Management of Natural Acadian Forest

a guide to resources

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NOVA SCOTIA

INTRODUCTION

This guide highlights and organizes resources that are available to help Nova Scotia woodlot owners and other forest stakeholders manage for natural forest and for multiple forest benefits and uses. The guide does not attempt to include every resource available but rather is a selection of resources that complement each other and introduce useful information and skills. This collection focuses on items that are available via the Internet, but also includes a selection of print and video resources. Most of these are available through Nova Scotia libraries as well as from other sources.

The guide begins with a collection of materials, classified as Basic Concepts, which are intended to provide a general introduction to woodlot ecology and management of natural forest. Remaining resources are organized by topic, as reflected in the table of contents beginning on page 3.

Each section of the guide begins with resources that were produced by the Nova Scotia Department of Natural Resources (NSDNR). These are followed by other resources produced in Nova Scotia and then by materials from outside of the province. This selection favours materials produced in the other Maritime provinces, Maine, and southern Ontario.

In the electronic version of this document, underlined text indicates a link to a web page or downloadable resource. (For actual web addresses, see Appendix D). When a copy of the item is available for free, ordering information is also included in the text. Appendix C provides information on how to access printed materials and videos through the Nova Scotia library system and also how to find copies of materials for purchase.

This guide was prepared with funding from NSDNR. Suggestions for resources to include in this guide came from a wide variety of sources, including reading lists previously compiled by others. The authors wish to thank all who contributed.

DISCLAIMER

Inclusion of a resource in this guide is for general educational purposes only and is not meant to endorse or recommend specific organizations or activities. Forest management decisions must be tailored to the characteristics of the forest being managed and to the owner's goals, objectives, resources, and skills. Forest owners are encouraged to seek competent professional advice in order to receive management recommendations that are appropriate for their individual circumstances.

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I. BASIC CONCEPTS

Generally speaking, an *ecosystem* is a community of interacting plants and animals that are adapted to living in similar conditions. The study of how ecosystems work is called *ecology*.

In recent decades, forest managers have come to understand that to ensure the health and long-term productivity of forests, it is important to understand the functions and processes of ecosystems at work in the forest, and how all ecosystems are interconnected. This allows the forest manager to promote and protect a healthier, more diverse, and more productive forest while also pursuing economic objectives.

The Nova Scotia Department of Natural Resources (NSDNR) has available a number of new tools to help woodlot owners implement ecosystem-based forest management on their land. These are discussed in Section III of this guide. A detailed overview of NSDNR's work in this area is available in the document titled *Implementing Ecosystem-Based Integrated Resource Management in Nova Scotia* (pdf) by Bruce Stewart and Peter Neily.

Module 7 in NSDNR's Woodlot Management Home Study program, *Woodlot Ecology: Your Living Woodlot*, provides an overview of ecosystems that may be present on a woodlot and how such systems are affected by woodlot management. Printed copies of the home study program are available free from woodlot@gov.ns.ca or 902-424-5444.

Restoring the Acadian Forest: A Guide to Forest Stewardship for Woodlot Owners in the Maritimes (Res Telluris, 2nd edition 2008) by Jamie Simpson presents introductory information on many of the topics covered in this guide, including the history of the Acadian Forest, water, soils, deadwood, harvesting trees, and wildlife habitat.

WHAT IS THE ACADIAN FOREST?

One of eight distinct forest regions in Canada, the Acadian Forest encompasses Nova Scotia, New Brunswick, and Prince Edward Island in Canada and also extends into the northeastern portion of the United States.

The Forest of the Acadian Ecozone, a section of Lesson One, Module 7, of the NSDNR Woodlot Management Home Study program, introduces the Acadian Forest region.

The Harriet Irving Botanical Gardens website offers an overview of different natural landscapes found in Nova Scotia, *Garden Habitats.* Of particular interest to woodlot owners would be the sections on deciduous woodlands, mixed woodlands, wet woodlands, and coniferous woodlands.

Simpson is also the author of the *Guide to FSC Certification for Woodlot Owners in Nova Scotia,* published by the Mersey Tobeatic Research Institute. Although focused on forest certification, this manual provides an introduction to the Acadian Forest and to management practices and

basic concepts that are appropriate in natural forest, along with a glossary of terms used in management of natural forest. Electronic and printed copies are available free from MTRI, info@merseytobeatic.ca or 902-682-2371.

Nature's Way: An Introduction to Forest Ecology (Earthwood Editions, 2006) by Girvan Harrison is an overview of forest ecology written in easy-to-understand language. Harrison is also the author of *Out Roddie's Way* (Earthwood Editions, 2002) and *Roddie's New Woodlot* (Earthwood Editions, 2007), in which a fictional Nova Scotian discusses his experiences as a woodlot owner and in the process, gives lessons in woodlot management and woodlot ecology.

Forest Management Resources is a page on the Nova Scotia Woodlot Owners and Operators Association's (NSWOOA) website where they have compiled resources about all aspects of private woodlot management, including timber management, wildlife, recreation, legacy planning, roads and trails, and many others. The NSWOOA has also created a free online goals assessment tool to help woodlot owners set their goals for woodland ownership based on their values. The Association's staff will follow up with every landowner who completes the assessment, leaves contact information, and requests additional resources.

Positive Impact Forestry: A Sustainable Approach to Managing Woodlands (Island Press, 2004) by Thomas J. McEvoy is an introduction to ecologically based forest management. McEvoy is also the author of an earlier short work titled *Introduction to Forest Ecology and Silviculture* (Northeast Regional, 2000), which focuses on forests of the Northeast.

Woodland Ecology: Environmental Forestry for the Small Owner (Syracuse University Press, 2nd edition 1980) by L.S. Minckler is a well-regarded introduction to this topic.

Although not specific to the Acadian Forest, *The Woodlot Management Handbook: Making the Most of Your Wooded Property for Conservation, Income or Both* (Firefly Books, 2nd edition 2009) by Stewart Hilts and Peter Mitchell covers many topics addressed in this guide, including woodlot ecology, reforestation, natural succession, and silviculture. The book emphasizes an approach that balances management of healthy natural forest with economic returns.

PLEASE NOTE

Printed materials and videos mentioned in this guide are often available through the Nova Scotia library system. (See Appendix C for details.)

In an Internet-enabled version of this guide, underlined text indicates a link to a web page or downloadable resource, or to another page of this guide. For those not using an Internet-enabled version, web addresses (URLs) of websites and web pages mentioned in the guide are listed in Appendix D.

II. UNEVEN-AGED MANAGEMENT

The expression *uneven-aged management* refers to management practices that are applied to a forest so that it will continually include trees of various ages, sizes, and species. This allows woodlot owners to maintain a natural Acadian Forest while pursuing a variety of goals.

The Nova Scotia Department of Natural Resources (NSDNR) web pages titled *Harvesting*, *Silviculture*, and *Selection Management* include information on uneven-aged management. Lesson Seven in Module 7 of NSDNR's Woodlot Management Home Study program, *Woodlot Stewardship and Sustainability*, also contains information on uneven-aged management. Module 7 is available free in printed form from woodlot@gov.ns.ca or 902-424-5444. NSDNR also has a *Woodlot Harvesting* (pdf) brochure, an overview of all types of harvesting, available free in print form from the same email address and telephone number.

NSDNR's *Tolerant Hardwood Management Guide* (pdf) and *Tolerant Softwood & Mixedwood Management Guide* (pdf), both by Tim McGrath, provide keys and other information designed to be used to manage trees for economic return.

