Biodiversity & Forestry

By Dawn Burke
Forests are important socially, economically, and ecologically

• Maintain clean air/water, provide habitat, recreational opportunities, income

• Dramatic loss of forest cover since European settlement

• Individual landowners are stewards over much of this land across southern Ontario

“We do not inherit the earth from our ancestors; we borrow it from our children”

Native American Proverb
Why Birds?

• Highly visible
• Hundreds of different species of extraordinary variety
• One of the most valued & appreciated components of our biodiversity
• Obvious and diverse component of our forest ecosystem
• Many are sensitive to the structure, composition, and configuration of forests and are good indicators of general forest health.
• Land birds in particular, provide billions of dollars in ecosystem services (natural processes that benefit humans) as consumers of pest insects, pollinators, dispersers, and predators of native seeds.
• They help maintain the same ecosystems that support human life
Pressure on forests
Pressure on forests
Issues

• Ontario *was* 80% forested

• Human activities have fragmented the natural landscape

• These activities do not affect all wildlife populations equally
What we see today does not resemble the presettlement landscape and will never do so again.
How have our forests changed

• Lack of mature and old growth stands on the landscape
• Puts pressure on species requiring these habitat features
Simplified stand structure

Second growth vs Old growth
Habitat diversity

Linked to forest structure, age, composition
Changes to species composition
Increased exotics

• Possess dominant biological characteristics that allow them to rapidly invade and out-grow native species for moisture, light, and nutrients

• Lack natural predators, competitors, and diseases that act as checks and balances.
Exotics

- Displace native species
- Introduce diseases that native species have no immunity to
- Create economic costs
- Destroy wildlife habitat
- Endanger protected species

Controlling exotics is an essential part of preserving and protecting our natural heritage for future generations.
Climate change is global in its causes and consequences and may be the greatest challenge to ever face man.

- Increased extreme weather
- Earlier egg laying, spawning, flowering
- Changes in abundance, shifts in range, changes to migratory patterns
- Spread of disease, pests, invasives
Partial Harvesting

• A large % of deciduous forests in eastern NAm are partially cut
• Many of these harvests tend to be economically NOT ecologically driven
• Woodlots are not being managed through the “selection system”
• Unlikely to be sustainable in the long term for wildlife or trees
Change is inevitable

• Whether you do something or nothing, your land will change over time
• Nature changes, whether through natural or human disturbance events or the process of succession
• With forest management the manipulation of succession is intentional with a goal in mind
How can you help maintain biodiversity on the landscape?
The human population currently consumes more than its share of Earth’s natural resources each year.

Humans have already cleared nearly half of the world’s natural habitats for their use.
Loss of biodiversity is alarming

• Our lives are dependent upon an intricate relationship between multitudes of organisms working together to achieve ecological balance

• Without biodiversity we would have no oxygen to breathe, no clean water to drink, no fertile soil to grow our crops, no food to eat, indeed no functioning biosphere

• Any human goal toward improving environmental sustainability must include actions toward maintaining and protecting biodiversity
Managing for Biodiversity

- Requires that forest management be anchored in the principles of ecology
- Should occur within the limits of natural disturbance patterns
- Our native species evolved under these patterns, mimicking them as closely as possible offers the best protection against the loss of biodiversity
- Taking an active role in properly managing our remaining natural resources, you will take a small but positive step towards protecting and sustaining biodiversity
Because our understanding of ecosystems is incomplete, preserving biodiversity allows us to keep our options alive.

We cannot predict the consequences of losing species, because all species in nature are connected.

