Logging Versus the Natural Habitat In the Survival of Tropical Forests

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Most of the world's tropical forests which manage to escape conversion to agricultural land in the future will be subjected to selective logging. The survival of plants and animals inhabiting tropical forests —one half of the world's species—may well depend on whether they can cope with an environment disrupted by logging.

National parks and other protected areas will be critically important for species preservation, but they may be too small and isolated to do the whole job. Much larger areas of commercial forest might provide enough additional space to ensure viable populations of most tropical forest species.

So the questions are: How does logging affect the forest as wildlife (including plant) habitat? And, what logging practices might be employed to reduce the impact on wildlife? Before there is any point in answering these two questions, however, one must ask a third: Can natural commercial forests be retained in the face of pressure from shifting cultivation and the enthusiasm of governments for large agricultural projects, plantation forestry, and other nonforest uses of forest land? The assumption here, although perhaps optimistic, is that the answer is yes, at least in some parts of the tropics.

At the moment, however, the prospect is dim for long-term maintenance of natural commercial forests in the American and African tropics. "The almost universal ambition of forestry departments [in Latin America]," writes Dr John Terborgh, a leading student of ecology and conservation in the tropics, "is to remove the tropical forest and replace it with monocultures of exotic species such as pine and eucalyptus" (1). The relentless push of landless farmers and wholesale clearance for cattle ranching and other big agricultural operations threaten to remove all remaining primary forest in Central America by the end of this century. Points out Terborgh, "Exploitation of the Amazon, although in its early stages, is beginning to give cause for concern. Loggers in search of rare and valuable timbers are already penetrating into the furthest reaches of the Basin."

West African forests suffer extensively from invasion by farmers after logging, and from fire. In the spring of 1983, for instance, the Ivory Coast lost 10 percent of its already severely depleted forests to bush fires (2). The vast, lightly populated forests of the Congo Basin on the other hand are not yet exploited commercially on a large scale.

Even where forests remain in Africa and the neotropics, hunting may decimate their wildlife. "In much of Latin America," says Terborgh, "there simply is no wildlife . . ." Something similar can be said of West African forests, where meat hunters roam almost at will. Therefore the question of tropical wildlife's coexisting with selective logging may, for the near future, be academic in the Americas and Africa.

Tropical Asia, however, offers more reason to look into the matter. Here the forests contain a much higher proportion of commercially valuable trees (primarily members of the family Dipterocarpaceae), giving more incentive to retain forests for long-term production. Forest management and research in the region go back more than 100 years. Although these forests, too, are being cleared at a disturbing pace, most governments of Southeast Asia are committed to keeping large sections as forest reserves. This history and intention of continuity may have encouraged the several existing studies of wildlife in relation to logging. Enough has been done to at least outline the effects of selective logging on the forests and their life, and to suggest practices that might reduce the impact.

Logging in Southeast Asia is more traumatic than it is in the temperate zone. Many of the trees are huge, with broad, interlocking crowns laced with woody vines. When one tree is cut, it usually brings down several others.

Truck roads and tractor trails destroy large areas of forest and lead to heavy erosion and siltation of streams. What remains after taking out 5 to 20 trees per hectare is a patchwork of open gaps, where trees were cut, and small untouched stands with no marketable trees. A typical Malaysian logging operation in lowland forest reduces the canopy coverage from near 100 percent before logging to about 50 percent averaged over the whole concession, and to about 30 percent in hill forest. It is almost axiomatic that damage increases with the scale of logging. The largest operators use the heaviest equipment and, because they have the best knowledge of markets, harvest the most species.

Apart from these more obvious effects, tropical logging compacts the soil; causes loss of soil structure, micro-organisms, and nutrients (through leaching, run-off, and removal of logs); induces more rapid run-off; and changes the internal climate of the forest (3).

