

FINAL REPORT

2001 Project Abstract

For the Period Ending June 30, 2004

TITLE: Evaluating Timber Harvesting and Forest Management Guidelines

PROJECT MANAGER: Charles R. Blinn

ORGANIZATION: Department of Forest Resources, University of Minnesota

ADDRESS: 1530 Cleveland Avenue North, St. Paul, MN 55108

WEB SITE ADDRESS:

FUND: MFRF

LEGAL CITATION: ML 2001, 1st Special Session, Ch. 2, Sec. 14, Subd. 8(a)

APPROPRIATION AMOUNT: \$200,000

Overall Project Outcome and Results

The purpose of this long-term effectiveness monitoring study is to determinate the extent to which Minnesota's forest management guidelines, once applied, protect the site-level forest resources that are potentially impacted by timber harvesting activities. Within this biennium, the study objectives were to locate and establish treatment sites, harvest the sites, and collect pre-harvest and immediate post-harvest data.

Eight sites were established on public lands in northern Minnesota. Pre-treatment vegetation, stream, and breeding bird data were collected. Seven of the eight sites were harvested during the winter of 2003/2004 and immediate post-harvest data was collected.

Preliminary vegetation data suggest differences in canopy and regeneration biomass following harvest. Preliminary data for snag and coarse woody debris suggests that coarse woody debris volume increased following harvest treatments, but snag volume decreased slightly. Most of the increase in the volume of coarse woody debris was attributed to logging debris from harvest.

The streams represent the array of aquatic environmental conditions expected across northern Minnesota and can be broadly categorized as trout streams or mudminnow streams. There was much more variation in habitat and biota among streams than among reaches within streams.

Bird communities within the riparian area varied geographically and were related primarily to amount of coniferous and sugar maple vegetation on the sites. Breeding bird communities changed between years, with the riparian treatment plots showing a significant difference in community composition after the treatment was applied. More bird species that were associated with early-successional habitats occupied the treatment sites after they were harvested. This result is consistent with our previous breeding bird studies on riparian harvest that have been conducted in northern Minnesota over the past 10 years.

Additional project details are available through a separate report to LCMR.

Project Results Use and Dissemination

Because data collection is still taking place, data were only available for select variables at the time of project completion. As long-term data has yet to be collected or analyzed, it is too early to evaluate responses from the applied treatments. Most questions we are addressing need to be evaluated over the long-term and it may not be appropriate to draw conclusions even after all the first year post-harvest data is collected and summarized. Ongoing sampling will continue in the years to come and from this research we hope to better understand riparian forests and how timber harvests affect their function and productivity. We also hope to contribute to a greater understanding of how different silvicultural prescriptions applied within riparian zones can meet long-term ecological objectives of long-lived, diverse stands and healthy ecosystems.

Project completed June 30, 2004

Date of Completion: September 15, 2004

LCMR Final Work Program Report

Date of Workprogram Approval:

Project Completion Date: June 30, 2004

LCMR Work Program 2001

I. PROJECT TITLE: Evaluating Timber Harvesting and Forest Management Guidelines

Project Manager: Charles R. Blinn

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University of Minnesota

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Web Page Address: None

Total Biennial Project Budget:

\$ LCMR Appropriation:	- \$ Amount Spent	= \$ Balance
\$200,000	- \$199,600.32	= \$399.68

Legal Citation: Laws 2001, First Special Session, Chapter 2, Section 14, Subd. 8(a).

Appropriation Language: 8 (a) Evaluating Timber Harvesting and Forest Management Guidelines

\$200,000 is from the future resources fund to the University of Minnesota, in cooperation with the Minnesota Forest Resources Council, to initiate an evaluation of the effectiveness of forest management timber harvesting guidelines for riparian areas. This is the first biennium of a five biennia project. This appropriation is available until June 30, 2004, at which time the project must be completed and final products delivered, unless an earlier date is specified in the work program.

II and III. FINAL PROJECT SUMMARY

The purpose of this long-term effectiveness monitoring study is to determinate the extent to which Minnesota's forest management guidelines, once applied, protect the site-level forest resources that are potentially impacted by timber harvesting activities. Within this biennium, the study objectives were to locate and establish treatment sites, harvest the sites, and collect pre-harvest and immediate post-harvest data.

