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Forests in Balance: How Tree Management Affects Biodiversity

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ABSTRACT

Forests are vital repositories of biodiversity and vital suppliers of ecosystem services that support human life and the natural world. The health and biodiversity of forest ecosystems are largely determined by silvicultural practices, which are techniques used to control the development and structure of forests. The effects of various silvicultural practices, such as crop tree management, coppicing with standards, thinning, selective logging, and clear cutting, on forest biodiversity are examined in this article. Under good planning, certain practices—like selective logging and thinning—can increase biodiversity, but others—like poorly managed coppicing and clear cutting—may harm ecosystems and decrease species richness. The results emphasize how crucial context-specific, well watched, and sustainable forest management strategies are to striking a balance between ecological integrity and human demands.

INTRODUCTION

B iodiversity of Earth is the foundation and key for the sustainable future. It provides both tangible benefits and

intangible benefits which are collectively represented as ecosystem services. It is believed the biodiversity richness can ensure



the resilience even when natural disaster torments. For generations the biodiversity richness in plant kingdom has been exploited by the humans.

The vast majority of wild plants and animals call forests home, and people always rely on them for their income. The calculation of human dependence on trees is illogical. Unfortunately, we have depleted this precious resource due to our excessive use and exploitation. To illustrate how we are losing our forests, FAO releases its Global Forest Assessment Report on a regular basis. The majority of the forest has some sort of human involvement, with only a small number of areas remaining virgin forest. We rely on the forest to meet our demands because of our constantly expanding population. Therefore, we must meet our expectations without putting the resources at risk (Gaudreault, et al., 2016).

A practical way to address human requirements while causing the least amount of disturbance to the forest is through sustainable forest management. Effective foresters or managers strike a balance between the requirements of people and the need to preserve the ecosystem and wildlife. The aim of this article is to identify the potential impact of the silvicultural practices on biodiversity.

Silviculture as a Tool

The maintenance of biodiversity and the expansion of biodiversity are not always adversely affected by forest management, and forest operations in particular. It is very likely that the majority of management actions in primary forests will result in a decline in tree biodiversity. On the other hand, tree biodiversity can occasionally rise in short- and medium-term actively managed forests. It is important to remember that initiatives to mitigate the effects of climate change and active forest management may be useful means of preserving and boosting tree biodiversity (Bouget, *et al.*, 2012).

Forest species may be stressed by logging because it can affect environmental factors like light, humidity, and wind speed. The longterm resilience of forests can be disrupted by local biodiversity loss brought on by timber extraction, which may ultimately have an impact on human well-being and result in a poor delivery of ecosystem services. Tree clearance is the most obvious effect of forest management in stands. Given that species composition influences forest structure, this shift in stand density may also result in some changes to the diversity of tree species. Forest management is made even more complex by the potential to implement various silvicultural and forest engineering choices, which can change forest biodiversity in a number of ways.

Influence of Silvicultural Treatment on Forest Biodiversity

Selective Logging- It's a low-impact forest management method that copies natural disturbances, but its effects on biodiversity vary. Many studies show little change in plant diversity, though recovery time and how much is logged make a big difference. Small gaps in the canopy help new plants grow better, while larger openings may need extra help. Still, changes like more evergreen plants or vines can happen, and full recovery can take anywhere from 5 to over 40 years. If done poorly or too often, selective logging can harm biodiversity, making good planning essential.

Clear cutting and coppicing with standards-Intensive silvicultural practices that can significantly alter forest ecosystems, though their impact on biodiversity varies with context. can impact biodiversity in different ways. While clear cutting may harm sensitive areas by encouraging invasive species, it can help restore degraded forests by promoting native tree growth. Coppicing with standards supports biodiversity if managed well, but



short rotations can lead to unwanted species. Careful planning is key to minimizing negative effects.

Thinning and Crop Tree Management-Thinning is generally seen as a positive method for managing forest biodiversity, especially in planted forests. Lighter thinning tends to better preserve biodiversity, but the best approach depends on the type of forest and management goals. In conifer plantations, thinning can help native hardwoods grow and improve biodiversity, even with heavier thinning. For example, in the U.S. Pacific Northwest, biodiversity stayed high 17 years after thinning, with few invasive species. In complex forests like tropical rainforests, lighter thinning is recommended to avoid harming species composition. Crop tree management has been less studied, but early research from China suggests it may boost plant diversity in the shrub layer. More research is needed to fully understand its impact (Latterini, et al., 2023).

Negative Impacts

Although silvicultural techniques are crucial for managing forests, if they are not used appropriately, they can also have a detrimental impact on biodiversity. Habitat degradation, fragmentation, and a reduction in species richness are frequently the results of intensive practices like clear cutting and monoculture plantings. By eliminating layers that sustain a variety of plant and animal life, these treatments can simplify the structure of forests. Logging-induced soil disturbance has the potential to worsen native ecosystems by introducing invasive species and lowering soil quality. Ecosystem function can change when biodiversity switches from native, shadetolerant species to non-native or fast-growing ones. Furthermore, many specialized species' habitats are diminished when old-growth features like deadwood and huge trees are

removed. Decades may pass before such disruptions are fully recovered from, and repeated or badly handled interventions may result in permanent harm (Pawson, *et al.*, 2006).

CONCLUSION

Silvicultural techniques effective are instruments that, when applied properly, can promote the preservation of biodiversity and forest production. They have a very contextdependent effect on biodiversity, depending on things like intensity, kind of forest, rotation cycles, and recovery times. While more intense techniques like clear cutting may cause long-term deterioration if not properly managed, practices like selective logging and thinning can have a positive impact when used with ecological sensitivity. The secret to reducing damage and optimizing gains is careful planning, ongoing observation, and practice adaptation the particular to requirements of any forest habitat. In addition to protecting biodiversity, sustainable forest management is necessary to guarantee that ecosystem services will be available for future generations.

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