HABITAT MANAGEMENT GUIDELINES
FOR WARBLERS OF ONTARIO'S
NORTHERN CONIFEROUS FORESTS, MIXED FORESTS
OR SOUTHERN HARDWOOD FORESTS

ONTARIO MINISTRY OF NATURAL RESOURCES

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Introduction

It has been stated that "if it were not for birds, no human being could live on earth, for the insects upon which they live would destroy all vegetation" (Henderson 1927). With few exceptions the conclusions of hundreds of studies is that birds do act as important components of natural biological control (Thomas et al. 1979a), lending considerable support to the vital role of insectivorus birds in forest ecosystems. Species such as the Cape May warbler and the Bay-breasted warbler are apparently even adapted to taking advantage of local outbreaks of abundant insects such as spruce budworm. They congregate in such areas, lay larger clutches of eggs than other warblers and increase faster in response to insect populations (MacArthur 1958).

Because migrant warblers make up the great majority of the breeding population in forest habitats, there is a special urgency to keep their needs in mind when planning forest management (Kendeigh 1947, Whitcomb 1977, Bury et al. 1980, Anderson and Robbins 1982). However, in most instances the needs of these warblers can easily be accommodated in normal logging practices. Several studies have indicated that within a few years of even severe logging (ie., clearcutting) the density and diversity of bird species in an area is equal to that prior to logging (Hagar 1960, Webb et al. 1977, Noon et al. 1979, Freedman et al. 1981). But the difference is that the species composition of these cut areas has changed. Species requiring more mature forest have been replaced by those preferring the pioneering stages of succession.

A few species, particularly those that are area sensitive and those requiring an old-growth component, need special consideration if they are to survive. Proper management now means that in future it will not be necessary to undertake costly recovery programs for single species. The majority of species will be little affected by management for the specialist (Webb et al. 1977).

A national trend toward greater urbanization, a tremendous increase in the noncomsumptive use of wildlife, and the recognition of the need for consideration of entire forest communities for the maximum health of those habitats, have increased the demand for nongame planning and research. Any agency making decisions that affect our forests should be responsive to these changing realizations (Evans 1978, Bury et al. 1980, Filion et al. 1983).

Factors Affecting Management Considerations

Pesticides

Insect populations have an innate capacity for tremendous growth within a short period of time. The application of chemical pesticides does not result in complete destruction of insect pests, and hence must be repeatedly applied at considerable expense in order to contain outbreaks (Kendeigh 1947, Takekawa et al. 1982). Moreover, the continued use of pesticides in the long term results in the evolution of genetically resistant strains of insects, making the continued use of poisons even less effective. At the same time the natural predators of insects suffer considerable mortality and become much less effective in controlling the pests (Rudd 1964, Miller and Varty 1975, Varty 1975, Comins 1979). The use of pesticides within forests, then, may prolong outbreaks and shorten the period between insect eruptions (Blais 1974, Holling et al. 1979, Takekawa et al. 1982).

Perhaps it is useful to note that most chemical insecticide manufacturers are based in the United States, and thus management with insecticides has been strongly encouraged in North America. In Europe management of forests for songbird predators has been used for centuries to increase avian predation on forest insects (Takekawa et al. 1982).

The Role of Birds in Insect Control

As long ago as the 1300's, European countries passed laws to provide specific habitat requirements for insectivorous birds in an effort to control destructive insects. Habitat manipulations have been shown to affect populations of birds by a five to twenty (5-20) fold increase in density (Otvos 1979, Takekawa et al. 1982). Documented cases have shown that where birds were artificially increased, outbreaks of forest insects were prevented, even on forests immediately adjacent to those with outbreaks (Takekawa et al. 1982). However, those manipulations are practiced in relatively small forest areas and rely in part on the provision of nest boxes for cavity-nesting birds. Although the provision of nest boxes is of no benefit to warblers, there is no doubt that habitat improvement for insectivorous warblers would greatly assist in the control of forest insect pests.

The conclusion of hundreds of studies is that birds act as important components of natural biological control at endemic insect levels, and that in some circumstances may act as a major cause of a suppression of a major outbreak (Thomas et al. 1979a, Takekawa et al. 1982). Most studies agree that the role of birds is in the prevention rather than the suppression of insect epidemics. During an outbreak, the reproductive potential of insects is so great that it literally overwhelms the birds ability to act as an effective control (Kendeigh 1947, Otvos 1979, Thomas et al. 1979a, Takekawa et al. 1982).

