Decreasing Woodlot Size and the Future of Timber Sales in Massachusetts: When Is an Operation Too Small?

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ABSTRACT. *The heavily forested landscape of Massachusetts is dominated by nonindustrial private ownerships. Statistics indicate that parcel size has decreased to a most recent average of 10.6 ac. Professional loggers were queried to determine if there was a timber sale size (expressed in either volume or area) below which they would not bid. Respondents indicated that they had operated on a timber sale as small as an average of 7.8 ac and 20.4 mbf, and would purchase one as small as an average of 5.3 ac and 17.1 mbf. The single most important factor in deciding to bid on a small sale was the quality and value of the timber. In the future, small parcels with a preponderance of low-quality timber resulting from high-grading may be deemed inoperable by loggers. The importance of high quality timber on small parcels emphasizes the need for stand improvement measures to ensure small parcels are feasible to commercially operate in the future. North. J. Appl. For. 13(2):00–00.*

Massachusetts is the third most densely populated state in the United States. In spite of this, it is roughly 65% forested. The vast majority of forestland (85%) is in nonindustrial private (NIPF) ownership (Birch 1989). There are over 100 sawmills and between 500 and 600 licensed timber harvesters in Massachusetts, with approximately 200 professional foresters working in both the public and private sectors (Bond and Loud 1992). Approximately 55 mmbf are harvested annually from Massachusetts forests (Dep. Environ. Manage., Mass; unpubl. data). Although its forests are relatively small in area and sometimes urban or suburban in nature, Massachusetts has a modest but active primary forest products industry.

The nature of the predominantly forested Massachusetts landscape is changing, however. USDA Forest Service statistics for 1972 and 1985 indicate that while the percent of forestland did not change significantly, the number of owners of forestland jumped from 103,900 in 1976 (Kingsley 1976) to 235,000 (Brooks et al. 1993). The result is that the average NIPF ownership in Massachusetts fell during this time from 23.4 ac to 10.6 ac (minimum forest size = 1 ac; Birch 1989).

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The increase in the number of owners is the result of real estate development and subdivision spurred on by upwardly spiraling land values, high rates of taxation, and the frequent need of heirs to liquidate property to meet inheritance tax obligations (Broderick et al. 1994, Small 1990).

Forest Service statistics are not the only data indicating change in the forested landscape of Massachusetts. Aerial photo interpretation of the entire state for 1971 and 1984/85 indicated a 2.9% loss in forestland (MacConnell et al. 1991). Over the same period of time, agricultural land declined by only 0.5%. In the meantime, all forms of residential, commercial, and industrial land increased by 3.2%. Similarly, the Massachusetts Audubon Society studied changes in land use and found that between 1981 and 1987, 103,000 ac of "open space" were converted to commercial or residential use. In 1986 alone, over 30,000 ac were converted (Greenbaum and O'Donnell 1987). By several indications, forestland in Massachusetts is being lost, and that which remains is becoming parcelized into smaller ownerships.

This trend toward smaller parcels may have important effects on harvesting. Smaller parcels potentially mean lower volumes per timber sale. By the same token, loggers may need to negotiate with more consulting foresters and landowners to access the same volume of wood. Dennis (1992) suggested that such parcelization in New Hampshire might limit the availability of timber to harvesters, since owners of small properties seemed less inclined to harvest. This disin-

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terest of owners of small parcels to harvest has also been reported by Sutherland and Tubbs (1959) and Thompson and Jones (1981). Other business-related factors may exacerbate these effects of parcelization. Machinery costs and insurance rates have increased drastically (Rizzo and Kittredge 1992, Hoffman 1991). Howard (1987) studied logging costs and profits in Connecticut using detailed production studies and accounting-based cost analysis. He reported submarginal profits in four out of seven cases, due to the harvest of unprofitable trees. Rising costs and a lack of markets put loggers in an economic squeeze. The overall trend of parcelization and its effect on harvesting warrant investigation.

We wanted to investigate the possible effect of a parcelizing forest land base in a rapidly suburbanizing state on timber harvesting. The specific questions asked were: (1) Is there a size of timber sale (estimated either by volume or area) below which loggers would not operate? (2) Does the trend of forest parcelization represent a problem for loggers, and incidentally for foresters interested in implementing silvicultural prescriptions?

