4.2 KNOWLEDGE OF FOREST ECOLOGY


E. Boysen

Some knowledge of several aspects of forest ecology such as in natural succession, natural disturbance, and hydrological and nutrient cycling permits a better understanding of stand dynamics and structure. Silvicultural practices will sometimes have to be adapted or modified to protect or to better emulate these processes and their natural patterns of occurrence at both the landscape and stand level. For example, when implementing a group selection prescription, managers and forest workers can vary the size, shape, density, and orientation of created openings, instead of creating unnatural openings of constant shape and size.

The consideration of the following ecological processes will improve the chances of success of future efforts to restore, rehabilitate, or perpetuate certain natural forest types or conditions in southern Ontario over the long-term.

Natural succession

Succession represents the normal growth and development of a forest stand. It is often initiated by some kind of disturbance such as wildfire, or cutting. Usually fast-growing species colonize the site. Over time, as stand and site conditions change, species composition also changes. As crown closure develops, tree growth and competition lead to recognizable patterns of stand development, with species with lesser shade tolerance in the upper layers and species of greater shade tolerance in the lower layers. As mature trees in the overstory die, shade-tolerant mid-canopy trees colonize these newly created gaps. Unless the openings are larger than one canopy height in radius, the succeeding regeneration will remain under some influence of the preceding overstory. These "gap-phase regeneration dynamics" are ecologically significant since the gaps are small enough to be influenced by adjacent overstory vegetation (Runkel and Yetter 1987).

The old-growth stage is achieved when the stand has developed a series of gaps over time that result in a stable balance of trees of different species, sizes, and ages. This stage tends to have greater stability in biomass and productivity than earlier successional stages (Guldin 1996). In reality, few stands attain true old-growth status since the required exclusion of major disturbance events for several hundred years is highly unlikely.

An awareness of the successional process encourages the selection of management activities that better imitate stand development through natural succession. For example, even-aged silvicultural prescriptions designed to encourage regeneration and the development of intolerant and mid-tolerant species are best applied during the earlier stages of natural succession (i.e., between stand initiation and the development of a closed canopy). Uneven-aged silvicultural prescriptions are best applied to stands in the later stages of succession when stand conditions favor the maintenance over time of stand structure, volume production, and continuous forest cover.

In addition, at the regional scale, an understanding of natural succession implies that sustainable forest management should encourage the development of a variety of successional stages at any one time.

Natural disturbances

In southern Ontario, catastrophic natural disturbance events such as severe wildfires that destroy all overstory vegetation and characteristically return succession back to the stand initiation stage now occur very infrequently. However, localized and less severe disturbances (e.g., insect infestations, severe windstorms, tornadoes, microbursts) are more common. Usually much of a stand is destroyed, but regeneration survives beneath scattered overstory and midstory trees. New regeneration and stand structure are more variable in these stands than in those that develop after complete disturbance.

Small-scale disturbances that affect only one to a few trees occur most frequently and are a basic element of stand development. They may add ecological complexity to stands by creating conditions for multiple species and canopy strata (Guldin 1996). But, some disturbances can simplify stands. For example, an over-population of white-tailed deer can consume virtually all seed, seedlings, and saplings of certain species, making species recruitment impossible. Grazing by cattle can have a similar impact in a short period of time. Invasive species such as garlic mustard can have the same effect, through competition with other plant species in the forest (Nuzzo 2000).

In the western Great Lakes region, fire was most important on pine-dominated uplands and in boreal environments, where such disturbance occurred at roughly 100-year intervals (Heinselman *et al*.1973). Large-scale disturbances in hardwood-hemlock forests were largely the result of severe windthrows but intervals were in the order of at least 1000 years (Canham and Loucks 1984). Small, local windthrows were the most common source of disturbance in this region (Frelich and Lorimer 1991), but outbreaks of insect herbivores, disease, and browsing by large mammals also had significant impacts (White and Mladenoff 1994). The pre-settlement forests of southern Ontario probably experienced a similar natural disturbance regime.

The better forest managers understand the ecological conditions resulting from natural disturbances, the more success they will have in implementing silvicultural prescriptions designed to approximate these disturbances. For example, single-tree selection is used to mimic the smallest scale of natural disturbance (i.e., loss of a single tree to disease, lightning, windthrow). When managers realize that these naturally occurring small openings often close before desirable mid-tolerant regeneration can grow into the canopy, they can foster more favorable ecological conditions for growth and development of regeneration by creating several small gaps of sufficient size in the same area.

Group selection is used to approximate intensive, small-scale natural disturbances that create variable-sized, but slightly larger openings within a stand. The resulting site conditions, such as the amount of sunlight reaching the forest floor, encourage the establishment and development of desired regeneration within the group opening. However, forest managers must also understand how bordering trees, the opening size and its configuration, and other factors can affect the ecological conditions within the gap.

Hydrological and nutrient cycling

Proper, unimpaired cycling of water and nutrients is critical to the functioning of ecosystems, therefore it is imperative that the application of any silvicultural prescription has minimal and preferably no adverse effects on these processes. The selection of the most appropriate silvicultural prescription should be determined in part by its ability to sustain and protect if necessary, these processes.

Water is required by all living organisms and hence is a key factor in their occurrence, distribution, and survival. Nutrient cycles are the processes by which elements important to living organisms such as nitrogen, phosphorus, and carbon move through the biotic and abiotic components of an ecosystem. The many small invertebrates and microorganisms that decompose dead material play an especially important role in nutrient cycles because they recycle nutrients that would otherwise not be returned to the soil.

Research in New York State revealed that soils of more urban oak woodlands had higher rates of mineralization of nitrogen (i.e., the conversion of organic forms of nitrogen to inorganic forms such as nitrate) than soils of more rural woodlands (McDonnell *et al.* 1993 as cited in Sauer *et al.* 1998). These researchers suggested that the principle changes brought about by nitrogen deposition may be an increase in the abundance of bacteria in the soil and litter, combined with reductions in fungal and invertebrate populations. In their study, urban forest floor litter also decomposed more quickly than that of countryside forests.

