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Macro explanations of the loss of biodiversity have emphasized how higher population levels have forced the transformation of relatively undisturbed areas, and how industrial pollutants and energy intensive agriculture have put new and relatively uniform selective pressures on species. This paper explores how a third macro phenomenon - social organization based on specialization and exchange - has contributed to the demise of biological diversity.

Development and Diversity Before the Global Exchange Economy

People have coexisted with other species for some three million years. While there is evidence that humans have caused species extinction in the past, earlier rates of extinction were far lower than current or projected rates. The world before the rise of the global exchange economy can be viewed as a mosaic of coevolving social and ecological systems. Within each area of the mosaic, human selective pressure operated upon other species according to how well their characteristics fit the evolving values, knowledge, social organization and technologies of the local peoples. At the same time, each of these components of the social system was also evolving under the selective pressure of how well it fit into the evolving ecosystem and the other social components. These mosaics were not entirely self-contained; elements spilled over into other systems where they may have thrived, adapted or died out. But to some extent they all influenced the further coevolution of system characteristics in their new areas, resetting the dynamics of the system. This coevolutionary vision of our past combines the evolution of belief systems with biological systems and suggests how each has contributed to the diversity of the other.

Remnants of coevolutionary agricultural developments remain today, providing clues to the past. In a wide array of traditional agroecosystems we find traditional farmers deliberately intermixing crop, non-crop and sometimes animal species over different places at different times. This is a system that has coevolved in the societies of traditional peoples over centuries or millennia, and was designed to ensure a dependable food supply. This dependability relied upon the ecological stability achieved through high species diversity within each system. On the basis of Western experience, natural historians have portrayed man's influence on natural systems as destructive; however, we are now beginning to learn how traditional peoples contributed to the growth and maintenance of genetic diversity.

Global Exchange Economy

Recent development has been distinctly different from the coevolving mosaic of the past. The mechanistic grid of universal truths developed by Western science and the global adoption of Western technologies has boldly overlaid and destroyed most of the mosaic. The environment has not been immune to this global unifying process. Environments are merging through common land management practices, while biological diversity is declining from the common cropping, fertilization and pest control practices of modern agriculture. Much of this has come about as a consequence of the pressures of global markets.

The global exchange economy evolved over several centuries and began to characterize the global order during the past century. While exchange was going on well before economists began to theorize about it, their models have affected policies and helped rationalize the global exchange economy. Development policies are heavily influenced by institutions like the World Bank, where in 1986 there were 692 designated economists on staff, and one biologist. Thus, how economists conceptualize social systems affects the maintenance of existing features and the design of new components of the global order.

The concepts of comparative advantage, specialization, and the gains from trade are central to the Western economic model. This framing of social order has affected diversity in two ways. First, the encouragement of development through trade has fostered specialization and a reduction in the diversity of crop and supporting species in every region. The implementation of free trade policies has encouraged Third World farmers to respond to international agricultural markets, supported by development efforts in road and port construction. Those who continue to practice subsistence agriculture are simply moved out by larger commercial or centrally planned agricultural ventures. The global exchange economy further transforms local agroecosystems because it forces farmers to produce as much as possible at low cost in order to remain competitive. Thus high yield seed stocks, fertilizers and pesticides are widely adopted, further reducing the remaining regional diversity.

A second cause of species extinction is that the global exchange economy induces temporal variation for which species have not evolved coping mechanisms. In market economies, individuals rapidly respond to exogenous factors (changing prices, tastes, institutions, technology, weather, etc.) that redefine which people, land, or tools have a comparative advantage. This flexibility in factor allocation is viewed as a crucial component of the dynamic efficiency that makes market economies so attractive. Thus if poor rice crops in Brazil induce a sharp rise in the price of rice, other global regions will substitute rice production for their current crop in a rational market response. This increased variability at the individual level actually contributes to the decline of diversity in the ecosystem.

Expanding on this further, we can see that the economic model is designed with the explicit assumption that land can move between uses much like people and tools. Land, however, is more complex than a tractor, and economists have given little thought to the environmental services that help give the land its value. The problem, put simply, is that environmental services cannot freely shift from the support of rice to the support of cotton, and then to the support of suburban lawns, to alfalfa, and back to rice, with the same ease with which a farmer may adapt to these different systems. There would not be a problem if the species that supply

the environmental services appropriate to particular crops could coevolve to fill their supporting niches as rapidly as the global economy leads farmers to shift crops, but this is not the case.

The difference between how economic and ecological models are presumed to respond to change stems from different degrees of mechanical and evolutionary thinking in the two disciplines. The economy is modeled as if it had predefined atomistic parts that will mechanically adjust through market signals or planning to optimize the systemic performance. However, believing that species and their interrelations coevolve in response to the particular conditions of the place and time, ecologists are more hesitant to generalize than economists. These differences help explain why the use of the neoclassical paradigm has contributed to species extinction.

People and the economic decisions they make are an integral part of the ecological system. The diversity of the ecological system is intimately linked to the diversity of the economic system. Local biological and social systems and the culture of agriculture are destroyed when international markets dictate that corn should be planted one year, wheat the next, and soybeans the year following that. Species conservation, as well as the continued coevolution of cultural knowledge, local technologies, and unique forms of social organization, all need more spatial diversity and temporal stability than the global exchange economy permits. Our economic model is well specified but barren, positing only exchange relations. The result is a failure to acknowledge the evolutionary basis of ecological systems, while fostering a policy-making process that is wiping out species at the most rapid rate since the hypothesized meeting with the asteroid that raised the dust that terminated the dinosaurs.