Public Preferences for Timber Harvesting on Private Forest Land Purchased for Public Ownership in Maine

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ACKNOWLEDGMENTS

This research was funded by the U.S. Forest Service, the Maine Agricultural and Forest Experiment Station, the Northern Forest Alliance, and the Natural Resource Council of Maine.

The authors would like to thank Malcolm Hunter, Alan Kimball, Thomas Holmes, and Shelly Phillips-Mills for their assistance with this research, and Karin Tilberg and Andrew Plantinga for their comments on an earlier draft of this manuscript. The authors would also like to thank Jon Luoma for providing illustrations used on the cover.

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INTRODUCTION

Public concern over the use, the management, and the protection of forests in Maine and throughout the United States has grown rapidly over the last two decades. Decisions regarding where, when, and how to cut timber are no longer purely silvicultural decisions made by forest managers, but are increasingly subject to public scrutiny, debate, regulation, and litigation. Public participation in forest management decisions on publicly owned forest lands, such as National Forests, is expected because these forests are owned by the citizens of the U.S., and participation in the planning process is authorized by the Multiple Use Sustained Yield Act of 1960, the National Environmental Policy Act of 1969, and the National Forest Management Act of 1976.[1] In contrast, public involvement in private forest management decisions has traditionally relied on policy tools including education, financial and tax assistance, and regulations to ensure regeneration of forests and to minimize undesirable environmental effects.[2]

Current efforts to influence forest management decisions appear to go beyond preventing obvious environmental degradation such as soil erosion and nutrient loadings in streams and lakes; the public is now demanding that forests be managed for aesthetic and ecological goals such as protecting forest aesthetics and ecosystem health. In Maine, the public has used referendum voting to address timber-harvesting practices on private forests. The referendum results clearly suggest that the majority of people in Maine are not satisfied with the status quo of forest management practices in Maine, but those who want change are not in agreement on how change should occur. Referenda only present limited choices for people to vote on, and there may be other alternatives that are more desirable to the public.

We conducted a mail survey in 1997 of a random sample of Maine adults to elicit their preferences regarding specific timber-harvesting practices when commercial forest land is purchased for public ownership.[3] This research was sponsored by the U.S. Forest Service, which was not interested in forestry debate in Maine.[4] Rather, they were interested in the general publics' views on the desirability of specific timber-harvesting practices. Maine, with nearly all of the state forested and an extensive timber industry, provided a good setting for this research. The survey results do, however, provide insights for the development of alternative forest management proposals that would be desirable to the citizens of Maine.

The research investigated public preferences for the management of a generic parcel of forest land that would be purchased by the state of Maine from a commercial timber company. After the land is purchased, respondents were asked their preferences for allocating the parcel of land between timber harvesting and setting land aside from timber harvesting. We found that respondents gave the highest rating to setting half of the land area aside from timber harvesting. On the half of the parcel where timber harvesting would be allowed, respondents prefer more benign timber-harvesting practices than is believed to commonly occur on commercial forest lands in Maine.

Within the survey we avoided using the term "clear cut" due to the controversial nature of this term. Moreover, while the Maine Forest Practices Act identifies a technical definition for a harvest to be designated as a clear cut, this technical definition may not be relevant to the average citizen's subjective perception of a clear cut. We did include a harvest practice that identified the number of trees greater than 6 inches in diameter (dbh) left standing after timber harvesting had occurred. Leaving no trees greater than 6 inches dbh received one of the lowest ratings in the survey. This indicates that people clearly prefer harvests that leave a substantial number of larger trees in harvest areas.

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[1] United States Congress, Office of Technology Assessment. 1992. Forest Service Planning: Accommodating Uses, Producing Outputs, and Sustaining Ecosystems. OTA-F-505, Washington, DC: U.S. Government Printing Office.

[2] Cubbage, Frederick W. 1997. The public interest in private forests: Developing regulations and incentives. In *Creating a Forestry for the 21st Century–The Science of Ecosystem Management*, K.A. Kohm and J.E. Franklin (eds.). Washington, DC: Island Press.

[3] The initial sample was composed of 2,500 individuals, 18 years of age or older, who were randomly selected from records of Maine drivers licenses and state identification cards. People who do not hold a drivers license generally posses a state identification card for check cashing and other occasions when official identification is required. These records cover over 90% of the adult residents of Maine. The sample was purchased from the Maine Department of Motor Vehicles. Of the initial sample of 2,500 individuals, 451 had addresses that were undeliverable by the U.S. Post Office (18%). A total of 926 surveys were completed and returned for a usable response rate of 45%.

[4] The survey was administered by mail in early 1997. The study was funded before the "clear cutting" referendum was proposed. However, the survey was ultimately conducted after the November 1996 referendum vote and before the 1997 referendum vote. This timing of the timing of the survey administration between the two referendum votes was purely a coincidence.