Growing High-Value Trees (pdf)*,* published by Nova Scotia's Association for Sustainable Forestry (ASF), provides an introduction to uneven-aged management.

The Otter Ponds Demonstration Forest (OPDF) in Mooseland, NS, is a place for woodlot owners and the public to witness the complexity, beauty, and profitability that comes from uneven-aged management of native forest ecosystems. The goal of the OPDF is to demonstrate responsible forestry that is environmentally, economically, and socially sustainable through workshops, field days, school trips and various other events.

The following pages provide additional resources on concepts and techniques that are important in the practice of uneven-aged management.

II. a. Crop Trees

Crop trees typically are trees chosen by the forest manager for their potential to yield high-quality wood products. Once harvested, these trees are likely to have high value when sold individually or in small lots. However, the term *crop tree* may refer to any tree the forest manager wishes to keep, for instance a tree that has no commercial value but has high value for wildlife, or a species that is scarce in the area and thus could serve as a future seed tree.

Crop Tree Management in Eastern Hardwoods (pdf) by Arlyn W. Perkey and others is a United States Department of Agriculture (USDA) Forest Service book that explains how crop tree management can be used to further a variety of woodlot owner goals. Most of the information in this resource is of a general nature and thus could be applied in the Maritimes and in mixedwood stands.

II. b. Tree Marking

Tree marking makes cutting and extracting timber easier for contractors and helps to ensure that harvests are appropriate for the landowner's goals. It is a new idea in Nova Scotia, but one that is expected to catch on as woodlot owners become familiar with this practice.

Tree marking is widely used in Ontario, where some tree species are the same as those found in Nova Scotia. The following articles from the Ontario Woodlot Association and Rideau Valley Conservation Authority's Land Owner Resource Centre explain tree marking and why it benefits woodlot owners:

- *Tree Marking*
- *Promoting a Healthy Forest Through Tree Marking* (pdf)

In Ontario, it is possible to take training and become a certified tree marker. The Ontario Ministry of Natural Resources has published the full *Ontario Tree Marking Guide* (Ontario Government, Ministry of Natural Resources, 2004)**,** which is used in training of tree markers. The guide covers not only tree marking for economic return but also selection of trees for wildlife habitat and biodiversity. Woodlot owners who want to manage natural forest will want to concentrate on the sections devoted to tree marking for individual tree selection and group selection.

II. c. Tending & Regenerating

The Canadian Encyclopedia defines *Silviculture* as "the branch of forestry that deals with establishing, caring for, and reproducing stands of trees for a variety of forest uses including wildlife habitat, timber production and outdoor recreation." Silvicultural activities may also be referred to as *tending* and *regenerating*, as they often involve ongoing care for the trees while they are growing (*tending*) and creation of conditions that will encourage establishment of desired species (*regenerating*).

Growing High-Value Trees (pdf), which is described at the beginning of Section II, introduces three silviculture treatments that are used in tending and regenerating high-value trees: *crop tree release*, *crop tree pruning*, and *selection management*.

A companion to the above is the *Leaving a Legacy* video, which can be watched in three parts: Part 1, Part 2, and Part 3. This 30-minute video briefly describes the Acadian Forest, explains the three quality-improvement silviculture treatments, and discusses funding available from the ASF.

II. c. i. Crop Tree Release

In *crop tree release*, a woodlot manager removes trees that are competing with trees the manager has identified as crop trees. This gives the more desired trees room to expand their crowns, which increases their food supply and thus helps them to grow in height, diameter, and root system.

NSDNR has published a Crop Tree Release brochure, which is available free in printed form from woodlot@gov.ns.ca or 902-424-5444 and in pdf format on NSDNR's *Publications for Woodlot Owners* web page.

Understanding and Measuring Basal Area, a section of Module 4 in NSDNR's Woodlot Management Home Study program, provides an explanation of how to determine the basal area of trees growing on a woodlot. This information is a measure of how much of the area of a woodlot is taken up by trees, and is used to determine how many trees should be removed during crop tree release. Module 4 is available free in printed form from woodlot@gov.ns.ca or 902-424-5444.

Crop Tree Management: A New Tool to Help You Achieve Your Woodland Goals is an Ohio State University Extension fact sheet that covers the basics of selecting and managing crop trees.

II. c. ii. Crop Tree Pruning

The silvicultural technique known as *crop tree pruning* is used to grow clear (knot-free) wood, which is highly valued for use in making veneer-quality products. Crop tree pruning is often used in combination with crop tree release to grow trees that will be economically valuable once harvested.

NSDNR has published a Crop Tree Pruning brochure that is available free in printed form from woodlot@gov.ns.ca or 902-424-5444 and in pdf format on NSDNR's *Publications for Woodlot Owners* web page.

Crop Tree Pruning (pdf) is an introductory brochure produced by the Association for Sustainable Forestry. The ASF also published *Crop Tree Pruning Quality Standards* (pdf), which they use in determining whether a given pruning job will qualify for funding.

The Nova Scotia Woodlot Owners and Operators Association has a helpful video on their YouTube channel about crop tree pruning for woodlot owners, *Intro to Planting Pruning & Thinning- Pruning*.

Though not specific to Nova Scotia, *Pruning Your Forest Trees* from the Maine Forest Service provides a detailed introduction.

Tree Basics (Shigo and Trees, 1995), *Tree Anatomy* (Shigo and Trees, 1994), *100 Tree Myths* (Shigo and Trees, 1993), *Modern Arboriculture: A Systems Approach to the Care of Trees and Their Associates* (Shigo and Trees, 1991), *A New Tree Biology and Dictionary: Facts, Photos and*

Philosophies on Trees and Their Problems and Proper Care (Shigo and Trees, 1989), and *Tree Pruning: A Worldwide Photo Guide* (Shigo and Trees, 1989) are all by Alex L. Shigo, a recognized authority on pruning.

II. c. iii. Selection Management

In *selection management*, trees are harvested individually or in small groups, with the aim of achieving and maintaining an uneven-aged forest. By creating small gaps in the forest canopy, selection management may also be used to encourage natural regeneration of valuable Acadian Forest species. Resources providing information on ways to regenerate specific species of trees will be found in Section II. e. of this guide.

Harvesting Systems: The Selection System, Lesson Three in Module 2 of NSDNR's Woodlot Management Home Study program, provides a brief overview of selection management. This and NSDNR's Selection Management brochure are available free in printed form from woodlot@gov.ns.ca or 902-424-5444.

NSDNR's *Tolerant Hardwood Management Guide* and *Tolerant Softwood & Mixedwood Management Guide* (pdf), described at the beginning of Section II, provide keys and other information that may be used for selection management.

The Nova Scotia Woodlot Owners and Operators Association published *Introduction to Low - Impact Forestry*. This is a short account of research conducted between 1946 and 1989 in New Brunswick, in which a selectively logged site yielded more wood than a clearcut area.

In 2008, Nova Scotia-based GPI Atlantic released a report titled *GPI Forest Headline Indicators for Nova Scotia* (pdf) by Linda Pannozzo and Ronald Colman, which gives reasons for using selection harvesting more often in the province.

A 2001 report by GPI Atlantic, *The Nova Scotia Genuine Progress Index Accounts Volume 2: A Way Forward: Case Studies in Sustainable Forestry* by Linda Pannozzo and Minga O'Brien, profiles Windhorse Farm, Pictou Landing First Nation, and the late Jeremy Frith to show how selection harvesting and other low-impact forestry approaches are used on local woodlots. A summary is also available online.