The last effect probably has the greatest impact on plant life. In primary rainforest, relative humidity at ground level stays near 100 percent, temperature fluctuates little, and incoming solar radiation is much less than 1 percent of that at the canopy surface. By opening the forest to sunlight, logging lowers the relative humidity and causes ground-level temperatures to fluctuate. If as little as 30 percent of the canopy is removed, according to Dr Benjamin Stone, a botanist at the University of Malaya, much of the ground vegetation dies off because of desiccation and the other environmental changes. With distance above the shrub level—in the subcanopy, canopy, and scattered emergent trees—the microclimatic effect is progressively less. The general result of logging, then, is an open forest.

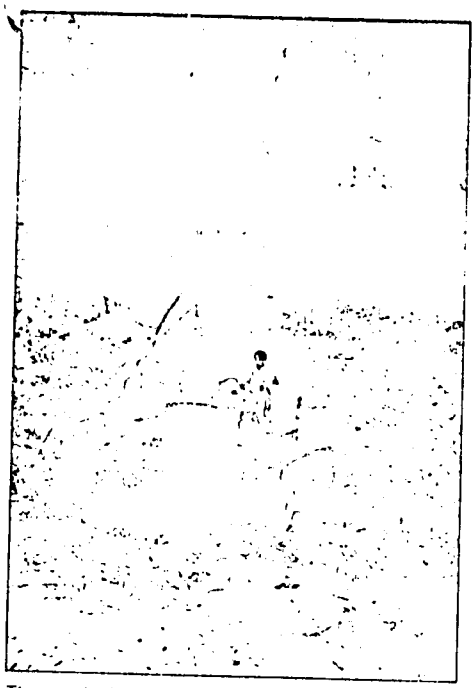
EFFECTS ON WILDLIFE

Animal life responds to this massive alteration in ways ranging from total withdrawal or extirpation to riotous multiplication. But certain generalizations can be made. Species dependent on undergrowth, large fruit trees, or a continuous canopy (for travel, *etc*) suffer the most. "Edge" species, browsers, and those adapted to using scattered, unpredictable food sources such as small fruits may all benefit.

Primates are probably the best studied group with respect to logging. Even within this small assemblage of species, reactions vary widely. Orangutans are extremely sensitive to such disturbance, fleeing before the chain saws like civilians from war. They head for quiet, mature forest, if any is available, where they undoubtedly upset the resident orangutans and may, by such crowding, inhibit reproduction (4). Loss of aerial pathways, cover, and many of the fruit trees, such as large strangler figs, apparently is what most discourages orangutans from returning soon to the logged forest: they occur only at very low densities in logged forests.

Gibbons, leaf monkeys, and macaques are less seriously affected. Gibbons, being fiercely territorial and afraid of meeting other gibbon groups, hang on in whatever remains of their home, while leaf monkeys and macaques, being less territorial, can move farther to seek security. Andrew Johns, a Cambridge University graduate student, closely observed these kinds of primates during and after logging of a concession in Peninsular Malaysia (5). He noted that logging activity caused extreme agitation among the adults and that within a few months after logging many of the infants had disappeared. He concluded that they probably died from falls or abandonment after falls when their mothers had to leap across wide gaps; insufficient food was another possibility.

The immediate response of individual animals to logging is little known, since radio-collar or mark-and-recapture studies have not been conducted, but most species seem to be reduced. Whether this happens through death or migration is, in most instances, unknown. Among the mammals,



The survival of plants and animals in the world's tropical forests depends on how they can adapt to an environment disrupted by logging.

a few large species—Sumatran rhinoceros (*Dicerorhinus sumatrensis*), honey bear (*Helarctos malayanus*), wild dog (*Cuon alpinus*), and the previously mentioned orangutan (*Pongo pygmaeus*)—appear to flee at the first signs of logging activity.

Birds that are hardest hit include insectivores of the understory and hornbills. The understory birds, such as babblers, pittas, trogons, and small forest kingfishers, probably are more affected by loss of cover and microclimatic changes than by reduction in insect food, which is probably relatively minor (6). Hornbills suffer from loss of large fruit and cavity-bearing trees needed for nesting.