Background

There is little information in the literature on the effect of parcel size on harvesting. Cubbage and Harris (1986) provided a comprehensive overview of the issue of parcel size and forest management practices in general. They reported on Swedish studies indicating that tract size and the degree of mechanization are the most important factors controlling harvesting costs. Most economies of scale were achieved on parcels ranging from 20 to 40 ac, with larger logging costs being incurred on smaller parcels. Likewise, in modeling studies conducted with southern pine, Cubbage (1982) estimated harvesting cost curves by parcel size for eight different systems ranging in degree of complexity and mechanization. Tree-length and more mechanized systems required harvest areas of 40 to 60 ac in order to operate at minimum cost levels. Harvesting costs were much higher on smaller areas.

The notion of harvest profitability is very complex. A wide variety of factors such as terrain, skid distance, mechanization, labor cost, productivity, tree size, and log value all combine to determine the degree to which a particular timber sale is profitable (Hoffman 1991). Likewise, interactions among these factors play a role in determining how small a parcel might be profitably logged. Rather than study logging profitability using cost analysis techniques, we decided to study preferences and perceptions held by loggers themselves, by asking them to determine what the most important factors were, and indeed, to tell us how small a timber harvest they would consider.

Methods

We designed a three-page survey to query Massachusetts loggers about harvest size feasibility. The draft survey was tested with six loggers, and modified slightly. Respondents were queried in three ways:

1. Specific questions such as counties in which they operate, equipment mix, whether or not they had purchased stumpage in the last 18 months, and both the smallest timber sale they had ever purchased (in terms of absolute volume and area) and the smallest timber sale they would consider purchasing.
2. Questions concerning hypothetical timber sales that varied incrementally by area, volume, distance from home, and the proportion of high-quality timber.
3. An open-ended question requesting the factors considered most important when deciding to purchase a small timber sale.

The survey was first sent to 522 loggers in April 1994, along with a cover letter and a postage-paid return envelope. A second mailing was made 4 weeks later to the same audience. Responses were anonymous in all cases. No test for nonresponse bias was made.

Results

Response

We received 195 responses after the two mailings, representing a return of 37%. Of those, 137 (70%) reported to have purchased stumpage in the last 18 months. Those who had not purchased stumpage more recently than that were excluded from further analysis, as it was felt that their views would not accurately represent those currently bidding on timber sales.

Equipment Mix

The vast majority of respondents use rubber-tired cable skidders, while fewer reported using grapple skidders, forwarders, or crawlers to skid wood (Table 1). Only nine respondents had mechanized their operation to the point of using a feller buncher. Likewise, chippers and slashers were uncommon. The typical mix of equipment used by respondents seemed to be fairly conventional for the region.

Timber Sale Size

The mean smallest timber sale area that the respondents had ever purchased was 7.8 ac (Table 2). The mean smallest volume that they had ever purchased was 20.4 mbf.

Response to the query of the smallest timber sale up for bid did not differ substantially. Respondents reported that they would purchase a timber sale averaging as small as 5.3 ac or 17.1 mbf.

Hypothetical Timber Sales

The hypothetical sale described in the survey had the following characteristics:

Table 1. Equipment mix of respondents (absolute number of responses, out of a total of 137).

Rubber-tired cable skidder: 106	Feller-buncher: 9
Rubber-tired grapple skidder: 18	Chipper: 13
Crawler tractor: 20	Loader: 16
Forwarder: 17	Slasher: 2
Farm tractor: 16	Log truck: 52
Horse/oxen: 2	

Table 2. Size of the smallest timber sale ever purchased and would ever purchase (n = 137 respondents).

	Had ever purchased	Would purchase
Area (ac)		
Mean	7.8	5.3
Standard error	0.8	0.7
Median	5.0	5.0
Maximum	70.0	70.0
Minimum	0.3	0.1
Volume (mbf)		
Mean	20.4	17.1
Standard error	1.5	1.3
Median	15.0	15.0
Maximum	110.0	100.0
Minimum	2.0	1.0

- Volume: 50% red oak, 25% white pine, 25% other hardwoods
- Terrain: level, dry, easily accessible
- No stream or wetland crossings
- Average skid distance = 2000 ft; larger timber sales have multiple accessible landings
- Average tree diameter = 18 in., ranging from 14 to 24 in.
- A consulting forester is managing the sale and has marked the trees for removal

Respondents were asked to indicate whether or not (i.e., yes or no) they would bid on the hypothetical sale, as it varied by two parameters (e.g., area and density of timber to be harvested). It was hoped that this type of questioning would reveal thresholds below which loggers would lose interest in a potential timber sale.

