Progress Report

(September 2005 to March 2007)

Integrated Selection System Research in Central Ontario

Official Project Title: *A large-scale experimental and longitudinal investigation of the impact of selection harvest regimes on sustainable forest management.*

Principal Investigators:
Ken Elliott and Dawn Burke, OMNR, Science and Information Section
Erica Nol, Trent University

Lead Partner Representative and Forestry Advisor:
Keith Fletcher, Algonquin Forestry Authority

Field Coordinators:
Karla Falk, OMNR Science and Information Section
Doug Tozer, Trent University

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Primary Funding Agencies and Partners:

- Enhanced Forest Productivity Science Program (EFPS)
- CFS/NSERC/SSHRC Research Partnership grant (NSERC)
- Ontario Ministry of Natural Resources, Science & Information Branch
- Trent University
- University of Toronto
- University of Waterloo
- Tembec Inc. (Forest Research Partnership (FRP))
- Algonquin Forestry Authority (AFA)
- Bancroft Minden Forest Company
- Westwind Forest Stewardship
- Ottawa Valley Forest Inc.
- Mazinaw-Lanark Forest Inc.
- Ontario Parks – Algonquin Park District

Project Objectives:

The objective of this study is to determine the impact of various selection system disturbances on forest stand structure, composition and regeneration and relate these changes to effects on bird and insect communities. Specifically, the **retrospective** component will compare single-tree selection stands at different times since harvest intervals to uncut stands of similar tree composition and site conditions in order to evaluate the ability of a stand to recover to reference conditions (including time required to do so). We will simultaneously evaluate stand quality improvements and tree regeneration success. The **experimental** component will assess the value of two different group selection techniques as tools for improving the regeneration of hardwood tree species with lower shade tolerances and the concomitant effects on wildlife, by comparing pre and post-harvest data.

Background:

In 2004 Elliott, Burke and Nol began designing companion studies for the continuous forest regions of eastern or central Ontario that could be compared to the integrated selection system research we had been conducting within the fragmented Carolinian Zone, since 1999. Sufficient funding to start work in central Ontario was not secured until late in 2005 through our industry partnered application to the EFPS program. At that point we began planning work for the retrospective study which was all that this level of funding would support. In January of 2006 the NSERC Partnership grant was awarded and the process of finalizing the project design with both the retrospective study and group selection experiment could begin. This provided a very short turnaround to get a suitable design, finalize the experimental prescriptions, pick the study sites, establish the plots, collect the data and get the sites harvested so that post harvest data could be collected in 2007.

Final Study Design

In all cases the study sites were intended to come from the upland tolerant hardwood forest type dominated by sugar maple with:

- Minimal conifer component < 20%
- Preferably some yellow birch and/or black cherry in the overstory
- Average or better quality sites: Site Class 2 or better
- Easily accessible by road
- 18 to 40 ha in area

i) Retrospective Single-Tree Selection Study

This study is designed to assess the stand structure and development at four different stages prior to and following single-tree selection harvest conducted under provincial guidelines. By selecting:

4 stands, uncut **reference**, (**Not harvested since 1965**)
4 stands harvested between **1980 to 1985**
4 stands harvested between **1985 to 1990**
4 stands harvested between **2000 to 2005** (2^{nd} single-tree selection cut)

We plan to assess the variation in the success and composition of regenerating tree species, residual tree health and quality improvement, and stand structure development. As well, as the availability of cavity trees, snags and downed wood at the various stages. From the wildlife perspective we plan to relate songbird and cavity dependent species diversity, abundance and breeding success to the changing habitat variables identified within each era.

ii) Experimental Group Selection Study

The intent of this experiment is to test two different applications of group selection silviculture within the Sugar Maple – Yellow Birch (Hemlock) forest type (Ecosite Types: ES28.1, ES28.2, ES29.1 and ES29.2). Study site selection targeted stands that had a minor component of yellow birch and possibly black cherry in the overstory but had not, as yet, developed a sufficient seedling or sapling layer of these species. With only 3 years of funding initially secured it was important to identify sites that could receive pre-harvest monitoring in 2006 with harvest occurring prior to the 2007 field season in hopes of capturing 2 or more years of post harvest data.