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Bird communities within the riparian area varied geographically and were related primarily to amount of coniferous and sugar maple vegetation on the sites. Breeding bird communities changed between years, with the riparian treatment plots showing a significant difference in community composition after the treatment was applied. More bird species that were associated with early-successional habitats occupied the treatment sites after they were harvested. This result is consistent with our previous breeding bird studies on riparian harvest that have been conducted in northern Minnesota over the past 10 years.

Additional project details are available through a separate report to LCMR.

IV. OUTLINE OF PROJECT RESULTS

Result 1: Project Set-up

The project will establish treatment sites within 14 - 20 pairs of stands (7 - 10 pairs for each of the two RMZ treatments) in northern Minnesota to monitor the biological effects of various riparian management practices. Within each watershed we will establish a control and one or more riparian management treatments to compare the effects of different residual basal area levels. We will work with cooperating land management partners to install and harvest the treatment sites. Particular attention will be placed on designing harvests to comply with site-level riparian wildlife guidelines including retention of conifers, snags, long-lived trees, and mast-producing trees and shrubs.

LCMR Budget: \$59,744.23

Balance: \$0.00

Personnel: US Forest Service technician (0.5 FTE) to select field sites, install treatments, and monitoring harvesting activities (\$52,226.64). The technician would be employed through Brian Palik, US Forest Service, because that is the most cost-effective approach and because of the need to have an individual dedicated to this research study who is located close to the field sites. The US Forest Service will provide total in-kind contributions of over \$52,000, including scientist time (0.1 FTE total), to the project.

Equipment: Aerial photography, tree marking paint, flagging (\$1,470.05)

Other: Travel (\$6,047.54)

Completion Date: April 2003

Result Status:

Eight sites were located and established on either State or County forest lands in northern Minnesota. Each site has adequate size and character to accommodate a treatment (low and medium residual basal area) block and a control block separated by a non-managed buffer. The two treatments of residual basal area were chosen to test “low” and “medium” levels of the current recommended values for riparian management within a fixed width RMZ of 150 feet. The target “low” and “medium” residual basal area values were 25 ft²/acre and 50 ft²/acre, respectively. Each of the eight sites was split into two blocks. The upstream block was treated using a passive management approach where no harvesting was allowed within the RMZ, and the downstream block RMZ was randomly assigned one of the two residual basal areas. After assigning treatments to the study sites, they were paired based upon similarities in species composition, soil and aquatic characteristics. This pairing will allow comparisons to be made between the low and medium residual basal area treatments and their respective management controls.

In January 2003 we began marking treatment boundaries/sale areas and no-cut buffer zones around the research areas to protect research activities. Leave tree marking in the RMZ was completed just before logging activity began in December 2003. Pre-harvest data collection was conducted during the spring, summer and fall 2003.

In mid-December 2003 the first harvest activity began. Harvest operations were completed in seven of the eight sites in March 2004. All harvest operations used conventional harvesting equipment (i.e., feller-buncher and grapple skidder on all sites except the West Split Rock River site where trees were chainsaw felled and cable skidded). Reservation Tributary in Cook County was not harvested due to weather and logger complications. That site is scheduled to be harvested during the winter of 2004/2005.

The US Forest Service provided total in-kind contributions of over \$52,000, including scientist time (0.1 FTE total), to the project.

Result 2: Evaluate terrestrial impacts

This objective will evaluate the site-level effects of applying the various riparian management treatments on variables associated with the riparian plant community. Specifically, we will monitor the success of regeneration of riparian tree species. We will evaluate habitat suitability of the riparian management area for wildlife species by measuring conifers, snags, long-lived trees, and mast-producing trees and shrubs. Finally, we will measure changes in the amount of tree leaf litter entering the stream under the different treatments.

LCMR Budget: \$91,755.77

Balance: \$0.00

Personnel: US Forest Service technician (0.5 FTE) and summer student (0.2 FTE) to collect and process data on terrestrial impacts (~~\$76,255.77~~ \$74,008.79). The technician would be employed through Brian Palik, US Forest Service, because that is the most cost-effective approach and because of the need to have an individual dedicated to this research study who is located close to the field sites. The US Forest Service will provide total in-kind contributions of over \$52,000, including scientist time (0.1 FTE total), to the project.

