

EXTENSION NOTES



MANAGING REGENERATION IN CONIFER PLANTATIONS TO RESTORE A MIXED, HARDWOOD FOREST

If you're managing an older conifer plantation, you may have noticed young hardwood and white pine trees growing in the shade of the conifers. Through the process of succession, these young hardwoods will someday form a new forest similar to the mixed, hardwood forests that covered southern Ontario before European settlement. However, the restoration of a native forest could take centuries.

This Extension Note tells you how to manage the hardwood regeneration in 20- to 70-year-old conifer plantations to speed the restoration of a more diverse, hardwood forest. In addition to improving habitat for wildlife, restoration can also increase the quality and commercial value of the conifer plantation and the future hardwood forest for wood products.

CONIFER PLANTATIONS: A GOOD FIRST STEP IN RESTORING WASTELANDS AND MARGINAL FARMLANDS INTO FORESTS

Since the late 1800s, governments and individuals have planted conifers to repair the environmental damage caused by European settlement in southern Ontario. When settlers cleared the native forest in the early 1800s, they cut nearly all the trees and tried to farm areas that were not suitable for agriculture. Without trees to anchor, enrich and shade the soil, many areas became more vulnerable to erosion. The wind and the rain took their greatest toll in areas with light, sandy soil, which became deserts of shifting sand in only a few years. Unable to grow food, many farmers abandoned their land.



The Ontario government established tree-planting programs to stop soil erosion and to reforest the growing wastelands. Through the Agreement Forest Program, conservationists created many of southern Ontario's older conifer plantations on lands owned by counties and conservation authorities. Later, through the *Woodland Improvement Act*, landowners planted conifer plantations to stabilize the soils on marginal farmlands.

As one of the few species that can survive in dry, exposed conditions, red pine was a frequent choice for reforestation programs. White pine, white spruce, Norway spruce, European larch, jack pine, tamarack and cedars were also planted in pure and mixed plantations.

A NATURAL STAGE IN THE PRESETTLEMENT FOREST'S CYCLE OF SUCCESSION

Pure stands of conifers were a small, but important component of the southern Ontario forest before European settlement. Conifers were usually among the first species to take hold in areas that were devastated by fire or other major disturbances. Through the process of succession, conifer stands eventually evolved into mixed hardwood forests.