Volume

At the 20-ac level, most respondents reported that they would purchase the sale, regardless of the total volume or volume per acre (Figure 1). Respondents show much more sensitivity to volume at the 5 ac level. Roughly half the respondents reported that they would not purchase the sale if it had fewer than 15 mbf (i.e., 3 mbf/ac). A hypothetical timber sale of 1 ac was very unattractive to respondents. Only roughly a third (35.3%) reported that they would purchase the sale even if it had as much as 6 mbf/ac. This is in contrast to the 20 ac hypothetical sale, which more than 75% of the respondents reported that they would bid on even if it only had 40 mbf (i.e., 2 mbf/ac).

Distance

Respondents were sensitive to the distance from home in all cases (Figure 2). Even for a 20 ac sale, only a third of respondents were willing to travel 50 miles. In contrast, fewer than half of the respondents (48.9%) would be willing to purchase a 1 ac sale 5 miles from home. Roughly half of the respondents (53.4%) would be willing to travel 25 miles from home for a 5 ac sale.

Timber Quality

Respondents showed sensitivity to the area of the hypothetical sale (Figure 3) when timber quality varied. Fewer than half of the respondents (48.9 %) would bid on the hypothetical 20 ac timber sale if only 10% of the volume was high quality. Most respondents (75.9%) would bid on the 5 ac sale if as much as 50% of the timber was high quality. The 1 ac timber was found unattractive again by respondents—

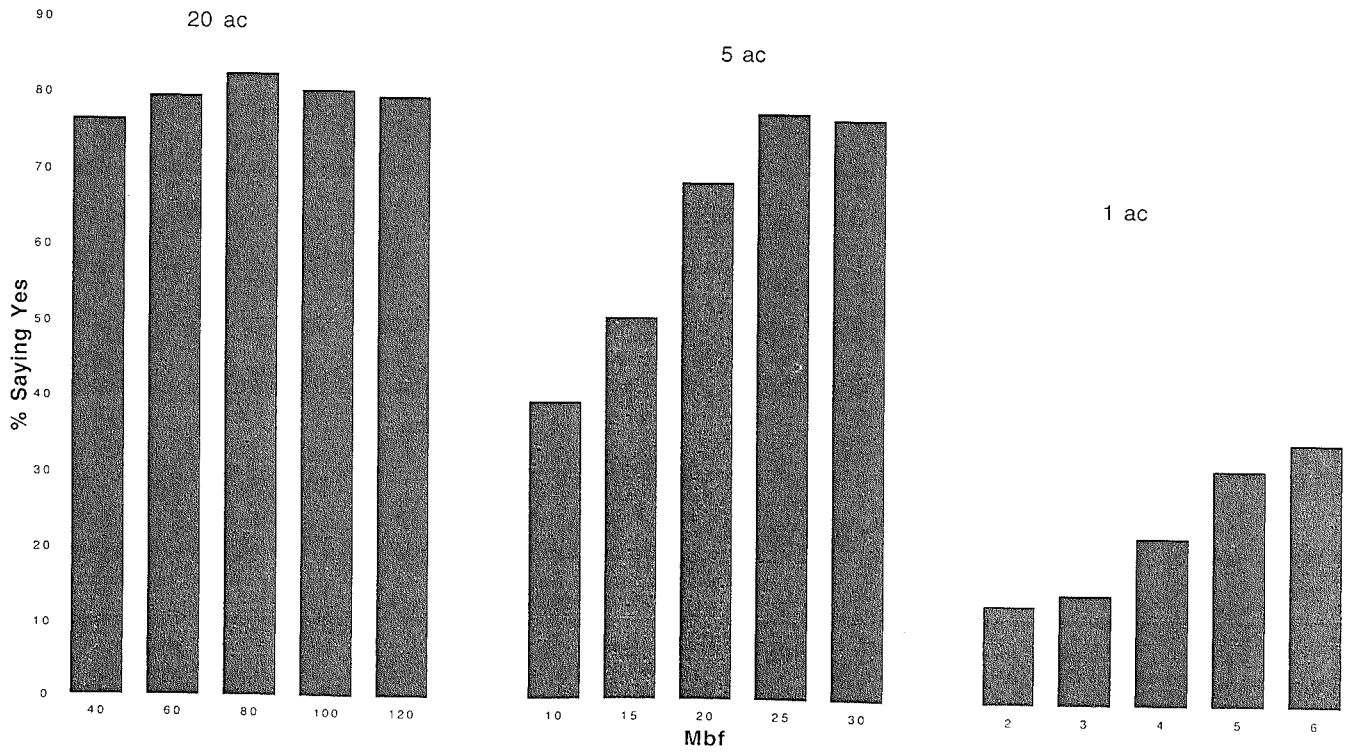

Figure 1. Percent of respondents indicating a willingness to purchase a hypothetical timber sale that varied in area and total volume.

