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## Letters to the Editor

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## Virgin Rainforests and Conservation

**IN REVIEWING THE HISTORY OF RAINFOREST** clearance, K. J. Willis *et al.* ("How 'virgin' is virgin rainforest?", *Perspectives*, 16 Apr., p. 402) conclude that rainforests are "quite resilient," and that given time they "will almost certainly regenerate" from modern slash-and-burn clearance. Out of context, such statements may mislead policy-makers and weaken protection.

Although regrown rainforest may appear floristically diverse or restored (1), it may hold only a small proportion of the prehuman ("natural") richness and abundance of most taxa—including vertebrates, invertebrates, lichens, mosses, and microbes. Such taxa are highly dependent on the structure and microclimate of a forest (2, 3). How would we know they were missing? Unfortunately, given the very poor preservation opportunities for many taxa, paleoecological evidence of the natural animal communities of rainforests is even more sparse than that for plants: The rainforests as discovered by scientists were possibly greatly impoverished compared with their prehuman state, yet we could not detect this. The prehistoric loss of the majority of the Pleistocene megafauna in some areas (e.g., giant sloths in the Amazon) means some forests can never be restored. The loss of endemic species from isolated forests is also irreversible. Few witnessing the loss of rainforest in Madagascar, for example, could believe it to be fully reversible.

We should not assume that modern slash-and-burn clearance is comparable in impacts to that of early forest peoples—just as modern coppice management on forest reserves in Britain does not produce the same community as did "traditional" coppicing (3). Rainforests may be hypothesized to have been substantially impoverished by traditional management and clearance, as were British forests. Contemporary

clearance—and hunting—may impoverish them further and may also be hard to monitor. A precautionary approach may be appropriate when advising forest managers.

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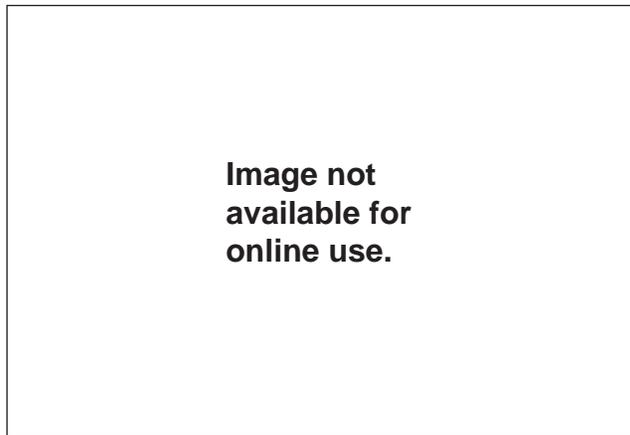


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Rainforest near Tari, Southern Highlands, Papua New Guinea.

**IN THEIR PERSPECTIVE "HOW 'VIRGIN' IS** virgin rainforest?" (16 Apr., p. 402), K. J. Willis *et al.* conclude that tropical humid forest regenerated quickly after the fall of prehistoric tropical societies, and that much of the "virgin" rainforest we see today is human-impacted and largely secondary. We must note that most practicing conservationists do not subscribe to the concept of "virgin" rainforest (1), and we disagree with the authors' suggestion that rapid rainforest regeneration may soon follow the impacts of modern development in the humid tropical forest biome (2).

Most prehistoric societies in the humid tropics were unlike the mechanized and industrialized societies that today dominate virtually every developing country. For example, the modern counterparts exhibit higher population densities, higher resource consumption, widespread common language, and rapid movement of the labor force in response to economic opportunities (3). The authors cite New Georgia in the Solomon Islands as a place where mature and species-rich "modern" forests regenerated quickly after the collapse and

dispersal of large prehistoric population centers. There we find today the major impacts produced by modern industrial activities to be larger and certainly longer-lasting than the rural, traditional disturbance regimes (swidden as well as site-stable agriculture, small-scale alluvial mining, gathering of forest products, small-scale cash-cropping) that we see in modern and ancient forest societies. Today, New Georgia is beset by industrial-scale development that has seen large-scale logging lead to forest clearance for oil palm, bringing about wholesale destruction of watersheds and additional negative impacts in adjacent lagoonal coral reef ecosystems. There is little likelihood that these high-impact development zones will revert to native forest (4).

In Papua New Guinea, also cited by the authors, the rural customary communities inhabiting the Lakekamu Basin continually disturb the native forest through swidden agriculture, collection of a wide range of forest products, and artisanal gold-mining. However, that interior forest basin today exhibits a predominance of "mature" native rainforest, only intermittently broken by small human settlements and gardens (5). As with

typical rural prehistoric societies, the rural subsistence human demographics of the Lakekamu produce a swidden gardening cycle that leads to rapid reforestation and minimal loss of biodiversity. Contrast this with the massive-scale development of oil palm in the fertile volcanic rainforest plains of Popondetta, about 100 km southeast of Lakekamu. There one finds large-scale monoculture that, because of its employment demands, has encouraged immigration and a demographic shift that will, for the foreseeable future, spell intense pressure on any remaining natural forested tracts in this area. As a result, instead of regenerating humid forest, one finds continuing expansion of oil palm (as encouraged by the national government), intensive vegetable cash-cropping, and habitat degradation, which over time leads to a widespread proliferation of unproductive rank grasslands (6, 7).