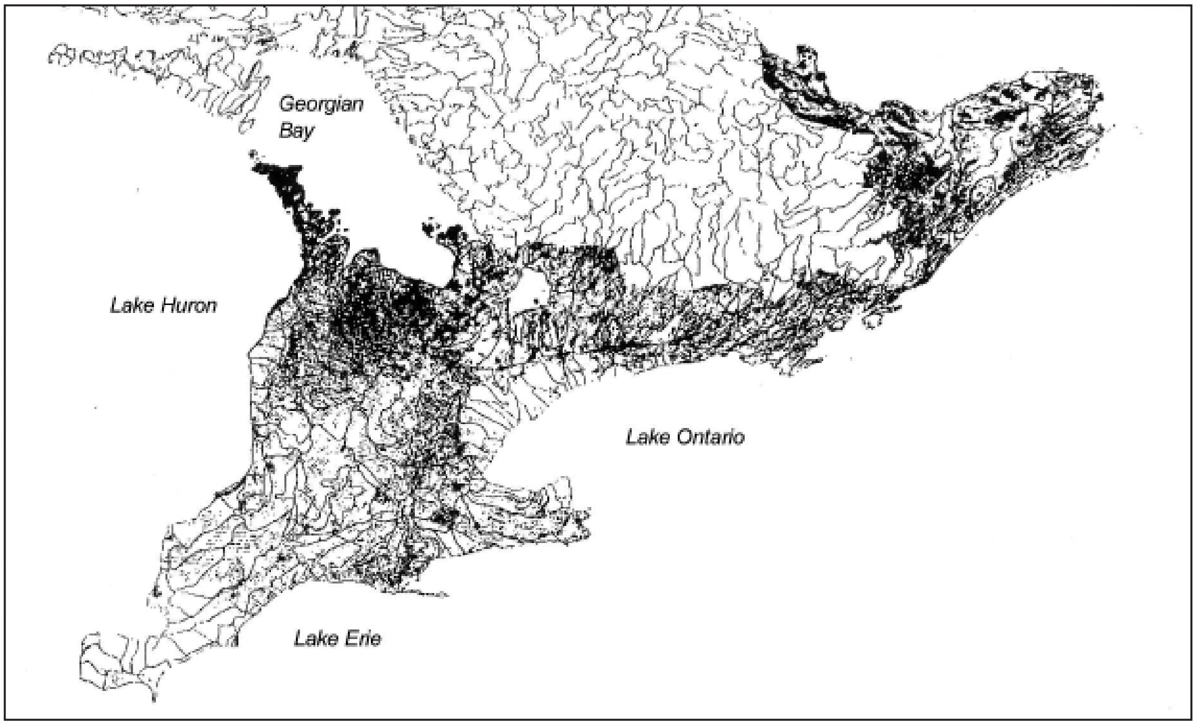
Soil structure is affected by soil nutrient changes too, particularly by a shift from fungal to bacterial dominance. The webby mycelia that comprise the bulk of the fungal component of soil serve to knit together soil particles and bits of organic matter, while the substances secreted by bacteria are slippery and cause soil to slump when it is exposed to rain (Harris *et al.* 1993 as cited *in* Sauer *et al.* 1998).

Although much remains to be learned about hydrological and nutrient cycles, results of these studies imply that forest managers should try to maintain them by protecting important sites such as seepage areas, woodland swamps, springs and creeks; providing natural buffers around them; and prohibiting harvesting and road construction in these areas. When developing prescriptions, they should have forest soils analyzed for their nutrient and pH status, especially in urban areas. Also they will need to consider the potential effects of proposed silvicultural treatments (e.g., increased soil dessication resulting from opening the canopy) on the soil structure and nutrient status.

Human impacts on the forested landscape

In southern Ontario, human activities have modified most, if not all forested landscapes. In parts of southwestern Ontario, the amount and pattern of forest cover, and stand composition and structure no longer even remotely resemble presettlement forests. **Figure 4.2.1** reveals some interesting patterns, including: narrow bands of linear forests in agriculturally-based southwestern Ontario and relatively continuous forest cover in the Bruce Peninsula/Grey County area and Renfrew, Lanark, and Frontenac Counties where poor soils and surficial bedrock impeded early agricultural efforts.

Figure 4.2.1: Forest cover (solid black) in southern Ontario (circa 1985-1991) as mapped from Landsat TM satellite imagery by Ontario Power Generation.



Managers can use their knowledge of some of the historical human impacts on forests to help them to interpret current stand distribution, composition, and structure in this part of the province, and to determine potential stand productivity, based on the past human disturbance of the stand and larger landscape.

Since the time of European settlement, forests in southern Ontario have been cleared for agriculture, logging, and urban development and these activities have had numerous impacts on the amount and distribution of forest cover, stand structure, and species composition.

Amount and distribution of forest cover

Compared to the presettlement era, today in most of southern Ontario forest cover dramatically decreased. For example, in southwestern Ontario, forest cover was once well over 80 %, but is now only 11.3 % (Reid *et al.* 1996). In southeastern Ontario and many parts of the northeastern United States the area of forest cover has actually increased since the 1930s due mostly to the abandonment and subsequent natural regeneration of marginal farmland (McKibbon 1996).

Distribution of forest cover has changed as well. It is likely that the increase in forest fragmentation has had several detrimental effects on native species of plants and animals. Increased isolation of forest patches favors plants better adapted to longer-range seed dispersal. Wide-ranging mammals such as black bear, lynx, and wolf are no longer widespread in this part of the province because there is insufficient forest cover to adequately meet their habitat requirements.

Sometimes the impacts are more insidious as species slowly disappear over time due to altered environmental conditions. For example, many smaller stands may be acting as population “sinks” because they continue to attract nesting forest birds, but may not be large enough to sustain their numbers over the long-term. Breeding birds nest on these sites, but the young are lost to predation or nest parasitism by more common species such as blue jays, grackles, crows, cowbirds, great horned owls, racoons, and domestic cats. Over time, local populations decline as birds continue to breed in these inferior habitats.

The fragmentation of existing forest cover has increased the amount of edge, providing abundant habitat for many species that are already widespread or becoming more common. At the same time, species that require forest interior habitats are declining. As forest edge increases and forest interior size continues to shrink, the more sensitive interior species disappear.

The drier, windier, and brighter microclimate on the edge of forest stands differs markedly from that of the forest interior. As a result, the vegetation structure and composition along the edge is different, being comprised of more xeric, shade-intolerant species. Physical edge effects such as higher diurnal air temperatures, decreases in humidity and wind may extend into a forest stand, along with pesticide, soil, and nitrogen deposition. In addition, exotic species often gain their first foothold in forest edges, from which they can spread farther into the forest, opportunistically seeking out small openings and other disturbed areas such as trails.

Many suburban forestlands are young, the result of recently abandoned farms. Often, they consist of small woodland fragments, unconnected to the larger natural landscape. These small isolated woodlots surrounded by croplands are more likely to suffer severe damage from a windstorm than a larger stand within a matrix of forested cover. Many interior species that are still found in these areas may be in jeopardy in the future because no extensive forest remains, and reproduction may be confined to a few, often invasive and abundant plant species that flourish in these fragments (Sauer *et al*. 1998).

All of these impacts have important consequences for forest managers because they may adversely affect local and regional biodiversity, as well as the regeneration, growth, density, and mortality of trees in the vicinity of forest edges.

Stand structure

Human activities have simplified the physical structure of many forest stands in southern Ontario. A loss of structural diversity in managed stands usually results in reduced biodiversity and abundance of many species. Any silvicultural system that fails to retain large downed logs, cavity and supercanopy trees, standing snags, and several vertical layers of vegetation will adversely affect associated species that depend upon them. Application of recent OMNR guidelines for the retention of these habitats is encouraged and discussed later in **Section 4.4.**

Forest stands that consist of several layers of vegetation (e.g., herbaceous plants, shrubs, understory, midstory, and overstory trees) provide vertical complexity important to many species of birds and insects. Therefore silvicultural systems that encourage this vertical complexity should be widely applied, particularly in larger stands that most likely support significant populations and species, and in stands where such complexity is obviously lacking. For example, harvesting activities such as skidding should minimize damage to herbaceous vegetation, shrubs, and understory trees. Removal of competing vegetation should be conducted with awareness of the wildlife habitat value of less commercially valuable tree species such as ironwood, beech, and basswood and shrubs such as spicebush, serviceberry, and chokecherry.