The secretiveness of reptiles and amphibians makes it difficult to assess their abundance, especially in tropical forest where many live in trees. Dr Kiew Bong Heang, a zoologist at the University of Malaya, considers a 50 percent loss of canopy to be very hard on ground-level amphibians, which can't tolerate desiccation. Most snakes, lizards, and tortoises, he says, are better adapted to dry environments and therefore can survive in logged forest if enough food and ground cover remain. Fishes and aquatic invertebrates are decimated through the impact of siltation on their environment.

After the shock of logging, a major change in the species mix occurs, and then comes a gradual return toward the plant-animal complement of the original primary forest. Scientists disagree, however, about the rate and degree to which logged forest biota can approach those of virgin forests.

There is no argument with the fact that life thrives in recently logged forest. Within the first few years, grasses, palms, wild gingers, and tree seedlings flourish. Secondary tree species, many bearing small fruits, spring up in openings everywhere. Vines swarm up small trees.

Some animals benefit, or at least do not totally move away from logged forest. They are principally the browsers, the "edge" species, and the predators of those animals. An Asian elephant, for instance, needs only about two-thirds as much area of logged forest as of primary forest in Malaysia, because logging leads to an increase of grasses and palms which are major elephant foods (7). Deer, which are browsers, and the grass-eating gaur (*Bos gaurus*) also do well.

In Latin America and Africa, some primates join the list of animals that seem to increase after logging. Dr Curtis Freese of the US Fish and Wildlife Service writes that in the neotropics, "... some of the smaller species, such as the pigmy marmoset (*Cebuella pygmaea*) and many of the tamarins (*Saguinus* spp.) and marmosets (*Callithrix* spp.) may do as well or better in secondary forest or heavily disturbed primary forest than in primary forest" (8). The black-and-white colobus monkey (*Colobus guereza*) in Uganda may respond the same way to logging (9).

In terms of animal biomass, that of recently logged forest may be similar to levels in primary forest, and important game species may increase. This prompts foresters in Southeast Asia, as well as in temperate countries, to talk with pride about what they have done for wildife by harvesting trees.

But species diversity, and abundance of many species, may take a long time to return to near-original levels. Studies of primate populations in primary and logged forest of various ages suggest that the full impact of logging on primate numbers may not be felt for several years. Studies in Kalimantan, Indonesia, indicated considerably lower numbers of primates in 3 to 5 year-old logged forest than in one-year-old logged forest (10, 11). Clive Marsh and Wendell Wilson, after a survey in Peninsular Malaysia, hypothesized that (nonmigratory) gibbons reach their lowest numbers about 5 years after logging, because of reduced recruitment to the adult class, and then very slowly increase (12). They reasoned that leaf monkeys, being less territorial, move more freely and therefore show an early decrease followed within two or three years by the beginning of a fairly rapid recovery which is boosted by the return of some groups.

Marsh and Wilson suggested that gibbon populations could recover to near primary forest levels in 20 to 30 years, and leaf monkeys within 10 to 15 years. Glyn Davies and John Payne, however, found that numbers of both gibbons and leaf monkeys in Sabah were substantially lower in 20-year-old logged forest than in primary forest (but hunting may have contributed to this result) (13).

The best data on bird populations with respect to logging come from the Pasoh Forest Reserve, an important ecological research site in Peninsular Malaysia where Dr David Wells and others have carried out long-term studies. Here, birds were mist-netted on two 16-hectare plots, one in virgin forest and one in 25-year-old logged forest (14). Of 83 species netted in the virgin forest, all but three were also netted or observed in the 25-year-old logged forest. This suggests that birds can recolonize logged forest in a relatively short time.

In Sarawak, all hornbill species previously present in primary forest were found to have reappeared in 15-year-old logged forest (15). *Densities* of the larger hornbills, which are more dependant on big trees for fruits and nesting sites than are the smaller species, may take a much longer time to recover.

Though there is disagreement as to the rate at which populations of primary forest plants and animals return toward their original levels, there seems to be a majority agreement that the biota eventually —perhaps in 25 to 50 years—approximates that of the undisturbed forest, assuming moderate logging intensity on slopes less than 25° or so, and proximity of fairly mature forest which can act as a refuge during logging and as a source of recolonization once the loggers move on.

