Info for evaluation of leave tree guidelines

Scoping recommendation for context

In the original scoping discussion, the site-level committee voted to not recommend evaluation of the leave tree guidelines. This decision was largely made for two reasons: 1) lack of any new information related to the effectiveness of Minnesota's guidelines, and 2) recognition that any changes to the existing guidelines without supporting information would likely be politically and socially untenable. Despite the reasoning, the Council voted to amend the revision scope and include evaluation of the suggested changes to the leave tree guideline.

Assessing the underlying issue: cost

Most of the justification for the suggested changes is that a large amount of timber is left on the site, presumably resulting in foregone revenue and increased costs for loggers. Regarding the revenue aspect, Gaylord Paulson (DNR Timber Sales Program Coordinator) indicated to me that sale volumes are adjusted for leave trees, especially when leave trees are left in clumps; leave trees are marked; or a specific species is reserved from harvest. When scattered leave trees are left, the sale volume may not always be adjusted because the total volume left is small compared to the total sale volume, falling within DNR's accuracy standards for appraisal. Based on this information, it appears that any cost associated with foregone stumpage is accrued by the landowner, and loggers should not be including leave tree volume when bidding for timber sale contracts (at least on DNR sales).

Regarding the cost aspect, the most commonly cited cost of tree retention to loggers is increased operating costs incurred by operating in close proximity to the leave trees (e.g., move around trees without damaging, increased skidding distance around clumps, etc.). However, a recent empirical study conducted by M. Kilgore and C. Blinn at >50 sites in the Grand Rapids area found that leave tree retention at currently recommended levels had no discernable effect on feller and skidder productivity, which would not support the contention of increased operating costs. The authors speculated that loggers may have figured out how to apply the guidelines in a manner that minimizes their adverse effects on productivity (e.g., greater utilization of planning maps, increase in feller operator experience, etc.). Note that other studies have found an effect of

tree retention on logging productivity, but retention levels in those studies were much higher than our guidelines (>30% retention).

Leave tree effectiveness

As noted previously, there is little new information related to the effectiveness of the leave tree guidelines specific to Minnesota. However, there are quite a number of papers related to leave tree effectiveness in other regions and locales with differing levels of tree retention, including a few substantive review papers. In general, most studies have found that leave tree retention can increase or have no effect on species richness and abundance. In a global metaanalysis (analysis that uses multiple studies in its assessment), Rosenvald and Lohmus (2008) found positive effects on species richness and abundance for woody plants, birds, and fungi, but no effect on arthropods and mammals (Figure 2). Effects were greatest at high levels of tree retention, and not apparent at levels similar to those currently applied in Minnesota (Figure 3).