Prescriptions (treatments):

3 stands, uncut **Reference** (shared with the Retrospective study)
3 stands, **Regular Group Selection**
3 stands, **Intensive Group Selection**

Regular Group Selection:

This prescription is designed to match the group selection approach currently being used in Ontario and as recommended in the Provincial guidelines for managing stands with minor mid-tolerant species components (see detailed prescription attached). **Larger group selection gaps are strategically located to capture mid-tolerant tree regeneration (primarily yellow birch and black cherry) within a typical single-tree selection harvest.** Markers were asked to place 10 to 20 circular gaps within these study

sites with at least 5 small gaps (20-25m diameter (0.03ha)) and 5 large gaps (25-30m diameter (0.07ha)). The area between gaps was to be marked to a residual basal area of approx. 18 to 20m2/ha and according to single-tree selection guidelines.

Intensive Group Selection:
This prescription is designed to match a fully regulated group selection approach where harvested trees are isolated to the gaps only (see detailed prescription attached). **The 25m diameter circular gaps (0.05h) were uniformly located on a grid with 50m centres. At a ratio of almost 4 gaps per hectare a typical site of 20 ha will have approx. 80 gaps. Approximately 20% of the land area is in gaps.** This equates to 5, 25 year cutting cycles, and a 125 year rotation age. Skid trails were laid out to avoid tree removals but do add to the overall ground disturbance (up to 4.5% additional area). Only very minor adjustments in gap locations were made to accommodate seed trees.

We plan to assess the impacts of group selection harvesting on the abundance and growth of regenerating trees, with a special focus on whether the less shade tolerant species respond better under either of the two prescriptions. Also we will investigate whether the variation in gap size has any effect. The response within gaps and in between gap areas will also be evaluated in terms of changes in availability of cavity trees, snags and downed wood, as well as the regeneration aspects mentioned above. From the wildlife perspective we plan to relate songbird and cavity dependent species diversity, abundance and breeding success, as well as insect communities to the changing habitat variables associated with these prescriptions.

Study Site Selection

The process of selecting study sites began in the fall of 2005 and was suspended until late winter 2006 and was not finalized until the end of April 2006. This involved consultation with most of the industry partners and an agreement that due to logistics (travel distances between study sites), historical treatment patterns, suitable group selection sites within allocated areas and guarantees for immediate harvest (within a year) we would need to focus on one or two Sustainable Forest License (SFL) units. After working intensively on the ground investigating potential study sites with both Westwind and the AFA it became clear that the AFA landbase was most ideally suited to meeting all the site selection variables and for this reason the entire study will take place within Algonquin Park with the generous professional and technical support of the AFA, lead by Keith Fletcher.

The attached map shows the general locations for the 22 study sites that comprise the project. Generally they are located along the Hwy 60 corridor (3 sites); Sunday Lake Rd. (3 sites); Louisa Rd. (4 sites); Cameron Lake and Shirley Lake Rd. (4 sites); and Hay Creek Rd. (8 sites).

Prescriptions, Site Layout and Marking

For the 6 experimental sites the prescription had to be set and sites marked prior to vegetation data collection. Keith Fletcher and Ken Elliott worked closely together on ensuring the prescriptions would meet the experimental objectives and be practical for both the tree markers and harvesting crews. A number of site meetings were held, followed by laying out the grid for the first intensive group selection site at Crossbar Lake, June 13 & 14, 2006. Fletcher and Elliott were assisted by Dave Peters (AFA) and the Growth & Yield staff, Wayne Reid and George Sanschagrin. We then proceeded to have this first site marked by one of the AFA's contract marking crews. This involved an on-site meeting with interactive training and consultation on how best to proceed with marking the gaps. Once everyone was satisfied with the approach the contractors completed the work independently. Similarly, the first regular group selection site

(Madawaska Lake) was visited as a group and following further field consultations the contract marking crew proceeded with completing the marking of that stand.