The latter point raises crucial questions: how to maintain areas of older forest within a logging concession, and what would be their most useful spatial arrangement. The matter looks considerably different to biologists and timbermen.

ANOTHER WAY TO "CUT THE CAKE"

One biologically attractive pattern would be to cut in a checkerboard pattern. In a forest reserve managed on a 50-year rotation, which is fairly typical in Malaysia today, a block amounting to one-fiftieth of the reserve would be logged each year. If alternate blocks were left unlogged until the second 25 years, there would always be at least 25 blocks of 25 to 49 year-old logged forest distributed evenly throughout the reserve. These blocks would be adjacent to more recently logged blocks, which would thus have a nearby refuge and source of seeds and animal colonizers.

Timber contractors would object to working in this way, however, because it would require continuous, expensive maintenance of the central road. The standard practice in Malaysia is to build a road into the most remote part of the concession, then to abandon the farther sections of it as logging progresses back toward the entrance point.

Under present practices, animals may have no escape route to mature forest, and mature forest may be some distance from the logged blocks that need recolonization. A practical solution to this problem of access and circulation is to maintain unlogged buffer strips along watercourses. If this practice were extended even to fairly small hill streams, then many parts of a concession would be linked by corridors of mature forest. Such corridors should include a strip of high forest (usually containing dipterocarps in Malaysia) as well as the shorter riverine vegetation immediately adjacent to lowland streams, which generally is not logged anyway. These corridors would have the major justification of protecting streams, water supplies, and downstream engineering works an argument that carries more weight these days than does wildlife conservation.

The corridor concept, as emphasized in conservation strategies now being developed for the individual Malaysian states by the World Wildlife Fund/Malaysia, should also be applied to watercourses through agricultural regions. This would

Loading a felled tree trunk in the Usambara Mountains of northeast Tanzania. Photo: Lars Kerdell

extend protection of water quality and provide natural avenues between forest reserves.

Another measure that would help wildlife coexist with logging is simply to leave certain patches within a forest reserve uncut. In Malaysia, many reserves contain a small Virgin Jungle Reserve, which is intended for research, preservation of genetic resources, and, in some cases, recreation. Unfortunately, protection is poor and many of these have been logged, but the idea is still a good one. According to David Wells, a zoologist at the University of Malaya, unlogged patches within a forest reserve should be at least 400 hectares to have significant value for wildlife conservation.

Preservation of cavity-bearing trees, a practice that is gaining favor in United States forestry, would assist a host of species from tree frogs and flying squirrels to hornbills. Present regulations in Malaysia prohibit cutting of such trees (as well as fruit trees valuable to humans and, in some places, species favored by honey bees for building hives). Loggers generally do not take hollow trees anyway, because they yield little lumber, but many are destroyed by falling timber. Greater care in direction of felling could reduce this loss.

Where certain plant species play a crucial role in support of animal life, preservation or encouragement of these species could have unusual benefit. In a section of Manu National Park, Peru, Terborgh discovered that less than 1 percent of the identified plant species "sustains a major part of the animal biomass through the worst period of the dry season" (16). He suggests that there may be such key species in the Amazon "wherever there is a pronounced seasonal amplitude in resource production," and that management of these species could pay exceptional dividends.

If sufficient public and governmental will existed, many such steps could be taken to improve the value of tropical logged forest for maintaining genetic diversity. Although it appears that most vertebrate and woody rainforest species in Southeast Asia could live with logging, much more research is needed to determine biological effects of various practices. The welfare of invertebrates and nonwoody plants is a more obscure matter. Clear cutting and commercial use of all tree species, which is slowly coming to tropical forestry, will introduce a new but probably not totally negative set of parameters to the wildlife-logging equation.

Studies will be meaningless, however, unless Southeast Asian forests and their wildlife eventually are freed from the pressures of land-hungry, meat-hungry rural people. Because of economic and population trends, it is possible to achieve this within the next century, and while a significant area of forest still remains. The survival of tropical forests in other regions, however, appears to be less secure.

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