When one species vanishes, others that rely on it are weakened and may become threatened, which can in turn weaken more species.
• Wildlife is directly affected by how humans use the land

• Responsibility for not simply preventing extinctions

• Maintain healthy populations of species that are still common
The fragmented forest
The Reproductive Challenge
Habitat selection

• Wildlife need a place to live
• For humans this place is called ‘home’
• For wildlife this place is called ‘habitat’
• When all parts blend together an individual not only survives but thrives
Wildlife needs

- Food
- Water
- Shelter (protection from predators, and habitat for breeding)
- Space
Habitat must meet wildlife needs

Habitat available must provide:

- Food
- Water
- Shelter
- Space

For a variety of organisms with various needs
Wildlife response

• Species disappears
• Species declines in abundance
• Stress response
• Breeding productivity declines
• Survival parameters decline
“When we use the tree respectfully and economically, we have one of the greatest resources on the earth.”

Frank Lloyd Wright
Silviculture

The art & science of controlling the establishment, growth, composition, and quality of forest vegetation to meet the diverse needs and values of landowners and society on a sustainable basis.
A Land Manager’s Guide to Conserving Habitat for Forest Birds in Southern Ontario

Ministry of Natural Resources
Southern Science and Information and Trent University

A Silvicultural Guide to Managing Southern Ontario Forests
Good Forestry Practices

Help forests grow healthy trees and valuable forest products, while maintaining important ecological functions and wildlife habitats.
Good Forestry Practices

- Minimize environmental damage to the site
- Protect forest components including species diversity
- Minimize damage to or enhance wildlife habitats
- Encourage sustainable forest management (improving forest health, continuous and improved forest products over time)
- Provide continual and increased economic benefits to landowners
Silviculture Systems

• Good forestry practices use the appropriate silvicultural system
Silviculture Systems

• Shade tolerant species = Single-tree selection
• Some mid-tolerants = Group + Single tree
• All mid-tolerants = Shelterwood
• All intolerants = Clear Cut
<table>
<thead>
<tr>
<th>Shade tolerance</th>
<th>Tree species</th>
<th>Additional Carolinian species</th>
<th>Moisture tolerance</th>
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<tbody>
<tr>
<td><strong>SHADE-TOLERANT SPECIES</strong> (Climax - Late Successional)</td>
<td>sugar maple, American beech, ironwood,</td>
<td>American chestnut, big shellbark hickory,</td>
<td>UPLAND</td>
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<td></td>
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<td>rock elm, pignut hickory,</td>
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<td></td>
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<td>eastern hemlock, balsam fir, red spruce</td>
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<td>black maple, blue beech, pawpaw</td>
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<td>black spruce</td>
<td>LOWLAND</td>
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<td>black gum, slippery (red) elm, red mulberry</td>
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<tr>
<td><strong>MID-TOLERANT SPECIES</strong></td>
<td>white ash, red oak, white oak, white pine</td>
<td>black oak, Ohio buckeye</td>
<td>UPLAND</td>
</tr>
<tr>
<td></td>
<td>red maple, white spruce, American (white) elm, white cedar, butternut, bur oak, bitternut hickory, basswood</td>
<td>shagbark hickory, cucumber tree, hackberry</td>
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<tr>
<td></td>
<td>silver maple, Freeman maple, yellow birch, red (green) ash,</td>
<td>swamp white oak, sycamore, blue ash, pumpkin ash,</td>
<td>LOWLAND</td>
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<td><strong>INTOLERANT SPECIES</strong> (Pioneer – Early Successional)</td>
<td>black cherry, red pine, jack pine, pitch pine, red cedar, Chinquapin oak</td>
<td>tulip tree, sassafras, northern pin oak, honey locust, dwarf hackberry, dwarf Chinquapin oak</td>
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<tr>
<td></td>
<td>trembling aspen, large-tooth aspen, cottonwood, white birch</td>
<td>flowering dogwood, black walnut, common hop-tree</td>
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</tr>
<tr>
<td></td>
<td>black Ash, balsam poplar, tamarack, black willow</td>
<td>Shumard oak, pin oak, Kentucky coffee tree</td>
<td>LOWLAND</td>
</tr>
</tbody>
</table>
Selection System

• Mimics small scale disturbance
• Maintains forests for wildlife
• Still allows timber harvest
Silviculture Guide Promotes

