, Charles Darwin, obtained fundamental information from these areas. Basic concepts such as evolution, species diversity and speciation have deep roots in the tropics.

It is astonishing to realize that all these contributions were made with the little knowledge available about the biota of these regions, and I often wonder what our world would have been like if development had been based in the tropics? What sort of evolution human society would have had if the knowledge of resources of the tropics were the same level as in the temperature region? Would our food production be the same? Would our land management techniques be different? Would our concept of conservation and wildlife management be the same?

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I would like to discuss one of the most important problems of the tropical rain forest ecosystems, one that may help us to see more clearly the differences and the problems arising from a missapplication of knowledge derived from the temperature regions to the tropical ones. I am refering to the process of regeneration of the rain forest.

Rain forests are without doubt the most diverse ecosystems on earth and the least known ones. This paradox has been worrying many scientists and interested citizens from all over the world. These ecosystems are being threatened today in many regions of the world by the increasing demand for new land posed by the growing population of the earth.

Rain forests grow mainly in very fragile soils and have certain biological properties that increase the risks caused by their destruction.

The greatest problem that ought to be known is their inability to regenerate under heavy and extensive destruction.

It has been taken for granted that once a forest is destroyed it may come back if so wished. This attitude, so provalent in the minds of many people, is based on the experience of very heavily populated countries in the temperate regions of the world. Here, even after intensive explotation and deforestation, forests have been reestablished successfully.

I would like to present some evidence that may help to understand the differences between the regeneration of the tropical rain forests and the temperate ones.

The regeneration process:

When a tree falls in the forests due to wind, old age, etc. a replacement occurs. This ecological process has evolved through a long process of evolution and has resulted in an homeostatic mechanism that mantains the stability of the ecosystems. This ecological process has been known for a long time and is the process of succession. The concept as a whole is ell accepted, eventhough the characteristics and specific variations of the process still are not well known.

The hot-humid tropical regions where the rain forests occur have one of the most complex successional processes, caused by the biological richness and the lack of clear cut limiting factors.

Let's try to gi into more detail on the process in this region. When a tree falls, a light gap appears and series of events occur. Certain seeds that were in the soil germinate, small plants that were on the site grow faster, others die. The seedlings start their growth and growing conditions promote a fast growth that has amazed students of succession in these regions.

The species composition in this light gap, is formed mainly by two groups of species: those that originated from seeds in the soil and those from plants already established in the area. This means that in nature regeneration occurs mainly from pre-established plants.

For this reason we have been studying these regeneration potentials as the key to understand the process.

The first approach was to collect soil samples from the rain forests to know what species are represented by living seeds. We have called this, the "floristic potential of a soil". After several years of studies we have discovered that the species present are mainly secondary species. The primary tree species were not present in the soil.

The question that came to our minds was obvious: What is happening with the seeds of the primary tree species? Several studies were designed and we have found that these seeds germinate immediately or are soon eaten or decomposed.

That finding was extremely important, since it means that the only way for a primary tree species to regenerate is to have seedlings present in the understory of the forests when a light gap occurs.

This is different from a temperate forests, which may have similar potential in seedlings, but a major difference is the amount of viable seeds of primary species stored in the soil, such storage permits the survival of many species for many years even under intensive use.

In a literature survey made by us, we found that the average seed viability for a primary temperate tree is 10 years and for a tropical primary tree 25 days.

Some of our findings in tropical Mexico are being confirmed by studies made in Central America and Asia.

If we analyse the regeneration systems from an evolutionary stand point, we may see that it is a very well adapted process to the prevalent ecological conditions and changes that have occured in the tropics in the past, before man appeared on earth.

A primary tree of a rain forest had to have a large seed, with enough food reserves, for fast growth into a large seedling well above the ground, in order to withstand partial predation with good restoration capacity. This adaptations was favored in evolution and this characteristic is new very wide spread in tropical trees. The fast and immediate germination also was desirable adaptation, as the large seed with large food reserves is a very appealing material for frugivorous animals and all kind of herbivores. Fast germination eliminates that problem, since an active young plant can survive better from partial predation if it also has physiological adaptations for photosynthesis udder filtered light of low intensity.

In addition to his, the seed will be affected by the intense microbiological activity that occurs in the litter of tropical soils, and a seed without any special protection decomposes very rapidly. Again therefore, the immediate germination also helps to prevent this problem.

