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Family Forest Owners' Motivation to Control Understory Vegetation: Implications for Consulting Forestry

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Forest vegetation management has evolved as a recognized component of intensive forest management practice. It involves the management of competing vegetation necessary to obtain the high yields expected in modern forest plantations via control of interfering plants that influence regeneration outcome, impact timber stand development, and limit native plant and wildlife diversity. It includes cultural control, fire control, mechanical control, biological control, and chemical control. The public perception of forest vegetation management, especially chemical control, is sometimes negative due to health and environmental concerns. It is an important tool in the forest management alternatives available to consulting foresters managing family forest lands (the vast majority of private forest land in the United States). We report on a study that addresses the motivations of family forest owners that implement forest vegetation management practices and the motivation of those who chose not to implement after forester recommendations to do so. For those who do implement forest vegetation management, improvement of wildlife habitat and increased timber growth was the main motivation. For those who did not, cost was the main concern. Size of forest holding plays a major role in determining who will practice intensive forestry.

Keywords: Forest Vegetation Management; Chemical Control; Family Forest Owners; Consulting Forestry

Introduction

The evolution of forest vegetation management (FVM) as a recognized component of intensive forest management practice was described by Wagner et al. (2006). FVM involves the management of competing vegetation necessary to obtain the high yields expected in modern forest plantations. It operates by controlling interfering plants that influence regeneration outcome, impact timber stand development, and limit native plant and wildlife diversity (Stout & Finley, 2001). Interfering plants mainly suppress natural plants by shading the understory, but also compete for water, space, and nutrients. By impacting forest stand development, interfering vegetation tends to create a suboptimal future forest stand, one with a lower future timber value (Jackson et al., 2009).

FVM is not just one practice, but an integrated series of practices (Jackson & Finley, 2011; Wiensczyk et al., 2011). It can include cultural control (maintenance of a "healthy" mix of desirable trees species that supports a robust forest with an unopportunistic environment for interfering plants), fire control (use of prescribed burning to reduce undesirable vegetation), mechanical control (removal of interfering plants by hand tools or machinery by cutting or pulling, commonly called weeding), biological control (introducing an insect or disease that is detrimental to the interfering plant), and chemical control (use of herbicides to reduce competition between undesirable interfering plants and the trees in the productive forest).

Integrated vegetation management (IVM) involves the use of the proper range of control methods. IVM uses the concept of a pyramid to delineate the treatments: cultural control is at the bottom and chemical control at the top of the pyramid. As a forester moves from cultural to fire to mechanical to biological to chemical control, the practices become more complex and costly. IVM involves starting at the bottom of the pyramid and moving up to more complicated and costly treatments (Nowak & Ballard, 2005; Miller, 2006; Smallidge, 2009).

In both recently-established forest plantations and naturally-regenerated forests, tree survival and growth is controlled by succession, a major process impacted by competition between trees and other natural vegetation. This competition for resources takes place in a battle for nutrients, water, and light, and by the temporal and spatial segregation of roots and shoots of neighboring plants that allows for completion for space and time (Balandier et al., 2006). The foundation of FVM is developed around this competition to employ techniques that optimize timber production while ensuring plant diversity. It is an intrinsic constituent of silviculture. The primary decision on competitive factors impacting tree survival and growth is silvicultural system: even-aged (clear-cutting, seed tree, or shelterwood) or uneven-aged (individual or group selection), with intermediate treatments of competition control and thinning (Nunamaker & Valachovic, 2007).

The first textbook on FVM defines the term as "the practice of efficiently channeling limited site resources into usable forest products rather than into noncommercial plant species" (Walstad & Kuch, 1987). Wagner (1994) defined it as "manag-

ing the course and rate of forest vegetation succession to achieve silvicultural objectives." In North American silviculture textbooks FVM generally includes release and site preparation treatments (Wagner et al., 2006). Timber volume gains from FVM are well-documented for the various forest-growing regions of the world and FVM has become associated with intensive forest management, primarily from chemical control (use of herbicides), especially in the American South (Wagner et al., 2006). Herbaceous and woody vegetation control in southern forest plantations has become a recognized practice when intensive forest management is practiced (Stringer et al., 2010; Osiecka & Minoque, 2011). Herbaceous weed control with herbicides has become closely associated with FVM. It is the top of the pyramid; it may be very costly, but it is also every effective (Vasic et al., 2012). The general public has also come to associate FVM with chemical control and this has resulted in public perceptions of FVM sometimes not enhancing sustainable forestry practices.

