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The vegetation of artificial forests

The purpose of this paper is to discuss the various possible degrees of artificiality of forests, to give examples of types of artificial forests and of ecological research carried out in this field in various countries, and finally to provide a general framework for a discussion of the problems involved.

Starting from the climax forest (now absent in the Netherlands) human influence first caused a change in the botanical composition inducing secondary forest. An increasing influence may lead to degraded "tertiary" forests, with approximately the same species as the secondary forest, but with a shrubby structure and with changes in the soil profile. Finally the forest may disappear and be replaced by shrub, heath or meadow communities etc.

A second line of increasing human influence is caused by sylvicultural treatment, *e.g.* the planting of trees. Native trees may be planted in sites where they can be expected to grow naturally – but not always in the same quantities and sometimes in places where there has never been a forest before, e.g. on marine clay soils. In some cases alien broadleaved trees do not seem to have much effect on the composition of the understory, compared with native species (e.g. *Populus euramericana, Aesculus hippocastanum, Castanea sativa*). In other cases (*e.g. Quercus rubra, Robinia pseudo-acacia*) this difference is more pronounced, but the main distinction probably is that between monocultures and mixed stands generally. Even after careful studies the supposed detrimental effect of coppicing remains doubtful.

Individual trees of coniferous species do not cause a serious disturbance in a broadleaved community. At the other extreme, pure stands of young conifers often have scarcely any undergrowth, and clear cutting of mature stands leaves its mark on the ecosystem in many respects. Again, there is a gradual transition between natural and artificial forests, corresponding with various sylvicultural treatments. Research has shown that tree species have a specific influence on soil development, and in some cases planting of alien coniferous forests may damage site production potential or have other undesirable effects.

There is some difference of opinion whether artifical woodlands should be placed in the existing system of forest communities. Since weed communities within cereal crops have also been classified in the Braun-Blanquet system, there is no valid argument against incorporation of these woodlands (German "Forstgesellschaften") in this system. A first generation of coniferous forest on broadleaved forest sites in most cases shows sufficient similarity in species composition to the natural forests of these sites to be classified as special "stand types" of the same association. After two or more generations of coniferous forest in the same locality, and possibly even during the first generation in environments which are too extreme for broadleaved forest, floristic composition and soil development may be sufficiently different to distinguish specific coniferous associations. The importance of fungi as "characteristic" species for artificial forests, even if they are new to the local flora, is doubtful. Since a large percentage of the fungi in some way or other may be linked to the trees, their use as such might well result in the distinction of separate associations for individual tree species. The same holds, however, for native species, e.g., there is a similar difference in the mycofloras of oak and birch in an "oak-birch forest". The practice of planting tree species in pure stands would thus have an overriding influence on ecological forest classification, which would seem to be undesirable to most ecologists.

Summarising, we may say that the effect of planting artificial forests is a gradual breaking down of plant geographical and ecological barriers, resulting in a levelling of existing differences in forest vegetation. Imported trees, like neophytic weeds, tend to grow better than in their original country (if soil and climatic conditions are suitable), mainly because of the scarcity of parasites and competitors. Sooner or later they are followed by other species originating from the same type of biotic community. The process of levelling may be described as consisting of 6 phases:

1. Experimental period. Introduction of alien tree species and selection of strains suitable for local conditions. Simultaneous introduction of mycorrhiza-fungi may be essential in many cases. Suitability for various soil types and sometimes even adaptability to various climates is unpredictable on the basis of occurrence in the native area of the species.
2. Afforestation with promising introduced tree species.
3. Penetration of local native species into the stand, mostly in the order mosses – herbs – dwarf shrubs – shrubs – trees.
4. Introduction (accidental or *e.g.* as ornamentals) of accompanying alien species.
5. Spontaneous establishment of introduced species in local empty ecological niches.
6. Penetration of introduced species into native communities, occasionally followed by reduction or extinction of certain native species (*e.g.* chestnut blight on *Castanea dentata* in North America).