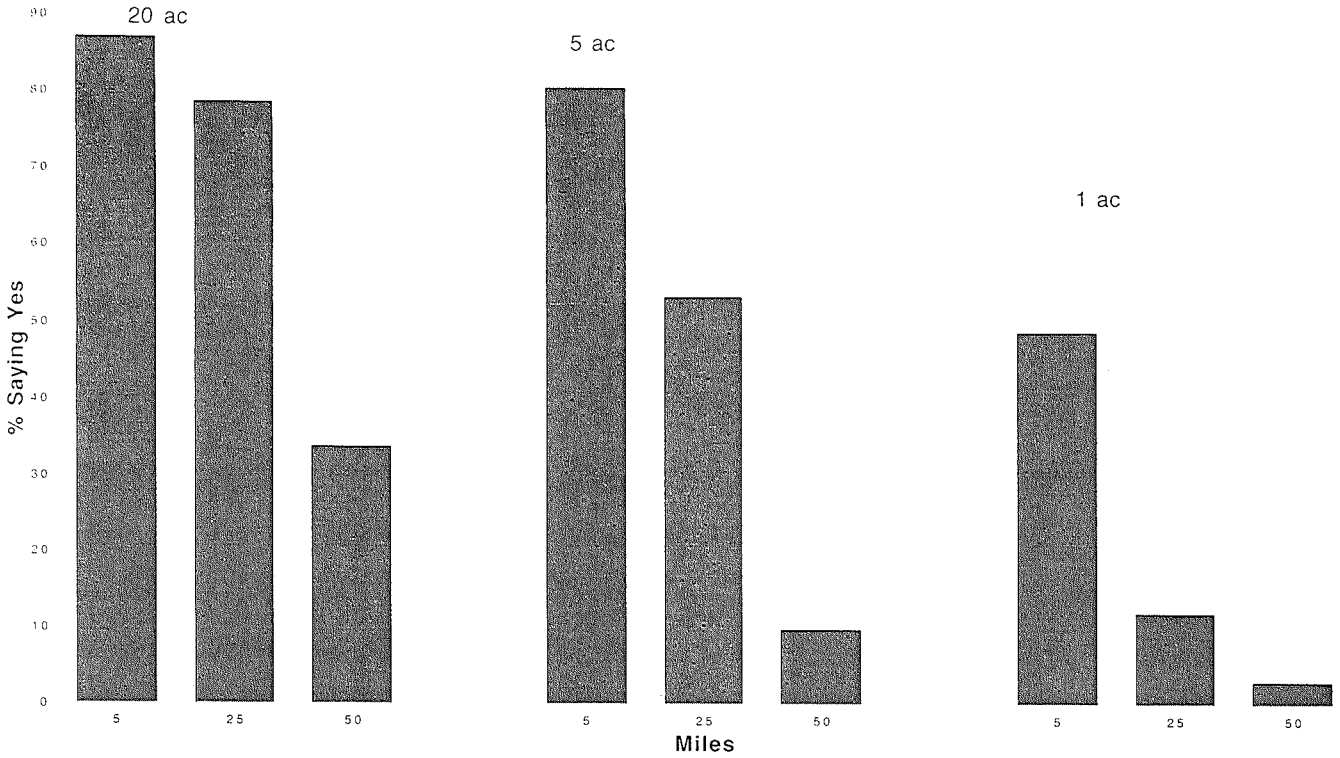

Figure 2. Percent of respondents indicating a willingness to purchase a hypothetical timber sale that varied in area and distance from home.

fewer than half (45.7%) would bid on the sale even if 50% of the timber was high quality.