The four remaining sites were marked by AFA tree marking staff who also received a ½ day of on-site training with Fletcher, Elliott and Dave Peters (AFA supervisor for the marking crew).

Harvesting Treatments

Harvesting of one of each type of group selection treatment was completed during the last two weeks of August 2006 (Madawaska and Crossbar Lake sites). The Harvesting of the remaining 4 experiment sites was conducted in the winter with all being completed by the end February 2007. Most of the harvesting was completed using feller-bunchers and both cable and grapple skidders. Three of the sites were also operated with some conventional cut and skid equipment. The operators were from the AFA's set of regular contractors who were scheduled to harvest these same stands prior to this research coming along. The operators were given some on site training from AFA staff with regards to the research and what was being attempted and were asked to keep disturbance low except in the gaps where some addition ground disturbance would be beneficial to seed germination. As well, they were asked to make the group selection gaps as clean as possible in terms of cutting all trees above 2cm dbh and trying to keep most of the slash to the outside of the gaps.

Plot Set-up and Data Collection

Staffing and Accommodations

A summer contract staff contingent of 5 field assistants led by our Project Biologist (Forester), Karla Falk and PhD. Candidate Doug Tozer along with another PhD. Candidate Sonya Richmond were housed at the **Wildlife Research Station (WRS)** near Lake of Two Rivers. These 8 staff utilized a fleet of 1 MNR Suburban, 1 small MNR ½ ton and a rented full-size Dodge ½ ton and a pair of ATVs. All sites required vehicles to travel to them. As mentioned below 2 additional staff began work in mid-August on the PGP program and stayed at the WRS until mid-October.

As well, the Ontario Growth and Yield Program contributed 40 days of in-kind support from their 2 person crew (Wayne Reid and George Sanschagrin) to collect the overstory data at the PGPs. They completed this along with providing training to two of our other staff from the south, who were hired to complete the remaining 76 person/days of work needed in order to have all the data collection completed on the 9 sites by early October.

The project leaders Elliott, Burke, Fletcher and Nol all made on site visits to provide direction, select sites, set-up sites, set prescriptions, provide training and assist with data collection.

Plot Set-up

Between mid-April and the first week of May, 2006 Falk and Tozer visited all of the 22 sites to establish a network of plot centres for both **permanent growth plots (PGPs**) in the experimental sites (10-12 control PGPs) or **enhanced prism plots (EPPs**) in the retrospective sites (12 EPPs). As well, some of these same plot centres were also assigned as **point count stations** (5 to 6 per site) for collecting bird census data.

After the tree marking was complete an additional 10 PGPs were randomly assigned to 10 of the gaps on each of the 6 treated experimental sites.

Vegetation Data

There were 10 to 12 nested, circular plots (PGP) of 11.28m radius (400 m^2) established and measured in each experimental stand to measure growth, survival and regeneration of all woody and non-woody vegetation in reference stands and outside of the gaps in harvested stands. Ten

additional plots were established and measured in marked gaps of harvest sites. For the retrospective sites we used enhanced prism plots (EPP), where the overstory plot data for trees 10cm and greater is collected using a Factor 2m prism to select the trees to be measured. A set of 3 smaller (4 m2) regeneration plots (RGPs) were established at each PGP/EPP with 3 additional regeneration plots in each experimental gap. These are used to measure the composition and density of woody regeneration in 3 layers and the ground flora composition. Within the RGPs on the 9 experimental sites individual seedlings were identified (with a pin and numbered tag) and measured to monitor survival and growth (1948 seedlings pinned in 2006).