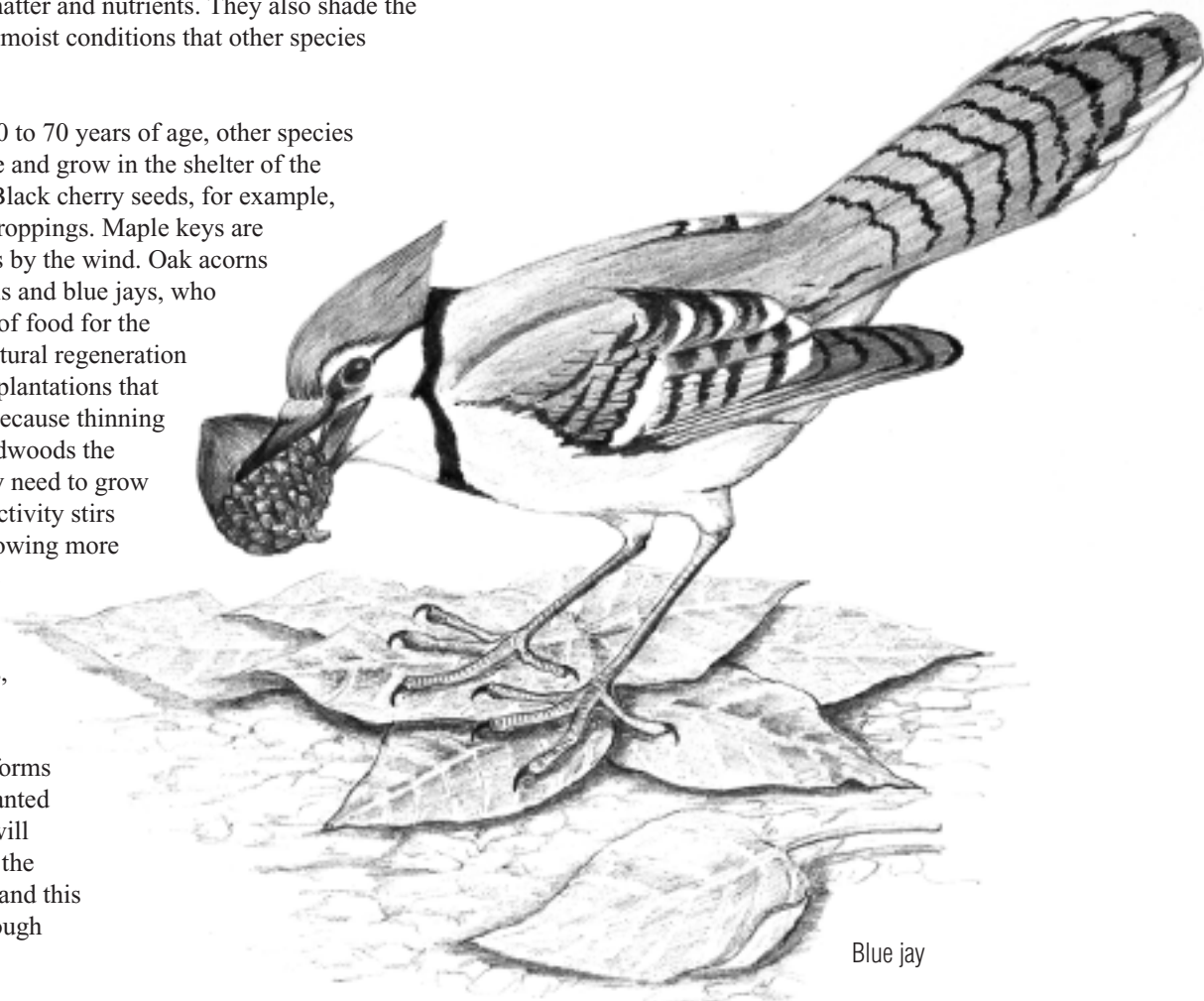
Far from biological deserts, conifer stands and plantations do provide habitat for many species of wildlife. Blue jays, crows, red crossbills and red squirrels are a few of the birds and mammals that live in older, pure stands of red and white pines. However, conifer stands lack the diversity of habitats provided by our native hardwood forests and do not support as many species of wildlife.

HOW CONIFER PLANTATIONS "NURSE" NATIVE FORESTS

As conifers grow, their roots stabilize the soil and reduce soil erosion. Eventually, their fallen needles and branches enrich the soil with organic matter and nutrients. They also shade the soil, creating the cool, moist conditions that other species need to grow.

As plantations reach 20 to 70 years of age, other species begin to invade the site and grow in the shelter of the conifer "nurse crop." Black cherry seeds, for example, are deposited in bird droppings. Maple keys are carried into plantations by the wind. Oak acorns are brought by squirrels and blue jays, who bury them as a source of food for the winter. The level of natural regeneration is highest in managed plantations that are thinned regularly because thinning gives the invading hardwoods the room and sunlight they need to grow and the management activity stirs up the soil surface, allowing more opportunities for seeds to germinate.

In many conifer stands, with sufficient natural seed, a dense, diverse new hardwood forest forms below the maturing planted trees. The new forest will naturally take over for the maturing planted pine and this can be accelerated through further thinning.



Blue jay

MANAGING NATURAL REGENERATION IN CONIFER PLANTATIONS

Restoration of a more diverse forest, increasing wildlife habitat and increasing the long-term commercial value of a stand may sound like conflicting goals. But they can all be achieved by managing natural regeneration and succession. Restoration may involve:

- thinning
- creating small clearings or canopy gaps
- protecting regeneration
- stimulating coppice growth
- planting and seeding

Before you begin restoration, you'll need to carefully assess your goals, the site conditions and the age, species composition and character of your plantation. Planning is also essential. The restoration activities need to be done in conjunction with each other and over a long period of time. For assistance with developing a forest management plan for your plantation or incorporating restoration goals into an existing plan, contact the Ontario Ministry of Natural Resources or an independent forestry consultant.

