



M. J. THOMSON

Forest Fragmentation

1

The loss of woodland habitat in southern Ontario is alarming. Over 80 percent of the upland woodlands south and east of the Canadian Shield have been lost since the nineteenth century. Not only has there been overall loss of woodlands, the quality and ecological viability of many of the remaining woodlands are also being degraded. Simply measuring the amount of woodland cover fails to address how well these features function or how effective they are in providing environmental benefits. Forest fragmentation, or the “carving up” of woodlands into smaller and more isolated patches is threatening forest ecosystems in southern Ontario. Understanding forest fragmentation is easier if you know a little about woodland ecology.

A primer on woodland ecology

Within a forest, a diverse and vibrant ecosystem is made up of different layers, from the forest floor, to the shrub-rich understorey, to the regenerating trees, and upwards to the canopy and “super-canopy”. A diversity of tree species and ages can provide many habitats for birds and other wildlife. Many woodland birds and insects live out their entire lives in just one of these forest strata, and so certain habitats within woodlands are particularly critical. But much of our current woodland habitat is made up of relatively young, regenerating replacement forest, homogeneous plantations, or forests with a large component of invasive non-native species. This means there are fewer areas of relatively undisturbed older growth forests with the specific habitat niches necessary for native wildlife.

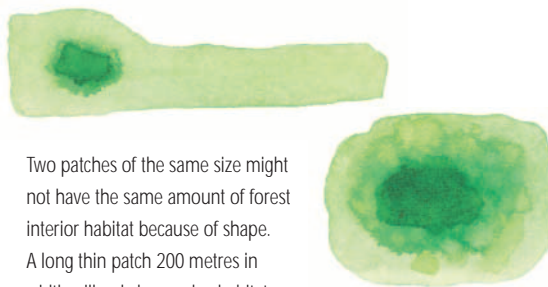
What about the areas between woodlands, wetlands and native prairies? What goes on in these in-between spaces is very important. Consider, for example, what happens to woodlands as the landscape changes from agricultural to urban. Increased noise affects wildlife. Cats and dogs become major sources of predation. Invasive non-native vegetation such as garlic mustard, Norway maple and European buckthorn become established and out-compete native species. As more land is lost to roads, parking lots and buildings, less rainwater percolates into the ground, changing surface and subsurface water flow patterns. This means less moisture is available to woodland plants and animals, but it can also decrease the amount of water in underground aquifers and increase the risk of flash floods downstream. (See fact sheet *Making the Connection Between Woodlands and Water*)

Both the size and shape of a woodland determine the type of habitat found there. Some plant and animal species are adapted to open areas, others to woodland interiors, and still others to transitional areas between the two, called edge habitats. A diversity of living things needs a diversity of places to live.

Species diversity typically increases with increasing forest cover, although the size and composition of woodlands determine what species live there. Birds are a particularly effective barometer of forest size and shape, since many of our native species need large expanses of interior habitat. Typically, forest patches 200 hectares or larger support 90 to 100 percent of the forest bird

species for that area. Many forest-nesting birds shun edges because of the increased risk of predation or nest parasitism, as well as inhospitable temperature and moisture conditions, or insufficient food. Edges are also more susceptible to human disturbance.

Small woodland patches have a proportionately high amount of edge habitat. Landscape ecologists often equate the edge habitat to an ecological buffer – typically 100 metres in width. Therefore, forest habitat must be at least 100 metres from the edge before it can be considered “interior”. Thus a 200 m x 200 m square woodland (4ha) or a 3 ha round woodland will contain no interior habitat and would not likely support interior wildlife species. Using the 100-metre definition, a circular forest patch would have to be almost eight hectares in size to contain just one hectare of interior habitat. Satellite images of southern Ontario show us that in many areas, most patches are smaller than eight hectares and those that are larger are often relatively long and narrow so that they provide little or no interior habitat.



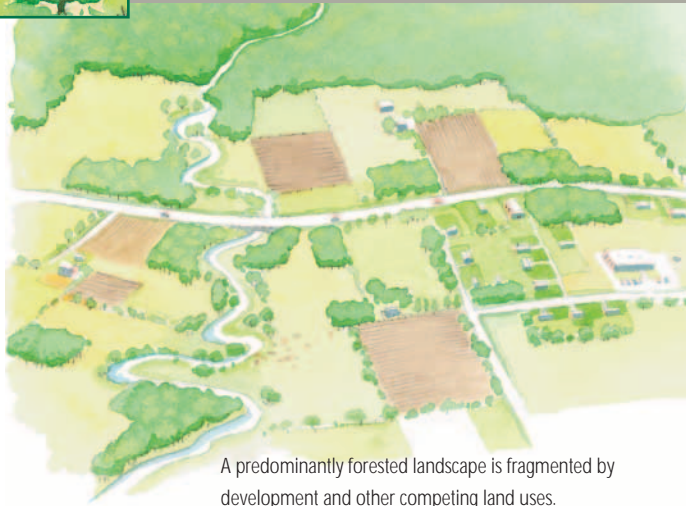
Two patches of the same size might not have the same amount of forest interior habitat because of shape. A long thin patch 200 metres in width will only have edge habitat.