A certain proportion of stands in late-succession, exhibiting structural diversity and vertical complexity, should be maintained and managed to perpetuate these important ecological conditions. For example, this could be done by managing a certain proportion of forest stands on longer rotations to encourage the development of these conditions. Also the best late-successional stands could be managed for old-growth characteristics because the structural diversity, multi-layered canopies, and scattered gaps of these older forests will eventually support high plant and animal diversity, as well as numerous species of conservation concern.

Activities having negative impacts on stand structure should be controlled. In southern Ontario, grazing cattle in woodlots is a common practice that can lead to soil compaction; loss of herbaceous plants, most notably the spring ephemerals such as trilliums; an abnormal increase in shrubs such as prickly ash and trees such as ironwood; and damage to and reduction of desirable understory regeneration. Missing age classes, a notable lack of seedling and sapling regeneration, and dominance by Virginia spring beauty and yellow dogtooth violet, two wildflowers that can tolerate trampling (Keddy and Drummond 1996), provide clues of past grazing activities.

Management that prevents cattle and other livestock from entering woodlots will help many stands to recover. Sometimes however, more intensive restoration efforts may be required. One method involves driving vertical stakes made from cut branches into compacted ground, as deep as possible in a dense pattern. This permits downward water movement into the root zone and loosens the soil surface as the stakes decompose, thereby increasing soil aeration, and decreasing soil compaction (Sauer *et al*. 1998).

Species composition

Since early European settlement, human landuse and environmental changes have influenced forest species composition. Before European settlement, periodic burning of oak and pine forests limited the domination of red maple. But fire suppression has encouraged the spread of red maple, a species with catholic requirements and the ability to act as both an early and late successional species. It has increased its predominance in the forests of eastern North America by exploiting the conditions that follow forest disturbance, abandonment of agricultural land, and fire suppression in the original forests (Abrams 1998).

During the 1800s, loggers removed once dominant tree species such as hemlock and white pine from many forests throughout the region, largely for navy ship masts (pine) and bark for the tanning industry (hemlock). Further changes occurred during the 1900s, often reflecting local market demand for timber. For example, in many woodlots, the proportion of beech increased because it had no commercial value. Over time, unnaturally high densities of this shade-tolerant species remained to influence the subsequent development of the stands in which they were growing. Certain landuse practices continue to affect tree species composition today. Allowing cattle and other livestock to graze in woodlots has increased the amount of ironwood because cattle do not eat it, preferring instead to graze on numerous other species.

Well-intentioned management programs have also drastically altered the natural species composition of many forest stands in southern Ontario. During the 1970s beech and ironwood were entirely removed from many woodlots due to their poor market value and because they provided unwanted competition for more desirable species (Elliott 1998). Conifer plantations seen today were planted on land that was once forested and later cleared for agriculture. Opportunity now exists to manage these plantations to encourage natural succession to native hardwood forest cover types.

Humans have also introduced several diseases that have led to a loss of once common tree species in southern Ontario such as American chestnut and white elm. Chestnut blight arrived in southwestern Ontario in the early 1920s and within 50 years had virtually eliminated American chestnut from the province. This provincially rare species is now only rarely found, growing on a few drier, sandy sites in southwestern Ontario. Dutch elm disease arrived in the 1920s and subsequently killed a significant portion of the elm populations in Ontario. However some resistant trees remained and many young trees have regenerated. Unfortunately when many of these young trees reach a diameter of 10 to 15 cm and their growth rate slows, they become infected and die.

More recently, other potentially lethal diseases are beginning to infect butternut trees across the province (butternut canker) and flowering dogwood (anthracnose). And beech bark disease and ash decline are affecting the health of many beech and white ash trees.

Forest clearing and the related loss of soil, ground debris, canopy closure, and associated species (e.g., invertebrates, insects, and others); as well as the leveling of pit and mound topography, reduction of downed woody debris, increase in forest fragmentation, and loss of old growth probably have had many other impacts on forest species composition and ecology that may never be fully understood.

Although the effects on forest ecology, caused by loss of tree species or drastic changes in their distribution and abundance, have been little studied, it often requires little intuition to realize that large-scale and/or sudden changes to a forest stand will seriously change the ecosystem. Consequently, landowners and managers are advised to remember that sometimes even their own management decisions and activities can greatly alter stand structure and composition, as well as the course of natural succession.

Here is a common example of such a scenario that can occur in many parts of southern Ontario. Landowners and forest managers may wish to manage stands using silvicultural prescriptions that encourage the reproduction, regeneration, and growth of red oak. This species has high market and wildlife value and aesthetic appeal to many people. However regeneration and growth requirements naturally restrict it to specific sites that are not widespread throughout a region that is dominated mainly by tolerant hardwood forests comprised of species such as sugar maple and beech. Therefore it is probably unwise (and potentially expensive) to convert these stands or portions of these stands to red oak unless this species is already a dominant component of them and/or the site conditions (e.g., dry, sandy soils) are particularly suitable.

Invasive exotic species

An invasive exotic species is a non-native plant or animal that threatens the survival of native species. Their biological characteristics and/or lack of natural control agents (e.g., insect herbivores) provide them with a competitive advantage over the native species with which they become associated. Some of these species should worry landowners and forest managers because they have demonstrated that they can quickly invade a site, proliferate, and then seriously affect the growth of native vegetation (Nuzzo 2000). For example, in a two-year study , the invasive exotic Japanese honeysuckle had a greater negative impact on the height and diameter growth of sycamore than did the native vine, Virginia creeper (Dillenburg *et al.* 1993). Also, once well established, they are often difficult to eradicate. **Table 4.2.1** lists the trees, shrubs, and herbs that most commonly cause problems in the woodlots of southern Ontario.

Due at least in part to this unwanted competition from these exotics, native plant diversity has declined in many stands, particularly those located near urban centers. Some of them (e.g., Norway maple, European and glossy buckthorn, various exotic honeysuckles, garlic mustard) become easily established in these woodlands because these areas provide many of the conditions that favor their introduction: they are often small and fragmented; highly disturbed by roads, and pedestrian and vehicular traffic; and located close to seed sources (e.g., gardens).

Increasing populations of non-native species also alter ecological functions within the forest. For example, a recent study (Whelan and Schmidt 1999) suggests that the decline of songbirds may be linked to increased dominance of forest understories by non-native shrubs. Predation of both robin and thrush nests was higher in the non-native shrubs than in the native shrubs and trees in a 200 ha (500 acre) deciduous woodland preserve near Chicago. At the study site, the non-native honeysuckle shrub had largely replaced the native arrowwood shrub and buckthorn had replaced hawthorn. Birds that nested in non-native shrubs lost more eggs to raccoons and other predators. The researchers speculated that the increased predation was partly due to differences in the physical structure of non-native and native shrubs. For example, buckthorn lacks the sharp thorns of hawthorn, that could deter mammalian predators, and honeysuckle has sturdier branches, that could both help predators climb higher and support nests closer to the ground, where they are more accessible to predators. The researchers also noted a six-fold increase in the number of robins that nested in honeysuckle (from 5 % to more than 30 %), and they speculated that honeysuckle attracts nesting birds because it sometimes leafs out earlier than native shrubs.