Public Perceptions of FVM

The use of FVM is a common component of silvicultural practice around the world; however, preferred methods differ by continent. For example, in Europe most herbaceous weeds are controlled by site preparation and in North America chemical vegetation control is most common (Ammer et al., 2011). Within North America, the southern US has attempted to develop competitive advantages in the international timber market with a focus on intensive high-yield forestry and strong support for the use of herbicides as necessary for effective FVM (McCormack, 1994). North American forestry studies have shown chemical control in timber production produces low risks to humans, soil, water and wildlife, while Europeans feel herbicides are a "serious threat for the maintenance of the set of multiple functions that forests provide" (Ammer et al., 2011). European-based forest certification systems, like the Forest Stewardship Council, take a much harsher view of chemical control than North American-based forest certification systems, like the Sustainable Forestry Initiative.

Not all forestry studies support the North American conclusion that FVM is a necessary part of intensive forest management. Some find results from research studies to be inconsistent in terms of the permanency of the growth and yield gains from FVM, the effects of overstory and gap size, the effects on ground vegetation control, the opposite effects of woody and herbaceous vegetation management, and the effect on species richness (Ammer et al., 2011).

Even in North America, some perceive FVM to be detrimental to forest sustainability goals. Research has tended to focus on the high yields that result from FVM and not on contribution to ecosystem management goals. Changes in cultural patterns may be necessary to gain a focus on ecosystem management concerns (Newton, 2006). Wagner et al. (1998) surveyed public perceptions of risk and acceptability of FVM alternatives in Ontario. Participants were given nine FVM alternatives and asked to rank them from riskiest to least risky. In order of riskiness, the alternatives were: aerially-applied herbicides, biological control, ground-applied herbicides, mulches, prescribed fire, site preparation, cover cropping, grazing animals, and manual cutting. Public acceptance was lowest for aerially-applied herbicides (18%) and second lowest for ground-applied herbicides (37%). There results suggest that strong public support can be obtained for FVM programs that do not include herbicides (Wagner et al., 1998).

Chemical control using herbicides has gained favor in North America due to its effective and low cost relative to results. International forest certification systems certainly discourage broad use of forest herbicides. Herbaceous weed control methods have developed somewhat independently and the use of non-herbicide methods (mechanical, manual, thermal, and biological) seem to be almost discouraged. Greater public concern, changing perceptions of risk, and international forest certification systems may combine to encourage a wider use of control alternatives (Little et al., 2006). The changing demographics of America's family forest owners (FFOs) certainly will affect public perception of these alternatives. What impact could this have on consulting foresters who have these owners as their main clients?

FFOs and Undesirable Vegetation

Family forest owners (FFOs), the main clientele of forestry consultants are surveyed nationally by the USDA Forest Service. The last survey was in 2006 (Butler, 2008). That survey showed FFOs had a strong concern over the issue of undesirable vegetation, or the problem solved by FVM. Statistics in that survey were stated in terms of area owned by FFOs and number or population of FFOs. This was an important distinction. At the extremes of forest tract size, say owners of small tracts (less than 5 ha) and owners of large tracts (greater than 2000 ha), there are many, many owners of small tracts and few owners of large tracts. Thus, statistic alone, area or number of owners will skew an interpretation of impact on the total forest.

Data from that survey, the National Woodland Owners Survey, is available for analysis using table making software developed by the USDA Forest Service (Butler et al., 2013). **Tables 1** and **2** were developed using that software. The survey included key health concerns of FFOs, including the issue of undesirable vegetation. Nearly one-third of FFOs (32%) were concerned with undesirable vegetation and these owners controlled one-third of family forest area.

Table 1 shows the distribution of FFOs by size of forest holding by both area and owners. **Table 1** also shows this same distribution for only the one-third concerned with undesirable vegetation. The two distributions are surprisingly similar. Notice

Table 1.
FFOs concerned with issue of undesirable vegetation by size of forest holding by total FFO population and area and the one-third of FFOs concerned with the issue, 2006 (Butler, 2008).

Size of forest holding (ha)	Total family forest		One-third concerned	
	%Area	%Owners	%Area	%Owners
1 - 3	7	6.4	7	60.6
4 - 20	22	30.8	23	27.9
21 - 40	16	6.8	15	6.3
41 - 200	32	5.3	30	4.7
201 - 400	8	0.4	8	0.3
401 - 2000	10	0.2	11	0.2
2000+	5	0.1	6	-

Table 2.
Characteristics of one-third FFOs expressing concern over issue of undesirable vegetation, 2006 (Butler et al., 2013).