THINNING YOUR CONIFER PLANTATION

Three things happen when a conifer plantation is thinned:

1. INCREASE IN THE DIAMETER, TIMBER QUALITY AND ECONOMIC VALUE OF THE EXISTING CONIFERS.

Thinning a conifer plantation is like thinning rows of carrots in your garden. When you take out the smaller, weaker carrots, you create more room for the other carrots to grow. Without thinning, you might get a crop of carrots that are too small to use. The same logic applies to plantations. After a stand is thinned, the remaining trees grow faster than those in an unthinned stand. The larger diameter pines can often be harvested and sold as telephone poles, sawlogs and logs for log homes.

2. INCREASE IN THE AMOUNT OF NATURAL REGENERATION AND NUMBER OF TREES IN THE FUTURE FOREST.

Thinning allows light to reach the forest floor and disturbs the soil surface, which stimulates the germination of seedlings and the growth of young trees. Without thinning the minimal numbers of seedlings and their reduced vigour slows progress towards a healthy, dense, mixed-hardwood forest.

3. INCREASE IN THE TIMBER QUALITY AND COMMERCIAL VALUE OF THE FUTURE HARDWOOD FOREST.

In hardwood forests, natural regeneration produces about 10,000 seedlings a hectare. The seedlings compete with each other for sunlight, each trying to outgrow its neighbour. This intense competition takes its toll: in each hectare only about 1,000 remain when they reach the sapling stage. But competition causes them to grow tall and straight — the qualities required for wood of high commercial value. The lower level of competition among regenerating plants in unthinned conifer plantations encourages crooked stems and larger crowns, characteristics which lowers the commercial value of trees.



Top: Complete rows of trees are removed during the first thinning operation.

Left: A brush saw is used to remove the above-ground portion of hardwood stems that will coppice.

THE FIRST THINNING

Most plantations are ready to be thinned 15 to 25 years after planting. In the first thinning, remove every third or fourth row to create access corridors into the plantation.

LATER THINNINGS

Thin the plantation every 10 to 15 years until the trees are 80 to 100 years old. The thinning method and pattern you choose depends on the site and your goals.

PREPARING FOR THE FINAL CONIFER HARVEST

Once the plantation has reached maturity and you are preparing to harvest the conifers, select and leave some

scattered pines to provide seed for regeneration and to become supercanopy trees and snags in the future. Supercanopy trees are tall pines that rise above the forest canopy. They provide nesting and roosting sites for birds, as well as landmarks for travelling songbirds. Snags are standing dead trees that provide habitat for many species. Also protect large-crowned hardwood trees that have survived from the days before the plantation was created. They provide nesting, perching and feeding sites for songbirds.

CREATING OPENINGS AND CANOPY GAPS

The mixed hardwood forests that covered southern Ontario before European settlement depended on natural disturbances to maintain the presettlement forest's multi-layered structure and diverse species-composition. Fire, wind, ice storms, insects and disease periodically destroyed areas of mature forest ranging in size from a few trees to hundreds of hectares. This created the space for new growth and started the cycle of succession. These forces created a diverse patchwork of stands in different stages of succession, broken by grassy meadows and openings of various sizes. Stands in the later stages of succession were dominated by mature maples, hemlocks and beeches, with scattered white pines.

The same processes can be used on a much smaller scale within a stand. For example, when a single large tree dies or is windthrown, a gap or hole is created in the canopy where its large crown once grew. Over time, as more large trees die, these natural disturbances would create a forest with trees of all ages and sizes.

You can mimic these natural disturbances and speed the process of succession by cutting gaps of various sizes in the forest canopy. As a guideline, cut openings in about two to five per cent of a plantation at each thinning operation: this is in addition to the conifers that are removed for thinning purposes. Each hole in the canopy should be greater than six metres from one edge to the other.