Equipment: Marking flags and stakes, litter traps, densiometer (to measure canopy cover), film, computerized data logger (~~\$2,900~~ \$3,073.05)

Other: Travel (~~\$12,600~~ \$14,673.93)

Completion Date: June 2004

Result Status:

Similar species composition and basal area is found within the treatment and control areas per site. The residual basal area values were close to the site-specific target goals. The range of pre-harvest woody plants present was from 2265 to 14171 stems per acre. The West Split Rock River Site had the greatest number of stems per acre as well as the lowest pre-harvest overstory basal area.

Pre-harvest data showed adequate stems per acre to re-stock treatment blocks with similar species. The presence of mid-tolerant to shade tolerant species like black ash, red maple, sugar maple, white spruce, and balsam fir could significantly affect species composition during post-treatment. However, visual estimates of trembling aspen growth within both riparian treatments indicate they may out compete the less tolerant species and will likely lead to a greater percentage of aspen in the overstory than was previously present. The number of woody species in the regeneration layer vary by site and range from 19 to 30 species. The greatest mean number of species on plot transects was found at the border of the RMZ and clearcut before treatments were applied.

The number of pre-harvest downed stems per acre greater than 10 inches DBH by individual site ranged from 4 to 48 logs/acre. Post-harvest data based on visual estimates are likely to show an increase with the addition of downed logs resulting from harvesting operations.

There was an increase in the amount of woody biomass post-harvest in the treated RMZ while the amount remains similar in the control as would be expected with the removal of the overstory and an increase in pioneer species such as trembling aspen and paper birch. The control block RMZ showed a decrease of 3-13 percent in total biomass from pre-to post-treatment while the control block clearcut showed an increase of 9 percent. The treatment blocks showed an increase across all plots after harvest with increases ranging from 3 to 36 percent. Plots at the edge of the RMZ and within the clearcut areas had the highest amount of total biomass before and after treatment, which may be explained by a higher average species occurrence at this distance from the stream.

The immediate post-harvest windthrow that occurred is too little in quantity to be statistically significant. As time goes on, it is anticipated that windthrow will increase. The coarse woody debris data suggest that dramatic amounts of wood were added to the forest floor when implementing the low residual basal area treatment.

Result 3: Evaluate aquatic habitat impacts

This objective will evaluate site-level effects associated with applying the various riparian management practices on aquatic habitat. Specifically, we will evaluate effects on fish and invertebrate habitat (temperature, sediment composition and embeddedness, depth, width, cover, bank stability, canopy coverage, woody debris, etc.) and benthic macroinvertebrates. Habitat sampling will be conducted before and after harvest in the stream reach within the harvested area and up- and downstream of the harvested reach (internal controls). A family-level, composited, multi-habitat rapid bioassessment protocol will be used to assess benthic invertebrates in each of the within harvest reaches before and after harvest. This very limited analysis should detect major changes in benthic communities associated with riparian management practices. Treatment (riparian harvest level) effects will be assessed via ANCOVA with the pre-harvest year as the covariate.

LCMR Budget: ~~\$28,500~~ \$28,496.90

Balance: \$399.68

Personnel: Technician or summer graduate student (0.2 FTE), undergraduate research assistant (0.75 FTE summer only). Personnel will collect, process and analyze data. (\$15,449)

Equipment: Temperature data loggers (48@ \$119 each plus shuttle and software). (\$5,961)

The data loggers will be used for temperature monitoring through the duration of the 5 biennium project, or until they stop functioning.

Other: Miscellaneous lab and field supplies including waterproof paper, ethanol, bottles, vials, tape measure, miscellaneous supplies (~~\$2,090~~ \$2,086.90), printing/photocopies (\$100), telephone, mailing (\$100). Travel to field sites including per diem and lodging (\$1,400), repair

and maintenance to calibrate flow meter and replace lamp on spectrophotometer for analysis (\$500), local vehicle usage (\$2,900). (~~\$7,090~~ \$7,086.90).

Completion Date: June 2004

Result Status:

Mean values for conductivity ($\mu\text{S}/\text{cm}$) per site (Appendix 1) varied from very low (30 – 50 $\mu\text{S}/\text{cm}$) to high (>300 $\mu\text{S}/\text{cm}$). Reaches within sites had similar conductivity, but conductivity was lower at all sites in 2004, with the exception of St. Louis River Tributary. Mean values for dissolved oxygen (mg/L) in 2003 were high for all sites. All sites were alkaline ($\text{pH} > 7$).