The diet of insectivorous birds may be more than eighty percent (80%) destructive forest insects (Takekawa et al. 1982). They have been proven to reduce significantly the numbers of insects in forests (by as much as eighty or ninety percent [80, 90%]) (Holmes et al. 1979, Takekawa et al. 1982). One study indicated that for a comparable reduction of insects by chemical means would have cost $3770 per square mile in an outbreak year, and this did not include the long term effects of birds in reducing insects prior to the outbreak. The benefits of successful biological control can be enormous particularly in the long run (Takekawa et al. 1982). On the scale of the mixed and boreal forests of Ontario, it may be far more economical in the long run to manipulate habitat for insectivorous birds than to attempt chemical control of insect pests.

Birds are able to survive in areas without high concentrations of one particular insect pest. They may, therefore, be able to prevent outbreaks more readily than other natural enemies such as parasites or pathogens that tend to be host specific. Birds are mobile and concentrate where insects are abundant, contributing to the suppression of outbreaks (Otvos 1979). Birds are selective in their consumption of insects in that they are known to eat nonparasitized insects and thus not compete with other natural controls (Buckner and Turnock 1965, Coppel and Sloan 1971, Sloan and Simmons 1973, Schlichter 1978). Birds may aid in the spread of viruses that attack forest insects (Entwhistle et al. 1977a, 1977b). But in order for birds to buffer insect epidemics, they must be maintained at sufficient population levels by the provision of habitat requirements (Evans and Connor 1979).

Logs and Slash

Logs on the forest floor are a valuable component of a woodland (Maser et al. 1979). They are used by numerous birds as lookout posts, as drumming sites, as thermal shelter in winter and by woodpeckers as food sources. They also contribute to nutrient recycling as does logging slash. Slash also provides cover and perches for many small vertebrates. The removal of logs and slash or intensive site preparation is not beneficial to warblers (Capen 1979, Dawson 1979).

Habitat Diversity

The provision of diversity in forest ecosystems, that is the provision of adequate areas of all ages from recently cut to mature forest, and of all tree species native to the area, is an objective that is considered to be essential to wildlife management (MacArthur 1964, Willson 1974, Connor and Adkisson 1975, Siderits and Radtke 1977, Webb et al. 1977, Evans 1978, Franzreb and Ohmart 1978, Crawford and Titterington 1979, Jackson 1979, Nilsson 1979, Temple et al. 1979, Thomas 1979, Thomas et al. 1979c, Bury et al. 1980, Luman and Neitro 1980, Anderson and Robbins 1982, Takekawa et al. 1982, Franzreb 1983).

Increasing tree species and age diversity contributes to greater avian diversity and hence better insect control. Emphasis on management for diversity will help ensure the continued existence of all living components of the ecosystem. The provision of diverse habitats is a worthy goal for aesthetic and moral reasons as well as being a worthwhile management practice (Thomas et al. 1979c).

Even-aged management, involving clearcutting of various patches is not necessarily incompatible with wildlife needs. Stands of various ages provide horizontal diversity, edge requirements and different aged stands for different species (Thomas 1979). But the rotation times must be sufficiently long to provide areas mature enough to meet the requirements of some species.

The number of species in pure coniferous forests tends to be low to start with (Capen 1979), but the mixed forests of central Ontario support some of the highest densities of birds in North America (Temple et al. 1979). Forest management that seeks to select for a single species of tree is known to be detrimental to wildlife populations (Nilsson 1979). In addition to failing to supply the diversified habitat necessary for a varied bird population, single-aged monocultures also fail to support an adequate diversity of arthropods to maintain a stable food supply for birds. Birds will tend to avoid such areas as this may actually contribute to insect outbreaks. Single-species forests also make it much easier for species specific arthropods to multiply (Jackson 1979).

However, although the provision of habitat diversity is basic to good wildlife management, specific rare or declining species may require special management to meet their needs (Siderits and Radtke 1977, Stauffer and Best 1980).

Forest Sizes

There are apparently no birds restricted to small forest tracts, although there are many that occur only in large patches (Luman and Neitro 1980). Many local forests thought of as preserves have failed to preserve the species characteristic of extensive communities of the same region (MacClintock et al. 1977). Some birds have become adapted over thousands of years to living in forests of a certain size. If an isolated forest tract is below this minimum size, the species can no longer breed successfully (Diamond 1975, Whitcomb 1977, Robbins 1978, Connor 1979, Robbins 1979, Samson 1980). Geneticists consider population sizes smaller than 1000 to be vulnerable. Hundreds of hectares may be required throughout the rang of a species to assure the long term survival of area sensitive bird species (Whitcomb 1977).

The disappearance of extensive forest tracts of deciduous trees in southern Ontario, south and west of the Canadian Shield has undoubtedly contributed to the almost complete disappearance of several species of insectivorous birds in this region. We should not be concerned with providing woodlots large enough to accommodate only a single pair of birds, but large enough tracts to provide for an entire population. Larger forest patches are essential to maintain a complete regional avifauna (Galli et al. 1976).