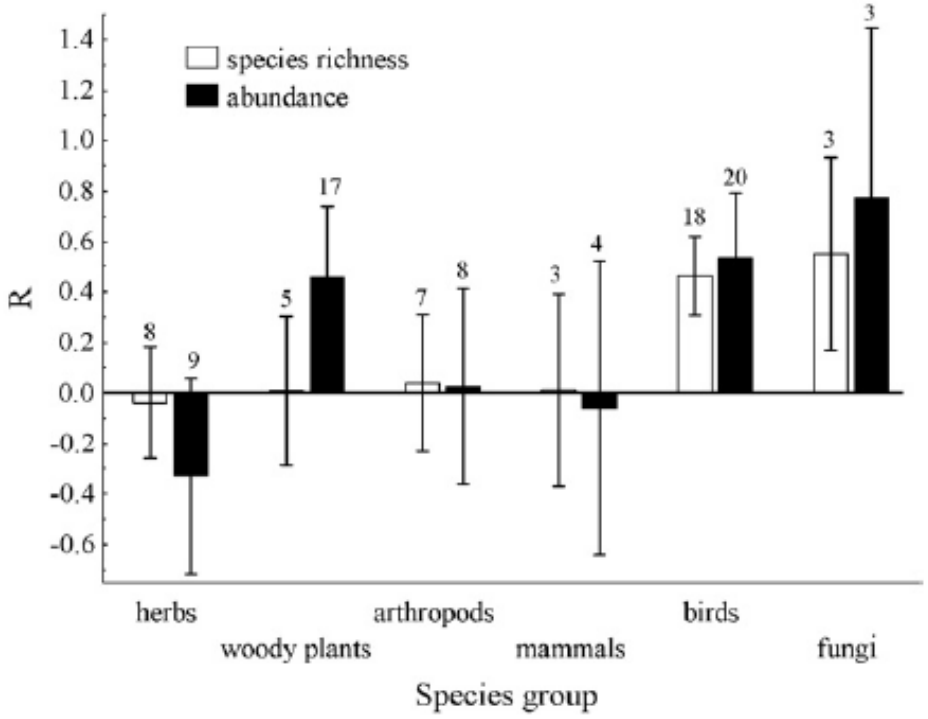

Fig. 2. Mean differences between GTR-cuts and clear-cuts in the species richness and abundance of different species groups. *R*, natural logarithm of ratio of the values in GTR-cuts vs. clear-cuts (positive values indicate higher values in GTR cuts); labels indicate the number of studies; lines are 95% confidence intervals for the mean.

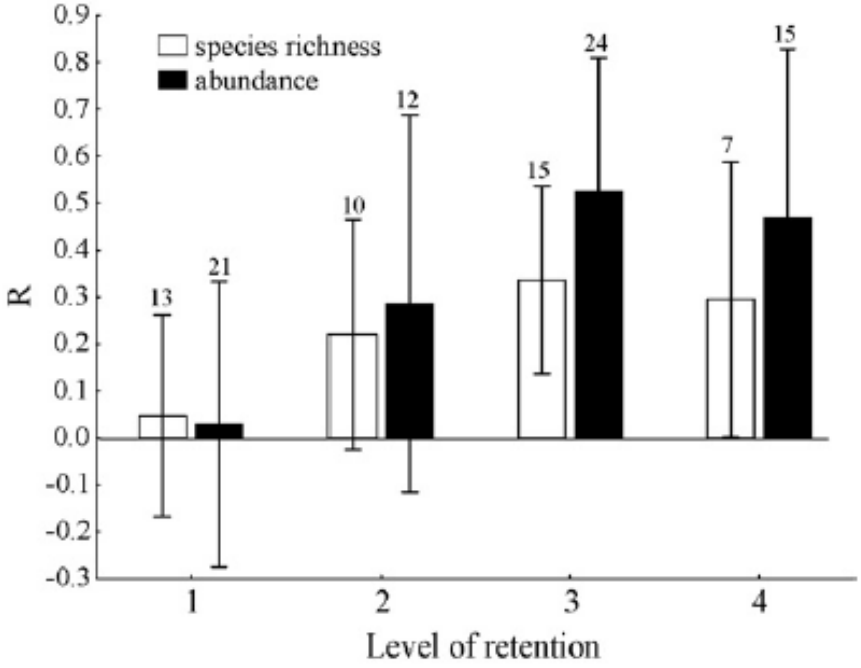

Fig. 3. Mean differences between GTR-cuts and clear-cuts in species richness and abundance of eight taxa in relation to retention levels: 1, solitary trees; 2, group-retention; 3, two-storey retention; 4, shelterwood. *R*, natural logarithm of ratio of the values in GTR-cuts vs. clear-cuts (positive values indicate higher values in GTR cuts); labels indicate the number of studies; lines are 95% confidence intervals for the mean. See Appendix A for the taxa included.

Several experimental manipulations and case studies from Minnesota paint a more complex picture, where leave trees can be beneficial to some species but be detrimental to others depending on their habitat requirements (early vs. late successional species) (See summary Table at end of document). However, all of the studies generally conclude that leave tree retention is beneficial to wildlife, providing more complex habitat for a larger variety of flora and fauna. Most of the MN studies retained more leave trees than currently recommended in the guidelines (e.g., Merril et al., 1998, Atwell et al., 2008), and several studies from other regions and reviews indicate that 10% or greater retention is necessary for bird community benefits (Schieck and Song, 2006; Vanderwel et al., 2007; Rosenvald and Lo˜hmus, 2008, Soderstrom 2009).

Scoping Issue: Clump vs. Scattered tree option

By far, the most common method used for leave tree retention is the scattered tree option (Table 1), even though clump retention is the preferred method (FMG, TH section, pg. 36). Low retention of clumps is likely due to higher cost because 5% of harvest area contains more volume than that in 6-12 trees / acre, especially if trees retained with the scattered option are small (~ 6 inch).

Table 1. Individual tree and clump retention rates from monitoring data

Monitoring years	Sites with scattered trees (%)	Sites with clumps (%)	Sites that met the guideline (%)
2000-02	49	31	61
2004-06	41	12	47
2009	50	22	61
Mean	**47**	**22**	**56**

In addition to wildlife benefits, clumps can provide additional protection of forest resources by:

1) serving as a legacy patch or rare species buffer
2) protecting cultural resources, nest sites and mast trees, and seasonal ponds
3) improving visual quality by reducing apparent harvest size.