Factors Considered Most Important

The open-ended question resulted in a wide variety of responses that could be grouped into 10 general categories (Table 3). Most important, understandably, was the relative value of the wood. This is consistent with the sensitivity to quality (Figure 3) that respondents indicated in the "hypothetical-sale" part of the survey. All other factors were not nearly as important (i.e., they were not listed nearly as often by respondents). Perhaps more interesting than the factors

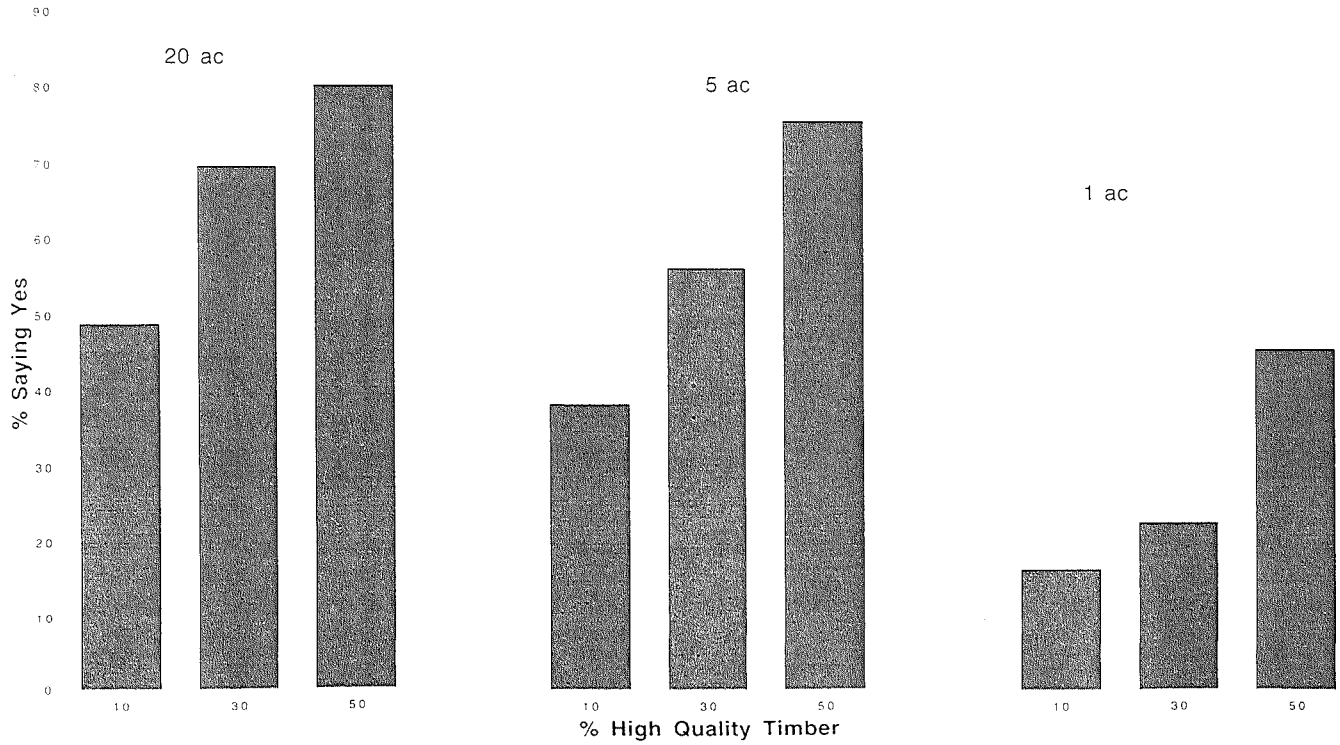

Figure 3. Percent of respondents indicating a willingness to purchase a hypothetical timber sale that varied in area and percent of high quality timber.

Table 3. The most important factors to consider when bidding on a small timber sale (percent of respondents mentioning the category in their open-ended response).

1. Relative value of the wood/quality/species	61.3
2. Landing location and size/access to sale	24.8
3. Proximity to another job in the area/cost of moving the machinery/travel distance	23.5
4. Presence of steep slopes/skidding difficulty	17.5
5. Wetlands	10.9
6. Problems with neighbors or local regulations	6.6
7. Size of the average tree	5.8
8. Proximity to mill	5.8
9. Well-drained site that could be operated during mud season	2.2
10. Job extras—e.g., remove all slash, junk cars, etc.	0.7

that are most important are the ones that are considered relatively unimportant by most respondents. Factors such as the presence of wetlands (listed 10.9% of the time), problems with neighbors or local regulations (6.6%), or "job extras" (0.7%) were apparently unimportant.