Nest predation by jays, grackles, crows and small mammals and increased nest parasitism by brown-headed cowbirds also results from increased forest fragmentation as these birds do not enter or hunt readily in larger forests (Whitcomb 1977).

Migrant birds are also dependent upon finding appropriate patches of habitat as stopover points to build up energy reserves for continuing flights. The ease with which they can locate suitable habitat may determine how well they survive. Larger blocks of habitat will be easier to locate and provide more suitable shelter and food supply (Rippole and Warner 1978).

Edges and Openings

The edges of woodlots, or borders between different aged stands or about forest openings are an integral part of any forest environment. They represent unique places that produce animals not found in any other vegetative association. Yet intensive forest management tends to select against them (Taylor and Taylor 1979). Edges are usually rich in wildlife because species from both adjacent habitats will be found there, and the increased diversity of vegetation there will attract additional species that will be found nowhere else.

Natural edges resulting from changes in soil, drainage and topography are relatively stable, long lasting communities of considerable importance to wildlife and worth preserving (Thomas et al. 1979c). The amount and arrangement of edge are important tools for enhancing wildlife habitat. A mosaic or irregular edge provides more habitat than an abrupt edge.

Understory

Most birds select patchy habitats with well-developed shrub layers. Observations suggest that this understory layer may be the most important factor in determining the numbers of birds present in an area. In insect damaged forests, the maintenance of a semi-open canopy to promote a well developed shrub layer will increase avian densities and contribute to insect suppression (Takekawa et al. 1982).

Riparian Areas

A major threat to some avian species is the loss of forests adjacent to lakes and rivers (Samson 1979, Stauffer and Best 1980). These areas offer water, greater vegetative production because of water and deeper soil conditions, greater vegetative diversity with rapidly changing conditions there and in contrast to adjacent areas. They provide edges and openings essential to some species. In coniferous forests they provide a disproportionately high number of habitat zones because of deciduous vegetation that may be there but not elsewhere, and distinct height layers of vegetation not found in adjacent forest (Thomas et al. 1979b).

Riparian forests are important for the preservation of water quality through control of erosion by wind and water, and thus for the preservation of fish habitat, for the preservation of rare plants, to provide travel lanes for wildlife, escape and thermal cover for numerous terrestrial vertebrates, and they provide a quality gene pool for forest trees (Allan and Bohart 1979). They are worth preserving for a whole host of species, and the bird species diversity making use of them increases with the width of these habitats (Stauffer and Best 1980).

Deciduous Forests

The deciduous forests of Ontario (of maple, beech and other hardwoods), particularly south of the Canadian Shield, are now very limited in extent in comparison to presettlement days. They are in much greater need of preservation and proper management than are the more extensive mixed forests (conifers with birches and poplars) and coniferous boreal forests on the Canadian Shield.

Fir and Hemlock Forests

The greatest potential damage to bird populations through logging in boreal forest regions is through the loss of hemlock trees in the transition from mixed to boreal forests and the loss of balsam fir in the boreal forests. These are the most fertile needle leafed forest communities and support a number of species that are virtually lacking elsewhere (Erskine 1977).

Management for Critical Species

Species that have very specific requirements must be considered carefully as priority species for management procedures if they are to be preserved at present levels or increased in numbers (Webb et al. 1977). The health of a critical species may be a good indicator of the overall health of the ecosystem and the success of management programs.

Legislation

All forest nesting warblers are protected under the provisions of the *Migratory Birds Convention Act of l917*, but their habitats are not protected. Without protection of their breeding habitats, no legislation protecting the birds can be effective.

Minimum Standards

Managers may be tempted to shorten rotation times for forest cutting in an attempt to provide only the minimum standards necessary for the maintenance of the most critically threatened wildlife species. In the long run this may bring about a biological disaster. The provision of only minimum habitat requirements may lead to suboptimal conditions that can lead to low nesting success, and eventual extinction of a population. Continued selection toward minimum standards could shift the genetics of the population, reducing the buffering effects of natural genetics that provide for natural environmental changes (Connor 1979).

But by providing optimum requirements, or at least a range of habitats, some of which exceed the known requirements, we can achieve the goals of multiple use without any gradual negative effect on species we wish to preserve.

Wild Areas

A growing number of people believe that every manager of forests should protect significant and representative areas from all habitat manipulations (Robbins 1979, Temple et al. 1979, Bury et al. 1980, Luman and Neitro 1980).

These areas serve as reservoirs of species that need mature vegetation for survival. They serve as biological indicators against which to measure the effects of various management practices. They provide a quality gene pool for forest tree species. In some instances they may be essential to the survival of some very rare species, or one whose specific habitat requirements we have not yet determined. If for no other reasons than moral and ethical, we should consider some areas inviolate.

