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## **The Ecological Dimension - Ten Years Later**

On April 22, 1970, almost at the same moment that CLAG was busy being born in Muncie, Indiana, the nation and the world celebrated something called "Earth Day." Whatever else, it was a well-publicized signal that all might not be well between we humans and our earth environment. Now, ten years later, we look back as a part of this reunion to see how things have gone, to see what we North American geographers with commitments south of the border have learned, and how the man-nature relationship in our area, always fragile, has fared in the intervening period. My paper on the occasion of our first meeting, "Ecological Problems and Approaches in Latin American Geography," reviewed these themes. Emphasis was placed on the lowland humid tropics and more especially on vegetation and vegetation change as sensitive indicators of ecologic disruption or well-being, on agricultural systems and contemporary forest clearance and colonization activities, and on the evidence for past aboriginal population densities and land-use systems. These same categories provide the framework for the "overview and update" that follows.

But first the bad news! In the face of the persistence of development goals that incorporate wasteful and unrealistic Western models of consumption, the population of Latin America has continued to explode. The 250 million of 1970 have become the 360 million of today, an increase of 50 percent in a scant decade. By the end of the century it should hit 700 million! Then Mexico City and São Paulo will be the world's two largest cities.

At the same time the uncomfortable fact remains that much of Latin America is not feeding itself. Food imports, the basic necessities, are major charges against the accounts of most governments and the frantic efforts to meet them through more foreign loans or extractive production for export only heightens the dependency that is more and more protested. One of the major developments of the decade has been the escalation of emigration, especially to the U.S., in response to the continued deterioration of conditions in rural Latin America, especially Mexico. The land as well as the "system" is under pressure. The so-called "Soccer War" between El Salvador and Honduras equally might have been

termed a war for elbow room.

Nor has the turmoil over energy spared Latin America. For the petroleum "have nots" the costs of imported crude oil and its products suddenly threaten both economic and political stability. In this decade bonanza discoveries have lifted Mexico and Ecuador into the big leagues, along with Venezuela, but for the rest energy self-sufficiency seems increasingly an impossible "pipe-dream." The heavy oil of the Orinoco Belt, a little coal here and there, hydroelectric developments to a point, the distant hopes for solar, geothermal, and perhaps "biofuels," and there is nothing else but the dubious last resort of a nuclear power based on imported technology. so the decade has brought Latin America new trouble here, too. Ten years ago the prospect would hardly have occurred to us, so fast does the world change.

### **A Decade of Natural Disasters**

In Latin America natural cataclysmic events have been significant modifiers of the physical landscape (e.g. Horst, 1976; Veblen and Ashton, 1978; Shlemon, 1979). When man is in the way, of course, they become "disasters." Such events have been unusually numerous in the decade just past, with the geographer's attention usually being directed towards their perception and human responses to them (e.g. Kates, 1973; Bowden, 1974; Lemieux, 1977; Nolan, 1979; Rees, 1979; Caviedes, this volume).

Two Central American capitals suffered devastating earthquakes in the decade. Managua was leveled in December, 1972, for the third time in 90 years (8-12,000 dead, 700 city blocks destroyed). Little more than three years later came the 7.5 Richter scale Guatemala quake which took at least 17,000 lives and left some 55,000 injured, the worst natural tragedy to hit Central America since the conquest. Even more deadly had been the May, 1970, temblor that destroyed the coastal port of Chimbote, Peru, triggering massive avalanches and mud slides in the interior that left some 64,000 dead with another quarter million injured, one of the greatest disasters in recorded history. There were at least four other earthquakes with major loss of life: In the Mexican states of Michoacán and Puebla in 1973, in San Juan province, Argentina, in 1977, and at Tumaco on the southwest coast of Colombia this past December. The renewal of activity at Soufriere, which affected much of St. Vincent in 1902-1903, failed to bring with it the destruction predicted although extensive evacuations were carried out.

Caribbean hurricanes tended to concentrate their force northwards towards United States coasts during the decade. But not "Fifi," which devastated the San Pedro Sula area of Honduras in September, 1974, with 5,000 lives lost, mainly through flooding and mud slides. Five years later "David" leveled Santo Domingo, taking 1,500 lives. Damage from these tropical storms was massive, estimated in excess of one billion dollars for each.