Table 1. Summary of Stand Level Vegetation Plots Measured in 2006

Plot Type	Reference Sites	Experimental Sites	Retrospective Sites - 2006	Retrospective Sites - 2007	Total PGP	Total EPP	Total RGP
PGP – no cut	36 (0)*	30 (30)			158 (122)		
PGP - selection		32 (32)					
PGP - gap		60 (60)					
EPP - selection			72 (0)	84**		156 (84)	
RGP – no cut	108 (108)	90 (90)					1086 (906)
RGP - selection		96 (96)	216 (0)	252**			
RGP - gap		360 (360)					

PGP = Permanent Growth Plot (400m2 + 25m2 plot for trees/shrubs 2.5 to 9.9cm dbh) – in the case of the gaps the data was to confirm the pre-harvest conditions, and following harvesting the focus will be on the RGPs.
EPP = Enhanced Prism Plot – same as PGP except overstory trees (10cm +dbh) are selected using a factor 2m prism.
RGP = Regeneration Plots (4m2) – the standard is 3 plots per PGP/EPP with an additional 3 within gaps.
*- number of plots in brackets represents how many will be re-established and/or re-measured in 2007
** - first measurements will be in 2007

Downed Wood
Downed woody material was quantified along two 30m transects running at right-angles through every PGP and EPP plot to determine distribution, quality and size. These volumes and quality classes will be analyzed further in relation to insects, and cavity species (nesting, foraging) and as a general biodiversity variable.

Nest Habitat
Vegetation data was also collected at the nests for targeted species (Rose-breasted Grosbeak (RBGR), Swainson's Thrush (SWTH), Yellow-bellied Sapsuckers (YBSA)). Habitat was assessed at nests and random points using a 5 m radius plot (11 m for YBSA) to characterize critical habitat and its availability across treatments.

Bird Data
On all sites, bird community composition was measured using 5-6 point counts (separated by 200m), twice during the season (early and late June). Nest success was monitored across a variety of species with a diversity of ecological needs. We focused heavily on cavity nesting birds (primary and secondary); forest interior: Ovenbird (OVEN), species in decline: Rose-breasted Grosbeak (RBGR); other songbirds of interest; Black-throated Blue warbler, Swainson's Thrush (SWTH) (Table 2). We had tremendous success on finding and monitoring Yellow-bellied Sapsucker (YBSA) nests (n = 102) and will focus heavily on this dominant primary cavity nester

in hardwood forests of Algonquin to determine if suitable habitat is better maintained under intensive group selection treatment where potentially more poor quality trees and snags can be retained (Tozer, Ph.D. candidate). Sapsuckers almost exclusively use snags for nesting. An interesting outcome of this research is the discovery of the high rate (~20%) of depredation of YBSA nests by Black Bears. Predation was occurring in the later stages of the nest cycle when YBSA nestlings were audible. Doug Tozer is preparing to submit a journal article on this novel finding (Tozer et al. in progress). As well, all YBSA cavities were monitored for rates and patterns of cavity reuse over the fall and winter to determine cavity web dynamics. Preliminary findings indicate approximately 20-30% of YBSA cavities are used by flying squirrels (likely Northern Flying squirrels).

We also discovered three Black-throated Green nests in Pileated Woodpecker feeding cavities (and 1 in Sugar Maple borer scar) (Tozer, D. submitted to Wilson Bulletin).

In addition to determining nesting success, we looked at the survival and habitat use of fledged young RBGR and SWTH on the retrospective sites (Richmond, Ph.D. candidate). Eight SWTH young and 4 RBGR young were radio-tracked every 2 days for up to 3 weeks after fledging. As well, 35 territorial adult Ovenbirds were colour-banded on the experimental sites to see if birds will return their pre-harvest territories after harvest.

Table 2: No. of cup and cavity nests found and monitored by species and treatment in Algonquin Park, 2006.