What is forest fragmentation?

Forest fragmentation occurs when large, continuous forests are divided into smaller blocks by roads, agriculture, urbanization, or other development. This process reduces the forest's function as a



SOUTHERN ONTARIO WOODLANDS



A predominantly forested landscape is fragmented by development and other competing land uses. Ecological function is diminished or lost altogether.



The degree of fragmentation can affect different organisms differently. For example, a county road or a narrow agricultural field separating two woodlands might not prove to be much of a barrier to a hawk. However, to other plant or animal species, such a barrier might be just as daunting as a four-lane highway or a subdivision.

habitat for many plant and animal species. As well, it reduces the forest's effectiveness in performing other functions, such as water and air purification. In southern Ontario, highways, subdivision developments, utility corridors, or agricultural fields typically interrupt natural cover. Even minor unpaved roads or wider trails through the woods can have an impact on the natural functions of a forest. Fragmentation not only reduces the area that is left as forest but also affects other biophysical aspects of the forest, such as forest structure, temperature, moisture and light regimes. It disturbs the habitat to which all forest animals and plants have adapted over millennia.

Why should we be alarmed?

Southern Ontario's forested landscape is a resource that provides both livelihood and leisure to residents and visitors. Ecological benefits include vital filtering and absorption of water into the system. Forests also absorb large amounts of carbon dioxide that would otherwise be released into the atmosphere. Through photosynthesis, plants use the energy from sunlight and nutrients from the soil and air to yield the oxygen that is essential to the survival of living things. Our forests and woodlands are still an important part of our region's economy and represent a significant source of revenue and employment, in both timber and non-timber products. Our forests serve as important education, research and recreation areas, and, not least, our forests and woodlands are treasured places for spiritual and psychological well-being. However, the rate at which woodlands are changing and disappearing in many areas is alarming. Ecosystems are dynamic, adapting and resilient living systems, but they cannot withstand the scale of this assault. If we want to maintain the benefits that woodlands provide, we need to keep them intact.

The fragmentation of existing southern Ontario woodlands is more dramatic than in any other region of comparable size in the Great Lakes basin. In the area between Woodstock, Brantford, and Lake Erie, more than 80 percent of forest patches are now less than three hectares in size. This means that few of these patches will have forest-interior habitats. More urban development, networks of roads and other human disturbances are continuing to carve many natural forests into smaller and more isolated parcels. The resulting woodland islands are often too small to maintain healthy gene pools or viable populations of plants and animals over the long term.

What are the causes of fragmentation?

Any land-use change can potentially result in fragmentation. The extent of the impact will depend on the type of change, the degree of fragmentation, and the species involved. In the early days of settlement, much of the forested landscape was fragmented by land clearing for timber and agriculture. In the more recent decades, some of the most serious fragmentation has been caused by urban sprawl.

Urban sprawl refers to new development that consumes land at a rate faster than that at which the population is growing. It uses more land per person combined with the fact that the population itself is steadily increasing in cities and towns. It promotes dependency on the use of cars, because it is characterized by low-density development that separates where people live from where they shop, work and recreate. It also separates them from access to green space and natural areas in their communities because typically natural areas are not incorporated into the design of these developments.

Roads and rights-of-way that go along with sprawl are particu-



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larly insidious because they include not only the paved surface of the road itself but also the area along the median, the shoulder, the ditch and an allowance beyond the ditch up to the forest's edge. Roads can be impassable barriers for wildlife, restricting their movement among forest patches.

Sprawl-type planning completely disregards the continuity of natural ecosystems, dissecting or removing them altogether instead of using less land area, integrating woodlands into the community, and leaving natural connecting corridors intact within carefully planned communities.

3

What are the consequences?

Forest fragmentation can have negative and often irreversible effects on local environments, especially when associated with human development.

Reduction of total habitat area. When habitat is reduced to smaller and smaller patches, there is less overall habitat as well as less diversity in habitat types. A reduced amount of habitat supports correspondingly smaller populations of wildlife, as well as fewer species.

Edge habitat. When a habitat is fragmented, the amount of edge habitat increases at the expense of interior habitat. Species dependent on interior habitat suffer, while edge-dependent species, including invasive species and predators, thrive. Highly fragmented forests cannot provide the food, cover, or reproduction needs of interior forest species. Predators such as crows and raccoons and nest parasites like the brown-headed cowbird find target nests more easily in edge habitats. Woodland-dependent bird species, even though they are found in nearby woodland areas, often avoid smaller fragments.

Woodland size is also important. Smaller forests usually support a lower diversity of forest-dwelling species and proportionally fewer numbers of each species due to edge effects, which can extend from 100 to 300 metres into the forest. Patches of 200 hectares are considered the minimum size for a forest ecosystem to recover from disturbance events such as wind-throw, fires, or insect and disease infestations.