The Asitu'lisk website contains a section on the history of the forest they steward. Asitu'lisk (formerly Windhorse Farm) was recently acquired by Ulnooweg Education Centre, an Indigenous-led charitable organization. It continues to be focused on educational programming, promoting Netukulimk (the interconnectedness of all living things) and acting as a living lab of Etuaptmumk (Two-eyed seeing).

Ecological Forestry in the Maritimes is a seven-minute video from New Brunswick-based Community Forests International, in which woodlot owners Clark Phillips and Susan Tyler describe how they have practiced selection management for more than 30 years on Whaelghinbran Farm in New Brunswick. The video begins with a description of natural Acadian Forest and an explanation of why selection harvesting is usually the most appropriate way to manage natural Acadian Forest.

Group Selection Cutting for the Landowner (PowerPoint®) is a slide presentation from the USDA Forest Service Eastern Region, Maine Department of Conservation, and Small Woodlot Owners Association of Maine. It provides an overview of selection cutting, including reasons to use this approach and equipment and methods used.

II. d. Low-Impact Logging

Uneven-aged management is closely related to *low-impact logging*, in which forestry operations are carried out in a way that minimizes damage to forest ecosystems. There are many resources available to help woodlot owners conduct general harvesting operations (not specifically selection management) in the least damaging way possible.

One resource that has been used in Nova Scotia for many years is *The Trees Around Us: A Manual of Good Forest Practice for Nova Scotia* (Nova Scotia Department of Lands and Forests, 1980).

Guide to FSC Certification for Woodlot Owners in Nova Scotia, which is described in Section I, includes information on low-impact logging.

Awakening: Living with Today's Forest is a short book created by the First Nations Forestry Program of Nova Scotia in cooperation with the Confederacy of Mainland Mi'kmaq. For print copies, contact Alton Hudson, 902-895-6385 or forestry@cmmns.com. Copies are free while supplies last.

Certification Standards for Best Forestry Practices in the Maritimes Region: Standard for Small and Low Intensity Managed Forests (pdf) contains guidelines specific to the Maritimes produced by the Forest Stewardship Council.

Principles, Goals, Guidelines and Standards for Low-Impact Forestry, an excerpt from Mitch Lansky's *Low-Impact Forestry: Forestry as if the Future Mattered* (Maine Environmental Policy Institute, 2nd edition 2003) has been reprinted online by the Nova Scotia Woodlot Owners and Operators Association under the title *Guidelines for Low-Impact Forestry*.

Laws & Regulations

Anyone managing forested land in Nova Scotia should be familiar with provincial laws and regulations. The NSDNR website has information on *Nova Scotia's Wildlife Habitat and Watercourses Protection Regulations*, which came into effect in 2002. These are mandatory on all lands, including small private woodlots.

Also at the NSDNR website, *Nova Scotia's Code of Forest Practice* (pdf) is the official framework for forest management on Crown land. While it is not required for private landowners, it is encouraged.

Nova Scotia Environment and Climate Change has information on the new *Nova Scotia Wetland Conservation Policy*, which was enacted in 2011.

The Nova Scotia Department of Justice website provides the *Forest Sustainability Regulations*, *Protected Water Areas* designations and regulations, and *Species at Risk List Regulations*.

The Nova Scotia Legislature website has copies of the *Endangered Species Act*, *Environment Act*, *Forests Act*, *Special Places Protection Act*, *Wilderness Areas Protection Act*, and *Wildlife Act*.

The Maine Organic Farmers and Gardeners Association's Low-Impact Forestry Program has posted Lansky's *principles and goals* on its website.

From the Greater Fundy Ecosystem Research Project at the University of New Brunswick, *Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem* (pdf) contains guidelines that cover a wide variety of management issues, including roads, protected areas, wildlife habitat, deadwood, and watercourse buffers.

In 2010, the Ontario Ministry of Natural Resources published a new forest management guide, *Forest Management Guide for Conserving Biodiversity at the Stand and Site Scales,* which covers protection of waterways and habitat, road and water crossings, and soil and water conservation.

The Horse in the Forest: Caring, Training, Logging by G. Sennblad (Swedish University of Agricultural Sciences, 1993) is a comprehensive look at this style of low-impact logging.

II. e. Tree Identification & Silvics

Silvics is the study of the conditions tree species need to regenerate and grow, as well as how trees respond to specific silvicultural treatments. Many books that assist in the identification of trees also provide at least some silvicultural information.

A wide variety of guidebooks and web-based resources aid in the identification of trees. From NSDNR, the *Interactive Guide to Common Native Trees of Nova Scotia* is a way to identify common trees and get basic information about them. This guide is also available in pdf format.

NSDNR's *Identification of Nova Scotia Woody Plants in Winter* is available free in print form while supplies last from woodlot@gov.ns.ca or 902-424-5444. Like other NSDNR publications, it is also available through Nova Scotia libraries.

Introduction to Silviculture, Module 1 of NSDNR's Woodlot Management Home Study program, includes information on silvics of all major species. Module 1 is available free in print form from woodlot@gov.ns.ca or 902-424-5444.

The two-volume *Roland's Flora of Nova Scotia* by A.E. Roland and E.C. Smith, first published by Nimbus in 1966 (Part I) and 1969 (Part II) and revised by Marion Zinck in 1998, is a detailed guide to the plant life of this province. The first edition, Part I and Part II, has been made available online by the DalSpace Repository as it appeared in the *Proceedings of the Nova Scotian Institute of Science*. The 1998 edition was recently reprinted by Nimbus.

Trees of Nova Scotia (Nimbus Publishing, 1996) by Gary L. Saunders includes a guide to identification of tree species along with profiles of the major hardwood and softwood species, including introduced species. Saunders is also the author of *At a Glance: A Guide to Identifying and Managing Nova Scotia Hardwoods* (Nova Forest Alliance, 2004).

The Macphail Woods Ecological Forestry Project's *Native Trees* and *Native Shrubs* pages profile conifers (softwoods), deciduous trees (hardwoods) and shrubs that are common in Nova Scotia as well as on Prince Edward Island, where the Macphail project is located. Each profile includes a photograph and description along with brief information on growing conditions, propagation, wildlife uses, and areas of usage. At the end of each profile there is a link to the web page for that species at the *Silvics of North America* website, which is described below.

From the United States Department of Agriculture (USDA) Forest Service, the *Silvics of North America* (USDA Forest Service, 1990) by Russell M. Burns and Barbara H. Honkala provides silvicultural information on approximately 200 forest tree species native to the United States. It is available in two volumes:

- *Volume 1: Conifers*. This is also available as a pdf.
- *Volume 2: Hardwoods*. This is also available as a pdf.

Trees in Canada (Fitzhenry & Whiteside, 1995) by John Laird Farrar is a highly regarded resource on this topic.

Field guides are designed for identification of species while in the field. A wide variety of printed field guides to trees are available through booksellers and the Nova Scotia library system. One example is *A Field Guide to Eastern Trees* (Houghton Mifflin, 1998) by George A. Petrides, from the Peterson Field Guides series.