Conclusions

Response

The survey used in this study was completed by 26% of the licensed timber harvesters in Massachusetts. This response does not necessarily represent a statistical sample from which conclusions can be drawn about the entire harvester population. Based on the reported equipment mix, however, we feel that the respondents are fairly typical of conventional operators.

Preferences Concerning Size of Sales

Respondents reported that they have harvested sales as small as 7.8 ac and 20.4 mbf, and they would bid on sales as small as 5.3 ac and 17.1 mbf. Small standard errors around these means and the similarity of means and medians indicate that in spite of a wide range in responses, participants in the survey were generally quite consistent. Also, it is worth noting that these averages are well below the current average woodlot size of 10.6 ac.

Sensitivity

More than three-fourths of the respondents would purchase the hypothetical 20 ac sale, even if it had only 2 mbf/ac. Likewise, more than three-fourths would purchase it if it was 25 miles from home. Almost half of the respondents (48.9%) would purchase the 20 ac hypothetical sale even if only 10% of the timber was of high quality. Respondents were willing to travel farther and put up with low harvest volumes per acre and low quality if they could operate on an area of 20 ac. Respondents were sensitive to distance in all hypothetical cases. Fifty miles was too far to travel.

Timber sales of only 1 ac were unpopular with respondents. Even with a density as high as 6 mbf/ac of harvestable wood, roughly two-thirds of the respondents would not bid on the smallest hypothetical sale. This is in direct contrast to the harvestable density of 2 mbf/ac that the majority of respondents (76.7%) found acceptable on the 20 ac sale. Also, fewer than half of the respondents (48.9%) would bid on a 1 ac sale even if it was only 5 miles from home. Finally, even though timber quality and value was the most frequently cited factor to consider, fewer than half of the respondents (45.7%) would bid on a 1 ac sale even if 50% of the timber was high quality. Sales of only 1 ac were unpopular regardless of proximity, density of harvestable trees, or timber quality.

Finally, respondents reported that the single most important factor in deciding to bid on a small sale was quality and value of the timber. All other factors paled in comparison. Remarkably low in importance were factors such as local regulation, problematic neighbors, and additional tasks to perform for the landowner.

The 5 ac Sale

Respondents indicated that they would bid on a timber sale as small as 5 ac. For sales of that size, harvestable volume density is moderately important. Half the respondents (51.1%) would need at least 3 mbf/ac in order to bid, and most (78.2%) would need 5 mbf/ac. As forest ownerships become smaller through the trend of parcelization, the desire of harvesters to cut greater volumes per acre may conflict with the attitudes of landowners, neighbors, and society about aesthetics and the appearance of harvesting (Birch 1989, Brush 1979).

Most respondents (80.5%) would travel 5 miles from home for a 5 ac timber sale, and over half would travel 25 miles. Hardly any respondents would be willing to travel 50 miles for such a sale. As the forested landscape is increasingly parcelized, harvesters may have to travel greater distances and search among a larger pool of landowners to find those willing to have timber sold from their property. Although the number of potential owners that may arrange for a harvest increases due to parcelization, studies have shown that these new owners of smaller parcels may be less inclined to harvest (Dennis 1992).

Finally, roughly half of the respondents required at least 30% of the timber on the hypothetical 5 ac sale to be of high quality. Few were willing to bid on the 5 ac sale with only 10% high quality timber. In the future, small woodlots that are victimized by high grading may be "stranded" without the ability to implement an improvement cutting if they do not have a minimum of high-quality timber for sale. Conversely, woodlots of 5 ac or more in which the timber quality has been enhanced by silvicultural practices such as TSI and improvement treatments should readily find willing loggers.

Application

Although the average forested parcel size is declining in Massachusetts, responding timber harvesters report that it has not reached the point where sales are so small that they cannot be profitably harvested by local loggers, at least with their current level of technology and mechanization. Participants in this study are currently willing to harvest as little as 5 ac and 17 mbf in a timber sale, but generally are not willing to drive more than 25 miles to reach it, and at least 30% of the timber should be high quality. This suggests the importance of silviculturally improving even large stands to ensure their feasible harvest in the future should they become part of a smaller property. It is especially important to improve the timber quality of small parcels if owners hope to maintain timber income as a future possibility. These relationships may change if timber prices increase. More valuable timber

or the total cash value of the sale may offset some of the negative effects of parcelization.

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