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SHORT COMMUNICATION

What is secondary forest?

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The recognition that tropical secondary forests are the tropical forests of the future has led to a rapid expansion in the literature. Unfortunately it has also resulted in an expansion in the meaning of the term 'secondary forest' which risks rendering it virtually useless. This is a relatively minor inconvenience for ecologists and foresters, who have the time, knowledge and experience to find out what is actually meant in a particular case. Imprecise terminology can, however, be a major stumbling block in communicating with decision makers at all levels and with the general public, tropical and extra-tropical.

What is secondary forest? A recent review defined man-made secondary forests as 'those formed as a consequence of human impact on forest lands', excluding plantations (Brown & Lugo 1990). Unfortunately, virtually all tropical forests have suffered some form of human impact – all, if one includes the impact of anthropogenic changes in atmospheric composition. The question is: how much disturbance is needed to make a forest secondary? The most widespread human impacts on tropical forests are: hunting, logging for timber (usually very selective), firewood collection (typically less selective), and clearance for agriculture (including pasture). Nobody has suggested that even total removal of all large vertebrates by hunters makes a forest secondary, although the long term impact of such defaunation may be at least as great as many more visible disturbances. In contrast, forests damaged by logging or firewood collection are often included with forest regrowth on abandoned agricultural land as 'secondary forest' (e.g. Brown & Lugo 1990, Wadsworth 1987, Weaver & Birdsey 1990). The most frequent and, apparently, older usage, however, restricts the term secondary forest to regrowth after clearance (e.g. Finegan 1992, Greig-Smith 1952).

As is so often the case with ecological nomenclature, this is a question of where to dissect a continuum. However, to combine the effects of logging and

similar impacts with the effects of forest clearance confuses a very important issue. Forest recovering from logging has very little in common with forest developing on a previously cleared area. Normal logging operations maintain species diversity, soil structure and nutrient capital over much of the site and permit rapid recovery, except on logging trails and similar areas (Johns 1992). Clearance, in contrast, eliminates most species from the site, and destroys soil structure and nutrient capital to a greater or lesser extent. Regeneration in this case is dominated, except at the earliest stages, by species which have dispersed from outside the cleared area.

The key difference is the break in the continuity of forest occurrence on the site and the consequent dependence for recovery on dispersal from outside. A similar emphasis on continuity of site occupation has great predictive value in European forests (Peterken 1977) and it is probably even more significant in the tropics, where dispersal into cleared areas is slow and highly selective. In Singapore, for example, remnant patches of lowland dipterocarp forest retain their typical flora despite massive nineteenth century impacts, short of clearing. In contrast, adjacent areas of 50–100 year old secondary forest on abandoned cultivation have a much lower species diversity, completely lack dipterocarps and other species with large, wind-dispersed seeds, and are very poor in species with large animal-dispersed seeds (Corlett 1991, 1992).

There are, inevitably, forests which do not clearly fit these definitions because continuity has been only partly broken. Tropical forests near human habitations are often so degraded by exploitation for timber, poles and firewood that, despite never having been completely cleared, a large proportion of the flora is lost from the site. On the other hand, many areas used for traditional shifting cultivation are incompletely cleared and some tree species survive on site. Another intermediate case can result from clearcutting for pulp or paper. Faber-Langendoen (1992) refers to the result of clearcutting followed by harvesting with skyline cables as 'secondary succession' because the early regrowth is dominated by species that were rare or absent in the original forest. However, he states that many species do survive on site as seedlings and saplings, and forest recovery is much faster than it would be on a completely cleared site.

If we accept the definition of secondary forest as forest occupying a site which has not been continuously forested, are all other forests primary? This seems logical but conflicts with the frequent usage of 'primary' in the tropical literature to mean unmodified (many authors). It would be preferable to use 'primary' – qualified where necessary by terms such as 'logged', 'depleted', or 'degraded' – to indicate continuity of forest presence at a site and to use 'unmodified' or 'virgin' to describe forests which have not obviously been changed by significant human impact.

Furthermore, there is no logical reason to distinguish between the results of human and natural impacts. Natural catastrophes which break forest continuity (e.g. large landslides) result in secondary forest while less severe disturbances result in modified primary forest (e.g. hurricane-damaged primary forest).

Thus, excluding borderline cases of the type mentioned above, all forests are either secondary – the result of a break in continuity of site occupation – or primary.

Finally, there is the question of how long it takes before an old secondary forest can be considered primary. This is not a trivial question because large areas of tropical forest are on old river terraces, old landslides, sites deforested by volcanic action, or areas cleared by earlier human inhabitants of the region. Much of the rest is probably a result of post-glacial invasion of other vegetation types and may still show gradual, unidirectional changes as a result of species migrations. All tropical forests could be considered secondary in the sense that they have not been there for ever. It makes sense, however, to limit the use of 'secondary' to forests where the effects of the break in continuity can still be detected in the structure and/or floristics. In practice, primary forest will usually be recognized by being self-maintaining, with the major species regenerating under the normal disturbance regime for the area.

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