The Species and their Requirements

Tennessee Warbler, *Vermivora peregrina*

The Tenneesee warbler breeds throughout the forested portions of northern Ontario, but extend south only to about Algonquin Park.

They are associated primarily with coniferous forests, but also mixed and less often deciduous growth. Coniferous trees of medium to tall heights are necessary, but they also need open forests or edges and openings where deciduous shrubbery is prevalent. They are often found in riparian areas or in swamps, but also in drier forest.

(Kendeigh 1947, Godfrey 1966, Erskine 1977, Dawson 1979, Welsh and Filman 1980, McLaren and McLaren 1981, James et al. 1982a, James et al. 1982b, Peck and James unpubl.).

Nashville Warbler, *Vermivora ruficapilla*

The Nashville warbler breeds across the province north to about Sandy Lake and Moosonee, but is absent from the extreme south and scarce south of the Canadian Shield.

An associate mainly of mixed forests but also coniferous and deciduous woods. Some tree growth is necessary, but they prefer scattered trees and open forests or edges and openings where deciduous shrubs are numerous. The trees may be half grown to mature heights, usually in drier, often rocky sites, but also fen and bog edges.

(Kendeigh 1947, Martin 1960, Godfrey 1966, Erskine 1977, Dawson 1979, James 1979, Temple et al. 1979, Welsh and Filman 1980, McLaren and McLaren 1981, Collins et al. 1982, Peck and James unpubl.).

Northern Parula, *Parula americana*

The Parula warbler breeds across Ontario, north to Lake Nipigon and Lake Abitibi and south to about Algonquin Park, seldom farther south.

They are characteristic of deciduous (maple-beech) forests but also occur in mixed and coniferous forests. They require mature and dense moist upland forests. They are apparently an area sensitive species probably requiring 100 ha (250 ac) or more of continuous forest in order to maintain a viable breeding population.

(Stewart and Robbins 1958, Beals 1960, Godfrey 1966, Erskine 1977, Dawson 1979, Niemi 1979, Noon et al. 1979, Robbins 1979, Samson 1980, Welsh and Filman 1980).

Magnolia Warbler, *Dendroica mangolia*

The Magnolia warbler breeds across northern Ontario, but is sparse north of Fort Albany and Big Trout Lake. In southern Ontario they are confined mainly to the Canadian Shield country.

They occupy mainly mixed and coniferous forests. The trees may be very short to mature, but they must have young coniferous trees usually with dense deciduous shrubs. Thus, if forests are more mature, they prefer open woods, or edges and clearings. They occupy a broad range of tree sizes and heights where coniferous shrubs are present.

(Kendeigh 1947, Stewart and Aldrich 1952, Stewart and Robbins 1958, Martin 1960, Godfrey 1966, Morse 1976, Erskine 1977, Dawson 1979, Noon et al. 1979, Welsh and Filman 1980, Crawford et al. 1981, McLaren and McLaren 1981, Collins et al. 1982, James et al. 1982b, Peck and James unpubl.).

Cape May Warbler , *Dendroica tigrina*

The Cape May warbler breeds across Ontario probably as far north as Sandy Lake and Moosonee and south to the tip of the Bruce Peninsula and Algonquin Park.

They occupy coniferous and mixed forests. They prefer relatively open woods and edges or openings, but also occupy dense forest. Their main requirement is for tall mature coniferous trees.

(Kendeigh 1947, Stewart and Aldrich 952, Bent 1953, MacArthur 1958, Godfrey 1966, Erskine 1977, Titterington et al. 1979, Welsh and Filman 1980).

Black-throated Blue Warbler, *Dendroica caerulescens*

The Black-throated Blue warbler breeds across central Ontario, north to about the latitude of northern Lake Nipigon and south on the Canadian Shield to Kingston.

They are found mainly in deciduous or mixed forest where trees are of older second growth to mature. They require a relatively closed canopy forest, but one with some shrub growth. Hemlocks are preferred in mixed forests.

(Bent 1953, Stewart and Robbins 1958, Beals 1960, Martin 1960, Godfrey 1966, Erskine 1977, Webb et al. 1977, Temple et al. 1979, Welsh and Filman 1980, Peck and James unpubl.).

Yellow-rumped Warbler, *Dendroica coronata*

The Yellow-rumped warbler breeds throughout most of Ontario, being rare or absent only south of the Canadian Shield.

They breed in coniferous or mixed forest where trees may be relatively short to very tall and scattered, as at edges, openings or in fens, to relatively dense. They have a wide tolerance to many forest conditions although they apparently prefer taller trees and open coniferous woods.

