ROLE OF SILVICULTURAL TREATMENTS IN LESSENING THE STRESS IMPACT ON FOREST PRODUCTIVITY

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ABSTRACT

Stress is defined as any environmental factor capable of inducing a potentially injurious strain in living organisms. Environmental stresses both biotic and abiotic commonly reduce plant growth and productivity. Natural and artificial fires, development of roads, cutting the trees for timber, harvesting effects, and soil erosion cause stress in plants, thus reducing their productivity. Extreme disturbances, such as wildfire or tractor logging, cause the loss of nutrients, mycorrhizae, and organic matter. Deforestation resulting in conversion of forestland to farms, ranches, or urban use also lessens the productivity. These combined losses reduce long-term site productivity and may lead to sustained periods of extended erosion that could exacerbate degradation. The importance of trees in providing essential services extends outside the traditional forest setting to urban forests and riparian zones, where trees stabilize soil, remove excess nutrients from groundwater, buffer groundwater flow, and remove airborne contaminants. There is an ongoing need in the area of forest restoration that initiates or accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability.

Silviculture is the art and science of managing forests for desired outcomes, such as wildlife habitat, aesthetics, and timber production. In silviculture the activity is known as reforestation, or afforestation, depending on whether the area being planted has or has not recently been forested. It involves planting seedlings over an area of land where the forest has been harvested or damaged by fire, disease or human activity. Usually a silvicultural treatment is planned with an objective to improve the composition of the forest and increase the growth of the remaining trees and to facilitate the production of new trees within or in place of the old forest. This is accomplished by applying different type’s silvicultural treatments, and long term planned sequences called silvicultural systems. Maintaining or increasing stand productivity is the concern of forest land managers worldwide. Consequently, there is increasing interest in understanding the impact of environmental stress on productivity and the development of management strategies that reduce the deleterious effects. The role of silvicultural treatments in lessening the stress impact on stand productivity is the present need which also requires an effective research.

Key Words: Environmental stress, Deforestation Silvicultural Treatments, stand productivity, management strategies, effective research.

INTRODUCTION

Silviculture is the art and science of reproducing and growing trees in a forest for sustainable benefit of society. Silviculture is to forestry as agronomy is to agriculture. It is concerned with the technology of growing vegetation. Like the rest of forestry itself, silviculture is an applied science that rests on the more fundamental natural and social sciences. It is the practice of controlling forest composition, structure, and growth to maintain and enhance the forest’s utility for any purpose.
Although forest land management goals and objectives may vary, it has long been recognized that the application of silviculture to diverse forest management units needs a unified, systematic approach. Continual improvement may be expected as new research results become available.

Effects of Multiple Stresses on Growth and Productivity of Forests

The importance of trees in providing essential services extends outside the traditional forest setting to urban forests and riparian zones, where trees stabilize soil, remove excess nutrients from groundwater, buffer groundwater flow, and remove airborne contaminants. But forests are subjected to environmental stresses both biotic and abiotic which are responsible for reducing plant growth and productivity.

The damage done to forest plants by other living organisms, such as bacteria, viruses, fungi, parasites, beneficial and harmful insects, weeds, and cultivated or native plants is the biotic stress. The abiotic factors are high winds, extreme temperatures, drought, floods, soil erosion, tornadoes and wild fires. The anthropogenic pressures are encroachment of forest area, development of roads, cutting the trees for timber, harvesting effect, tractor logging, diversion of forest land for non-forestry purposes, Fragmentation of forest area: infrastructure development also lessens the productivity. These combined losses reduce long-term site productivity and may lead to sustained periods of extended erosion that could exacerbate degradation. Hence there is an ongoing need in the area of forest restoration that accelerates the recovery of an ecosystem with respect to its health, integrity and sustainability. This is achieved to some extent by applying Silvicultural treatments in lessening the stress impact and increase forest productivity.