Changing the recommendation to clump only retention may increase protection of these additional resources, as the likelihood of a clump being available when needed for protection would increase. There is also potential for reduced blowdown with clump retention, as trees in close proximity provide physical support to their neighbors. However, there is potential for detrimental effects, as it will become less likely that individual trees with outstanding wildlife value or benefit will be retained. This is a particular concern of the DNR - Div. Wildlife. If clump retention only was recommended, the recommendation should be tailored to promote retention of individual trees with outstanding wildlife benefits if possible.

Both MI and WI recommend clumps for harvests larger than 10 ac, with retention levels of 3-10% and 5-15% in MI and WI, respectively. Scattered trees contribute to the retention area in

MI and WI by including crown area associated with a scattered individual tree in the calculation. This calculation is not currently done in MN, but this could be easily incorporated into any recommendation that included retention of outstanding wildlife trees. The existing guidelines note that scattered trees may be easier to apply at narrow or small harvests (Timber harvesting, pg. 36), and this should be considered in any recommendation.

Scoping Issue: Clump locations / 5% RMZ area

The suggestion to recommend locating clumps only at harvest boundaries is based on the premise that clumps located interior of the harvest area would increase operational costs. As noted earlier, the study by Kilgore and Blinn does not seem to support this, but there are no studies I am aware of that have specifically examined the influence of clump location on logging productivity. Depending on clump arrangement within the harvest area, there are likely times when productivity is lower with interior clumps (e.g., longer skidding distance). Clumps are probably most useful to wildlife when distributed throughout harvest areas as this increase connectivity among similar habitat types (think of stepping stones), but empirical evidence in support of this concept is lacking (Rosenvald and Lohmous 2008). Locating clumps only at the harvest unit boundaries may also increase the likelihood of their removal during future harvesting of nearby stands, especially if no effort is taken to document the presence of clumps at harvest boundaries (DNR received a CAR related to this during their last certification audit).

The existing recommendation to locate leave tree clumps next to RMZ's is part of a strategy to address blowdown of residual trees in the RMZ (Rationale section, Riparian areas, pg 10), which essentially creates a buffer that protects trees within RMZ area. This strategy is also why RMZ area is not included in the leave tree area. These recommendations benefit riparian area functions (including habitat), but may be detrimental to wildlife in other areas of the harvest unit if large swaths of land end up with no leave trees (i.e., if stream is at the harvest edge). If recommended RMZ widths were to increase as suggested by the RSTC, then it may be appropriate to :1) remove recommendation to locate clumps next to RMZ's so that clumps are more evenly dispersed across the harvest unit, and 2) allow RMZ area to count towards leave tree area if the RMZ is within the interior of the harvest unit (not adjacent).

Scoping Issue: Establishment of harvest size minimum

From an ecological perspective, the goal of retaining leave trees is to provide suitable habitat and forest structure for a variety of organisms within their respective dispersal range. Given the wide range in dispersal (consider a migratory bird vs. a small mammal vs. a bryophyte) among organisms, it is likely that harvests of any size will encompass the dispersal range of some organisms. However, current focus appears to be on organisms with large dispersal ranges (e.g., bear or songbirds), where the presence of suitable habitat is probably best considered at the landscape scale. This is partially addressed in the existing guidelines, where it is noted that leave tree retention may not be necessary if suitable habitat exists in proximity to the cut. Ideally, management at the landscape scale would plan for a variety of harvest sizes, stand conditions, and leave tree configurations suitable for the habitat needs of diverse wildlife populations.

I was unable to find any reference to a harvest size minimum for leave tree retention in any guidelines (including federal, State, and certification standards) despite claims to the contrary. If there is a justifiable reason to limit tree retention to larger-sized harvests, it is not commonly recognized. This may be indicative of the underlying concept of leave tree retention – to develop structural legacies representative of natural disturbance events which span a range of sizes. The default minimum harvest size if clumps are left is currently 5 acres in Minnesota (since clumps must be >0.25 ac in size). If a minimum harvest size of 40 acres were recommended, approximately half of the area harvested in Minnesota would not be subject to the leave tree retention guidelines.

Percent of total harvest area by harvest block size increments for the monitoring years 2004-06 and 2009 and the mean across years.