- Single tree selection
- All-aged system
- Periodic partial cutting (10-25y)
- Single trees of all ages removed
- Controlled by basal area
Basal Area

• Can be seen as a **summary** of the **number** and **size** of trees in a stand

• Determined by the cross sectional area of a tree at 1.3 m (breast height)

• Generally recorded as stand basal area (m$^2$/ha)

**General rule of thumb:** Forests with larger BA tend to have more large trees because these contribute **disproportionately** to stand BA measures.
Basal Area

- 50 cm dbh tree = 0.2 m² basal area
- 16 cm dbh tree = 0.02 m² basal area

If BA target = 20 m²/ha you could have:

100 (50cm dbh) trees

OR

1000 (16cm dbh) trees
Guidelines for Selection Cut

• BA target 20 m²/ha (for trees 10+ cm dbh)
• Do not remove >33% in one single harvest

• Guidelines are for stands of shade tolerant hardwoods
• Based on optimizing quality, growth and ensuring sustainability
Group selection
provide more light, allowing mid-tol. species to regenerate and develop where they would normally be lost to suppression in the light-deficient understorey.
Group Selection Planning Considerations

- Species Priority = Opening Size
- Location of Openings
- Shape of Openings
- Sustainable - # of gaps
- Harvest
- Other Considerations
  - Tending
  - Thinning btw gaps
  - Ungulate browsing
Focus on:
• What is removed: biggest, most valuable
• Short-term revenue

• All management is not created equal (frequency, intensity vary)
Tree cutting by-laws

• Regulate the cutting of forests on private lands
• Simple, easily enforced method of keeping forests on the landscape
• However, over the long-term diameter limit harvests result in less financial return and fail to preserve high quality wildlife habitat
Pervasiveness of Tree-cutting By-laws
Changes in forest structure vs. silviculture

Changes in forest structure following various silviculture and harvesting approaches

This table illustrates the structure and composition of a typical deciduous forest in southern Ontario under six different harvesting methods at five distinct time periods over the course of 30 years. Forests with more vertical structure or layers will provide more habitat types for a greater variety of forest bird species. The unharvested condition is the starting point for each of the six cutting scenarios, and reveals a multilayered structure that is the product of a forest left undisturbed for many decades. Year 0 illustrates the immediate impact of tree removal. Year 5 shows the amount of growth and development that occurs within the first five years following harvesting. Year 15 shows the structure and composition at 15-year mark following harvesting. With shelterwood, group selection, stand improvement, and single-tree selection another harvest would likely occur around Year 15. These considered for removal are marked with a spot of orange tree marking paint on their stem. Year 20 shows another 15 years of growth and development on the trees that remained following the initial harvest and the regeneration from Year 0 and Year 15. Each frame in this diagram shows a different stand structure within this 30-year period. If our landscape included a mixture of these 25 varying stand conditions along with others, such as all growth, then we would provide a broad range of habitats over the long term, for a broad range of species while also allowing for economic return from the harvesting of wood products.
<table>
<thead>
<tr>
<th>Group</th>
<th>Diameter Limit</th>
<th>Single tree</th>
</tr>
</thead>
</table>

After 30 years
Integrated Silviculture Studies

- **Partners:** public and private landowners, 3 levels of gov’t, CAs, forest industry, universities, academic funding agencies, NGOs

- Long list of graduate students and field staff.
Silviculture study

- 30 upland tolerant hardwood forests (19-261 ha in size)
- Landscape intensively agricultural (average 76%)
- Harvested between 1994-1998 (<5 years post harvest at start of study in 1999)
- Three treatments: Control, Standard Cut, and Heavy Cut

- Additional group selection study
- Algonquin Work
- Additional time series
What are we learning?