Characteristic	%Area	%Owners
Owns over 20 ha of forest area	70	2.8
Over 55 years of age	70	65.1
College graduate (B.S. or higher)	45	34.5
Income greater than $50,000	64	52.4
Had a forest management plan	22	5.4
Harvested timber with forester advice	47	25.4
Received management advice	43	17.1
Source of management advice:		
State forestry agency	27	9.4
Federal agency	15	3.9
Extension	10	4.1
Forestry consultant	22	4.9
Forest industry	8	1.3
Logger	10	2.7
Non-profit organization	2	0.6
Another landowner	10	3.3

while it may seem that not a great a proportion of FFOs are concerned with the issue, when forest area owned by concerned owners is considered, then the issue becomes one of major importance. Tracts greater than 40 ha included only 6% of FFOs in the concerned third, but that 6% of owners controlled 55% of family forest area. Area, and not just number of owners, must be part of any analysis that involves FFOs.

The National Woodland Owners Survey Table Maker also allowed for a detailed analysis of that nearly one-third of FFOs who had a concern over undesirable vegetation (Butler et al., 2013). **Table 2** shows the proportions of these owners in terms of key characteristics. Only 13% of them own tracts larger than 20 ha in size, but 70% of the area owned by the group is in tracts larger than 20 ha. There may be a few of them, but they own very large holdings.

Older, more educated, FFOs, with higher incomes, tend to be more concerned with the issue (**Table 2**). As you'd expect, more active managers (those with management plans or who recently harvested timber or consulted a forester for timber harvesting advice) were more greatly concerned with the issue. The forestry advice question is one of the more interesting questions on the survey, at least in relation to consulting forestry. Those FFOs who sought forest management advice were much more likely to be concerned with the issue. But where did they get that advice? State forestry and other agencies was the top listed source. However, forestry consultants were a close second. Federal agencies and extension have a primary responsibility to provide advice, but both had lower percentages than consultants. Other sources were also much lower than consultants in terms of advice. Apparently, consulting foresters are one of the largest sources of forest management advice, at least in terms of undesirable vegetation.

The source for forest management advice is such a surprising result it seems necessary to ask the question: how does this relationship affect other issues in the survey? The survey had seven biophysical issues (like water pollution or fire) and ten sociopolitical issues (like endangered species and property taxes). The relationship of consulting forestry being a very strong secondary source of forest management advice held across both biophysical and sociopolitical issues consistently in terms of area and nearly always in terms of owners. In fact, the survey identified state forestry agencies and other state agencies separately. They are combined into one category for **Tables 1** and **2**. If state agencies are separated out, forestry consultants are the number one forest management advice source in dealing with endangered species, lawsuits, regulations for timber harvesting, and timber theft issues.

Forestry Consultants' Clients and FVM

FVM is one of the costliest practices clients of consulting foresters confront. Site preparation and planting are also costly, but they are usually considered mandatory to the type of FFOs that invest in a forestry consultant. FVM is not as mandatory; the results are not as predictable and the increased yields not guaranteed. There are many factors that influence the decision to use FVM or not; it boils down to benefit/cost analysis by the forest owner who will make an ultimate decision on cost-effectiveness (Howle, Straka, & Nespeca, 2010).

FFOs that used FVM (or chose not to use it in situations where it was recommended) and were clients of a consulting forester were surveyed to determine their attitudes towards and motivations concerning FVM. This study was confined to FFOs in the southeastern United States. A survey questionnaire was designed to elicit basic information about two central questions 1) does the landowner utilize FVM and 2) what motivation(s) drove their decision, along with a few demographic questions. A large southern forestry consulting firm provided a list of clients that had used or rejected FVM options.

The clients were allowed to suggest motivations for implementing or not implementing FVM practices. If possible, they were grouped into predetermined categories on the "questionnaire" used to lead the conversation towards specific questions. Seven categories of motivations for FVM were eventually developed from the discussion: 1) eliminating competition for improved timber growth, 2) improvements to wildlife habitat, 3) most cost effective, 4) aesthetics, 5) fuel reduction/safety, 6) forester recommendation, and 7) proximity to residential areas. Six motivations for not implementing FVM were also developed: 1) not cost effective, 2) pollution, 3) too early in rotation, 4) never implemented control before, 5) short holding, and 6) not intensely managed.