Silvicultural systems

A silvicultural system is the process by which the crops constituting a forest are tended, removed and replaced by new crops, resulting in the production of stands of distinctive form. It is a planned process designed to tend immature trees and establish new trees in a forest stand. Silvicultural systems usually develop as a response to the practical need to balance market, socioeconomic and ecological requirements in a technically feasible way. There are number of ways for classification of silvicultural systems, but most common is on the basis of Mode of Regeneration which is further classified according to pattern of felling carried out in the crop.

Silvicultural treatments

A silvicultural treatment is a planned programme of silvicultural operations that can be implemented during the entire or partial rotation of a stand. These depend on the characteristics of its site like locality, slope and soil type and stocking i.e., on composition, age, diameter distribution and regeneration. These treatments are applied throughout the life of the stand and are combinations of regeneration methods and stand tending, called intermediate treatments. Sound silvicultural treatments must be biologically feasible, socially acceptable and economically possible owner’s
objectives for the woodlot, the environmental conditions, and the tree species present and desired for the future. These also depends on numerous items such as tribal goals and objectives, past disturbance patterns, forest health, site attributes, stand attributes, plant communities, economics, and the available resources. Determination of the best silvicultural system must first rely upon sound ecological principles.

Forests are frequently managed in smaller units called stands. A stand is a group of trees similar enough in species composition, condition, and age distribution. Stands may be even-aged i.e., trees are of relatively the same age or uneven-aged. A forest manager can choose among these systems of silvicultural treatments to harvest and grow new trees within a forest stand. They are:

Even-aged (EA) Systems. These systems result in stands of trees that are about the same age. They all became established at almost the same time and mature together. As the trees develop, they are naturally or artificially thinned to provide the remaining trees with more sunlight and nutrients. The different methods applied are

1. Clear cutting
   All the trees are removed at the same time. Clear cutting usually is used in stands having abundant, good-quality seedlings in the understory or when abundant sprouting can be expected from the cut stumps. Clear cutting is a particularly good method to use when regenerating species, such as yellow-poplar, that grow best in full sun.

2. The seed-tree method
   In this method a new age class develops from seeds that germinate in virtually a fully-exposed microenvironment after removal of the entire stand, except for a small number of widely dispersed trees retained for seed production. Seed trees are usually removed after regeneration is established. Seed trees must be of high quality and desirable species. A second cutting will remove all of the “seed trees” as soon as the new seedlings are 5-10 feet tall. The seed tree system is used when seedlings are not abundant in the understory before cutting.

3. Shelter wood method
   The large trees are removed in stages over a period of years. Generally, one-third to one half of the mature trees are removed initially. This lightens the understory but leaves a reserve of mature trees to serve as a source of seed and to partially shade the ground. A second cutting will remove all of the mature trees as soon as the regeneration reaches 5-10 feet tall.

4. Coppice method
   It is a method of regenerating a stand in which all trees in the previous stand are cut, knocked over, or injured at the root and the majority of regeneration is from stump sprouts or root suckers. This is primarily used in hardwood stands; however,
coastal redwoods may also be regenerated using this method. Various Methods of Coppice System that are followed are:

1. Simple Coppice
2. The Coppice of Two Rotations System
3. The Sheltered Wood Coppice System
4. Coppice with Standards
5. Coppice with Reserves
6. Coppice Selection System
7. Pollard System.

**a. Simple Coppice:** A Silviculture System in which the old crop is clear filled completely with no reservation for sheltered wood or any other purpose. There are many advantages in this method as it is very simple and requires no skill. The crop grows fast so cost of weeding, cleaning and protection is less. Regeneration is more certain and reduces rotation period as growth is very fast. More over the returns are more even though small sized wood is produced. There are some disadvantages of Simple Coppice as the timber price is low and it exhausts more mineral substances as more shoots are produced. It is not desirable from aesthetic point of view.

**b. Coppice of Two Rotations Systems:** Modification of Simple coppice system which at the end of the first rotation of coppice, a few selected poles are left scattered singly over the coupe in the second rotation to attain bigger size.