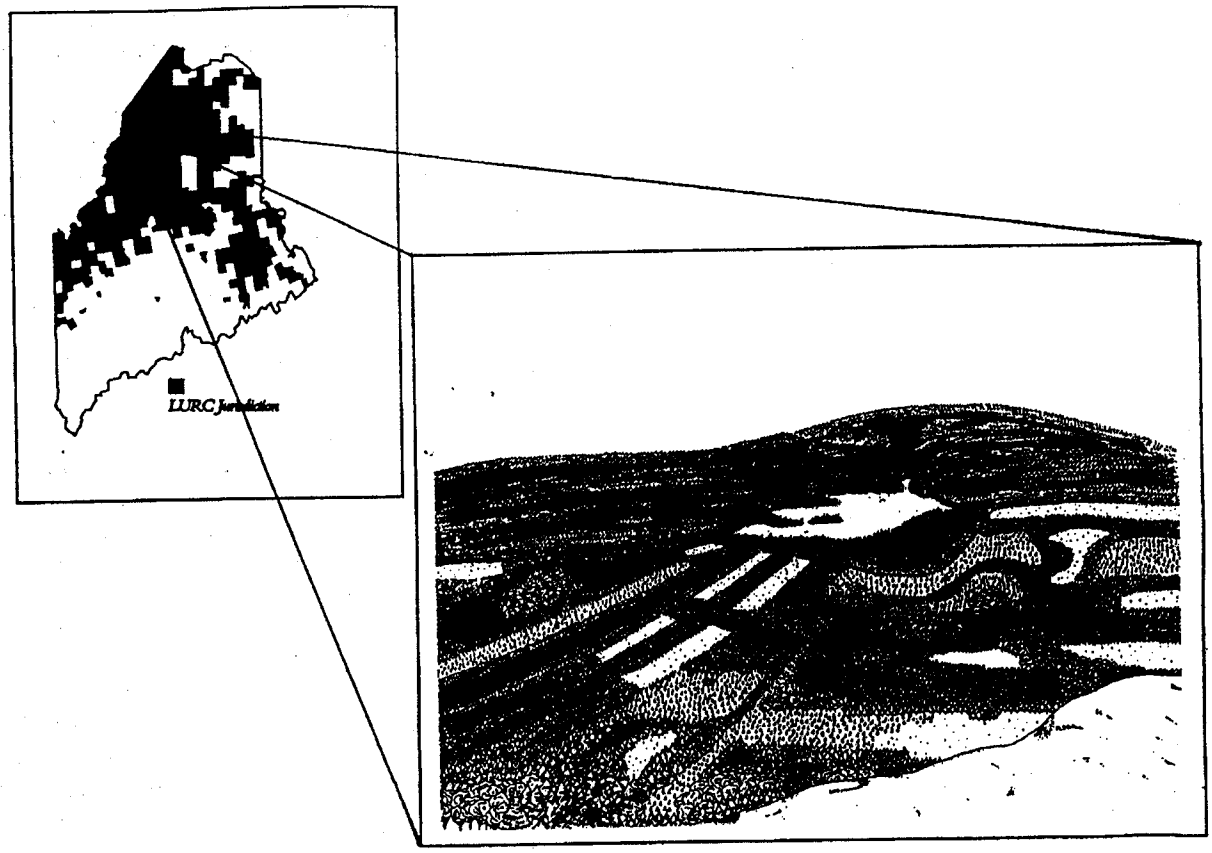


Figure 1. Map identifying the general location of the land.

Finally, we found that the average household is willing to make a one-time payment of $444 for the public purchase of a 23,000-acre parcel of forest land when half of the land would be set aside from timber harvesting and, on the half where timber harvesting would occur, harvesting practices would be employed that are more benign than those believed to commonly occur on commercial forest lands in Maine. Using a conservative estimate of $100 per household and expanding this to the population of Maine households, while assuming that nonrespondents to the survey hold a value of $0, yields an aggregate estimate of nearly $21 million. This suggests that the publics' willingness to pay for the state to purchase commercial timberland exceeds the cost of purchasing this type of land. In addition, our model predicts that 69% of Maine voters would vote to approve such a purchase.

SURVEY DESIGN

Within the questionnaire, a scenario for evaluating forest management practices was described in the context of the state purchasing a 23,000-acre parcel of forest land (one township).[5] A map showed that this land would be northwest of Baxter State Park (Figure 1). The intent here was for the parcel to be a generic piece of industrial forest land that was located in an area where people would believe that it contained many of the common features of forest land in Maine. Thus, the map portrayed the land as being in the heart of land under the jurisdiction of the Land Use Regulation Commission

[5] The survey instrument and an accompanying information booklet were pretested in focus groups held in Bangor (n=5) and Portland (n=7). Focus group participants were solicited by telephone using random selection from local telephone directories. No major problems were identified in the questionnaire design, but respondents did make a number of suggestions that helped to clarify the contents of the information booklet.