Treatment	No. of nests							
	OVEN	RBGR	BTBW	SWTH	YBSA	Other Cup	Other Cavity	Total Nests
Recent (1-5 yr)	6	3	3	3	16	30	5	66
Medium (15-19yr)	2	8	4	9	13	22	4	62
Old (20-24yr)	3	7	1	0	14	25	7	57
Regular Group	2	1	8	1	11	12	5	40
Intensive Group	7	7	3	1	15	21	2	56
Reference (+40yr)	7	4	9	15	33	29	7	104
Total	27	30	28	29	102	139	30	385

Insect Data

A total of 17 malaise-traps were set-up across treatments in both retrospective and experimental sites to monitor aerial insects throughout the breeding season. Additionally, pitfall traps (12/site) and "Tanglefoot ™" traps (10 each of dead (snags), declining (Unacceptable Growing Stock (UGS)), and live trees (Acceptable Growing Stock (AGS)) (30 total); sticky traps placed on the bark) were used to monitor ground and bark insects, respectively, on all experimental sites throughout the season (2 rounds of sampling). These samples will be used to assess the impacts of harvesting on insect biomass and biodiversity and further relate food availability to target bird species productivity. For bark insects, trees of different 'quality' were used to make comparisons between the abundance of available food present in trees of varying health (dead (snags), declining (UGS) and live/healthy (AGS)), in order to analyze stand improvement (for timber purposes), impacts on insect and avian communities. Insect samples have all been weighed and sorted, but have not yet been identified for biodiversity purposes.

Economics Data

Although NSERC did not support (fund) "the non-market valuation of maintaining biodiversity" aspect of the economics component of the study, we were able to isolate volume and productivity information for harvesting on one of the intensive group selection sites and this can be used to compare to common single-selection statistics collected by the AFA over the last few years. With this we should be able to do some calculations on the operational cost and benefits associated with harvesting using intensive group selection with feller-bunchers.

As well, with the species composition and quality data being collected on all the sites we should be able to do some straight value calculations in terms of relating managed stands to unmanaged stands (or unmanaged portions) along with modeling growth rates.

Connection to Carolinian Studies

Through other funding sources we are continuing to study the 8 sites (2 Reference, 3 single-tree selection and 3 group selection) that are part of the *Group Selection a Tool for Maintain Biodiversity Study* began in 2001. As well, we will continue with the establishment and monitoring of the companion *single-tree selection retrospective study*. Four more sites will be identified and monitored to bring the southern totals to: 4 references, 4 old cuts (1986-1991), 4 medium cuts (1991 to 1996) and 4 recent cuts (2001 to 2006. By using the same protocols and studying similar species we hope to compare the responses from the two different landscapes.

Plans for 2007

We will again be relying on the assistance of the Growth & Yield staff to lead the re-establishment of our plot network within the 6 treated study sites. This will include repinning the plot centres and replacing plot tags and flagging tape in addition to assessing logging damage. Only regeneration plots (RGPs: 654) within the experiment sites will be re-measured this year, to assess the response of seedlings, and non-woody plants to harvesting. Within the experimental sites previous pinned seedlings will be relocated and re-measured. As well, new germinants will be pinned (numbered) and measured. Staff will be trained to identify these new young trees and they will be targeting the yellow birch, black cherry as well as maple and beech that have the greatest potential. A tremendous seed crop of both yellow birch and sugar maple was observed last fall (2006), giving us hope that we will get a regeneration response. Finally, EPP(84) plots and the corresponding RGPs (216) will be measured on retrospective sites not measured in 2006 (see Table 1).

In the 2007 field season we plan to continue with the bird data collection as outlined above, with a concentrated focus on target bird species: OVEN, RBGR, YBSA, and all other cavity nesting birds, with hopes to increase sample sizes of nests found. We will expand the study of RBGR to assess the density, pairing success and age structure of populations and foraging behaviour of adults, nestlings and fledged young on the retrospective sites (Richmond, PhD. candidate). In addition, we will have up to 8 video cameras that we plan to set up at OVEN nests to monitor feeding rates of nestlings at different stages of the nesting cycle (J.P. Leblanc, MSc. Candidate). We would also like to further monitor post-fledgling habitat use and compare bird community composition nesting vs. post-fledging with mist-netting and banding of fledged young (contingent upon funding and staff).

Questions should be directed to:

Ken A. Elliott, R.P.F.
Carolinian Forestry Specialist
Ontario Ministry of Natural Resources
Southern Science and Information Section
659 Exeter Road, London, ON, N6E 1L3
519-873-4626 P
519-873-4645 F
ken.elliott@ontario.ca

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