Table 4.2.1: Common invasive plants of forested habitats[1] in southern Ontario.

Scientific Name	Common Name
Herbaceous plants	
Aegopodium podagraria	Goutweed
Alliaria petiolata	Garlic Mustard
Chelidonium majus	Celandine*
Hesperis matronalis	Dame's-rocket
Lysimachia nummularia	Moneywort
Trees and shrubs	
Acer negundo	Manitoba Maple
Acer platanoides	Norway Maple
Elaeagnus umbellata	Autumn Olive
Celastrus orbiculatus	Oriental Bittersweet
Cynanchum sp.	Dog-strangling Vine*
Lonicera tatarica	Tartarian Honeysuckle*
Morus alba	White Mulberry*
Populus alba	White Poplar*
Rosa multiflora	Multiflora Rose
Rhamnus cathartica	Common or European Buckthorn
Rhamnus frangula	Glossy Buckthorn
Robinia pseudo-acacia	Black Locust*
Ulmus pumila	Siberian Elm*
Viburnum opulus	European Guelder Rose

[1] Species marked with an asterisk are more common in forest edges.

How to control exotic species

It is often impossible to prevent the introduction of some exotic species. Here are some actions that can reduce the incidence of invasion by these species and sometimes prevent their spread altogether.

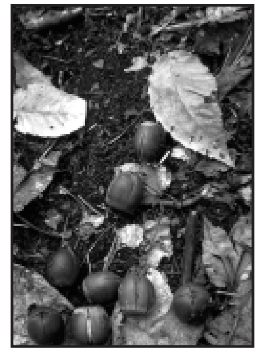
- Avoid or minimize ground disturbance (e.g., from road, trail, landing, and ditch construction; clearing of trees and "brush"; all-terrain vehicle (ATV) traffic) since this encourages the establishment of many invasive exotics.
- Do not take equipment (e.g., tractors, skidders) into a woodlot without hosing off all soil that might be harbouring weed seeds.
- Learn to identify the most serious exotics and then regularly monitor the woodlot and adjacent land.
- Remove plants when they first show up in the woodlot or adjacent to it. This may require cooperation among landowners and the municipality. It is much easier to prevent the establishment of these species rather than try to eliminate them once they have become established. See **Table 8.1.4** for recommended control methods for the most important species.
- If large numbers of them are found on the property, get expert advice before attempting to remove them. Certain removal activities may actually cause populations of some of these species to increase.
- Do not deposit brush from shade-tree trimming or removal or garden plant material in or adjacent to woodlots because this material may have viable seeds.

Conclusion

Many of the forests in southern Ontario are unlikely to ever resemble those of the presettlement landscape. Nevertheless, at the site level, landowners and managers who prudently select and apply the most appropriate silvicultural prescriptions, according to accepted guidelines, will help to improve the structure and native species composition of their managed woodlots, as well as help to prevent the spread of exotic species. Collectively, this conscientious management across the larger landscape could prevent further loss and fragmentation of forest cover where these have become serious problems.

Landowners and managers are more likely to realize these changes if they use silvicultural systems that will provide a broad range of appropriate ecological conditions rather than simplify forest ecosystems by reducing forest structure and species composition. At the very least, they should be aware of how their silvicultural prescriptions are likely to affect these fundamental elements in different types of forest stands. For example, a management directive to thin the canopy may be effectively used to stimulate desirable understory regeneration within a large, natural forest stand, but could be a totally inappropriate activity in smaller, remnant woodlands located in a suburban landscape because it tends to encourage invasion by exotic species and/or disproportionately increase the amount of detrimental edge habitat.

4.3 KNOWLEDGE OF AUTECOLOGY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Autecology refers to the study of the ecology of a single species, including its requirements, tolerances, adaptations to its environment, and responses to environmental changes. It has wider application than the word 'silvics' since this branch of ecology is not limited to the study of tree species. Foresters and silvicultural professionals use the word 'silvics' to refer only to biological characteristics of trees that affect their growth, reproduction, and responses to changes in their environment.

Resource managers should understand the autecology of target tree species and their principle competitors. Autecology tables for most tree species that occur in the forests of southern Ontario are found in **Appendix B**. Forest managers can use these tables, in conjunction with their knowledge of the site (i.e., information from the site/stand inventory and the ecosite description), to help them develop effective prescriptions. They can use this information to create more natural and favorable site and stand conditions; to promote certain species and/or discourage others; to maintain or improve stand quality; and to reduce the level and impact of unnatural disturbance.

For example, the ecological requirements (e.g., nutrients, amount of shade, moisture regime) of the target species can be compared with site inventory data to determine how well the site currently satisfies these requirements and might continue to do so, under each proposed silvicultural prescription.

Then the biological characteristics of the crop and non-crop species can be examined to determine their respective capacities to become established and develop on a particular site. Knowing something about the reproductive biology of these species will enable managers to choose silvicultural prescription(s) best designed to promote desired species and/or discourage undesirable species. For example, if red oak is the crop species, the aspects of its reproductive biology highlighted in **Table 4.3.1** could prove helpful in designing a silvicultural prescription (e.g., using either the shelterwood or group selection system) to promote its regeneration, as described in the table.

The species tables in **Appendix B** provide a basis for prescribing treatments that meet other silvicultural objectives, besides regeneration. For example, an understanding of how target species will likely respond to proposed silvicultural prescriptions that encourage production of high-quality saw- and veneer logs can be determined. **Appendix B** provides information on a species' response to release (i.e., by selective thinning treatments). Returning to the red oak example, managers know that oak responds best if the first thinning of trees in the codominant or above-average intermediate crown classes occurs before trees are less than 30-years-old (trees will still respond well to thinning in later years). Therefore, when considering thinning in an even-aged stand dominated by red oak, the first thinning should be timed accordingly.

Table 4.3.1: Autecology of red oak influencing silvicultural prescriptions for regeneration.

Autecological traits of red oak	Application to silvicultural prescription
Sexual reproduction (e.g., acorn production)	
• larger acorn crops are not usually produced until trees are 50-years-old • most mature acorns are shed during September to October • bumper crops of acorns are usually produced on 3-5 year cycles • some trees are inherently better acorn producers than others on the same site • best seed-producing trees have: diameters of 40 - 60 cm DBH; large, healthy crowns exposed to full sunlight; straight boles; and, exhibit faster growth	Tailor silvicultural prescriptions to improve acorn production by: • identifying the better seed-producing trees (i.e., before the first cut in shelterwood, and in areas of the stand where single-tree selection thinning occurs adjacent to future planned group openings) • retaining a mixture of these trees (i.e., after the shelterwood's removal cut and in areas of the stand adjacent to freshly-made group openings) • increasing the exposure of these crowns to sunlight by thinning • making both regeneration cuts (in shelterwood system) and group openings (in group selection) in a good year for acorn production to ensure adequate seed in spite of insect and animal predation • encouraging regeneration of the best identified seed producers
Asexual reproduction (e.g., sprouting)	
• stump sprouting potential and growth of sprouts decreases with parent tree age • red oak is a prolific sprouter to about 60 years of age • red oaks > 50 cm DBH sprout infrequently • stump sprouts from buds at or near the ground are more likely to survive and produce a straight stem of good quality than sprouts originating from higher up near the root collar • height growth of sprouts is much greater than that of true seedlings • heavily shaded advanced reproduction and stressed trees exhibit decreased sprouting ability	Tailor silvicultural prescriptions to compensate for deficiencies in the amount of seedling-origin red oak advanced reproduction by: • enhancing and exploiting the sprouting potential of red oak stumps and seedlings • cutting small trees (< 50 cm DBH) that are removed in the "thinning from below" low to the ground (ideally in snow-less conditions) to encourage sprouting
Seedling light requirements	
• best growth at 30 % of full sunlight	Tailor silvicultural prescriptions to provide optimal light requirements by: • retaining a 60 - 70 % residual crown closure following the regeneration or seed cut when using the shelterwood system • creating a canopy gap diameter size of 1X tree height for south-facing openings and 2X tree height for north-facing openings (see **Table 6.1.10**) when using the group selection system
Response to disturbance and competing species	