(Bent 1953, Stewart and Aldrich 1952, MacArthur 1958, Martin 1960, Godfrey 1966, Erskine 1957, James 1979, Noon et al. 1979, Welsh and Filman 1980, McLaren and McLaren 1981, James et al. 1982a, James et al. 1982b, Franzreb 1983).

Black-throated Green Warbler, *Dendroica virens*

The Black-throated Green warbler breeds across Ontario as far north as Sandy Lake and Moosonee, but seldom south of the Canadian Shield.

They prefer mixed forest, but also occupy coniferous woods. These may be somewhat open or preferably dense, usually drier sites but the trees must be mature. Hemlock and fir are favoured conifers.

(Kendeigh 1947, MacArthur 1958, Stewart and Robbins 1958, Beals 1960, Martin 1960, Godfrey 1966, Morse 1976, Erskine 1977, Webb et al. 1977, Temple et al. 1979, Welsh and Filman 1980, Green and Niemi 1980).

Blackburnian Warbler, *Dendroica fusca*

The Blackburnian warbler breeds north to about Sioux Lookout and Lake Abitibi, but seldom south of the Canadian Shield.

They prefer a species of coniferous and mixed forests that are undisturbed. They require old to over mature large trees, preferably in mature and somewhat open forest. These may be in lowland or upland areas. Fir and hemlock are preferred conifers.

(Kendeigh 1947, Bent 1953, MacArthur 1958, Stewart and Robbins 1958, Martin 1960, Godfrey 1966, Morse 1976, Erskine 1977, Webb et al. 1977, Niemi 1979, Noon et al. 1979, Temple et al. 1979, Titterington 1979, Welsh and Filman 1980, Collins et al. 1982, Peck and James unpubl.).

Pine Warbler, *Dendroica pinus*

The Pine warbler breeds across Ontario north at least as far as Kenora and Cochrane, probably somewhat farther. They are rare south of the Canadian Shield.

They occur only in mature pine forests (white or red) that are usually somewhat open. They appear to be an area sensitive species needing at least fifteen to thirty (15 – 30) ha (forty-five to seventy-five [45-75] ac) to sustain a viable population.

(Stewart and Robbins 1958, Godfrey 1966, Anderson and Shugart 1974, Erskine 1977, Capen 1979, Robbins 1979, Green and Niemi 1980, Collins et al. 1982, Peck and James unpubl.).

Bay-breasted Warbler, *Dendroica castanea*

The Bay-breasted warbler breeds across northern Ontario as far as Ney Lake and Fort Albany. In southern Ontario they are found only north of the top of the Bruce Peninsula and Muskoka District.

They are found in coniferous and mixed forests. They require tall, mature and relatively dense coniferous trees with live branches in the shade of forest canopy. There is usually a dense understory of deciduous and coniferous shrubs in or at the edges of the forest. They may be in lowlands or drier uplands.

(Kendeigh 1947, Stewart and Aldrich 1952, MacArthur 1958, Martin 1960, Godfrey 1966, Erskine 1977, Dawson 1979, Welsh and Filman 1980, Peck and James unpubl.).

Cerulean Warbler, *Dendroica cerulea*

The Cerulean warbler breeds only in southern Ontario, mainly south of the Canadian Shield.

They are found only in deciduous forests and require dense and tall second growth to mature woodlands. They prefer swamps and floodplain forests, but also occur in moist uplands. They seem to be an area sensitive species, apparently needing rather extensive areas of forest.

(Bent 1953, Bond 1957, Stewart and Robbins 1958, Godfrey 1966, Noon et al. 1979, Anderson and Robbins 1982, Peck and James unpubl.).

Black-and-white Warbler, *Mniotilta varia*

The Black-and-white warbler breeds throughout Ontario as far north as Fort Albany, but are increasingly scarce near Lake Erie.

They occur primarily in mixed or deciduous forests, less often in coniferous. They require a dense understory of deciduous shrubs in open forests, edges or openings. The trees may be short or tall and in wet riparian or swampy land or drier uplands. They thus show a wide tolerance of forest conditions, but appear to be area sensitive, requiring in excess of 100 ha (250 ac) or continuous forest to maintain a viable breeding population.

(Stewart and Robbins 1958, Beals 1960, Martin 1960, Godfrey 1966, Erskine 1977, Connor and Adkisson 1975, Noon et al. 1979, Robbins 1979, Samson 1980, Welsh and Filman 1980, Crawford et al. 1981, Anderson and Robbins 1982, Collins et al. 1982, James et al. 1982b, Webb et al. 1982, Peck and James unpubl.).