- When the silviculture guides are applied, selection system sustains more of the natural forest biodiversity.
- Many landowners do not follow the guidelines.
- Pervasive use of diameter-limits on the landscape is jeopardizing the sustainability of forested ecosystems above and beyond the stress of habitat fragmentation.
Logging and bird diversity

- Community approach
- Measure abundance & diversity of forest birds
- 2 surveys done per season
• Heavy cut sites had greater numbers of species (16.3) than reference stands (11.9) (P=0.004).

• Heavy cut sites had more individuals (24.2) than reference stands (17.8) (P=0.011).

• So DIVERSITY isn’t everything. We lose sensitive species, gain invasives and generalists.
Positive response to logging

INBU, AMRE, CSWA, GCFL all showed a similar response
Negative response to logging
In Summary....

• Preference varies across species such that any *single site* fails to capture all the forest bird diversity in the landscape

• Manage for landscape heterogeneity
Cavity Trees
Cavity trees

• 50+ use holes in trees to nest, roost, den, feed, or hibernate in
• Cavities are critical habitat for 25 of these species

• Primary cavity nesters: primarily woodpeckers
• Secondary cavity nesters: Owls, squirrels, martens, raccoons.
Natural vs. excavated
Feeding/Escape
Nest/Roost cavities
Cavity nesting birds

- Limited by availability of nest and roost sites even in *absence* of timber extraction
- Research has shown +ve relationship btw snag availability and CNB abundance
Logging Implications

• Result in loss of large diameter, declining and dead trees

• These are critical components of habitat for cavity nesting birds
Nest webs

Cavities flow from PCNs to WCNs or SCNs

Who are the keystone species?
Cavity dependent species

- Provisions for habitat geared towards PIWO (umbrella species)
- 10 live cavity trees/ha (1 > 40 cm dbh, others > 25 cm dbh)
- Provisions for snags is difficult to attain
Cavity Trees

Top priority
Cavity Trees

2nd level priority
Cavity trees

• Low priority
Low Priority trees
Objectives

• Monitor density, nest success and habitat use of cavity nesting birds in response to forest treatment

• Examine critical components for use and re-use of cavities

• Refine guidelines
Yellow-bellied Sapsucker

- Life history virtually unstudied
- Dominant cavity nester in this community
- Migrant
- Population stable
- Believed to be a keystone species
Keystone Species

- The very presence of these species contributes to a diversity of life.
- Keystone species help to support the entire community of which they are a part.
- Loss of a keystone species would consequently lead to the extinction of other forms of life that depend on the resources or structures they create or maintain.

“When one tugs at a single thing in nature, he finds it attached to the rest of the world.” John Muir
Keystone Species
Potential cavity trees

F_{2,9} = 11.3, P < 0.003*
Primary cavity nesters

$F_{2,7} = 21.4 \ P < 0.001^*$

![Bar chart showing density PCN/ha for control, standard, and heavy categories.](image)
Cavity Abundance: Experimental

- Number of Cavity trees/ha
  - pre-harvest
  - post-harvest

- Live vs. Dead

- Bar chart showing the comparison between pre-harvest and post-harvest cavity abundance for live and dead trees.
Snag density vs. Harvest Intensity

![Bar chart showing the number of snags per hectare across different harvest intensities.](chart)

- **Reference**
  - Number of Snags Per Hectare: 50
  - P-value: 0.003

- **Standard**
  - Number of Snags Per Hectare: 30

- **Heavy**
  - Number of Snags Per Hectare: 20

The bar chart indicates a significant difference in snag density across different harvest intensities, with the highest density observed in the Reference category.
Snag availability

Suitable YBSA nesting snags / ha
ANOVA: $F = 32.59, P < 0.0001$

Error bars are 95% CIs

Reference Recent Medium Old
Suitable YBSA nesting snags / ha

$F = 32.59, P < 0.0001$
Tree Class Preference

- Live
- Declining
- Dead
Higher nest survival in....