One web-based guide that provides extensive information on almost all plants found growing in the wild in North America is the USDA's *PLANTS Database*. Although created and maintained by the USDA's Natural Resources Conservation Service, this database provides detailed information on plants found in both the United States and Canada. The entry for each plant is typically accompanied by at least one illustration, range maps showing the plant's present distribution and where it is native, and links to other information available online. Most listings also include information about the plant's characteristics, and often a fact sheet. By clicking on "State PLANTS Checklist" it is possible to get a list of plants found in Nova Scotia in a format that can be imported into many databases and spreadsheets.

III. ECOLOGICAL APPROACHES TO FOREST MANAGEMENT

During the last few decades, the forestry profession has moved increasingly toward management approaches that treat forested areas, forests, and individual stands as individual ecosystems requiring management approaches that are tailored to their specific structure, functions, and species. At the large-scale level, *ecological land classification* is being used to divide landscape areas into ecological units based on similarities in features such as climate, soils, geology, topography, water, and plants. At the level of the forest stand, *forest ecosystem classification* is being used to provide information that can be used in making management decisions.

The Nova Scotia Department of Natural Resources (NSDNR) has available a number of tools to help woodlot owners implement ecosystem-based forest management on their land. The department's introduction to ecosystem management can be found at the NSDNR website. A detailed overview of NSDNR's work in this area is available in the document titled *Implementing Ecosystem-Based Integrated Resource Management in Nova Scotia* (pdf), which is described in Section I.

Ecological Forestry- A Nova Scotia Approach to Woodland Stewardship, Module 18 of NSDNR's Woodlot Management Home Study program, is another excellent source of information for woodland owners.

The 500-page *Natural History of Nova Scotia* has been made available online by the Nova Scotia Museum of Natural History, providing a comprehensive overview of different ecosystems found in the province, with their associated plant and animal types. *Volume I* covers topics such as the geological history of Nova Scotia, climate, the ocean, freshwater, soils, plants, animals, and how the landscape we have today evolved since the time of the glaciers. The habitat section covers offshore, coastal, freshwater, freshwater wetlands, and terrestrial unforested habitats in addition to hardwood, softwood, and mixedwood forests. Each of these forest habitats is further broken down into forest types, which are described in terms of physical aspects, successional sequence, plants and animals, special features, and distribution in Nova Scotia. The online version of *Volume II: Theme Regions* includes an interactive map. Clicking on a region will yield information about the history of a specific area, including how soils were formed.

III. a. Ecological Land Classification

In order to manage natural forest, it is important for a forest manager to understand the land's geological history, past human uses, climate, drainage, and other features that affect it from an ecological perspective. It is also important to know how it fits in with the surrounding landscape. One tool available to help landowners visualize how their forested property fits into the larger landscape is NSDNR's Forest Inventory web page, which has links to an interactive map and other tools.

The primary tool used to understand how a property fits into a larger landscape is ecological land classification. Using this approach, Nova Scotia has been divided into nine *ecoregions*, defined primarily based on climate. These have been divided into 39 *ecodistricts*, which range in size from 126 square km to 6,481 square km.

One way to determine what ecoregion and ecodistrict a particular woodlot is in is to visit NSDNR's *Ecodistricts of Nova Scotia* map (pdf). Locating an area on the main map will provide the name and number of the ecodistrict. The smaller map in the lower right-hand corner shows ecoregions.

Once the ecodistrict and ecoregion of a woodlot have been established, *Ecological Land Classification for Nova Scotia* (pdf) by Peter D. Neily and others will provide information on the history of the area, elevation, soils, drainage, and forest species associated with different growing conditions found within the ecoregion. This document also explains how Nova Scotia's ecological classification system was developed.

Note that the nine "theme regions" discussed in *Volume II* of the *Natural History of Nova Scotia*, which is described at the beginning of Section III, have almost the same boundaries as the nine ecoregions currently delineated by NSDNR.

Another useful resource is the interactive Ecological Land Classification map on the Forestry map layer of the *Provincial Landscape Viewer*.

TIPS FOR USING THE INTERACTIVE ECOLOGICAL LAND CLASSIFICATION MAP FOR NOVA SCOTIA

- "Layers" in the upper right-hand corner allows you to choose whether you want to see ecoregions or ecodistricts, and which of these will be the "active" layer. You must use the "Refresh Map" button in order to see the new view.
- To see a key that will identify the ecoregions or ecodistricts, click on the button in the upper left-hand corner.
- While viewing a layer, click on the "i" button on the left side of the screen, then click on an ecoregion or appear below the map.
- For a closer look at an area, click the "+" button on the left side and then click on the area you are interested in. You will "zoom in" on this area and will be able to see additional information such as community names and roads.
- Click on the button with the hand on it and then on the map to move the map area. Use the magnifying glass with a plus sign to zoom in.

III. b. Forest Ecosystem Classification

NSDNR has developed tools that can help forest managers make decisions based on an understanding of the ecology of their woodlots. While ecological land classification provides information for relatively large areas, forest ecosystem classification (FEC) is used to provide information at the level of the forest stand.

The *Forest Ecosystem Classification for Nova Scotia Field Guide* by Peter Neily and others is comprised of three parts prepared by the NSDNR Forestry Division's Ecosystem Management Group: *Part I: Vegetation Types*, *Part II: Soil Types*, *Part III: Ecosites*. This guide provides information that has many practical applications in woodlot management, particularly in developing appropriate prescriptions and operating plans. A limited number of printed copies of these guides are available from the Forestry Division, NSDNR, Arlington Place, 664 Prince Street, Truro, 902-893-5692. The most recent version of this guide is 2022.

In FEC management of a woodlot, generally the first part of the FEC manual is used first, in order to determine the vegetation type or types present. The second part is then used to determine soil type. Once these are known, the third part is used to determine what *ecosites* are present on the woodlot. Ecosites are the smallest level of ecological classification.

III. b. i. Vegetation Types

Vegetation type refers to groups of plants that are typically found together in areas with similar characteristics. Identifying the vegetation type or types present on a woodlot can provide the forest manager with information about the site's disturbance pattern, successional state, and moisture and soil conditions.

III. b. i. 1. Natural Disturbance & Succession

Natural succession and *natural disturbance* are important concepts in forest ecology. They are ways of describing changes that take place in an ecosystem and are particularly useful for understanding vegetation patterns. The *Disturbance & Succession* page of the NSDNR website provides a brief introduction to these topics.

Forest Stages, a section of Lesson One, Module 3 of NSDNR's Woodlot Management Home Study program, provides an account of how an area of forest in southwestern Nova Scotia changed as a result of the 1869 Saxby Gale and the process by which the area slowly evolved from a high shrub and early tree stage to eventual maturity. Module 3 is available free in printed form from woodlot@gov.ns.ca or 902-424-5444.

NSDNR's *Mapping Nova Scotia's Natural Disturbance Regimes* (pdf) by Peter Neily and others is a detailed examination of the types of events that initiate change in the Acadian Forest and where these may occur.

Several books mentioned in Section I of this guide provide introductions to disturbance and succession.

The Acadian Forest: Historical Condition and Human Impacts by J.A. Loo and N. Ives is a detailed overview of the history of the Acadian Forest in the Maritimes. The full article, which appeared in a 2003 issue (Volume 79) of *The Forestry Chronicle*, may be obtained free from the Government of Canada's Open Science and Data Platform website, which also has a summary of the article.

III. b. i. 2. Identification Guides

The first step in using FEC on a woodlot is to identify plants growing in the area. This includes not only tree species but also shrubs, wildflowers, ferns, mosses, and lichens. Several guides that were mentioned in Section II. e. of this guide could be useful in identifying woodlot vegetation.