American Redstart, *Setophaga ruticilla*

The American redstart breeds across Ontario as far north as Sandy Lake and Moosonee.

They occupy deciduous or mixed woods where they require a closed canopy of vegetation. However, this may be only tall shrubs, or dense young trees or more mature forests with dense shrubbery within or at the edges. They may be in wet or dry forests, usually with some trees amongst dense growth closer to the ground.

(Bond 1957, Stewart and Robbins 1958, Martin 1960, Godfrey 1966, Erskine 1977, Webb et al. 1977, Stauffer and Best 1980, Crawford et al. 1981, Sidel and Whitmore 1982, James et al. 1982b).

Ovenbird, *Seiurus aurocapillus*

The Ovenbird breeds across Ontario as far north as Ney Lake and Fort Albany.

They occupy deciduous, mixed or less often coniferous forest. The trees may be relatively short to very tall, but the canopy must be closed. They are much more common in mature forests, generally dry to mesic situations, and where shrub growth is limited. They seem to be area sensitive, requiring seventy (70) ha (175 ac) or more of continuous forest.

(Kendeigh 1947, Bond 1957, Beals 1960, Martin 1960, Godfrey 1966, Connor and Adkisson 1975, Erskine 1977, Back 1979, Capen 1979, Niemi 1979, Temple et al. 1979, Titterington 1979, Samson 1980, Stauffer and Best 1980, Crawford et al. 1981, Anderson and Robbins 1982, Collins et al. 1982).

Northern Waterthrush, *Seiurus noveboracensis*

Although scarce in the extreme south, the Northern Waterthrush breeds throughout Ontario.

They breed in mixed, coniferous or deciduous woods, in swamps, around isolated pools and ponds and in riparian edges. Trees may be sparse and short to tall, but they require a dense layer of shrubs.

(Bent 1953, Stewart and Robbins 1958, Godfrey 1966, Erskine 1977, James et al. 1982a, Peck and James unpubl.).

Mourning Warbler, *Oporornis philadelphia*

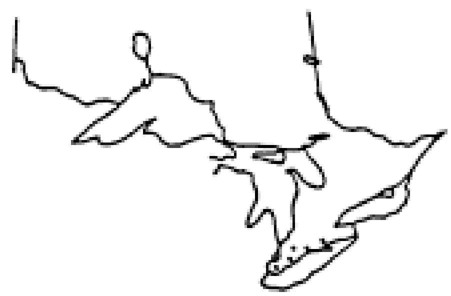
The Mourning warbler breeds throughout Ontario as far north as Big Trout Lake and Fort Albany.

They occur in mixed and deciduous but rarely coniferous forest. They require a dense shrub layer under short or tall trees, especially aspen, in open woods and edges or openings. The area may be moist or dry.

(Kendeigh 1947, Bent 1953, Stewart and Robbins 1958, Godfrey 1966, Erskine 1977, Back 1979, Noon et al. 1979, Temple et al. 1979, Titterington et al. 1979, Welsh and Filman 1980, Collins et al. 1982, James et al. 1982b, Peck and James unpubl.).

Hooded Warbler, *Wilsonia citrina*

The Hooded warbler breeds only in the extreme south of the province. They require mature deciduous woodlands, but with a relatively open canopy and numerous shrubs on the forest floor.



They may be in wet areas or in moist uplands. They appear to be area sensitive, requiring at least thirty (30) ha (seventy-five [75] ac) and perhaps much more to maintain a viable population.

(Bent 1953, Stewart and Robbins 1958, Godfrey 1966, Anderson and Shugart 1974, Robbins 1979, Crawford et al. 1981, Anderson and Robbins 1982, Peck and James unpubl.).

Canada Warbler, *Wilsonia canadensis*

The Canada warbler breeds across Ontario as far north as Pickle Lake and Moosonee, but south of the Canadian Shield they are scarce and possibly absent near Lake Erie.

They occupy mixed, deciduous and coniferous forests, often in swampy and riparian places. The trees may be short although they prefer taller and they require a dense layer of shrubs under an open forest canopy, or at edges and in clearings.

(Bent 1953, Stewart and Robbins 1958, Beals 1960, Martin 1960, Godfrey 1966, Erskine 1977, Webb et al. 1977, Temple et al. 1979, Welsh and Filman 1980, Peck and James unpubl.).

Summary Information About Warbler Habitats

Several species of warblers may occur in basically the same type of forest, but they partition the habitat, each selecting a different microhabitat (MacArthur 1958).

Most warblers have relatively small territory sizes, in the order of a half to one ha (0.5 to 1) (one and a quarter to two and a half ac [1.25 - 2.5]) per pair depending upon the quality of the habitat available. However, in each type of habitat there appears to be at least one species that is area sensitive. They will not successfully breed in isolated pairs in small patches of habitat. In the long term they require at least small populations occupying a number of hectares of continuous forest (usually at least 100 ha).