**c. The Sheltered Wood Coppice System:** In this system even in the first clear felling, some sheltered trees about 125 to 150 trees/ha are retained for frost protection. This method is applied where locality is good; where the species to be worked can coppice up to a longer age, where in addition to small sized timber there is demand for large timber also.

**d. Coppice with Standards:** Defined as Silviculture System. based on coppice in which an over wood of standards usually seedlings origin and composed of trees of various ages as kept over coppice for periods which may be multiples of coppice rotation and a permanent feature of the crop throughout two peculiarities which differentiate it from the simple coppice.

**e. Coppice with Reserves:** Felling is done only in suitable areas likely to benefit, after reserving all financially immature growth of principal as well as other valuable miscellaneous species. This is done in tree yielding products of economic importance and entire crop for protective reasons.

**f. Coppice Selection System:** Silviculture System in which felling is carried out on the principles of selection system but regeneration is obtained by coppice.

**g. The Pollard System:** Pollard is defined as a tree whose stem has been cut off in order to obtain a flush of shoots, usually above the height to which the browsing animals can reach. Thus, the Pollard system consists in Pollarding trees periodically to obtain exploitable material.
Uneven-aged Systems: These systems will result in stands that include trees of various sizes and ages. They become established and will mature at different times. Treatments create and maintain conditions in which trees of various ages occupy about the same amount of space in the stand. This is called a balanced structure. The different methods followed are

**Single-tree selection (STS):** STS is a method of creating or perpetuating new age classes in uneven-aged stands in which individual trees of all size classes are periodically removed more-or-less uniformly throughout the stand to achieve desired stand structural characteristics. Under this method, only individual undesirable or excess trees are harvested. Their removal releases established understory trees from suppression and helps establish new regeneration through exposure of mineral soil and increased penetration of light and moisture to the forest floor. Care must be taken to select a desired residual level of stocking that will permit the establishment of the desired species of regeneration. These cuttings open space in the crown canopy, allowing new seedlings to become established and also enhancing growth of remaining trees by reducing crowding.

**Group Selection**
Small groups of trees of all sizes are removed from throughout the woodlot every 10 to 25 years. Scattered openings that range in size from one-fifth to one-half acre (100 -160 feet wide) are created. In addition, single immature trees are cut between the group openings to reduce crowding among the remaining trees. Group selection may be a good choice for maintaining a canopy of larger trees while regenerating species that do better in full or partial sunlight. Single-tree selection is a good choice for regenerating such species which can survive in a heavily shaded understory. This also may be a good system to use if you would like to maintain a canopy of larger trees at all times.

**Patch Selection**
Patch cutting combines elements of even-aged and uneven-aged systems. Patches of ¼ to 5 acres are created in the stand annually or at specific intervals. Patch cutting can be used to regenerate sun-loving species while maintaining the canopyover some of the stand at any given time.

**Conclusion**
In India, the management of forests is undertaken with working plans which are prepared using a uniform code for each forest division, which is for a period of ten years at a time. Although scientific management of forests in India is over 100 years old, the focus has been on silviculture rather than landscape. The forest is divided into working circles, on the basis of crop composition, geographical features and socioeconomic requirements, for prescribing management to different species and different kinds of forests.
In application, silvicultural systems are developed based predominantly on consideration of the silvical characteristics of the forest cover type, site potentials, and landowner goals. Stands and sites tend to be heterogeneous units and require adaptive interpretation and management. As stand and site characteristics vary, so do current management alternatives and potentials to meet different management objectives. General methods and systems can provide a guide to the development of stand level prescriptions, but must be sufficiently flexible to respond to variable stand and site conditions and to facilitate adaptive silviculture to meet landowner goals.

Maintaining or increasing stand productivity is the concern of forest land managers worldwide. Consequently, there is increasing interest in understanding the impact of environmental stress on productivity and the development of management strategies that reduce the deleterious effects. Silvicultural treatments in lessening the stress impact on stand productivity must be used, particularly as alternative methods for environmental stress management.

References