- Large diameter trees
- Cavities positioned higher up
- Trees with additional cavities present
- Far from edges

Can incorporate these findings into guidelines
Good predictor of Sapsucker Density

UGS tree density is strongly correlated to sapsucker density.
Sapsucker Density

ANOVA: $F = 49.28, P < 0.0001$

Error bars are 95% CIs

YBSA territories / 10 ha

Reference $\text{a}^\text{b}$
Recent $\text{b}^\text{c}$
Medium $\text{c}^\text{c}$
Old
More nestlings are lost in recent cuts.
Begging is Risky Behaviour
Ecological Traps

- Recent cuts sites have similar densities of YBSA as Reference stands
- But these sites suffer high nest failure rates because of high levels of bear predation
- The operate as TRAPS
Logging impacts

![Graph showing female fledglings per year vs. years since harvest, comparing predation and non-predation years. Error bars indicate ± 90% CIs.](image)

**Legend:**
- □ Predation year
- ■ Non-predation year

**Y-axis:** Female fledglings per female per year

**X-axis:** Years since harvest

- 1-5
- 16-20
- 21-25
- >60
Source and Sink Habitats

Fecundity (# female fy)

Pre-harvest
1 yr Post
2 yr Post

Reference
Intensive
Typical
Uncut stands

* Higher density
* Initiate nests sooner
* Dominated by older birds
* Higher hatch success
* Fewer dead nestlings
* Population source, always

Stands 20-25y old are least productive
Nest Re-use

• Southern ON we have >1000 nest records
• APP > 800 nest records
• In the south, most abundant cavity nesters are Hairy Woodpeckers & Y.-bellied Sapsuckers
• Central ON, YBSA are clearly dominant cavity nester
Nest web (Southern Ontario)

Secondary Cavity Nesters

WODU Mammal EUST GCFL WBNU HOWR

Primary Excavators

PIWO NOFL RBWO HAWO YBSA DOWO NATURAL

Weak Excavators

BCCH

Nest use proportion

- 0-20%
- 21-40%
- 41-100%

Habitat

Ash Beech Birch Hard Maple Soft Maple Other

Wood Duck European Starling Great-crested Flycatcher White-breasted Nuthatch House Wren Pileated Woodpecker Northern Flicker Red-bellied Woodpecker Hairy Woodpecker Yellow-bellied Sapsucker Downy Woodpecker Black-capped Chickadee
Nest Re-use

• Monitor nest and tree use and re-use between breeding seasons
• Monitor use patterns in non-breeding season
• Provide Ontario data to test tree-marking guidelines
Are cavity nests being re-used?

- Cavities were lost at a rate of 5-15% per year
- In Southern Ontario, nest reuse is highest in nests originally excavated by: Hairy Woodpeckers (23%) & Northern Flickers (18%)
- Cavity nest reuse varied with tree quality:
  - 20% were in healthy trees
  - 42% were in declining trees
  - 38% were in snags

*Additional 3 y of data, following over 700 trees to be analyzed*
Sapsucker nest web

- 45% holes
- 50% tree
- 10% 6% holes
- 1% 50% tree
- 5% 8% 2%
In Summary....

• By retaining cavity trees through tree marking
  ▪ there’s a 60% chance of the cavity being re-used by a cavity-dependant species
  AND
  ▪ There’s a 20% chance of the tree being re-used by a Primary Cavity Nester

Few species create the cavities upon which many others rely
Bandung Insights

• Uncut stands have the highest proportion of older birds, particularly males.
• Group selection sites had high proportions of young birds, particularly females.
• **Most previous territories, and many old nest trees are re-occupied, but not necessarily by the same pair.**
• Though birds successful the previous year tended to return to their territory more often, many successful breeders still switch nest trees or territories.
• Even seasoned breeders will reuse old nest sites from previous pairs.
Habitat Management Considerations

• Overwhelming task of managing full range of biodiversity
• Impossible to maintain all elements, in all places, at all times on a single parcel of land

• Focus on a combined coarse filter + fine filter approach at a large scale
• More likely to maintain native species and ecological processes if your forest resembles something created by natural disturbances
Coarse Filter

• Provides a broad range of habitats for a broad range of species
• Maintain biodiversity by maintaining habitat patterns and successional stages similar to those present naturally
• Fulfills the needs of most organisms
Fine Filter

• Managing for critical habitats for key species may be necessary for species whose habitat requirements aren’t met in the coarse filter approach
• Modify prescriptions at the stand scale to protect or enhance suitability for individual species
Guidelines for forest management and maintenance of wildlife diversity
“A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise.”