Guidebooks published by Halifax-based Nimbus Publishing include *Common Wildflowers & Plants of Nova Scotia* (2004) by Diane LaRue, *Weeds of the Woods: Small Trees and Shrubs of the Eastern Forest* (2004) by Glen Blouin, *Native Orchids of Nova Scotia* (2001) by Carl Munden, *Spring Wildflowers* (1993) by A.E. Roland, and *Shrubs of Nova Scotia: A Guide to Native Shrubs, Small Trees and Woody Vines* (1998) by Raymond R. Fielding.

From the Mersey Tobeatic Research Institute, *Common Shrubs, Herbs & Mosses of Nova Scotia* by Alain Belliveau is a guide to identification of 39 common plants. Also by Belliveau, *Ferns of Southwest Nova Scotia* aids in the identification of 21 common ferns. Each fern is accompanied by information on the type of woodland in which it is usually found.

The Mersey Tobeatic Research Institute also has created posters on tree lichens of Nova Scotia and Species at Risk in Nova Scotia. These may be viewed online by clicking on the images on MTRI's Products page.

Species of plants that are commonly found in areas with wet soils have special value because they may be used to identify the boundaries of wetlands, a type of habitat that is of special conservation concern. Wetlands are discussed in Section V of this guide, which includes a link to a Nova Scotia Environment and Climate Change introduction to the *Wetland Indicator Plant List* and a Wetland Indicator Plant List in spreadsheet format (Excel® document).

For assistance in identifying Nova Scotia vegetation, also see the Nova Scotia Wild Flora Society and *Blupete's Wildflowers of Nova Scotia*.

Information designed for use in nearby provinces may often be used in Nova Scotia because many of the species are the same. The following are from the Macphail Woods Ecological Forestry Project on Prince Edward Island:

- *Native Shrubs*
- *Wildflowers*
- *Ferns*

A wide variety of printed field guides to various types of ground vegetation are available from booksellers and through Nova Scotia libraries. Examples include *A Field Guide to Trees and Shrubs: Northeastern and North-Central United States and Southeastern and South- Central Canada* (Houghton Mifflin, 2nd edition 1972 and 1986) by George A. Petrides from the Peterson Field Guides series, *National Audubon Society Field Guide to North American Wildflowers: Eastern Region* (Random House, 2001) by John W. Thieret and others, and *A Field Guide to Ferns and Their Related Families: Northeastern and Central North America* (Houghton Mifflin, 2005) by Boughton Cobb and others from the Peterson Field Guides series.

III. b. i. 3. FEC Vegetation Types

Part I: Vegetation Types begins on page 11 of the Forest Ecosystem Classification for Nova Scotia Field Guide.

To use the manual, the recommended approach is to first identify tree and understory species using resources such as those listed in Section III. b. i. 2. of this guide. Photos and descriptions in the *Vegetation Types* section may also be useful for this purpose.

The next recommended step is to use the Forest Group Key (pgs. 17-18), which will direct you to the appropriate Vegetation Types Key for that stand. You can then use the Vegetation Types Key to refine the classification of the area from forest group down to vegetation type.

The next step is to learn more about that group and vegetation type by reviewing the corresponding pages in the guide, which includes information on successional dynamics, ecological features, characteristic plants, distinguishing features, site characteristics, and a map showing where this vegetation type is likely to be found.

Having determined what vegetation type is currently present on a woodlot, use the information on *Successional Development* from the NSDNR website to determine what vegetation types the site might have included at an earlier stage of succession or might be capable of developing into at a later stage. This information can be used to determine a site's potential for growing specific tree species.

III. b. i. 4. Coarse Woody Debris & Snags

Deadwood includes both *coarse woody debris,* which refers to limbs and other dead wood lying on the ground, and *snags*, which refers to standing dead trees. These are important features of natural Acadian Forest, as explained in the section *on Coarse Woody Debris and Snags* of the NSDNR *Vegetation Types* manual.
For additional information on the value of deadwood, *Deadwood- Living Forests: The Importance of Veteran Trees and Deadwood to Biodiversity* (World Wide Fund for Nature, 2004) by the World Wildlife Fund discusses the effect of removal of coarse woody debris and snags from European forests. The study demonstrates the importance of deadwood for healthy forests and healthy communities.

The following resources provide further information on deadwood:

- *Cavity Trees are Refuges for Wildlife* (pdf) by Brian Naylor, Ontario Woodlot Association
- *Guide to Wildlife Tree Management in New England Northern Hardwoods* by Carl H. Tubbs and others, USDA Forest Service Northern Research Station
- *Managing Cavity Trees for Wildlife in the Northeast* (pdf) by Richard M. DeGraaf and Alex L. Shigo, USDA Forest Service

III. b. ii. Soil Types

The next step in applying FEC on a woodlot is to determine soil type or types. It can be helpful to first gain an understanding of how soils are formed over time and how this process is related to the land forms found on a woodlot.

III. b. ii. 1. Soils, Geology & Topology

NSDNR's *A Virtual Field Trip of the Landscapes of Nova Scotia* takes viewers on an airborne, ground-level, and sometimes below-ground tour of the province. In the process readers are introduced to the history of each area as well as its notable landscape features. The "field trip" may be taken by paging through all stops or using an interactive map.

Also on NSDNR's "Virtual Field Trip" page, look for three "Vistas of the Month" and a tour of *The "Great Ditch" of Nova Scotia,* an eight-foot-deep trench that was dug across the province in 1999 in order to bury the Sable Island gas pipeline.

Having begun in the 1960s as the library of the Nova Scotia Department of Mines, the NSDNR Library has an extensive collection of materials on the geology of Nova Scotia.

Much of Nova Scotia's contemporary terrain was formed by the glaciers that were here more than 10,000 years ago. NSDNR's *Reading Room 1: The Story of Glaciers in Maritime Canada* tells the story of how Nova Scotia land forms were created by glaciers. *Reading Room 5* contains a variety of maps, including a map of the regional bedrock geology of Maritime Canada, a map of bedrock areas, and maps of various types of landforms left behind by glaciers.

An introduction to the different landforms left behind by glaciers may be found under "Depositional Features" in the *Glaciation* section of the Canadian Encyclopedia.

III. b. ii. 2. FEC Soil Types

Part II: Soil Types begins on page 289 of the *Forest Ecosystem Classification for Nova Scotia Field Guide* and provides a detailed explanation of how to determine soil types on a woodlot. The information in this section, along with using a soil auger or digging a soil pit, will help to navigate the Soil Types Key (pages 294-295). Once the soil type is determined, it provides management interpretations that permit a forest manager to assess potential risks of conducting operations on a particular site.

Kevin Keys has also developed a number of tools for identifying and recording information on soils that are associated with areas that are saturated or under water for at least part of the year (aka *wetlands*). These are listed in Section V. b. of this guide.

III. b. iii. Ecosites

Once the vegetation type and soil type of an area are determined, the next step in FEC is to determine the *ecosite*. An ecosite is the smallest level of ecological classification. As explained in the introduction to *Part III: Ecosites* beginning on page 297 of the *Forest Ecosystem Classification for Nova Scotia Field Guide*, Nova Scotia is divided into two macrogroups: the Acadian Forest Macrogroup and the Maritime Boreal Forest Macrogroup. Each has its own set of ecosites which encompass different moisture and nutrient combinations that affect growth and the type of vegetation that can grow naturally under those conditions.