Fish communities varied within and between streams. We observed 21 fish species across all sites with a mean of 9.3 species for larger streams and 2.8 for smaller streams. These streams could broadly be classified as containing higher numbers of either trout or mudminnow. Differences in fish populations are often associated with stream temperature regimes, size/discharge, vegetation composition and structure, channel complexity, woody debris, and sediment composition.

There were differences in the coldwater Index of Biological Integrity (IBI) scores among streams. The mean IBI scores ranged from 16 to 85 (of a possible 120 points) yielding “Poor” and “Good” classifications, respectively. Differences in IBI scores were higher between streams than within streams. Within each site the number of fish and species sampled per reach showed little variation.

Mean water temperatures for July 2003 and 2004 ranged from 15.4 to 20.7 °C. Mean water temperature was cooler in July 2004 than in July 2003 at all sites. Within-site differences between reaches were small in all cases.

Initial analyses from the 2003 samples indicate differences in macroinvertebrate composition and abundance within and between sites. Differences within sites were related to abundance, whereas between sites, abundance and taxa differed. Although macroinvertebrate communities are a reliable indicator of the health of streams, we will need to analyze the data further before reaching a conclusion on stream health.

Result 4: Evaluate wildlife impacts

This objective will evaluate the effects of riparian buffers and application of specific wildlife riparian guidelines on breeding birds in northern Minnesota. We will collect before- and after-harvest data on breeding birds with standardized methods (line-transects). Before-harvest data will be collected in June of 2003 and after-harvest data in June of 2004. This information will allow us to collect data which can be used to later document short-term response of breeding birds to wildlife habitat elements such as conifers, snags, long-lived trees, and mast-producing trees and shrubs.

Bird community composition did not change on the control transects from 2003 to 2004 based on the Blocked Multi-response Permutation Procedure analysis (n=7; delta = 0.017; p=0.303). No significant change was found in bird community composition on the uncut transects from 2003 to 2004 (n=14; delta=0.077; p=0.111). However, a significant change in the bird community composition was found on the treatment transects from 2003 to 2004 (n=7; delta=0.048, p=0.01). Additional analyses will be completed on bird community composition with Principal Response Curves after the 2006 field season.

III. Total Project Request Budget:

All Results: Personnel: ~~\$158,831.41~~ \$159,515.16

All Results: Equipment: ~~\$10,431.05~~ \$10,604.08

All Results: Other: ~~\$30,737.54~~ \$29,880.76

TOTAL BUDGET: \$200,000.00

IV. PAST, PRESENT AND FUTURE SPENDING:

A. Past Spending:

No previous studies have focused on evaluating the effectiveness of the guidelines.

B. Current and Future Spending:

Project partners provided in-kind support of approximately \$56,000 during the funding period. The USDI Geological Survey-WRRI 104B Program through the Minnesota Water Resources Center funded one graduate student for 14 months (\$28,500) during the biennium. Approximately \$100,000 would be provided in-kind by project partners during the next eight years if the project receives additional funding in subsequent bienniums.

C. Project Partners:

In addition to the Project Manager, other project team members are noted below.

JoAnn Hanowski
Natural Resources Research Institute
University of Minnesota
Duluth, MN

Randy Kolka
USDA Forest Service
North Central Research Station
Grand Rapids, MN

Ray Newman
Department of Fisheries and Wildlife
University of Minnesota
St. Paul, MN

Brian Palik
USDA Forest Service
North Central Research Station
Grand Rapids, MN

Eric Zenner
Department of Forest Resources
University of Minnesota
St. Paul, MN

During the biennium, the University of Minnesota/College of Natural Resources, University of Minnesota/Natural Resources Research Institute, and US Forest Service North Central Research Station will provide in-kind support of 0.25 FTE, laboratory, and office facilities for a grand total of approximately \$56,000. The Lake County Land Department, Minnesota DNR, and/or St. Louis County Land Department will provide study sites and 0.02 FTE for a grand total of \$25,000. If the project receives additional funding during the next four biennia, the University of Minnesota/College of Natural Resources, University of Minnesota/Natural Resources Research Institute, and US Forest Service North Central Research Station will provide in-kind support of 0.2 FTE, laboratory, and office facilities for a grand total of \$120,000. Over those same four future biennia, the Minnesota DNR will provide in-kind support of 0.02 FTE for a grand total of \$5,000.

