CROSS-BOUNDARY COORDINATION AMONG PRIVATE FOREST OWNERS TO ACHIEVE LANDSCAPE MANAGEMENT OBJECTIVES

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ABSTRACT

Cross-boundary coordination, where multiple private land owners or their agent(s) coordinate forest practices across properties, offers an opportunity to improve ecological and economic benefits over landscapes, but is largely untested. We quantify such opportunities to coordinate and the benefits that may be achieved in three landscapes in Wisconsin, USA. Methods include spatial analysis of patch distributions, simulation of forest practices over a 20-year horizon, and focus groups with private forest owners. Results show that coordination can overcome previously observed management constraints (e.g., stand fragmentation, timber volume), increase economic returns to forest owners, and assist in meeting landscape ecological objectives. Focus group discussions suggest that policies that consider the diverse goals of forest owners, utilize professional knowledge and experience, and are attentive to social networks may be helpful in realizing coordinated management on-the-ground.

Keywords: Conservation strategies, Ecosystem management, Interdisciplinary research, Parcelization, Private land

INTRODUCTION

Most forestland in the Upper Midwest, as elsewhere in the U.S., is owned by private individuals or families (i.e., private forest owners). A significant challenge facing forestry today is managing these forests sustainably in the face of continued ownership fragmentation (i.e., parcelization). The number of private forest owners in the U.S. has increased by one million between 1993 and 2003, and is expected to rise in coming years (Butler and Leatherberry 2004). While the effects of redrawing property lines are not immediately obvious, subsequent changes in the ecological, economic, and social character and function of the landscape may lead to consider-able challenges for natural resource managers and rural communities (Crow et al. 1999; Egan and Luloff 2000; Rickenbach and Gobster 2003).

Over time, parcelization can results in changes in the composition and structure of landscapes and lost economic activity across several scales (Wear et al. 1996; Crow et al. 1999). Due to economies of scale, timber sales on small parcels can be unprofitable if only a small volume is available. Regional economic activity is also lost if this is a common occurrence (Rickenbach and Gobster 2003). A long-term ecological effect associated with decreased levels of forest management is an inability to maintain early successional forest types (Rickenbach and Steele 2006). If parcelization is followed by housing development, as is often the case (Mehmood and Zhang 2001), changes within the ecological and socioeconomic communities are even more pronounced (Hansen et al. 2005). Overcoming these ecological and socioeconomic concerns will require concerted, multiscale, and multiowner planning and management.

Whereas such efforts have become the norm on public and some industrial forestlands (Schulte et al. 2006), most non-industrial private forest management reflects blocky ownership units and nearly always fails to consider the broader ecological and operational context. Cross-boundary

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coordination, where multiple owners and/or their agent(s) coordinate forest practices across properties, offers an opportunity to improve conservation benefits over landscapes as well as economic prospects for forest owners, but is largely untested.

Here we analyze the constraints and opportunities associated with cross-boundary coordination of forest management activities. We quantify and compare ecological and socioeconomic outcomes for *individual property* (i.e., status quo) and *coordinated* forest management scenarios within three landscapes in southwestern Wisconsin, USA. Specific questions we ask are:

What are the opportunities for landscape-scale forest management in a privately owned and managed landscape? What, if any, ecological and economic benefits can be achieved through the coordination of forest management practices across ownerships? How is cross-boundary coordination perceived by private forestland owners?

METHODOLOGY

STUDY AREA

We selected three study landscapes within the Driftless Area of Wisconsin, USA, named for the counties in which they primarily lie: Iowa, Richland, and Vernon. The region is characterized by steep terrain, abundant rock outcroppings, and swift streams, and predominant land uses include rowcrop agriculture, dairying, forestry, and recreation. Rowcrops and grasslands are prevalent on bluff tops and in valleys, while hillsides are forested. Oak (*Quercus alba*, *Q. rubra*, *Q. velutina*), Central Hardwood (*Quercus* spp., *Carya* spp., *Juglans nigra*, *Prunus serotina*, *Ulmus* spp., *Fraxinus americana*, *Celtis occidentalis*), and Northern Hardwood (*Acer saccharum*, *Tilia americana*) forest types are dominant in the region; Conifer plantations (*Pinus strobus P. resinosa*, *Picea glauca*) and Bottomland Hardwood forests (*A. saccharinum*, *Betula nigra*, *Ulmus* spp., *Populus deltiodes*, *F. pennsylvanica*) are also present but comprise a much smaller portion of the total forest. Similar to most of the eastern U.S., the majority (93%) of forestland is privately owned (Leatherberry 2001). We chose study landscapes because they offered a large number of private forest owners enrolled in Wisconsin's Managed Forest Law (MFL) Program. The MFL is a deferred tax incentive program that significantly reduces annual property taxes to the forest owner. In exchange, forest owners commit to a contractual forest management plan with the state that includes a significant emphasis on timber production for either a 25 or 50 yr period. Compliance rates are high (78%) (Shockley and Martin 2000) and, for our purposes, mandatory practices scheduled within MFL plans represent a realistic forest management future. On average, 4.4 mandatory management practices have been scheduled for plans within our study landscapes.