Information about ecosites tells the forest manager what species will grow naturally on a specific site and what the growth potential for each species is. To determine which ecosites are found on a woodlot, use information on the site's vegetation and soil type, along with tables found on pages 303-313 of the FEC manual.

III. c. Ecological Forestry Planning Tools

In addition to the guides mentioned above, NSDNR has several other tools that can help forest managers make decisions based on an understanding of the ecology of their woodlots. The *Nova Scotia Silvicultural Guide for the Ecological Matrix* (SGEM) was developed by NSDNR in response to one of the key recommendations of *An Independent Review of Forest Practices in Nova Scotia* by William Lahey in 2018 (also known as the Lahey Report). Meant to replace the previously developed Nova Scotia Forest Management Guide, the SGEM uses decision keys to help forest professionals choose silvicultural treatments appropriate for a particular stand.

NSDNR's Woodlot Management Home Study program's Module 18, *Ecological Forestry - A Nova Scotia Approach to Woodland Stewardship*, and *A Field Guide to Forest Biodiversity Stewardship* are also both great resources for woodland owners wanting to learn more about ecological forestry.

Community Forests International has recently released *Into the Wabanaki: A Forest Care Guide*, a resource guide for forest stewards. The electronic version is available for free, or a hard copy can be purchased by donation through their website.

Another useful tool for woodlot owners is Avenza Maps, an app for smartphones and tablets available in the Apple Store and Google Play Store. The free version of the app has enough tools for most landowners, though there is also a paid version with additional capabilities. There are many free maps available in the app, but users can also upload their own geo-referenced map of their woodlot. Avenza allows you to map points of interest, record trails, and measure distances and areas while in the woods. *Intro to Avenza Maps for Forest Stewards*, a webinar from the Nova Scotia Woodlot Owners & Operators Association, is a good primer for getting started.

III. d. Climate Change Adaptation and Forest Resilience

Nova Scotia is already seeing the impacts of a changing climate. With more frequent and destructive wind events, periods of drought and flooding, spread of invasive forest pests, and shifting species ranges, it has become important to integrate climate change adaptation and forest resilience into our forest management planning.

Managing Woodlands in a Changing Climate, Module 19 of NSDNR's Woodlot Management Home Study program, is a valuable resource for woodland owners looking for information on managing our forests with a changing climate in mind.

Community Forests International has recently developed several excellent resources on climate adaptation and resilience for woodland owners and forest professionals based on current research and modelling. *Managing Forests for Climate Change: Climate Change Resilience and Carbon Storage Silvicultural Prescriptions for the Wabanaki-Acadian Forest Region* uses a decision key to help forest stewards determine appropriate silvicultural treatments for stands with a focus on climate resilience and carbon storage.

Our Changing Forest is a short video series by Community Forests International on climate change in the Wabanaki-Acadian Forest Region. The series was produced in partnership with the New Brunswick Federation of Woodlot Owners and with the financial support of Natural Resources Canada.

Climate Change-Resilience in the Acadian Forest: A Review by Megan de Graaf looks at current research and modelling on the climate resiliency of individual tree species in the Wabanaki-Acadian forest, and includes a helpful table of species projected to do well as climate changes.

IV. RESTORATION OF NATURAL ACADIAN FOREST

Many Nova Scotia woodlots have been intensively harvested at some point, or perhaps several times, in the past. The individual trees currently growing on such land may be of low value, and the land may no longer be suitable for other uses such as wildlife habitat and recreation. Because of this situation, there is growing interest in Acadian Forest *restoration*—that is, taking an area that has been degraded by past harvesting practices and restoring the structure, functions, and species that are characteristic of healthy, natural Acadian Forest.

The Nova Scotia Department of Natural Resources (NSDNR) Forest Ecosystem Classification manual (described in Section III. b. of this guide) can be used to inform decisions on Acadian Forest restoration.

One of the few resources that talks specifically about Acadian Forest restoration is *Restoring the Acadian Forest: A Guide to Forest Stewardship in the Maritimes*, which is described in Section I of this guide.

Restoring Acadian Forest can be a long-term commitment.

IV. a. Old Growth Acadian Forest

While recognizing that it can take hundreds of years for a degraded forest to develop the characteristics of a mature old forest, known as *old growth*, forest managers interested in Acadian Forest restoration often use the characteristics of old growth forest as an inspiration for their efforts and a way to gain insight into the elements that make up a healthy older forest.

NSDNR maintains a web page titled *Old Growth*. The department has also published a *Field Assessment Score Sheet* with characteristics used to determine whether a stand qualifies as old growth. *Selected Nova Scotia Old Growth Forests: Age, Ecology, Structure, Scoring* by Bruce Stewart and others provides a detailed description of four old-growth Acadian forests in Nova Scotia. NSDNR released a revised *Old Growth Forest Policy for Nova Scotia* in 2022.

Saving Our Last Great Forests by the *Nova Scotia Nature Trust* paints a portrait of what Nova Scotia's natural Acadian Forest would have been like 300 years ago and how it has changed since.

From the Food and Agriculture Organization of the United Nations, *Old Growth Forests in Canada — A Science Perspective* by Alex Mosseler and others describes old growth characteristics with a focus on the Acadian Forest.

Restoring Old -Growth Characteristics (pdf) by Anthony D'Amato and Paul Catanzaro, from the Harvard Forest gives reasons why restoring old growth characteristics is important and lays out strategies for doing so. While this document is focused on the forests of southern New England, the general principles laid out are equally applicable further north.

From the Land Owner Resource Centre in Ontario, *The Old-Growth Forests of Southern Ontario* (pdf) provides a non-technical overview of the structure and functions of old forests that are quite similar to those found in the Acadian Forest region.

Late-Successional Forest: A Disappearing Age Class and Implications for Biodiversity by John M. Hagan and Andrew A. Whitman, from the Manomet Center for Conservation Sciences in Maine, discusses the role older forests play in maintaining biodiversity, even if they do not yet qualify as old growth.

IV. b. Indicator Species

Another approach to restoration directs efforts toward creating conditions suitable for specific species. The theory behind this approach is that the manager can promote overall biodiversity and a healthy, balanced ecosystem by managing for one or more specific species with habitat requirements that will support many other species.

In ecological restoration, such species may be referred to as *indicator species*. This concept is discussed in *Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem* (pdf), which is described in Section II. d. of this guide, and in *Old-Growth Forests in Canada—A Science Perspective,* which is discussed in Section IV. a.

The indicator-species concept is also used in *Biodiversity in the Forests of Maine: Guidelines for Land Management* (University of Maine Cooperative Extension, 1999) by Gro Flatebo and others, which was the product of a multi-year process in which forest stakeholders came together to develop voluntary guidelines to maintain biodiversity in the state. It is made available online by the Maine Forest Service.

Indicator species may be plants or animals, but this approach to restoration has special appeal for woodlot owners who wish to create habitat for specific types of animals (e.g., birds) or specific species of animals (e.g., flying squirrels). Listing of resources on the habitat needs of individual species is beyond the scope of this guide. However, resources on general principles for creation of wildlife habitat are listed in Appendix A.

IV. c. Restoration Tools

Any forest management tool that helps to create a healthier forest can be used in Acadian Forest restoration. Thus, most of the resources already listed in this guide can be considered tools for Acadian Forest restoration, including NSDNR's Forest Ecosystem Classification manual, which is described in Section III. b.