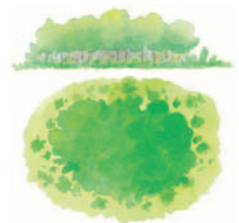
Vulnerability during movement among patches. As a habitat becomes fragmented, patches become separated from one another by relatively inhospitable terrain. Wildlife attempting to cross

between patches becomes temporarily vulnerable to predators, harsh environmental conditions, or simply to starvation.

Isolation of a population. Both plant and animal populations can become isolated within a patch when surrounding patches of habitat are destroyed. Migration or movement becomes difficult and hazardous. Isolated populations are prone to decline due to inbreeding, swings in numbers due to over-exploitation of habitat, and sudden removal from the patch due to disturbances such as fire, wind damage, or insect or disease infestations.

Vulnerability to external competition and predation. If prey species wander too close to the edge of protective habitat, predators can take them. Some species may be excellent competitors deep within their own specialized habitat, but less successful against those species found at the edge of their habitat.

Flow of genetic material throughout landscape. Wildlife should be able to move freely from one forest patch to another. This movement allows for interbreeding, creating genetically stronger populations and ensuring that suitable habitats can be filled. In a fragmented forest landscape, large distances between woodlots may prevent this movement and are an impediment for migrating wildlife. For this reason, corridors between isolated patches can help wildlife by providing routes through which they can travel. Corridors also benefit plants, making seed dispersal and establishment into new areas easier. While even narrow hedgerows can help create linkages between fragments, corridors of 100 to 200 metres wide or greater are considered more effective.



A woodland patch with edge habitat

What can be done?

"Defragmentation"

Fortunately, the ecological value and function of forest fragments can, in many cases, be improved through restoration activities.

Planting and otherwise encouraging natural regeneration can enhance the size and shape of fragments or patches to create more interior habitat. Restoration activities can also include building or enhancing linkages between isolated patches. But we must also address fragmentation at a broader scale. (See fact sheet on *Cores and Corridors: The Importance of a Green System in Southern Ontario*)



SOUTHERN ONTARIO WOODLANDS

4

Visions or strategies that have been proposed by various organizations share the aim of building a more connected, integrated natural system. These approaches all take into account the whole landscape on a scale that is appropriate for ecological function. They also acknowledge the reality that the landscape in southern Ontario is largely settled, and that we need to maintain a healthy, strong agricultural community as well.

Big Picture 2002. Using data sets and Geographic Information Systems (GIS), the *Big Picture 2002* identifies existing natural cores and corridors and maps out potential areas for restoring corridors between natural areas, as well as enhancing large core natural areas. This process takes into account the fact that urban areas and transportation corridors are not suitable for restoration, and that wildlife (both plants and animals) have a hard time crossing these barriers. This project looks at all of southern Ontario from the Carolinian Zone to the Canadian Shield and into eastern Ontario. www.mnr.gov.on.ca/MNR/nhic/nhic.cfm

NOAH-Niagara Escarpment-Oak Ridges-Algonquin to

Adirondack Heritage Project. The vision of this project is to broadly link these natural physiographic features into a connected system that would support the migratory movement of many species, including large mammals, on a large geographic scale. (www.utoronto.ca/env/st/pspaces/publicspaces.htm or www.noahprojectontario.org)

Oak Ridges Moraine. This natural 160 km long moraine feature, which has experienced heavy urban development, has special provincial legislation to protect and maintain it as a broad natural area. The Oak Ridges Moraine Conservation Plan holds urban development to 8 percent of the moraine. Protected countryside areas cover 30 percent, while 62 percent remains in natural core and linkage areas. (www.stormco.org)

Niagara Escarpment Plan. This plan, approved in 1985, is a good example of land-use planning limits on development to maintain a connected system of natural areas and to protect the landform itself, a natural feature running 725 kilometres from Queenston to Tobermory. (www.niagaraescarpment.org)

Written by Helena Rusak

Illustrations by Clive Dobson

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The Federation of Ontario Naturalists (FON) protects Ontario's nature through research, education, and conservation action. FON champions woodlands, wetlands and wildlife, and preserves essential habitat through its own system of nature reserves. FON is a charitable organization representing 25,000 members and supporters and 125 member groups across Ontario.

Fact sheets in this series include:

Cores and Corridors: The Importance of a Green System in Southern Ontario

Forest Fragmentation

Introducing Old Growth – The Ultimate Forest

10 Ways to Save Your Local Woods (and Water!)

Urban Forests: An Important Part of Our Natural Heritage

Making the Connection Between Woodlands and Water

Woodlands At Risk is a 32-page full colour booklet about the threats to southern Ontario's woodlands, available from FON.

If you wish to support FON or learn more about current conservation issues in Ontario visit:

www.ontarionature.org



FEDERATION OF ONTARIO NATURALISTS

355 Lesmill Road, Don Mills, Ontario M3B 2W8

Tel: (416) 444-8419 Toll free: 1-800-440-2366

Fax: (416) 444-9866 E-mail: info@ontarionature.org