LANDSCAPE AND ECONOMIC ANALYSES

We compared and contrasted outcomes across the three study landscapes under individual property and coordinated forest management. Under the individual property scenario, each stand is managed using the mandatory forestry practices specified in the MFL plans. Under the coordinated scenario, we combined stands based on the plan, ecological, and operational adjacencies defined below. *Plan adjacency* is based on whether management plans associated with two or more individual property owners shared a common parcel boundary. Although the existence of social networks that could facilitate coordination cannot be assumed from spatial neighborhoods, plan adjacency highlights the potential for coordinated forest management in the future. MFL-defined stands were considered *ecologically adjacent* if two or more stands of the same forest type and size class shared a common parcel boundary.

We calculated basic patch metrics to quantify the ecological impact of the individual property versus coordinated scenarios, and compared patch size distributions to assess the maintenance of large patches over landscapes. We defined *operational adjacency* using a combination of the potential market opportunities, the timing of mandatory commercial forestry practices under

MFL enrollment, and distance. We consolidated mandatory practices into periods using five-year time horizons (i.e., 2005: 2003-2007; 2010: 2008-2012; etc.). Distance is factored in because logging costs can be minimized if equipment does not need to be transported between operations. Based on the expert opinion of practicing foresters, we conservatively estimated that stands located within a 0.8 km linear distance of one another as operationally adjacent. We used the Forest Vegetation Simulator (FVS; Bush and Brand 1994) model to estimate future stand productivity and timber harvest volumes.

Focus groups

We conducted five focus groups with 31 MFL enrollees who owned forestland within the three study landscapes. Participants included a mix of resident owners, absentee owners, and forestry cooperative members, and were selected to represent the range of MFL enrollees found within the region. Focus group discussions centered on the constraints and opportunities presented by three hypothetical cross-boundary coordination approaches (Gass et al. 2006).
All discussions were recorded and transcribed for subsequent analysis based on the qualitative method of thematic coding. Focus group participants additionally provided information on their basic demographics and forest management objectives and experience through a brief questionnaire.

Results

Landscape analyses

Our results indicate that substantial opportunities for cross-boundary coordination exist. Between 62% and 88% of the MFL properties were adjacent to other MFL properties. Plan adjacency is highest in landscapes such as Iowa (88%), which has a high percentage of forestland and high density of MFL plans; however, plan adjacency tends to be high even for Richland (74%), a much larger landscape with less forestland (Table 1). Opportunities to manage according to ecosystem rather than parcel boundaries and increase forest patch sizes vary (Table 1). In contiguous landscapes, such as Iowa, where forestland is not as fragmented by agriculture and where MFL plans are highly clustered, 67% of all stands are ecologically adjacent to one another; coordinated management according to current ecosystem boundaries has the potential to result in 3.8 times fewer ecosystem units over time. Correspondingly, an average stand is 5.0 ha under individual-based management and 19.1 ha under coordinated management. Even in fairly fragmented landscapes, such as Richland and Vernon, plans with ecologically adjacent stands are common, though not as numerous as in the Iowa landscape (Table 1).
Coordinated management in the Richland and Vernon landscapes can result in 2.5 times fewer ecosystem units over time, while average stand sizes increase from 5.2–5.8 ha to 12.6–14.4 ha. Substantial opportunities also exist to increase the number of large patches within all three landscapes through coordination. For example, in the Iowa landscape, few stands larger than 10 ha exist and stands greater than 30 ha are presently absent (Figure 1a).
With coordination, large stands (25+ ha) comprise a considerable proportion of the landscape (Figure 1b). Opportunities to coordinate harvesting operations, based on the strictures of the current MFL plans, are fairly consistent across all landscapes: between 21% and 28% of stands and 14% and 43% of plans meet our operational adjacency (Table 1). In all cases, economies of scale can be realized: the average size of the harvest unit and harvested timber volume show substantial increases under the coordinated scenario (Figure 2). Such harvests would likely result in greater likelihood of competitive bids and subsequent returns to forest owners. The opportunities for coordinated harvests are greatest again in the Iowa landscape (Figure 2). Here, the number of timber sales declines by 57% while the average sale volume increases by 43%.