(LURC). LURC's jurisdiction includes most of the industrial forest land in Maine. Respondents were told the land would be purchased from a large timber company and were given a brief written description of the parcel (Figure 2).[6]

Preferences of Maine residents for different timber-harvesting practices on this land were solicited using a mail survey. In responding to the survey questions respondents were asked to indicate their personal preferences for the management of the generic parcel of forest land if it were transferred to state ownership. These questions asked respondents about the allocation of land between timber harvesting and setting some of the land aside from timber harvesting, and forestry practices on the portion of the land where timber harvesting would be allowed.

Respondents were asked to consider seven timber-harvesting/land management practices: the density of forest roads, the number of dead and dying trees left in the harvest area, the number of live trees left after harvesting, the maximum size of harvest areas, the percentage of forest land available for timber harvesting, the size of watershed protection zones, and how slash (bark, branches and stumps left after harvesting) is to be disposed of. While this is not a comprehensive list, with issues such as separation zones between harvest areas not being addressed, we chose these practices as key features to begin to develop a general understanding of public preferences.[7] The selection of these practices and their descriptions in the survey were developed in consultation with colleagues at the University of Maine (Malcolm Hunter, Libra Professor of Conservation Biology and Wildlife Ecology, and Alan Kimball, Associate Professor of Forest Management).

Information on forest practices was presented in an information booklet that accompanied the survey instrument. The practices and their levels are listed in Table 1 with the presumed standard or common level of each practice identified in bold.[8]

Respondents were asked to reveal their preferences to the levels of each practice on a Likert scale ranging from 0 (very undesirable) to 6 (very desirable). An unsure option was also included. The question for dead and dying trees is replicated in Figure 3 as an example.

- This piece of forest land has been offered for sale by a large forest land management company.
- This forest land is in northwestern Maine and is within LURC (Land Use Regulation Commission) jurisdiction.
- This forest land is the size of a township and is approximately six miles long and six miles wide.
- This forest land contains one lake that is the headwaters of a small stream.
- The lake and the stream are used for fishing and canoeing.
- The property has about 23,000 forested acres of spruce, fir, and pine.
- Trees have been harvested in the southern half of this forest land within the last five years.
- No trees have been harvested in the southern half of this forest land within the last five years.
- A map of the location of this piece of forest land is on the next page.
- This study has nothing to do with the clearcutting referendum that was on the November 5, 1996 Maine ballot.

Figure 2. Hypothetical purchase proposal.

[6] Respondents were also told that dispersed recreation would continue to occur on the land.

[7] Two respondents in the Portland focus group found the task too burdensome, which led us to reduce the number of forest practices respondents were asked to evaluate.

[8] A prior concern was that respondents would focus on the maximum size of the harvest areas given the media attention of the clear-cut controversy in the state. We did not find that this was a problem in the pretests. One item that was clear from the focus groups was that the public was not likely to favor allowing timber harvesting on all of the land once it was conveyed to state ownership nor were they likely to approve precluding any timber harvesting. Thus, when considering the amount of land for timber harvesting, respondents were asked to evaluate options that allowed timber harvesting on a portion of the land area and set some land aside from timber harvesting.

Table 1. Forest practices and levels.*

Practices	Levels
Percentage of Land Available for Timber Harvesting	90% for timber harvesting and 10% as a natural area **80% for timber harvesting and 20% as a natural area*** 50% for timber harvesting and 50% as a natural area 20% for timber harvesting and 80% as a natural area 10% for timber harvesting and 90% as a natural area
Roads	One road every mile **One road every half mile** One road every quarter mile
Dead and Dying Trees	**Remove all** Leave one dead or dying tree about every 66 feet (10 trees per acre) Leave one dead or dying tree about every 93 feet (5 trees per acre)
Live Trees Standing in Harvest Opening	No trees greater than 6 inches left standing **One tree 6 inches thick about every 17 feet (153 trees per acre)** One tree 6 inches thick about every 5 feet (459 trees per acre)
Maximum Size of Harvest Openings	Less than 5 acres **5 to 35 acres** 36 to 125 acres 125 to 250 acres
Wetland Protection	At least 500 foot zone **At least 250 foot zone** At least 75 foot zone
Slash Disposal	Leave where it falls on the ground Distribute along skid trails **One large pile by road** Remove all

*Levels denoted in bold were presumed to be most commonly used levels of each practice.

How would you rate each of the following options for roads on this piece of forest land? (CIRCLE ONE NUMBER FOR EACH LEVEL)

	Very Undesirable			No Opinion			Very Desirable	Unsure
One road every mile....	0	1	2	3	4	5	6	7
One road every half mile...	0	1	2	3	4	5	6	7
One road every quarter mile....	0	1	2	3	4	5	6	7

Figure 3. Example preference question.