At the Macphail Woods website, *The Wabanaki-Acadian Forest* gives a portrait of natural Acadian Forest and discusses options for restoration.

From the Land Owner Resource Centre, *Restoring Old-Growth Features to Managed Forests in Southern Ontario* (pdf) cites benefits of restoring features of old forests in a region that has many species in common with the Acadian Forest, and provides an overview of principles and techniques. Also from the LRC, *Do You Have a Healthy Woodlot?* explains some basic approaches that are useful in keeping a woodlot healthy for the long term.

The Society for Ecological Restoration is an international non-profit organization that promotes ecological restoration as both a way of protecting biodiversity and a way to support sustainable human communities. The society's *Ecological Restoration: A Means of Conserving Biodiversity and Sustaining Livelihoods* (pdf) brochure summarizes what ecological restoration is and basic principles of ecological restoration. *The SER International Primer on Ecological Restoration* (pdf) and *Guidelines for Developing and Managing Ecological Restoration Projects* by Andre Clewell and others outline general principles and practices used by restoration professionals.

Abandoned farmlands (aka *old fields*) present special restoration challenges. The Land Owner Resource Centre offers Management Options for Abandoned Farm Fields.

Former plantations also present special challenges. *Managing Regeneration in Conifer Plantations to Restore a Mixed, Hardwood Forest*, from the Land Owner Resource Centre, presents a strategy.

IV. d. Planting for Restoration

Managers of natural forest typically design their activities so as to encourage natural regeneration of native species. This is discussed in Section II. c. iii. of this guide.

One exception to this general rule, however, is when the forest manager wants to bring back a plant species that used to be present on a woodlot but has been eradicated, for example by past harvesting practices. In these situations, planting may be used to establish the desired species, in the expectation that these plants will be seed sources for future generations.

NSDNR has a *Tree Planting* (pdf) brochure available with basic information about tree planting. This is available free in print form from woodlot@gov.ns.ca or 902-424-5444. A longer *Tree Planting Manual* by R.G. Robertson and R.W. Young is also available free from the NSDNR Library, 902-424-8633 or natural.sciences@novascotia.ca.

The Ontario Woodlot Association has the following resources that would help forest managers decide when to plant, what to plant, and also how to obtain plant materials:

- *Planting Tips*
- *Why Seed Source Matters*
- *Knowing Your Planting Site*
- *Selecting Seedlings*

From the Land Owner Resource Centre:

- *Successful Transplanting of Woodland Vegetation for Plant Salvage or Habitat Restoration Projects*
- *Tree Guards Protect Your Trees*
- *Tree Shelters Help Hardwood Trees Grow Faster*
- *Careful Handling and Planting of Nursery Stock*

Deer browse is a growing problem in Nova Scotia, particularly among woodlot owners attempting to plant hardwoods. This problem is discussed in *Impacts of White-Tailed Deer Overabundance in Forest Ecosystems: An Overview* (pdf) by Thomas J. Rawinski, from the USDA Forest Service Eastern Region.

V. WATERCOURSES & WETLANDS

Wet areas are ecologically important parts of a woodlot that are highly sensitive to disturbance during forest-management operations. *Water and Wetlands*, Lesson Six in *Module 7: Woodlot Ecology*, of the NSDNR Woodlot Management Home Study program, discusses watercourses, special management areas, vernal pools, streams, and various types of wetlands.

Healthy Lakes and Wetlands for Tomorrow from the Mersey Tobeatic Research Institute discusses the importance of protecting lakes and wetlands, with special emphasis on species at risk.

V. a. Watercourse Buffers

Protection of areas near watercourses is a very important consideration during all forest management operations, and is almost always included in resources on proper harvesting practices, especially low-impact logging. Some examples of such resources are listed in Section II. d., including *Nova Scotia's Wildlife Habitat and Watercourses Protection Regulations*.

Riparian or watercourse *buffers* are areas next to watercourses where forest management activities are limited in order to protect these ecologically sensitive areas.

From the Land Owner Resource Centre, *Buffers Protect the Environment* (pdf) explains that buffers can be used to protect a range of sensitive areas, including watercourses.

V. b. Wetlands

NSDNR's *Nova Scotia Wet Places* web page introduces this topic and has links to detailed information on the following common wetland types: *Freshwater Wetlands*, *Freshwater Marshes*, *Bogs and Fens, Floodplains*, *Swamps*, and *Lakeshore Wetlands*.

Section T8.3 of the Nova Scotia Museum of Natural History's *Natural History of Nova Scotia* is devoted to *Freshwater Wetlands*.

Nova Scotia Environment and Climate Change maintains a web page on wetlands. The introductory page, *Nova Scotia's Wetlands,* defines wetlands, explains wetland functions and services, introduces the *Wetland Inventory* and *Wet Areas Mapping* tools, discusses wetlands of special importance in the province, and describes the following wetland types that are common in the province: bogs, fens, coastal saline ponds, marshes, swamps, and vernal pools.

NS Environment and Climate Change also offers:

- A page on the *Nova Scotia Wetland Conservation Policy*, enacted in 2011, with a link to the full text of the policy in pdf format.
- *Wetland Alteration Approval Process*, with a link to *So You Need to Alter a Wetland*, a checklist.
- *Wetland Consultants for Hire*
- *Functional Assessment of Wetlands*, an introduction to the Wetland Ecosystems Services Protocol (WESP)
- *Indicator Plant List*, an introduction to the concept of wetland indicator plants, which are commonly found in wetlands and are used to identify wetlands and their boundaries
- *Wetland Indicator Plant List* in spreadsheet format (Excel document)
- *Resources for Wetland Assessors*
- *Links to Wetland Resources*

As part of their Atlantic Wetland Care Program, Ducks Unlimited Canada has produced *The Wetland Care Guide: A landowner's guide to Atlantic Canadian wetlands*, an excellent resource on wetland types, management strategies, and opportunities for landowners to partner with DUC on wetland conservation projects.

Wetland Ecosystems (Wiley, 2009) by William J. Mitsch is by an authority on wetland ecology and restoration.

APPENDIX A: GENERAL PRINCIPLES FOR IMPROVING WILDLIFE HABITAT

Different wild animal species often have different needs. Managing a natural forest for wildlife habitat may require making a determination about what species are present on a property or are able to reach the property. The manager may then choose to make decisions based on meeting the habitat needs of specific desired species.

For this level of management, the manager may require an in-depth understanding of the biology and habitat needs of specific species. This type of information is often available online or through Nova Scotia libraries by searching the species name, but is beyond the scope of this guide.

That said, there are many ways a forest manager can create or protect habitat features that will be beneficial to a wide array of animal species. These include maintaining an adequate amount of coarse woody debris and snags, as described in Section III. b. i. 4. of this guide; protection of watercourses and wetlands, as described in Section V; and planting native species of plants, including not only trees but also other vegetation, which is described in Section IV. d.

Here are some Nova Scotia Department of Natural Resources (NSDNR) materials that have information useful in providing habitat for a wide range of animal species:

- *A Field Guide to Forest Biodiversity Stewardship*
- *Woodlots and Wildlife,* Module 4 of NSDNR's Woodlot Management Home Study program
- *Wildlife & Birds of Nova Scotia*, selections from *Wildlife of Nova Scotia* (Province of Nova Scotia and Nimbus Publishing, 1980) by Julie Towers
- *Habitats Program —Special Management Practices*
- *Living with Wildlife*
- *Biodiversity Data and Information*

Biodiversity in the Forests of Maine: Guidelines for Land Management, which is described in Section IV. b., contains a great deal of information about wildlife habitat. It is made available online by the Maine Forest Service.