• sprouts will originate from buds near the root collar on seedlings that experience complete shoot kill due to environmental conditions (e.g., fire, frost damage)
• sprouting (from cut stems) ability of competitor species (e.g., maples) can affect oak regeneration, but these species are usually unable to sprout following fire
	Tailor silvicultural prescriptions to control competing understory vegetation by:
	• enhancing both the ability of new red oak seedlings to become established and discouraging the growth of competing maple species, for example:
	  • prescribing fire or selective herbicide application to release established red oak seedlings and sprouts
	  • avoiding mechanical cutting that would stimulate sprouting and increase density and vigor of competing maples

Predicting response to disturbance (e.g., from silvicultural treatments) requires some knowledge of forest ecology, especially the autecology of crop and non-crop species, existing site conditions, and potential changes in site conditions resulting from a specific activity or disturbance. For example, to understand the response of crop and non-crop species in a forest stand consisting of tolerant and/or mid-tolerant species that will undergo some partial cutting (e.g., single-tree or group selection), managers should know as much as possible about the following ecological factors.

- Current site/stand conditions that can influence impacts of the disturbance (i.e., cutting) on site and stand (e.g., drainage, soil moisture regime, species composition in the vicinity of the proposed cutting, presence of adjacent seed trees).
- Potential changes in existing site conditions due to the nature, scale, and timing of this disturbance. Potential microclimatic changes provide a good example. Increased sunlight could lead to greater soil and seed desiccation. Increases in air movement and temperature extremes of air, soil surface, and seedbed might have negative impacts on seed germination. Group selection openings or patch cuts in low-lying areas may create a frost pocket where regenerating seedlings can be damaged by late spring frost events. Changes to the microsite that affect the infiltration of water might alter the water table. Changes resulting in exposed mineral soil and organic material, or soil compaction and rutting could change the availability and cycling of essential nutrients.
- Autecological characteristics of crop and non-crop species concerning their response to these changes described above, particularly as they affect the ability of these species to reproduce, regenerate, and compete.

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4.4 CONSERVATION OF WILDLIFE HABITAT

Many species of wildlife depend on forest cover. Some knowledge of the habitat requirements of selected mammals, birds, reptiles, amphibians, and certain guilds of species (e.g., forest songbirds) makes possible the selection of silvicultural prescriptions and management activities that can safeguard significant wildlife habitats in forest stands or at least minimize damage to them. This information can help managers and landowners to:

- identify significant features within a stand, such as a population of a regionally rare plant
- time the implementation of forest activities so as to cause a minimum of disturbance to a habitat
- determine the most critical habitat components that should be maintained for a species (e.g., a movement corridor linking a winter deer yard area to the summer range)
- identify potential silvicultural treatments that could be used to improve or restore a specific wildlife habitat within a stand
- recommend potential mitigation strategies to minimize habitat degradation or loss

Even when wildlife habitat conservation is not a primary management objective, forest managers should try to find out what significant habitats and species might be found in the forest stands under their management and then tailor their prescriptions to avoid harming them. Often OMNR ecologists and biologists, as well as local experts, can provide much of this information.

Although much remains to be learned about the critical habitat requirements of many species, adherence whenever possible to two basic guidelines will help managers to conserve wildlife habitat associated with forested areas.

1. First, silvicultural prescriptions that provide as much continuous forest cover as possible are likely to meet the habitat requirements of a greater number of forest species than prescriptions that increase fragmentation and the amount of forest edge.
2. Second, more conservative and stringent regulations on harvesting (**Section 8.3**) should lead to less disruption of forest ecosystems and retention of more wildlife habitat than lax regulations.

Regional approach

Forest managers and landowners can contribute to wildlife conservation by adopting a larger, regional perspective to all their planning and management activities. Using this approach, the stand to be managed is regarded within the broader landscape context, not in isolation from other stands. Knowledge of the overall landscape (e.g., percent of forest cover, age and distribution of stands, presence of significant species depending on selected forest types, regional wildlife movement) can be incorporated into silvicultural prescriptions to try to maintain a diversity of forest types, at different successional stages, with broad corridors of native vegetation connecting as many of them as possible.

For example, certain songbird species appear to require forest habitats of a minimum size for their long-term survival; once the area of their habitat falls below this minimum size, their populations begin to dwindle due to losses from predation, nest parasitism, and other unknown causes that reduce breeding and nesting success (Freemark 1989; Robinson *et al.* 1995). Unfortunately, in many parts of southern Ontario, remaining forest stands may not be sustaining current populations of these songbirds. Wherever such birds are found, resource managers and landowners should consider not only the effects of their management activities on these birds, but also potential impacts of their decisions on other stands within the region. Furthermore they should also be aware of possible impacts on their stands resulting from the management of adjacent tracts of forest.

Every silvicultural system has at least some negative impacts on the physical environment and wildlife habitat. Therefore, managers should always encourage the strict protection of wildlife habitat features in forest stands with regionally significant conservation value. Many of these areas have already been identified (e.g., Areas of Natural and Scientific Interest (ANSIs), Environmentally Sensitive Areas (ESAs), potential old-growth stands) and management plans should recognize them (i.e., they would be mapped and described) and state clearly that no silvicultural activities should occur in them, unless required for the maintenance of a particular habitat or successional stage. Relatively undisturbed, potential old-growth stands, should be allowed to undergo natural succession because of their value to so many wildlife species, especially numerous species of conservation concern, and their value as benchmarks for scientific research.

Landowners and forest managers can contribute greatly to wildlife habitat conservation at the local level as well. In most parts of southern Ontario, many stands are small, forested islands that are surrounded by croplands, roads, and residential development. But, these habitats are probably incapable of supporting much wildlife over the long-term due to their small size, isolation, greater susceptibility to human impacts, and the adjacent landscape. However managers could consider enhancing larger stands (e.g., those greater than 10 ha) that are situated amid a more natural landscape, by using silvicultural prescriptions to improve forest structure and composition, minimize edge habitat, and where feasible, establish linkages to other forest stands. In addition, managers could work at the local level to restore natural forest cover to suitable sites. They might identify critical areas such as potential linkages among remaining forest stands or gaps within stands, and then allow them to mature or regenerate to forest cover.

Some important forest habitats

The forests of southern Ontario provide several general types of wildlife habitat. These habitat types are described below. Recognizing them can help landowners and forest managers to identify them more easily and then tailor silvicultural prescriptions to protect or minimize damage to them.