Secondary species do not have these problems, they are adapted to live normally under intensive light conditions, and also have fast growth that is their better adaptation for an ephemeral light gap. Their problem, then, is opposite to the primary species, they have to remain dormant until an opportunity arrives, and this happens after a light gap occurs. Light is the most important trigger factor for germination. Their problem is to mantain their seeds viable and dormant in the soil. They have accomplished this by having some opposite adaptations such as small, well-protected, dormant seeds. These species are extremely important, as they rapidly restore the environment for the primary species. Several studies on the adaptation and evolution of these secondary species have been made by my research group and the results obtained prove their fundamental role in the natural regeneration process.

Up to now I have been talking only of the natural process without the participation of man.

With the activities of man in agriculture the light gaps became larger although primitive groups have followed unconsciously the natural process of small openings. After a few years of clearing patches of forest for agricultural use, the fertility of soils declines and also pests of different kinds become a problem, The only solution has been the abandon of the land, giving time to the old gap to regenerate. In this primitive, shifting method, natural succession has operated quite well, and examples of a mosaic of land use produced by shifting cultivation can be seen all over the tropical world.

This system was a well establish and ecological sound method for the tropical hot humid areas where the population density was low. Many different adaptations of this systemscan be found in the tropics today.

In recent times the increasing population pressure and the demand for land to produce more food have posed new problems compounded by the scartity of primary forest to ppen. The follow or resting period of shifting cultivation has shortened, producing in some areas infertile and improductive soils.

In areas where there are no more primary forests left, even if we allow time for succession to occur, these forests will never come back to their original stage because there are no more primary trees around to produce seeds, and there are no viable seeds in the soil. The larger the clearing and the more intensive and prolongued the time of use, the less possibility there is of the primary trees coming back. What has happened in these places is the establishment of a new stable impoverish ecosystem composedoof secondary species which were the only ones available for regeneration.

If to this we add the ever increasing tendency for extensive permanent agriculture, the problem for future recovery is even worse.

It is my impressinn that because of these factors we have lost in recent times many hundreds of species of plants in the tropical world, even before we knew they existed. This trend will be faster in the years

to come, because the loss of primary trees goes together with the lost of other life forms of plants that exist in that ecosystem. This is also true for many of the animals that are not preadapted for the new arrested successional habitat.

There is much more to say in this regard, but I would like to leave it there in your minds. If you wish more information you could read some of our publications and also the literature that is appearing recently on the subject.

I want to turn now my discussion to possible solutions. There are no simple solutions as the problem is complex and of tremendous magnitude.

I see two types of solutions: short term and long term ones.

The short term solutions are:

a) To increase the surveys of the biological diversity of tropical rain forests, specially in those areas that are in immediate danger.

b) To increase the number and quality of botanical gardens, biological reserves and national parks in the region occupied by rain forests.

c) Develop land use planning methodology in which ecologically sound considerations could be incorporated in the core program.

d) To do more research in regeneration with the idea of obtaining sound recommendations for determining size and shape of biological reserves.

e) To study carefully the land use systems of "primitive" agriculture systems as they may have some of the answers to our problem in the future.

f) To investigate the use of rain forests as a productive resource in itself. The main reason for destroying the forest is that it is seen as an enemy for agriculture development, and as a resource of little value. It is evident that the best way of conserving these ecosystems is to convince the people with facts, that they can earn their living from them, that man and the rain forests are not incompatible. That they can provide products of use to mankind. I believe this approach to be the only one that effectively could stop the destruction of these magnificent forests. The aesthetic values of them should not be overstressed. Romantic conservationism can do more harm than good.

The only long term solution will be: to solve the poverty, ignorance and hunger problems of the people in the tropical regions of the world. We cannot keep living in peace in a world of contrasts of to much on one side and to little in the other. Selfishness and injustice should give way to

cooperation and justice. My thinking may appear too naive, but I foresee a dark future for the wild plant and animal life on earth if we cannot develop a widespread, well understood and scientifically based land ethic.

Many may try to destroy nature but there are more chances that among the millions of species on earth we will find species preadapted to man's disturbance, man mistakes and human species may not be one of them. It is in our hands now to provid for the future.

México, D. F., May 30, 1975.