FOCUS GROUPS

Most of focus group participants have small parcels, averaging 22 ha in size. They experience economic and logistic constraints when conducting MFL mandatory forestry practices. Several participants had coordinated with their neighbors previously in order to increase their economies of scale, share access, and save the time and money it takes to contract with a professional individually. The majority preferred coordination to be led by a forester.
This approach utilizes a professional's experience and knowledge, but also accesses other forest owners, who are considered reliable and trusted sources of information (see Gass et al. 2006 for detailed analysis of participants' opinions of coordination approaches). Participants recognized several benefits that would motivate them to manage across parcel boundaries. These perceived benefits differed by forest owner type. We label the major types as *active owners*, *typical owners*, and *members*.

Active owners are frequent managers. They tend to use their own knowledge and equipment, and infrequently use a professional. They are motivated to coordinate as a means of increasing their economies of scale when there is no other way to interest timber buyers. For example, Andrew is a very active private forest owner who spends over 10 hours a week working on his property. He sees no other way to harvest his pine than to coordinate with neighbors:

> *Part of the problem with selling pulp is that they just aren't worth that much unless you have a whole bunch of them to sell at the same time. And you're almost forced to cooperate with somebody else in that situation. I haven't been in that situation, but I will be in about two, three, four years. So I know a couple of guys around there with MFL contracts. So I'll just get together with them and see what we can do.*

Typical owners conduct management only infrequently, but rarely have the experience to control professional opportunism. They are motivated to coordinate to learn from and share with their neighbors. Phil, as an average owner, sees cross-boundary coordination with neighbors as a protection measure that lowers his perceived risk:

> *You'd feel better about your timber sale because you're saying there's five minds together and we can all kind of agree that this guy should buy it at this price and stuff. You'd probably feel better than just making the decision yourself.*

Members are participants in a forestry organization that supports sustainable forestry. Even though all focus group participants recognized the ecological benefits of cross-boundary coordination, it was the members of the local forestry cooperative who were motivated by these benefits. Several members joined because they thought the cooperative could promote sustainable forestry through cross-boundary coordination: "Although the land is getting broken up more and more, I would like to see the management of the forest become more contiguous."

DISCUSSION

Our research indicates that cross-boundary coordination can effectively address several concerns associated with parcelization in privately-owned landscapes. Coordinating existing and future forest management practices can result in greater economies of scale, with increases in the size and volume of timber sales. Operational costs associated with harvesting are also likely to be lower, as stand access can be optimized, logging equipment is moved less often, and the overall number timber sales declines.
These benefits are likely to be accrued by loggers and foresters, however, and it is unclear whether they would be willing to pass such savings on to the forest owner (i.e., higher stumpage prices), providing further incentive for coordinated management. Coordinating existing and

future management also provides opportunity to manage according to ecosystem boundaries instead of the often more linear property boundaries. Although such opportunities can be fairly numerous in landscapes where forest management plans are spatially clustered, coordinated management would result in at least a doubling of the average patch size in all three of our study landscapes. Cross-boundary coordination is necessary for large patches (>25 ha) to be maintained over time, which in the Driftless region is critical to maintaining forest bird populations. Maintaining a more natural patch structure and larger patches overall can also assist forest owners in achieving mutual aesthetic and wildlife goals, where they exist. The economic and landscape ecological analyses show potential for coordination, but coordination will only be viable if the social factors are also aligned.

Analysis of the focus groups show that forest owners see cross-boundary coordination as a means to increase their economies of scale, provide trusted sources of information, and benefit their community ecologically. Even though these benefits exist, participants noted that a social network must first exist to provide a foundation for any type of coordination to take place. Forest owners need to establish communication with their neighbors and share their management objectives to develop the level of trust required for acceptance of cross-boundary coordination. This is not an easy task as many new forest owners are absentee, and psychological "fences" are built quickly between new and old owners based purely on assumptions. Private forest owners in highly parcelized areas will be brought to cross-boundary coordination out of need or to promote ecological benefits.