The following species all require mature to old-growth forests:

> Cape May, blackburnian and bay-breasted warblers in coniferous forests of various types (fir and hemlock may be preferred) or in mixed forests of conifers with poplars and birches.
>
> Parula, black-throated blue and black-throated green warblers in mixed or deciduous forests of various types. Fir and hemlock, with maples are preferred.
>
> Pine warblers in pine forests.
>
> Cerulean and hooded warblers in southern hardwood forests.

In addition, the cerulean, parula and hooded warblers are all apparently area sensitive.

On a short term basis, warblers requiring mature forests will tolerate little more than selective cutting of a few trees. They can be accommodated only through leaving large patches of forest uncut, or by setting long rotation times so that there are always large areas of mature to old growth stages available in any management area if clearcutting is the procedure followed.

The following species are much more tolerant of timber harvesting and may respond positively to logging, particularly to selective cutting:

> Tennessee also requires tall conifers in mixed or coniferous forest, but can be accommodated in riparian areas and edges or openings as it also requires shrub growth.
>
> Nashvile, magnolia, black-and-white, mourning and Canada warblers all require a dense growth of deciduous shrubs on the ground (magnolia also needs coniferous regeneration). On a long term basis, they would tolerate clearcutting, but would prefer selective cutting of only the largest trees in significant areas. Most would also be found in edges and riparian areas, but the black-and-white warbler is apparently also area sensitive and needs large areas more extensive than provided by riparian strips.
>
> Yellow-rumped warbler does not require shrub growth and is accommodated by a range of tree heights and densities and probably needs no specific management.
>
> Northern waterthrush does require dense shrubs, but prefers riparian or swampy areas where restricting harvesting to selective cutting would easily accommodate them.
>
> The American redstart and ovenbird both require closed canopy situations, but trees need not be mature. The ovenbird is also apparently area sensitive. In deciduous forests, both will be accommodated through selective removal and in mixed or coniferous forests through clearcutting with longer rotation times.

Management Guidelines

General Guidelines for All Species

1) In deciduous forests south of the Canadian Shield or in maple dominated hardwood stands on the shield, avoid clearcutting. Selective cutting of small patches or thinning of single trees is the optimum practice (Crawford and Titterington 1979, Takekawa et al. 1982). Encourage reforestation of blocks of hardwoods, particularly in lowland areas. There is a need for more extensive forests in southern forests where many species have already vanished. This is one type of habitat where the provision of maximum diversity is not advisable (Samson 1979).

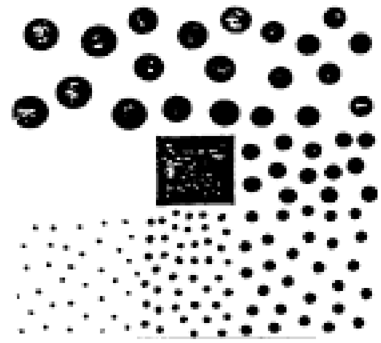
2) In coniferous forests or mixed forests of one or more coniferous trees with poplars and aspens clearcutting will likely remain the overriding practice and is compatible with warbler needs if rotation times are set long enough that trees have time to reach maturity (Evans 1978, Connor 1979, Dawson 1979, Evans and Connor 1979, Temple et al. 1979). The fraction of a management area to be cut in any decade equals 1/R where R is the desired stand rotation age in decades (ie., if the time for a forest to mature is 100 years, the fraction to be cut in any decade is 1/10th (Mealey et al. 1982).

3) In mixed forests with maples, hemlocks and balsam fir, consider only selective logging as these areas are particularly rich in warbler species (Erskine 1977).

4) In pine forests consider only selective logging. If pine forests are widespread, long term rotations with all ages represented would be acceptable.

5) Consider leaving five to ten percent (5-10%) of any management area uncut (at least 255 ha, but preferably as much as 1000 ha - 640 to 2500 ac) to provide for area sensitive species. These areas may include riparian habitats, but should also include some uplands. Various unique features may be preserved here (Evans 1978, Evans and Connor 1979, Robbins 1979, Temple et al. 1979, Luman and Neitro 1980). If absolutely necessary, selective cutting of only the largest trees would open up the canopy and enhance bird populations and thus insect control (Takekawa et al. 1982).

6) If possible maintain a large undisturbed tract as the nucleus of any managed area in regions where extensive forests still exist. Then avoid unnecessary fragmentation. Plan for large blocks, not necessarily all the same size, but probably ten to twenty ha (10-20) (twenty-five to fifty ac [25-50]) minimum. Use a fairly uniform plan of rotation on the large blocks so that species displaced on mature stands have a minimum of distance to move to similar forest (Robbins 1979). The manager should maintain a diversity of habitats so that the minimum area of each successional stage is always available for the breeding birds in that region.