There were other major natural catastrophes: "El Nino" with its destructive rains on the desert coast of Peru (Caviedes, 1975), droughts in Chile, Mexico, and the Nordeste of Brazil, frosts damaging to coffee in southern Brazil, recurrent floods in the Magdalena valley and elsewhere following on progressive deforestation, and landslides on the steep slopes of the rainier Andes, some of which wiped out whole villages.

Other environmental disruptions have been more directly the result of human action. Continuing soil erosion, urban air pollution, contamination of water supplies by mining and industrial wastes and sewage, pesticide and herbicide poisonings, a major supertanker spill in the Straits of Magellan, the recent oil well blowout (Ixtoc 1) off the Mexican gulf coast, and the near destruction of the once great Peruvian anchovy fishery, are but examples of how modern technology may "backfire" with major deleterious environmental consequences.

### **Vegetation Alteration**

But all of these pale before the accelerating rate of vegetation alteration, especially the destruction of tropical rainforest and its replacement by degraded secondary scrub or pasture in the past decade (e.g. Sandner, 1971; Daugherty, 1973; Goodland and Irwin, 1975; Farnworth and Golley, 1975; Patino, 1975-76). Denevan's dramatic warning of the "imminent demise of the Amazon rain forest" at the 1971 CLAG meeting (Denevan, 1973) has been followed by much speculation as to the ecologic consequences of this rush of new highway construction and the new land clearing technology it has brought with it. In the recent years the attention of researchers has tended to switch from the *vías de penetración* reaching down from the Andes to the crash program of road building in Brazilian Amazonia that followed the creation of the Superintendencia do Desenvolvimento da Amazonia (SUDAM) in 1966. This push to open the empty selva, pressed with unparalleled speed and intensity, has been widely documented (e.g. Sioli, 1973; Goodland and Irwin, 1975; Smith, 1980; Mahar, 1979). Its brutal ecological consequences seem likely for the most part to be irreversible.

Whether the eight-nation Treaty of Amazonian Cooperation signed in Brasilia in 1978 will hasten or slow the progress of forest clearing is uncertain. There are recent indications that both Brazil and the Andean nations may be becoming increasingly sensitized to the dangers of this uncontrolled destruction of the world's greatest lowland forest. One hope may be a new agroforestry based on plantations of fast-growing trees. In tropical environments this is still in the experimental phase, although in more temperate Brazil and Chile vast, man-made tracts of eucalyptus and *Pinus radiata* have been producing lumber, wood pulp, and charcoal for many years. The conversion of large-scale, biologically diversified forests to monocultural systems, however, opens the way to disease, insect infestations, and soil deterioration, and may extract other ecological and social costs. In the equatorial zone nothing has matched the audacious and much publicized venture of Daniel K. Ludwig, the secretive United States shipowner and industrialist, who has been converting much of a 6,000 square mile tract of rainforest on the remote Rio Jarí, a left bank Amazon tributary, into a vast plantation of fast-growing *Gmelina arborea* from India and Burma, together with *Pinus caribaea* on thinner soils (Halperin, 1980). We should learn much from this "experiment."

Most of the land cleared of tropical forest in the Americas is converted to pasture, either directly or after a short period in subsistence crops. This process of "grassification" which threatens to convert much of the tropical lowland of Latin America into cattle ranching (Sternberg, 1973) has been well documented by geographers (e.g. Dominguez, 1975; Kirby, 1976; Bruchner, 1977) and ecologists (e.g. Hamilton, 1976). Encouraged by the availability of cheap land, easy credit, and favorable tax laws, multinational as well as local interests have moved aggressively into the production of beef cattle, often for export (West, 1976; Nations and Nigh, 1978; Feder, 1979). Everywhere the forest is yielding to the axe and the bulldozer. Within ten years of being cleared and planted to introduced pasture grasses, most properties along the new highways of Amazonia have reverted to worthless secondary scrub. The Panama Canal is threatened by deforestation that is causing a severe shortage of water needed to operate the canal. In Mexico reservoirs are rapidly silting. Some areas, like Haiti, are at an almost irreversible stage of environmental degradation. The President of Costa Rica made deforestation a major issue in his recent inaugural address, stating that his country was "approaching the point of no return in regard to management of its renewable resources." During the decade 1965-1975 the area in pasture

increased by some 64 million acres, almost entirely at the expense of forest in tropical America.