Gaps that are six to 10 metres in diameter encourage the growth of tolerant species, such as maples, beeches and hemlocks. This gap size can be created through the removal of three or four trees in a group. Large gaps, in the range of 30 to 50 metres in diameter, encourage the growth of mid-tolerant species, such as oaks, white ash and white pine. Larger openings, greater than 50 metres in diameter, favour intolerant species, such as white birch, poplar and black cherry. Clearings of this size provide excellent habitat for wildlife. However, these large openings are not recommended in forested areas that are already quite small and fragmented.



These views from below illustrate the different amounts of sunlight reaching the forest floor in a 25-year-old red pine plantation. The amount of open sky visible is directly related to the quantity of light reaching the plants on the forest floor.

Top: An unthinned plantation allowing little sunlight to pass through.

Centre: One row removed with a 10-metre diameter canopy gap providing a hole for sunlight to pass to the forest floor.

Bottom: With two rows removed and three left, even more light can reach the plants on the forest floor.

Many species of forest nesting birds actually prefer large areas of unbroken forest for nesting and feeding. Make sure your gaps are more than 50 metres from each other

and from the edge of the stand. Build on small, natural openings to create larger clearings.

PROTECTING REGENERATION IN THE CANOPY GAPS

As you harvest, protect the existing seedlings and saplings from damage, which can reduce their future value for wood products. Damage can be reduced by felling neighbouring trees away from the openings and restrict travel in the regenerated areas of the stand. Alternatively, you can cut all the hardwood saplings in the openings and rely on coppice growth to regenerate the site with new, undamaged stems. At the very least damaged stems of saplings should be cut to ground level to allow for good quality coppice growth.

STIMULATING COPPICE GROWTH

Coppice is the regrowth of tree shoots from the stumps and roots of oaks, ashes and most other hardwoods following cutting or other damage. This type of growth produces a dense layer of saplings that often grow faster and straighter than trees grown from seed. This cutting can be used to improve the quality of saplings damaged through thinning and harvesting operations or in cases where extensive damage is expected, as with the creation of larger canopy gaps, managers may consider cutting all hardwood regeneration to the ground prior to gap creation. If possible, do this kind of work in the late fall or winter when trees are dormant.



Tall, straight coppice sprouts grow from the base of a cut basswood stump.

SUPPLEMENTING NATURAL REGENERATION WITH PLANTING OR SEEDING

SUCCESSION

Succession is the natural process of change that occurs in a forest over time as one community of living organisms replaces another. In southern Ontario, succession usually begins in abandoned agricultural fields or after a major disturbance, like wind or ice storms or disease and insect attacks that create areas where new growth can occur. Pioneer species, which are best able to live in harsh conditions, take hold first. These shade intolerant species (tolerance is a measure of how much shade a tree can survive) change the environment as they grow, creating the shaded, moister conditions that more tolerant species need to grow. As conditions improve, mid-tolerant and tolerant species move in and, over time, create a mixed forest with a high component of mid-tolerant species. As the forest reaches the later stages of succession, tolerant species become dominant. Known as climax species, they will dominate the site until disturbances launch the cycle of succession again.



Planting hardwood seedlings can provide a head start to the succession process.

If there are not enough sources of hardwood seed near your plantation, you can plant hardwood seedlings or disperse hardwood seed in the canopy gaps. This will increase the level of regeneration and diversity in the stand — and provide future sources of seed for natural regeneration. Be sure to select tree species that are suited to the soil conditions and the size of canopy gap that will be used.

IMPROVING THE NEW FOREST



A 60-year-old plantation before the creation of a canopy gap, and understory treatment.



The same area immediately following the thinning operation.



Abundant regrowth of high quality hardwoods after one growing season.

Although extensive thinning in small sized trees (< 8 metres tall) is not recommended, it can be a very good practice to use cutting or other methods to release good quality trees of those species best suited to the site and which best meet your management objectives. By thinning coppice stump sprouts to 1 and 2 stems and providing full crown release for 100 to 200 of the better saplings per hectare managers can greatly increase the growth and quality of their future forest. This type of work should be considered between 9 and 15 years following the creation of the canopy gap.

THE RESULTS

These methods for managing natural regeneration in conifer plantations will eventually produce a diverse, all-aged, mixed forest of hardwoods, white pines and other conifers.



Dense sapling layer after eight years of growth in the canopy gap.

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