Results and Discussion

The survey of FFOs in the Southeast resulted in 53 usable responses out of the 132 clients that were contacted and resulting in a response rate of 40%. The 53 clients that responded to the survey give a total of 64 motivations for either implementing (34 responders) or not implementing (19 responders) FVM. The leading motivation for FFOs to implement FVM was to improve wildlife habitat (**Table 3**). This is somewhat surprising

Table 3.
Motivations of FFOs to implement FVM, percentage of responses, n = 34.

Motivation	Percent of respondents
Wildlife habitat	38%
Timber growth	24%
Aesthetics	18%
Safety or fuel reduction	18%
Cost-effective	6%
Residential area	6%
Site preparation	6%
Tradition	6%
Demonstration	3%
Forester recommendation	3%
Pine straw production	3%

as costly treatments are usually justified by increased wood yields. Reducing competition for improved timber growth was the second most cited motivation by 24% of respondents. The small percentage is also surprising for the same reason. FVM is a very costly treatment and increased wood yield would seem to be the driving force. However, secondary motivations like aesthetics and fuel reduction were major motivations also. One landowner said, "Fuel reduction and the threat of wildfire is a major concern for me." The range of motivations also downplays the importance of wood yield, as one landowner put it, "I just like the way my forest looks without all that underbrush." It is obvious that FFOs are not driven primarily by cost-effectiveness when considering the FVM decision and that a wide array of motivations control the use of chemical control in forest management.

Cost was the leading motivation for not implementing FVM at 58% (**Table 4**). A strong secondary reason was disagreement over need. FFOs who use consulting foresters pay for advice and tend to be more business-minded that the average owners. They are much more likely to be concerned with cost-effectiveness issues. Pollution (health concerns) was a minor issue, although one landowner was quoted saying, "I'm worried but runoff of herbicides from my property, as well as adding CO_2 to the atmosphere from burning."

Some demographics were obtained: how many forested area owned, age, highest level of education, and primary management goal. Educational level did not seem to be a major factor in a landowner's decision to implement or not implement FVM, while respondents older than 55 seemed to be involved in more intensive management regimes. This is a little different from the earlier study cited (Butler, 2008), but considering the major variable of size of forest holding, the results were identical with the earlier study (**Table 5**). As size of forest holding increases (tract size increases), so does the percent of FFOs that chose to use FVM; this can be answered by economies of scale (Cubbage, 1983).

The types of treatments and their frequency are shown in **Table 6**. Other studies have found fire control to be a minor reason for FVM (Ammer et al., 2011), but our results show fire control was the most popular form of FVM by FFOs in the Southeast. Mechanical treatments included chopping, mowing, and cutting, and occurred on tracts closer to residential areas.

Table 4.
Motivations of FFOs not to implement FVM, percentage of responses, n = 19.

Motivation	Percent of respondents
Cost	58%
Never have/no need	21%
Too early in rotation	11%
Pollution	5%
Lack of help	5%
Short holding	5%
Tract too small	5%

Table 5.
FFOs implementing FVM by tract size (n = 54).

Tract size	Percent implementing FVM
<200 ha	50%
200 - 400 ha	60%
>400 h	86%

Table 6.
Treatment type by FFOs who implemented FVM (n = 34).

Treatment type	Percent using type
Fire control	63%
Mechanical control	19%
Chemical and fire control	15%
Chemical control	3%

Implications and Conclusion

The decision by FFOs to engage in FVM is significantly affected by the size of the landholding. Like any producer, the typical landowner seeks to maximize the benefits from their timberlands. The fact that some landowners were willing to use multiple, more expensive, and/or more labor intensive treatment types represents their willingness to invest in their family forests. FVM by FFOs is an important aspect of the intensely managed forest regimes of the south eastern US.

The most prevalent type of FVM found in this study was fire control, which most closely mimics the natural disturbance regime for the region (Gilliam & Platt, 1999). The most common motivation for using fire control was improving wildlife habitat; indicating that most landowners are more concerned with the annual benefits associated with wildlife, whether by revenues from hunting leases or by maximizing their utility function, rather than the discounted values of future timber harvesting. Cost being the most frequently cited motivation for

not implementing FVM signifies that other landowners are reluctant to invest in their family forest. More importantly, the findings of this study show that the size of landholdings correlates directly with the level and intensity of forest management.

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