The functioning of tropical forests as systems and especially the rate and the potential consequences of their destruction has recently become a major research concern of numerous private, governmental, and international agencies, as documented in the "Tropical Moist Forest Conservation Bulletin," which began publication in 1978 under the auspices of the Natural Resources Defense Council, Washington, D.C. (see also the recent National Academy of Sciences report, *The Destruction of Tropical Moist Forests*). An unpublished report to the President by a United States Interagency Task Force on the world's tropical forests (November, 1979) decries the lack of internationally qualified professionals available for tropical forestry programs. In this general area there would appear to be growing opportunities for properly trained professional geographers.

### **Refugia, Savannas, and Parks**

There has been a revolution in thinking about the history of the rainforest in the past decade. Evidence increasingly indicates that the Amazonian selva, instead of being an ageless and static entity, is of relatively recent origin and that during the last glaciation it was semi-arid, a quiltwork of savanna landscapes and forest refugia. Its bird fauna, for example, is said to be explicable only if the Amazonian rainforest were divided into several discrete blocks in the Pleistocene. Pollen studies and the distribution of fossil sand dunes, too, have been cited as contradicting the long prevailing view of the stability of climate and vegetation at low latitudes (Vuilleumier, 1971; van der Hammen, 1974; Prance, 1978). Attempts to relate this new view to the culture history of Amazonia is generating considerable controversy (see, e.g., Whitten, 1979; Meggers, 1979). Myers (1979) has dramatically emphasized how the tropical moist forest is tied to the preservation of species diversity. In most of these new interpretations (e.g. Flenley, 1979) there has been an attempt to draw on the theory of island biogeography. Both the diversity and the successful regeneration of the forest has been held to be a function of the size of the forest block preserved. Recent reviews of the history of tropical forests continue to emphasize the meager data base available and the speculative nature of many currently held ideas. The pre-eminent role of soils and soil weathering processes within it is increasingly recognized (Farnworth and Golley, 1974; Golley and Medina, 1975; Herrera, 1978) but quantitative data are largely lacking.

The origin and maintenance of savanna landscapes has continued to generate a growing literature (e.g. Eden, 1974; Sarmiento and Monasterio, 1975; Scott, 1978; Medina, 1980), as has their exploitation (e.g. Brunnschweiler, 1972). So has the role of weedy or invasive species including introduced African pasture grasses (e.g. Frenkel, 1972; Kellman, 1974; Veblen, 1975; Gade, 1976). Threatened and endangered species of plants in the Americas were surveyed in an important volume growing out of a New York Botanical Garden symposium (Prance and Elias, 1977) but no geographer was among the more than 25 contributors. However, in recent work in Chile on human impact on vegetation, some associated with the MAB Mediterranean Ecosystem Program, they have been well represented (Cunill, 1971; Aschmann, 1973; Veblen, 1977; Thrower and Bradbury, 1977; Bahre, 1979). Studies of vegetation disturbance along the United States-Mexican border (Bahre and Bradbury, 1978) and in the Guatemala highlands (Veblen, 1976; 1978) may also be mentioned.

In Latin America as elsewhere increased ecological awareness has been a major impetus to the national park movement (Beltran, 1974; Barker, 1980; Bennett, this volume). In most countries substantial areas have been set aside in recent years, but government's ability to protect them is characteristically limited. Geographer Howard Daugherty and students, working through the Canadian International Development Agency, have been especially active in studying the consequences of human intervention on natural ecosystems in El Salvador and in a program for setting aside reserves in that country. Ecologically minded presidents, most conspicuously in Costa Rica and Venezuela, have been influential in setting aside reserves of lowland and tropical montane forest tracts. An Amazon Forest Policy Commission in Brazil has recommended that some five million square miles of additional forest land be placed in park or ecological reserve status (*New York Times*, December 2, 1979).

The preservation of endangered species of wildlife and the convention limiting trade in endangered species have likewise been in the forefront of ecological concern, especially through the activities of the International Union for the Conservation of Nature (IUCN) and the World Wildlife Fund. In Nicaragua the new government has set aside a Caribbean coastal reserve for marine turtles, an announcement made at the International Conference on Sea Turtles at Washington in November, 1979 where the issue of turtle farming, especially on Grand Cayman, was a topic of lively debate. The establishment of this Miskito Coast reserve was influenced by the work of geographers (Nietschmann, 1977).