Overall, we see rural subsistence forest communities as forest stewards. By contrast, the large industrialized extractive industries are leading us inexorably to a world of degraded and low-biodiversity

## LETTERS

post-forest habitats where indigenous peoples have a minimal role and no resources.

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## Response

**FORESTS ARE NOT MUSEUM PIECES BUT LIVING**, dynamic ecosystems that have been affected by various factors—climate change, human influences, animal populations, and natural catastrophes—for millennia. The suggestion made by Hambler that tropical forests are impoverished because of prehistoric impact is not only unfounded, but also seems to imply that evidence for forest regeneration after clearance should be suppressed in case it diminishes the case for preservation. The key point that we were making is that human impact has left a lasting legacy on some areas of tropical rainforests, and the biodiverse landscapes that we value today are not necessarily pristine. In both tropical and temperate forests, there are areas in which previous human activity has enhanced biodiversity (1, 2). For example, we now know that mahogany-rich forests, and the diverse flora and fauna that they support, may have originated following prehistoric catastrophic disturbance (3, 4). Natural regeneration of African and Brazilian mahoganies is inhibited by the presence of more shade-tolerant rainforest tree species. In the face of increasing logging pressures, this discovery allows us to understand the steps necessary for its conservation in areas of evergreen forest—an environment in which it cannot normally regenerate (5).

We also argue that long-term data should be central to reexamining deforestation issues, such as that described by Hambler for Madagascar. Although there is no doubt that rapid deforestation is occurring in some areas, the process of deforestation is complex. The hypothesis that, prior to human arrival, the whole island had once been forested was overturned in the 1980s by extensive palynological work (6–8)—yet many estimates of deforestation rates in Madagascar are based on the erroneous assumption of previous 100% forest cover [e.g., (9)].

In response to Beehler *et al.*, we reiterate that our Perspective referred to the process of slash and burn and did not address the issue of permanent conversion of the forest following industrial-scale logging. Nor did we suggest “rapid” regeneration of forest. Indeed, the paleo-record is important in this respect because in a number of instances, it has been demonstrated that forest regeneration following clearance can take hundreds if not thousands of years.

We agree with Beehler *et al.*'s assertion that probably many conservationists working on the ground are aware that prehistoric human populations have affected currently undisturbed rainforest blocks. What they fail to mention is that this information is rarely acknowledged by the organizations for which they are working. For example, in their Web sites, major conservation organizations such as Conservation International, Wildlife Conservation Society, and the World Wildlife Fund rely on value-laden terms like “fragile,” “delicate,” “sensitive,” and “pristine” to generate interest in rainforest projects. Although these terms certainly apply to many of the macrofauna that face extinction from commercial trade, they may be unjustified in reference to the rainforest vegetation.

The Letters of Hambler and Beehler *et al.* highlight a growing dilemma in conservation: How can long-term data on ecological resilience and variability be reconciled with a strong conservation message in the short term? We suggest that information on the long-term history of tropical rainforests can aid conservation in several ways. First, as the mahogany example highlights, management of contemporary ecosystems can be more effective if it utilizes all the ecological knowledge available. Second, providing realistic estimates of the extent and rates of forest cover change enhances the long-term credibility of the conservation movement. Such realistic estimates of the long time scales involved in the recovery of vegetation should aid those arguing for careful planning in the utilization of forest resources. Third, inevitable disturbance from rainforest exploitation should not be justification for permanent conversion of land for plantations, agriculture, cattle ranching, and mining, because long-term data highlight the potential of this biodiverse ecosystem to recover.

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## Stem Cell Research in Korea

**LAST FEBRUARY, A GROUP OF KOREAN** scientists led by W. S. Hwang and S. Y. Moon surprised the world by deriving a human embryonic stem cell line (SCNT hES-1) from a cloned blastocyst (“Evidence of a pluripotent human embryonic stem cell line derived from a cloned blastocyst,” Reports, 12 Mar., p. 1669; published online 12 Feb., 10.1126/science.1094515). This is the first example of success in what might be considered a first step to human “therapeutic cloning,” and it captured the attention of the world media. In response to the announcement, many have raised questions about the ethical and social environment of Korea with regard to such biotechnological investigations.

In December 2003, the Korean National Assembly passed the “Bioethics and Biosafety Act,” which will go into effect in early 2005. According to the Act, human reproductive cloning and experiments such as fusion of human and animal embryos will be strictly banned [(1), Articles 11 and 12]. However, therapeutic cloning will be permitted in very limited cases for the cure of serious diseases. Such experiments will have to undergo review by the National Bioethics Committee (NBC) [(1), Article 22]. According to the Act, every researcher and research institution attempting such experiments must be registered with the responsible governmental agency [(1), Article 23]. Since the Act is not yet in effect, the research done by Hwang *et al.* was done without any legal control or restriction.

The Korean Bioethics Association (<http://www.koreabioethics.net/>), a leading bioethics group in Korea, consisting of bioethicists, philosophers, jurists, and scientists, announced “The Seoul Declaration on Human Cloning” (2) in 1999, demanding the ban of human reproductive cloning and the study of the socio-ethical implications of cloning research. Many nongovernment organizations and religious groups in Korea agreed with and supported the declaration.

We regret that Hwang and Moon did not wait until a social consensus about reproductive and therapeutic cloning was