Seasonal concentration areas

At certain times of the year, some species and species guilds (e.g., forest songbirds, amphibians) concentrate in certain areas at relatively high densities. Whenever possible, these habitats should be protected because their degradation can result in the loss of high numbers of the animals that depend on them, and local populations of some species could be severely reduced. For example, a pond within a woodlot might provide the only breeding habitat for the majority, if not all of the frogs and salamanders in the stand. Most of these amphibians are unable to move large distances, especially across open areas, to find other breeding ponds. Therefore if local populations of these animals are to be protected, it is essential that management plans identify these areas as significant wildlife habitat, and then ensure that any silvicultural activities at any time of the year will not result in their degradation or loss. Also the plan might state that the implementation of the selected silvicultural prescriptions must not lead to loss of riparian vegetation or corridors for amphibians to move to and from their breeding ponds, or adversely affect the hydrology of the pond and surrounding area.

Guidelines for protection of specific habitats have been developed by the OMNR, and these should be included in forest management plans. Examples of well-known seasonal wildlife concentration habitats that are found in forests, and for which OMNR guidelines have been developed, include winter deer yards (Voigt *et al.* 1997), moose habitat (OMNR 1988), and colonial bird nesting sites such as heronries (Bowman and Siderius 1984).

Other seasonal concentration habitats in southern Ontario are not as well known or studied. Examples of these include amphibian woodland breeding ponds, landbird migration stopover areas, reptile hibernacula, and wild turkey winter-feeding and roosting areas. Several OMNR documents provide habitat management recommendations that could be applied to some of these habitats. For example:

- protection and management of spring, seepages, and intermittent streams could be applied to amphibian woodland breeding ponds and winter wild turkey habitat (Naylor 1998)
- protection and management of conifer stands providing thermal cover for white-tailed deer (Voigt *et al.* 1997) could be applied to wild turkey winter feeding and roosting areas

Some of these habitats that are found in the forests of southern Ontario are briefly described below. See **Table 4.4.1** for additional details, as well as suggestions for how these habitats should be treated while implementing silvicultural prescriptions.

Amphibian woodland breeding ponds

Most amphibians need water to reproduce (e.g., American toad, spring peeper, gray treefrog, wood frog, blue-spotted salamander, red-spotted newt). Swamps, marshes, and weedy shorelines of waterbodies are prime breeding areas. Other important breeding habitat is found within wooded areas, usually in wet depressions and groundwater seepage areas. Critical habitat components include ponds free of predatory fish that, in most years, retain enough shallow, unpolluted water for the duration of the spring breeding season. Emergent and submergent vegetation, both herbaceous and woody, in and around ponds provide sites for calling and egg laying, as well as escape cover. The surrounding forest habitat with an essentially closed canopy provides a shaded, moist understory environment for the pond and its environs that prevents excessive growth of algae and different plant species, and premature drying up of the pond. Abundant downed woody debris supplies cover habitat for more terrestrial amphibians.

Landowners and forest managers can help to protect local populations of amphibians by using only silvicultural prescriptions that will retain the hydrology of the breeding pond (i.e., preserve water level), maintain the key habitat components previously mentioned, and not isolate the breeding pond from summer or winter habitat. Again, the importance of preventing the fragmentation of existing forest cover is evident. Management plans should identify important breeding ponds and clearly state that trees in the vicinity of the pond should not be felled. A no-cut buffer of one tree length (20 to 30 m) will usually suffice but should be evaluated on a site-specific basis.

Landbird migration stopover areas

Large numbers of migrating birds move along the shorelines of the Great Lakes, stopping to rest, feed, and/or wait for inclement weather to pass before attempting to cross open water. They require a variety of relatively undisturbed habitat types, ranging from open fields to mature forests, because each species has different habitat requirements. Forested habitats within five kilometers of the Great Lakes (e.g., especially Lake Erie and Lake Ontario) are particularly important because they provide roosting areas, cover from predators and foul weather, and food for large numbers of many migratory species. Landowners and managers can help to protect important migratory stopover areas by using silvicultural approaches such as partial cutting to maintain forested land, especially along watercourses and in areas where little woodland remains, and to encourage tree species diversity and structural complexity of stands.

Reptile habitat

Many snake species (e.g., garter snake, redbelly snake, brown snake, milk snake, black rat snake) hibernate in woodlands. Hibernacula are often found in areas with cliffs, talus slopes, broken or fissured rock, and burrows that allow snakes and reptiles to get below the frost line. Associated loafing trees and logs that provide shelter in spring and fall also may be important. Additionally, several snakes, including milk snake and black rat snake commonly lay their eggs in the rotting wood of stumps and fallen logs, and seek out these, as well as hollow trees. Thus retention of cavity trees and abundant downed woody material is critical to them. In general, larger stands (i.e., greater than 20 ha) with an interior of mature forest are likely to provide more favorable conditions than small, narrow, or younger woodlots.

Silvicultural prescriptions should recognize the importance of these key habitat features described above, especially downed woody debris. Management plans specify that known hibernacula be protected, and that woody debris greater than a certain size be left as it is, and not be removed or converted to smaller slash. Hollow logs in particular should be left intact, whether standing or fallen. In this way reptile hibernation and gestation sites might be protected and even created. Management of the stand should not result in its fragmentation; although skid trails may be constructed and trees will be removed, the continuous nature of the woodlot should remain intact. This is important to allow snakes to move freely between their summer range and hibernacula. Also prescriptions should try to maintain the relatively stable microclimate of the forest interior by not opening up the overstory canopy too much.

Wild turkey winter range

As winter temperatures decrease and snow accumulates, wild turkeys concentrate in areas with conifer cover. Specific habitat components include mature coniferous trees for roosts (e.g., hemlock, white pine), preferably located next to agricultural fields; sufficient conifer cover to minimize ground accumulation of snow, permitting movement by birds; and spring seeps that reduce snow depths and provide additional food and water.

Silvicultural prescriptions that promote mature conifers, especially hemlocks; protect existing conifer cover, particularly adjacent to agricultural fields and in valleys; and maintain spring seeps can help the overwinter survival of these birds. If forestry activities result in loss of conifer cover, long-term mitigation might result from tree planting designed to enlarge existing areas of cover or reforest recently harvested areas. Over the short-term, planting trees around seeps located in open areas might make them more attractive to turkeys and other wildlife, but should only be undertaken if it is clear that the planted trees will not dry up the seep.

Specialized wildlife habitats

Specialized wildlife habitats include habitats for wildlife with special requirements (e.g., specific nesting, feeding, or seasonal needs). Many specialized habitats are found along the shorelines of waterbodies (e.g., mink and otter feeding and denning sites, moose aquatic feeding and calving areas, and bald eagle and osprey nesting habitat). Key habitat components vary among species (see **Table 4.4.1)** but in general, lack of human disturbance is important. Therefore, where these specialized habitats have been identified or could potentially exist, landowners and managers are urged to refrain from harvest activities during the breeding and nesting seasons. Also buffer zones, to reduce the disturbances (e.g., from machinery noise, habitat loss, presence of people) to these habitats, should be designated and respected. In addition, silvicultural prescriptions that encourage the growth and retention of large trees, especially conifers, along or near shorelines, and downed woody debris, will further enhance the wildlife habitat value of these areas.