## **Agriculture and Population**

As food production has fallen behind population growth in much of Latin America concern for the functioning of peasant agricultural systems has heightened. Critics have argued that the Green Revolution, with its new high yielding varieties, may have widened the gap between rich and poor, increasing dependency on energy inputs and foreign technology and threatening the genetic diversity of crop plants accumulated during thousands of years. The distinctive problems, characteristics, and limitations of tropical agro-ecosystems have been brilliantly delineated in a widely quoted essay by biologist Dan Janzen (1973) which cites extensively from geographers. Like others (e.g. Sternberg, 1973) he criticizes the temperate zone bias of most work being done in the American tropics. Watters' FAO report (1971) on shifting cultivation and Wilken's papers on traditional farming systems and technology in Middle America (10 volumes, 1975-1979) deserve special attention (but see also Wilken, 1972; Nietschmann, 1973; Denevan, 1979; and studies of the incorporation of subsistence societies into commercial systems by Denevan, 1974 and Nietschmann, 1979). Others have looked at pre-Columbian farming, especially new evidences of agricultural intensification as represented by irrigation, terracing, and raised or drained fields (see Patrick, this volume).

Contemporary subsistence farming practices have also been the object of critical attention by a substantial number of geographers as reported in the contribution to this volume by Denevan. A seminal paper by the Colombian anthropologist Reichel-Dolmatoff (1976) describes the highly adaptive behavioral rules and beliefs that control population growth and the exploitation of the natural environment in the Colombian rainforest, a blueprint for ecological adaptation that has been compared to modern systems analysis. Yet another anthropological contribution of special interest to geographers relates to vertical ecological zonation as exploited by native Andean populations (Murra, 1972). Agricultural origins have been of lesser concern (but see especially Harris, 1977), a recent discovery of an unexpectedly early maize in Ecuador having brought into question some widely held earlier views. The research field of ethnobotany, with roots reaching back to Sauer, seems to have been largely usurped by anthropologists and botanists, although some geographers (e.g. Johannessen; Gade) continue to make significant contributions to it (see Denevan this volume). Hunting and fishing societies, however, have received considerable attention (e.g. Daugherty, 1972; Nietschmann, 1972; 1973; Frost, 1974; Smith, 1978; 1979;

Bennett, this volume).

The reconstruction of aboriginal populations and population densities at the time of the conquest, stimulated by the earlier work of Sauer, Cook, Borah, and Simpson, have continued (Turner, 1976; Denevan, 1976). The historian Crosby (1972) has elegantly summarized the impact of the European conquest on aboriginal populations and vice versa. Remaining native populations both in the tropical forest and in the highlands continue to be shamelessly pressured for living space (e.g. Davis and Mathews, 1977; reports of the International Work Group for Indigenous Affairs (IWGIA) in Copenhagen and the Mexican-based Instituto Indigenista) but protectionist legislation and public interest groups dedicated to the interests of Indian people have been increasingly evident and, in a growing number of cases, effective.

## **Conclusion**

The recent profusion of international and interdisciplinary symposia has underscored the new environmental and ecologic awareness. Participation of geographers in these has been modest. Much of the best material on the issues and their policy implications is being provided by journalists and essayists (e.g. Vidart, 1976) and it is worth the effort to keep abreast of it through the local Latin American press. The malfunctioning of ecologic systems and the misuses of resources, too, have begun to attract the attention of "radical" social scientists, who see the redistribution of power and wealth rather than unbridled population growth and inappropriate technologies as at the root of the Third World's problems (e.g. *NACLA Reports*).

Our coterie of ecologically minded geographers has tended to be more proficient at documenting environmental degradation and decrying ecologically unsound development than in showing the way to alternatives (but see Dickinson, 1972; and Sternberg, 1973 and in press). Yet looking back through the sessions of CLAG over the past ten years, perhaps we have progressed. No longer is it necessary to argue that man is ecosystem dependent, or that tropical environments are fragile and finite systems that present special problems. Cultural diversity is being seen more and more not as a part of the problem but as part of the solution (Bennett, 1976). No longer are we quite so stereotypically divided, either "for" or "against" development. For those of us who profess to make the study of this congenial and magnificently diverse culture area our concern, Latin America continues to offer endless unmet challenges and opportunities. The

ecologic dimension of our concern becomes larger and more critical with each passing year.

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