An ideal model might be as seen here with the centre uncut and the size of spots representing different ages of trees.

The edges of different stands need not be straight. Uneven edges provide increased edge effect.

7) Avoid cutting riparian forests. Plan to leave them as part of the nesting requirements for specific species, as well as for the needs of numerous other animals. The closer the cutting is to a stream or lake, the greater the impact on wildlife. Leave forest on all steep banks. Limit cutting to selective removal if it is to be done. Try to maintain a minimum of fifty (50) m uncut on either side of a river or lake (Allan and Bohart 1979, Evans and Connor 1979, Thomas et al. 1979b).

8) Avoid huge monocultures of single species. Natural regeneration or planting of several species along with natural regeneration to provide more diverse composition is preferable (Capen 1979, Crawford and Titterington 1979, Temple et al. 1979, Evans 1982).

9) In even aged management, leave all unwanted trees (broken tops, twisted, scarred or unwanted species). Programs that leave some live trees standing have the effect of increasing the number and density of birds over the entire area being managed (Connor and Adkisson 1975, Franzreb 1983).

10) Leave all logs and logging slash on the forest floor for shelter (Connor and Adkisson 1975, Back 1979, Capen 1979, Dawson 1979, Maser et al. 1979).

11) Where an insect population is threatening to grow to epidemic proportions, but time does not permit a complete harvest of trees, selective removal of only the largest would open up the forest, encourage shrub growth and attract more birds to the area helping to contain the outbreak (Webb et al. 1977). The provision of snags for cavity-nesting birds would also assist in containing insect outbreaks (see James 1984).

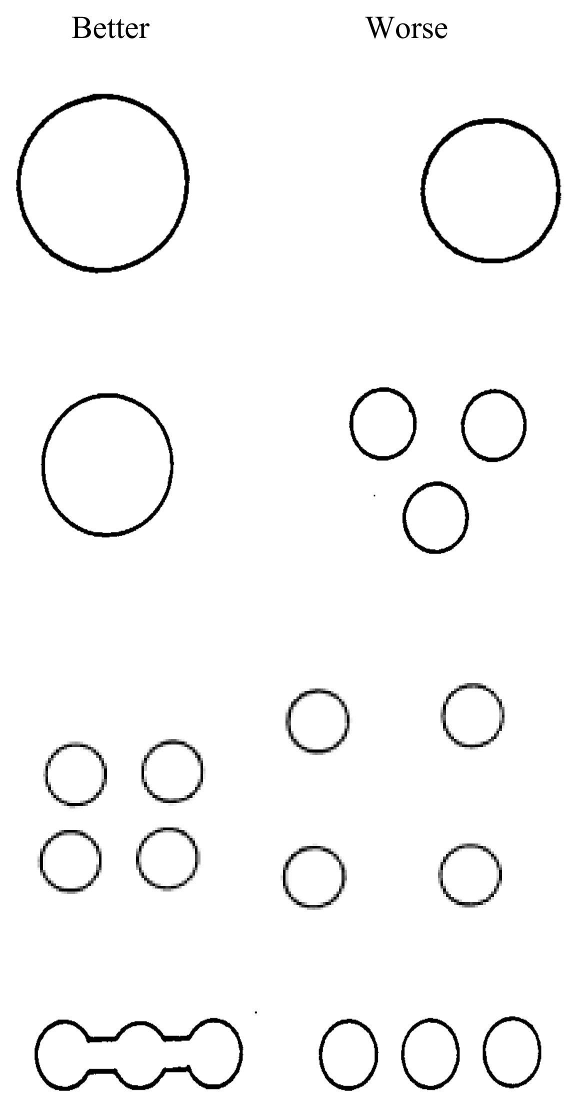
12) Avoid the use of pesticides on forest (Rudd 1964, Miller and Varty 1975, Varty 1975, Comins 1979, Takekawa et al. 1982).

13) Avoid constructing roads along riparian corridors, as this greatly increases disturbance in these critical areas (Thomas et al. 1979b).

14) Try to provide optimal and not just minimal habitat requirements (Connor 1979).

Design Principles for All Species

These principles will minimize local extinction rates (Diamond 1975).



– Manage for large rather than smaller plots

– One large plot is better than several smaller ones that cover an equivalent area. Small ones may be useful for small unique habitats.

– If fragmentation is necessary, the more closely they are grouped the better to facilitate dispersal.

- If fragments are necessary, try to provide corridors of at least 100 m width between them (eg., along watercourses)

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