Many of the species dependent on specialized habitats, such as raptors (e.g., red-shouldered hawk) and some of the bigger mammals (e.g., fisher, black bear) are known as “area sensitive or dependent species”. These animals require larger (at least 200 ha), more continuous tracts of forest, often with a high degree of canopy closure, to sustain their populations (Environment Canada *et al.* 1998).

In areas of southern Ontario, such as the Frontenac Axis and Grey and Bruce Counties, where remaining forest cover is relatively high, landowners and managers can contribute to the conservation of these species (and many others) by maintaining current levels of forest cover and discouraging stand fragmentation. Silvicultural prescriptions could be designed to encourage key features of the habitat for these species such as foraging areas (e.g., by retaining mast-producing trees) and denning habitat for fisher and other mammals (e.g., by encouraging growth and retention of trees larger than 40 cm DBH). In areas such as southwestern Ontario where little forest cover remains, they could adopt a long-term approach and focus on connecting significant forest fragments through reforestation and restoration efforts. Over time, colonization of suitable habitats by these species would become a real possibility.

The OMNR has produced or is in the process of developing guidelines for the protection and management of many of these habitats including raptor nesting habitat, moose calving and aquatic feeding areas, foraging areas with mast species, cavity trees and snags, supercanopy trees, springs and seeps, scattered conifers in hardwood stands, scattered hardwoods in conifer stands, and lake shorelines and other riparian areas. Landowners and managers are encouraged to ask OMNR ecologists for more specific information.

Mast-producing trees

Although red oak is probably the most important hard mast-producing tree in southern Ontario, other important mast trees include white oak, black oak, bur oak, swamp white oak, hickories, beech, black walnut, butternut, American hazelnut, and ironwood. Codominant and dominant trees with large, relatively round and vigorous crowns usually produce the most mast. Many species of wildlife prefer white oak and American beech, but red oak normally produces mast at an earlier age and in larger quantities than white oak. Hickories have more frequent good seed crops than oaks.

Whenever possible, landowners and managers should retain a variety of mast-producing tree species to support a greater diversity of wildlife species and ensure a relatively continuous supply of mast. Naylor (1998, 1999) recommend at least seven to eight good mast producers per hectare at a spacing distance of less than 50 meters between the same species, to ensure successful pollination and seed-set. Additionally, managers might consider creating openings to encourage soft mast-producing species such as cherries, grapes, elderberries, and raspberries.

Cavity trees

Cavities are found in dead trees, snags, and live trees (often culls). A valuable cavity tree for wildlife has the following characteristics:

- a healthy crown and the potential to survive at least through the next cutting cycle
- a cavity that stays dry (i.e., rainwater cannot enter it)
- the potential to provide several benefits for wildlife (e.g., mast production, nest tree, multiple cavities)
- evidence of current use (e.g., fur and claw marks, gnawing around entrance)

Since snag formation and decline of living trees are usually slow processes, intensive timber management over a 20-year period can reduce the amount of cavity habitat to a very low level (Tubbs 1977; Trimble 1963 *in* Anderson and Rice 1993). Therefore thinning operations should not drastically reduce the number of existing or future cavity trees in a stand. Retained cavity trees should not constitute a safety hazard, as defined by the *Occupational Health and Safety Act* (R.S.O. 1990). Major visible defects such as butt rot, large wounds, seams, dead limbs, or dead tops are important indicators of potential cavity and foraging sites (Anderson and Rice 1993).

Current OMNR guidelines (Naylor *et al.* 1996; James 1983 *in* Naylor 1994) recommend retaining:

- six cavity trees per hectare in all shelterwood and seed tree cuts. If six trees cannot be found, the guidelines suggest leaving trees that have a high potential to become cavity trees, for example, those with advanced heart rot
- at least one cavity tree per ha with a minimum 50 cm DBH, with the other cavity trees with DBH measurements between 25 and 50 cm
- cavities in living tree species with dense wood (e.g., maples, oaks) because they will last longer than those in tree species with softer wood (e.g., poplars)
- a uniform distribution of cavity trees throughout the stand (but not within a given hectare)
- cavity trees providing multiple benefits (e.g., cavities and mast)
- a diversity of hardwood and softwood trees with cavities that will benefit a range of wildlife species.

More specifically the order of priority for selection of cavity trees is listed below, as recommended by Naylor *et al.* (1996):

1st Pileated woodpecker roost or nest trees.
2nd Trees with nest cavities of other woodpeckers or natural nest or den cavities for any species.
3rd Trees with escape cavities.
4th Trees with feeding excavations.
5th Trees with the potential to develop cavities.

Stick nest trees

A variety of large bird species (e.g., hawks, owls, ravens, crows) nests in the forests of southern Ontario. Nests are usually located in large-diameter, living trees with forks or crotches that are capable of supporting a big stick nest. Since suitable nest trees are often in short supply, landowners and managers should try to retain all trees containing stick nests. In addition, the retention of at least one forked tree per 10 ha might ensure an adequate number of future nesting sites for these birds. OMNR guidelines (Szuba and Naylor 1998) recommend leaving at least one tree-length reserve around active nests. Additional protective measures may be needed, depending on the species.

Supercanopy

These are living trees whose crowns (i.e., tops) stick up above the main canopy of the forest. They are valuable to large raptors such as bald eagles and ospreys for nesting and perching and may be used by black bears as refuge trees and bedding sites. Managers should keep at least one supercanopy tree (usually > 60 cm DBH) or potential supercanopy tree for every two hectares. These can be the same ones as those identified as “large-diameter” trees if tall enough.

Downed woody debris

Downed woody debris refers to fallen trees, limbs and branches, and their remains, found on the forest floor. This organic material provides important habitat for fungi, reptiles, amphibians, small mammals, invertebrates, and bacteria. As the wood decays, it returns nutrients to the forest soil and creates and maintains the fertile, moist conditions that many tree and herbaceous species need to grow. Some tree species, such as yellow birch and hemlock commonly regenerate on rotting logs and stumps.

Research by Goodburn and Lorimer (1998) found more downed woody debris in old-growth stands (99 m^3/ha) than in managed stands (60m^3/ha). Kurzava and Mladenoff (1999) discovered fewer fruiting bodies of polyporoid and coricoid fungi species per unit area in managed stands than in old-growth stands. Although small - and medium-sized mammalian predators were more abundant in managed stands, amphibians were more common in old-growth stands. Also species composition of ground-dwelling beetles was found to be more sensitive to forest habitat and management regime than was overall abundance or species richness Kurzava and Mladenoff (1999).

Shorelines, springs, and seeps

These areas and their associated riparian vegetation often constitute highly significant wildlife habitat for numerous plants and animals. In addition, they are frequently sensitive environments that could be seriously harmed by various silvicultural activities. Therefore they should be considered for protection, and roads and skid trails should not be established in these areas. If cutting is unavoidable, thinnings should be light with felled trees removed by winching. Also managers should retain at least 70 % canopy closure to maintain current levels of shade and existing water temperatures.