Aldo Leopold
• Goals
• Ecological conditions
• Stand characteristics
• Species regeneration characteristics
• Age
• Wildlife
• Economics
• Time
• Roads and skid trails
• Biodiversity
Stand Characteristics

- Inventory your woodlot
- Use current conditions to clarify your goals
- Cutting needed now, later or never
- Determine which silviculture system or harvest method is most suitable
Assessing the Health, Vigour, and Quality of Your Woodlot

- Soil type
- Topography
- History
- Tree species composition, density across size classes, age class
- Forest type
- Understorey vegetation
- Growth rate
Current condition of the trees drives what you can accomplish with your woodlot
What are you starting with?

- Evidence of disease or rot
- Deformities
- Invasive species
- Low diversity of wildlife, plant life, or habitat structures

- Trees with tall straight trunks, smooth bark, and full crown are a clear sign of high quality trees
You may have a degraded woodland

Repeated high-grades diameter cuts, and poor logging can result in:

• lack of mature and semi-mature trees

• few trees of good vigour or quality = limited commercial value

• poor tree distribution

• limited desirable regeneration and poor seed potential & genetics

• degraded site

• Dense shrubs and competing plants
Current management activities may need to focus on stand improvement before you are ready to move ahead with long-term habitat and wood production objectives.
Don't clean up your woodlot

Keep in mind, maintaining the full range of birds & other wildlife requires a supply of declining, dead, and downed trees to be retained.
Benefits of birds in forests

• Presence of birds (and other wildlife) is essential to maintaining the health, integrity, and productivity of the forest.
  • Symbiosis
  • Predators, pollinators, seed dispersers
How do we manage?
Who do we care about?

• Declining species?
• Habitat specialists?
• Umbrella species?
• Can’t manage habitat for everyone
• Manage at a larger scale to maintain habitat for all species
In Summary...

• Forest management changes woodlots
• Response to forest management will be species specific
• Intensity of harvest a major concern for conservation
Move beyond diameter limits

- Follow silviculture guidelines to promote good forestry practices
We can do better...
Resilience

• Our remaining forest ecosystems are dynamic and resilient
• But there are *limitations* and *thresholds*
• Our management regimes are designed to mimic nature and based on the best available science
• You are an important piece in the puzzle
• Your woodlot matters
They are counting on you
What are you going to do?
Ten ways to be careful managers....

1. Get professional forest management advice

2. Use an appropriate, recognized silvicultural system (*move beyond diameter-limits; consider group selection*).

3. Use a written prescription for harvesting.
Ten ways to be careful managers....

4. Retain large and extra large trees (some of which will be low quality/value).

5. Maintain or manage for high levels of structural diversity.

6. Consider leaving uncut areas
7. Retain old growth and wildlife features:
   - live cavity trees + mast trees (10/ha), snags (5-10/ha)(the bigger the better)
   - maintain or improve native tree diversity
   - protect existing downed wood or add
   - retain stick nests where they exist
   - preserve the integrity of wet areas
   - retain and protect the habitat of species-at-risk
Ten ways to be careful managers....

8. Demand careful, high quality logging without damage.

9. Calculate economic benefits over the long term.

10. Enjoy your woodlot!!!
“We do not inherit the earth from our ancestors; we borrow it from our children”

Native American Proverb
Thank you!

“Nature is an infinite sphere of which the center is everywhere and the circumference is nowhere”

Blaise Pascal