D. Time:

It is anticipated that the entire project will take 10 years to complete. During the first biennium, the focus would be on site identification, installation of treatments, pre- and post-harvest data collection and synthesis. In subsequent biennia, the focus would be on long-term data collection, analysis, and reporting; assessment of landscape and cumulative effects; and dissemination of study results. Additional funds would be requested from LCMR in subsequent biennia. The results from this study will be used by the Minnesota Forest Resources Council to make appropriate modifications to the guidelines. Throughout the 10 years, additional monies to support this project will be solicited from other sources.

VII. DISSEMINATION: During the first biennium, there are no specific plans for dissemination, presentation, documentation and sharing of data, samples, physical collections, or other products outside of facilitating exchanges among project partners. Project personnel will offer presentations to appropriate groups both inside and outside of Minnesota based on future requests. Dissemination will become more important in future biennia as long-term monitoring results become available.

VIII. LOCATION: The eight sites will be located in Beltrami, Carlton, Cook, Lake, and St. Louis Counties. The specific site locations will be identified after project initiation while undertaking Result 1.

IX. REPORTING REQUIREMENTS: Periodic workprogram progress reports will be submitted not later than January 2002, July 2002, January 2003, July 2003, and January 2004. A final workprogram report and associated products will be disseminated by September 15, 2004, or by the completion date as set in the appropriation.

• Professional or technical (with US Forest Service North Central Research Station)	52,226.64	---	0	70,755.77 <u>68,508.79</u>	20,568.37	0	---	---	---	---	---	---	122,982.41 <u>120,735.43</u>	20,568.37	0
Duplicating	---	---	---	---	---	---	100	25.12	64.88	250 <u>0</u>	---	0	350 <u>100</u>	25.12	64.88
Communications, telephones, mail, etc.	---	---	---	---	---	---	100	14.24	62.76	250.02 <u>20.02</u>	---	0	350.02 <u>120.02</u>	14.24	62.76
Other Supplies (list specific categories)															
• Aerial photography	1,088.53	---	0	---	---	---	---	---	---	---	---	---	1,088.53	0	0
• Tree marking paint, flagging, and stakes	381.52	---	0	250	---	0	---	---	---	99.98	---	0	731.50	0	0
• Litter traps	---	---	---	500	---	0	---	---	---	---	---	---	500	0	0
• Aquatic sampling supplies (e.g., vials, sample bottles, ethanol, waterproof paper, tape measure)	---	---	---	---	---	---	2,090 <u>2,086.90</u>	1,458.55	78.35	---	---	---	2,090 <u>2,086.90</u>	1,458.55	78.35

Repair and maintenance to calibrate flow meter and replace lamp on spectrophotometer for analysis	---	---	---	---	---	---	500	410.44	89.56	---	---	---	500	410.44	89.56
Local automobile mileage paid	1,000	---	0	500	---	0	2,900	1,218.49	28.51	---	---	---	4,400	1,218.49	28.51
Other travel expenses in Minnesota															
• Vehicle rental	1,792.10	---	0	6,300 8,132.11	2,172.11	0	---	---	---	---	---	---	8,092.10 9,924.21	2,172.11	0
• Lodging and per diem	3,255.44	---	0	5,800 6,041.82	1,538.68	0	1,400	300	32	4,500 2,052.37	1,078.21	0	14,955.44 12,749.63	2,916.89	32.00
Tools and equipment (list categories)															
• Computerized data logger ²	---	---	---	1,900	---	0	---	---	---	---	---	---	1,900	0	0
• Densiometer (to measure canopy cover)	---	---	---	250	---	0	---	---	---	---	---	---	250	0	0
• Temperature data loggers, shuttle, and software	---	---	---	---	---	---	5,961	---	0	---	---	---	5,961	0	0

• Other supplies (batteries, leather gloves, nails, plastic bags, paint, and chainsaw bar oil)	---	---	---	<u>173.05</u>	173.05	0	---	---	---	---	---	---	173.05	173.05	0
COLUMN TOTAL	59,744.23	---	0	91,755.77	24,452.21	0	\$28,500 <u>28,496.90</u>	13,075.22	399.68	\$20,000 <u>20,003.10</u>	15,409.45	0	200,000	52,936.88	399.68

¹All expenses are invoiced by the Office of Sponsored Projects Administration (SPA) at the University of Minnesota.

²The data loggers will be used for temperature monitoring through the duration of the 5 biennium project, or until they stop functioning.