Habitats of species of conservation concern

Species of conservation concern include endangered, threatened, vulnerable, or rare species; species currently experiencing significant population declines in the province; or species of importance to a local region. Currently, in southern Ontario, 82 % of the species provincially listed as vulnerable, threatened, or endangered (often referred to as VTE species), excluding fish, occur on private lands (D. Sutherland and W. Bakowsky, OMNR, personal communication, 1998).

Numerous species of conservation concern are found in the forests of southern Ontario. A few examples are briefly discussed below (see **Table 4.4.1 to 4.4.4**). Landowners and managers can help to conserve them by first determining which species are known to occur or could potentially occur in regional forests. Then they can learn about their specific habitat requirements and how selected silvicultural activities might be used to benefit these species. OMNR district ecologists can provide some of this information. Recovery plans have been written for some of these species and can help forest managers who want to protect or restore their habitat. Copies of recovery plans may be obtained from OMNR district ecologists.

Rare/uncommon tree species and associations

Some forest stands, particularly in southwestern Ontario, support provincially rare, threatened or endangered tree, shrub, and herbaceous species (**Tables 4.4.2 to 4.4.4**). As well, in many municipalities in southern Ontario, there are woodlots comprised of trees, tree associations, and successional stages that are uncommon and/or poorly represented in the surrounding region (**Table 4.4.5**).

Landowners and forest managers can promote the conservation of these significant species and associations in several ways. Their management plans could state that all such tree and shrub species should not be cut and no-cut buffer zones could be designated. In addition, managers could use silvicultural prescriptions promoting the natural regeneration of tree species that are at the edge of their natural range, using these remnant seed tree populations.

Southern flying squirrel

Southern flying squirrels build nests in hollow trees created by heart rot and holes made by woodpeckers. Prime habitat for these animals consists of mature deciduous forests, particularly those comprised of maple, beech, and oak that produce an abundance of foods such as tree seeds, nut crops, and mushrooms. Preferred woodlots are relatively large (i.e., at least 20 ha) and usually have numerous trees over 20 m high with advanced heart rot.

In order to protect the habitat of this species, silvicultural prescriptions should not reduce the size or change the composition of mature deciduous woodlots. Thinning, especially of mast-producing species such as oak and beech, should not significantly reduce food supplies for these animals. Management plans for woodlots supporting these mammals should state that sufficient cavity/nest trees must be retained and that older trees be allowed to age to replace nest trees that will eventually fall down.

Since southern flying squirrels are difficult to identify, any flying squirrel should be assumed to be this species of concern. They can be found by tapping cavity trees, using flashlights after dark to detect their eyeshine, listening for their high-pitched calls, and mist-netting (a permit for netting will be required from the OMNR or the Canadian Wildlife Service).

Woodland raptors

A variety of raptors found in woodlands of southern Ontario are species of conservation concern (e.g., Cooper's hawk, northern goshawk, sharp-shinned hawk, red-shouldered hawk, broad-winged hawk, and barred owl), due largely to forest fragmentation and their dependence on larger tracts of continuous forest cover. These birds also tend to be relatively intolerant of human disturbance, particularly at the nest site.

Silvicultural prescriptions should encourage the recovery of local populations of these species by retaining the area of existing forest cover, avoiding further fragmentation of woodlots, and minimizing disturbance to nesting areas. In addition, management plans should recognize that:

- large trees provide potential nest sites for many of these species
- a large increase in regeneration can make hunting more difficult within the stand for species such as the accipiters, red-shouldered hawk, and barred owl
- sufficient canopy closure is important to many species

- opening woodlots up by heavy thinning could subject rarer red-shouldered hawks to direct competition from red-tailed hawks which can displace this more sensitive species
- downed woody debris provides cover for prey species such as small mammals and amphibians
- barred owls require cavity trees
- many raptors use supercanopy trees for perches and nests
- decadent trees and snags are important habitat features for raptors

Forest interior birds

This guild of birds is also vulnerable to forest fragmentation because most species require larger, continuous forest tracts for long-term survival. Some are also VTE species and found in southern Ontario including: Acadian flycatcher, red-shouldered hawk, cerulean warbler, prothonotary warbler, Louisiana waterthrush, and hooded warbler. Other forest interior birds are considered species of conservation concern, depending on the listing authority, and the status of the birds within a given part of the province.

The habitat requirements of these species are variable and complex. But in general, they tend to avoid forest edges, and prefer to nest in the interior of a stand. Landowners with habitat for species of conservation concern are strongly encouraged to include its maintenance and protection as an objective in a management plan. Also they are advised to seek the advice of OMNR district ecologists and local experts before developing a management plan. Once again, silvicultural prescriptions should discourage forest fragmentation and the creation of edge habitat, and encourage the development of structural diversity within the stand (e.g., downed woody debris, large mature trees, snags). In areas facing severe white-tailed deer browsing pressure, silvicultural practices should discourage foraging by this mammal because it prevents regeneration of the shrub and tree sapling layer, critical habitat for the survival of many birds of the forest interior.

Recent studies from southwestern Ontario (McCracken 1999) suggest that some forest interior bird species, including the endangered Acadian flycatcher, and the wood thrush, veery, scarlet tanager, cerulean warbler, and American redstart prefer to nest in parts of the forest with a high basal area of large-diameter size trees. This finding suggests there may be some advantage to maintaining large- and extra-large sawlog size trees in close proximity to each other as well as the opportunity for future revenue from large veneer-quality trees.

Animal movement corridors

Movement corridors are essential to sustain long-term populations of many wildlife species because they permit animals to move safely across the landscape, between different parts of their habitat and also provide opportunities for the future re-colonization of an area. Many types of habitat (e.g., wetlands, woodlands, old fields, fencerows, creeks, shorelines, unopened road allowances, railroads) function as movement corridors. They are found at both the local and regional scales and often encompass a variety of different terrains.

Forest management plans should identify all known and potential movement corridors. Consultation with OMNR district ecologists and biologists and local experts might help managers to identify significant corridors. Important wildlife habitats might be identified and then corridors linking habitats can be designated. Corridors could be mapped and included within the management plan for the forest.

For example, in parts of southern Ontario where significant snow depth occurs, areas of conifer cover are important for the winter survival of white-tailed deer, numerous small mammals, and wild turkeys. These animals must be able to move safely to this habitat from their summer range. However, many animals prefer to travel through wooded areas to reach them and will not cross large open landscapes. Landowners and managers can use topographical maps and aerial photographs to identify potential corridors and areas of conifer cover in the vicinity of the managed stand.

Landowners and forest managers can contribute to the conservation of animal movement corridors in several ways. First they can ensure that their silvicultural activities will not sever existing links between key habitats both within and outside the management area.

Second, they can ensure that their silvicultural prescriptions do not result in further fragmentation of forest cover, particularly in stands known to provide significant wildlife habitat for forest species (e.g., woodland raptors, area sensitive songbirds, southern flying squirrel, some amphibians). Even within a stand, when large openings are created, some small mammals and amphibians may be reluctant to cross these areas.

Third, they can try to connect, through the restoration of natural forest vegetation, the most ecologically significant, remaining forest stands that were once probably contiguous at an earlier time. In southern Ontario, many of these stands have already been identified (e.g., ANSIs, ESAs). OMNR district ecologists can provide specific information about the conservation value of many of these sites.