Monitoring year	Percent total harvest area < **10** acre blocks	Percent total harvest area < **20** acre blocks	Percent total harvest area < **30** acre blocks	Percent total harvest area < **40** acre blocks
2004	4.8	18.6	31.7	50.4
2005	3.8	22.4	47.7	62.5
2006	2.8	18.7	33.3	42.1
2009	6.2	24.9	44.9	58.2
Mean	**4.4**	**21.1**	**39.4**	**53.3**

Scoping Issue: Retention of sawlog-sized trees (trees greater than 8-12 inches in diameter)

The guidelines (and other guidelines and standards) emphasize leaving a range of tree sizes to provide habitat benefits over time, where large trees provide immediate benefit following harvest and smaller trees provide longer-term benefits as the stand develops. Past implementation monitoring has only assessed if the minimum requirement is met, so it is difficult to determine if a range of sizes is commonly retained. Anecdotal impressions (primarily from researchers at UMN/USFS and monitoring contractors) suggest that most leave trees are non-merchantable, suppressed, and of poor quality. Large trees are necessary at all stages of stand development for wildlife requiring perches, tree cavities and bark-foraging sites. A recommendation to retain trees less than sawlog size (as suggested during scoping) would result in some time period during early stand establishment when these trees would not be present. Ownerships certified by the Forest Stewardship Council are required to retain "large live trees" and "trees of all sizes" (Indicators 6.3.f and 6.3.g.1), which would include sawlog size trees.

Existing exceptions to the guidelines

There are many exceptions and examples listed in the guidebook where deviation from the leave tree guidelines is warranted, including operator and public safety, visual quality, insect and disease concerns, proximity to agricultural or prairie land, and the presence of "suitable" existing habitat. Although substantive, these existing flexibility considerations do not address the underlying argument in favor of changing the guidelines (i.e., the issue is not difficulty in meeting the guideline, it is the perceived cost of application and the associated low rate of implementation).

Literature

Rosenvald, R., and A. Lohmus. 2008. For what, when, and where is green-tree retention better than clear-cutting? A review of the biodiversity aspects. Forest Ecology and Management. 255:1-15.

Schieck, J., and S.J. Song. 2006. Changes in bird communities throughout succession following fire and harvest in boreal forests of western North America: literature review and meta-analyses. Canadian Journal Forest Research. 36:1299-1318.

Soderstrom, B. 2009. Effects of different levels of green- and dead-tree retention on hemi-boreal forest bird communities in Sweden. Forest Ecology and Management. 257:215-222.

Vanderwel, M.C., Malcolm, J.R., Mills, S.C., 2007. A meta-analysis of bird responses to uniform partial harvesting across North America. Conservation Biology. 21:1230–1240.

Other literature from MN cited in table below

Summary of leave tree retention studies in and near Minnesota.

Reference	Study Location	Retention level	Primary response variable	Conclusions
Atwell et al. 2008 Forest Ecology and Management 255:3621-3631	Minnesota Chippewa NF Red Pine 3yr post-harvest	18 m^3 basal area (50%) either scattered or clumped in 2 gap sizes (0.1 and 0.3 ha gaps)	Birds	-No discernable differences among treatments -bird abundance, richness, and diversity increased in all treatments relative to controls three years after harvesting -loss of habitat for some interior forest species, including Black-throated Green Warbler and Ovenbird
Merrill et al. 1997 Conservation Biology 12:190-199	Minnesota Superior NF Aspen 3-9yr post-harvest	Paired sites with or without patches that ranged from 0.6 to 2 acres in size	Birds	-clumps used by bird species that avoid forest edge (e.g., ovenbird, black-throated green warbler) -cuts without clumps had increase in early successional species -clump effect mostly limited to immediate clump area, but did increase Veery and ground-nesting birds across entire harvest area
Moses and Boutin 2001. Canadian Journal Forest Research 31:483-495	Alberta, CA Aspen 4yr post-harvest	Case study comparing cuts with 2-4 tree/acre, 10% patch retention, with controls	Small mammals	-s. red backed voles decreased, and deer mice and meadow voles increased, with low retention -small mammal abundance and success similar between 10% retention and controls
Niemi and Hanowski, 1984. Journal of Wildlife Management	Minnesota Superior NF Mixed stands	Observational study with varying levels of snag and live tree retention	Birds	-Chestnut warbler density positively correlated with habitat complexity; song sparrow negatively correlated with complexity -greater habitat complexity provides more opportunities for nesting and foraging, increasing species richness