Governments, forestry professionals and organizations with a vested interest in the benefits of cross-boundary outcomes (e.g., state forestry bureaus, The Nature Conservancy, industry, etc.) must take an active and guiding role in facilitating coordination through a variety of policy mechanisms. These mechanisms will need to be diverse and address the motives of each private forest owner type.

Future research can help narrow the range of potential mechanisms to those with the greatest likelihood of effecting change. Our research provides state forestry bureaus, private consulting foresters, timber companies, and conservation organizations with an understanding of cross-boundary management and the benefits it may provide in privately-owned landscapes. Although opportunities may be found in many locations, pilot efforts that seek to encourage coordinated management may realize greatest benefit in landscapes with a high percentage of forestland and spatially-clustered forest plans.

Success is also dependent on the social landscape, however, and such efforts should also consider forest owner motivation toward coordination, utilize professional knowledge and experience, and be attentive to the local social networks.

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Table 1: Summary metrics for study landscapes

Metric	Iowa	Richland	Vernon
Spatial extent (ha)	6,127	11,815	10,478
Percent forestland (%)	65.6	47.4	53.4
Percent forestland with plans (%)	45.2	38.6	22.8
Total number of plans	89	105	63
Average extent of plan (ha)	21.7	22.0	21.0
Average stand size	6.1	5.2	4.8
Plan adjacency:			
Number plans	78	87	39
Percent plans	87.6	74.3	61.9
Ecological adjacency:			
Number plans	65	57	24
Percent plans	73.0	54.3	38.1
Operational adjacency:			
Number plans	35	45	9
Percent plans	39.3	42.9	14.3

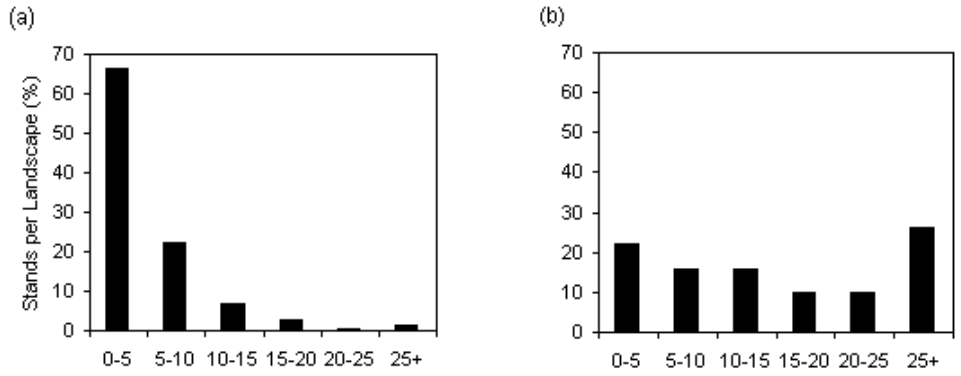

Figure 1. Patch size distribution under (a) individual property-based versus (b) coordinated management scenarios for the Iowa study landscape.

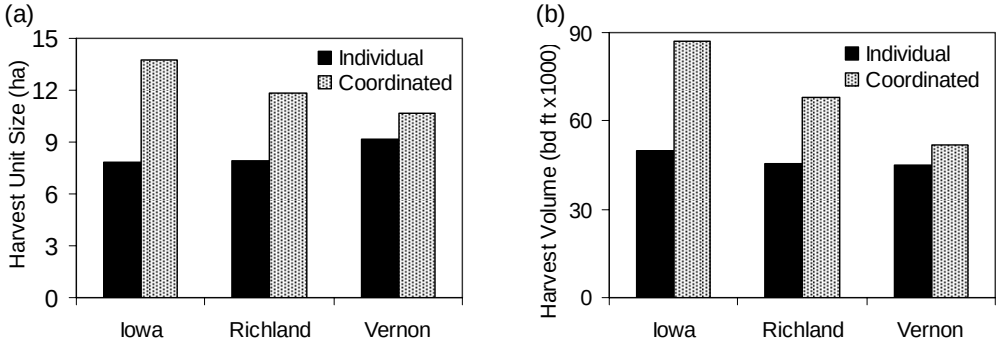

Figure 2. Mean harvest statistics under individual-based versus coordinated management scenarios: (a) harvest unit size and (b) harvest volume.