A Landowner's Guide to Wildlife Habitat: Forest Management for the New England Region (University of Vermont Press, 2005) is by wildlife authority by Richard M. DeGraaf.

Conserving the Forest Interior: A Threatened Wildlife Habitat, from the Land Owner Resource Centre, deals with the importance of large areas of intact forest.

These resources address other habitat features:

- *Building a Pond* (pdf), Land Owner Resource Centre
- *Wildlife Shrubs and Edge Habitat* (pdf), Ontario Woodlot Association
- *Managing for Mast Trees in Your Woodlot*, Ontario Woodlot Association

The following resource from the Mersey Tobeatic Research Institute specifically addresses Species at Risk, including plants as well as animals: *Species at Risk in Nova Scotia: Identification and Information Guide*.

APPENDIX B: GLOSSARIES OF FORESTRY TERMS

The following websites and web pages provide definitions of technical terms that might be encountered in the resources cited in this guide:

The glossary on page 43 of Module 3 of NSDNR's Woodlot Management Home Study program contains many terms that are commonly used in woodlot management.

Page 55 of Module 5 of NSDNR's Woodlot Management Home Study program provides the abbreviations commonly used to designate tree species in Nova Scotia.

The 2022 version of the Forest Ecosystem Classification for Nova Scotia Field Guide includes a glossary on pages 323-328.

Appendix A- Definition of Terms from Climate Change Resilience and Carbon Storage Silvicultural Prescriptions for the Wabanaki Forest Region by Community Forests International provides an excellent description of common terms used in climate-adaptive silvicultural treatments.

Forestry Talk: A Glossary of Common Terms is available from the Land Owner Resource Centre in Ontario.

An extensive online glossary is maintained by the Canadian Forest Service.

APPENDIX C: HOW TO FIND PRINTED MATERIALS & VIDEOS MENTIONED IN THIS GUIDE

Nova Scotia government libraries—including the Nova Scotia Department of Natural Resources Library, public libraries, and academic libraries—collaborate in order to facilitate access to their collections by Nova Scotia residents. Many of the printed resources listed in this guide, including print versions of NSDNR publications, are available through this system. Videos may also be available through libraries, along with other media.

Materials may be accessed through local libraries, which are listed on the Nova Scotia Public Libraries page of the Nova Scotia Provincial Library website.

The NSDNR Library, 902-424-8633 or nsdnrlib@gov.ns.ca, maintains copies of NSDNR publications.

Printed books and other materials are often also available for purchase, either new or used. An Internet search on the publication title will often turn up copies available from online sellers. (Place the title between quotation marks—e.g., "Title of Book"— in order to narrow your search to that specific phrase.)

In addition to the many materials it has available for free, the NSDNR Library also has resources available for sale. These may be located through the *Publications, Maps, Digital Products* web page, particularly the section on *Forestry Publications*.

Many of the organizations listed in this guide have materials available for sale.

APPENDIX D: WEB ADDRESSES (URLs) IN THIS GUIDE

PAGE 5:

Nova Scotia Department of Natural Resources, https://novascotia.ca/natr/

Implementing Ecosystem-Based Integrated Resource Management in Nova Scotia, https://novascotia.ca/natr/forestry/reports/Systematic-Approach.pdf

Module 7: Woodlot Ecology: Your Living Woodlot, http://www.nswooa.ca/uploads/5/9/6/9/59690537/ns_module_7_woodlot_ecology.pdf

Restoring the Acadian Forest: A Guide to Forest Stewardship for Woodlot Owners in the Maritimes, http://www.bondrup.com/uploads/6/7/6/5/6765532/1-30.pdf

Harriet Irving Botanical Gardens, http://botanicalgardens.acadiau.ca/

Garden Habitats, https://kcirvingcentre.acadiau.ca/harriet-irving-botanical-gardens/garden-habitats/

Guide to FSC Certification for Woodlot Owners in Nova Scotia, http://www.merseytobeatic.ca/sites/merseytobeatic.ca/files/FSC%20Guide%20Edition%202_web.pdf

Mersey Tobeatic Research Institute, http://www.merseytobeatic.ca/

PAGE 6:

Forest Management Resources, https://www.nswooa.ca/forest-management-resources.html

Nova Scotia Woodlot Owners and Operators Association, http://nswooa.ca/

Online Goals Assessment Tool, https://www.nswooa.ca/what-are-your-goals.html

PAGE 7:

Nova Scotia Department of Natural Resources, https://novascotia.ca/natr/

Harvesting, https://novascotia.ca/natr/forestry/programs/timberman/harvesting.asp

Silviculture, https://novascotia.ca/natr/forestry/programs/timberman/silviculture.asp

Selection Management, https://novascotia.ca/natr/forestry/programs/timberman/selection.asp

Module 7 of NSDNR's Woodlot Management Home Study program, http://www.nswooa.ca/uploads/5/9/6/9/59690537/ns_module_7_woodlot_ecology.pdf

Woodlot Harvesting, https://novascotia.ca/natr/woodlot/pdf/WoodlotHarvesting.pdf

Tolerant Hardwood Management Guide, https://www.asforestry.com/wp-content/uploads/2015/07/NSDNRResearchHW.pdf

Tolerant Softwood & Mixedwood Management Guide, https://www.asforestry.com/wp-content/uploads/2015/07/NSDNRResearchSWMW.pdf

Growing High-Value Trees, https://www.nswooa.ca/uploads/5/9/6/9/59690537/asf-growing-high-value-trees.pdf

Association for Sustainable Forestry, http://www.asforestry.com/

Otter Ponds Demonstration Forest, https://www.otterponds.ca/

Crop Tree Management in Eastern Hardwoods, https://cpb-us-w2.wpmucdn.com/u.osu.edu/dist/a/836/files/2016/02/CropTreeMgmt-1h35gph.pdf

United States Department of Agriculture (USDA) Forest Service, https://www.fs.usda.gov/

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Ontario Woodlot Association, http://www.ontariowoodlot.com/

Land Owner Resource Centre, http://www.lrconline.com/

Tree Marking, http://www.ontariowoodlot.com/forest-management/forest-management/tree-marking

Promoting a Healthy Forest Through Tree Marking, https://www.ontariowoodlot.com/Tree-Marking

Ontario Ministry of Natural Resources, http://www.lrconline.com/Extension_Notes_English/pdf/tree_marking.pdf

Ontario Tree Marking Guide, https://dr6j45jk9xcmk.cloudfront.net/documents/2807/guide-treemarking.pdf

Canadian Encyclopedia, https://www.thecanadianencyclopedia.ca/en

Silviculture, https://www.thecanadianencyclopedia.ca/en/article/silviculture

Growing High-Value Trees, https://www.nswooa.ca/uploads/5/9/6/9/59690537/asf-growing-high-value-trees.pdf

Leaving a Legacy

- Part 1: https://www.youtube.com/watch?v=94ZaHFGsq-o
- Part 2: https://www.youtube.com/watch?v=OVSZM3-OkEw
- Part 3: https://www.youtube.com/watch?v=jenY6aRyvxQ

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Forestry Publications, http://novascotia.ca/natr/library/publications/forestry.asp