After evaluating each practice and their levels singularly, respondents were presented with four management plans to consider (Figure 4 presents one example). Each management plan was composed of randomly assigned levels of each of the forest practices identified in Table 1. To make the potential number of combinations of forest practice levels tractable for survey design, specific levels were not carried forward from the individual attribute evaluations to the evaluations of combinations of levels. The attribute levels that were excluded from the combined evaluations are 90% of the land available for timber harvesting, 10% of the land for timber harvesting, one road every quarter mile, harvest openings of 125 to 250 acres, a 75-foot wetland protection zone, and removing all slash. The logic for excluding these levels, for example, was that denser roads and smaller wetland protection zones are unlikely.

Thus, in developing the management plans, two road levels were considered in the random design: one every half mile and one every mile. As each road level had an equal likelihood of being selected, about half of the management plans included the one road every half mile level and the other half included the one road every mile level. The dead and dying tree practices had three levels. Thus, about one-third of the management plans had the no dead and dying trees level, about another third had the five dead and dying trees per acre level and the remainder had the 10 dead and dying trees per acre level. Considering the interaction between the road levels and dead and dying trees levels, about one-sixth of the surveys contained one road every half mile and no dead and dying trees and the other five-sixths each contained the other combinations of roads and dead and dying trees. Similar logic applies to all practices/level combinations.[9]

An eighth attribute was included that was a one-time increase in state income taxes to pay for the proposed public purchase of the forest land. Respondents were then asked whether they would vote to approve the state purchase of the land when each of the four management plans was employed (Figure 5).[10]

Other questions in the survey included respondents' knowledge of forestry issues in Maine, ownership of forest land, socioeconomic characteristics, etc.

PROPOSED FOREST MANAGEMENT PLAN (A)

• Roads	One every mile
• Dead and Dying Trees	One dead or dying tree left about every 93 feet (5 trees per acre)
• Live Tree Standing after Harvesting	One tree at least 6 inches thick about every 10 feet (459 trees per acre)
• The Maximum Size of Harvest Openings	Less than 5 acres
• Percentage of Forest Land for Timber Harvesting	50% for timber harvesting and 50% set aside as a natural area
• Watershed Protection	At least a 500 foot zone
• Slash Disposal	Leave where it falls on the ground

• Purchase of the forest land will be paid for by special one-time increase in your 1997 State household income tax of $_____.

Figure 4. Sample forest management plan

[9] The number of practice/level combinations was 972 (3x2x3x3x3x2x3). The survey was sent to 2,500 people, which implies that two to three people received each management plan combination. With 926 people responding to the survey, roughly one person evaluated each management plan combination. Approximately 300 or more people evaluated each forest practice level in the management plan combinations.

[10] Mitchell, R.C., and R.T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method.* Washington, DC: Resources for the Future.

Now assume there will be a vote in the next election to decide if the State of Maine should buy this piece of forest land. How would you vote for the purchase if the land were managed using each of the proposed forest management plans?
(CIRCLE ONE NUMBER FOR EACH PLAN)

	YES to approve	NO to defeat	Unsure
Plan A.....	1	2	3
Plan B....	1	2	3
Plan C....	1	2	3
Plan D....	1	2	3

Figure 5. Management plan voting question.

RESULTS

The majority of respondents were male (56%). The average respondent was 48, had a high school education or some education beyond high school (64%), and had a household income of $42,388. These statistics indicate that people who are male, have more education, and have higher incomes were somewhat more likely to respond to the survey than Maine residents who are female or have lower education and incomes. For example, the U.S. Bureau of Census reports that 49% of Maine adults are male and the household income estimate for Maine, converted to 1997 dollars, is $36,634.

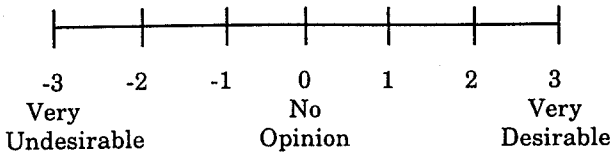
Most respondents (58%) indicated they are "very interested" in how Maine's forests are managed, and only 1% indicated they are "not at all interested." Most respondents (64%) consider themselves to be "somewhat knowledgeable" about forest management in Maine, while 30% indicated they feel they are "not knowledgeable." Eighty-seven percent of respondents had heard or read about Maine's forest management issues in the media, while 62% of these people regularly followed media stories on forest management issues in Maine. These results suggest that respondents have at least a casual awareness of forest management issues in Maine.

Respondents generally think that Maine's forests are composed of "mostly areas of standing trees with few harvested areas" (39%) or "an even mix of areas of standing trees and harvested areas" (33%). Only 5% of respondents believe that Maine's forests are composed of "vast harvested areas." The majority of respondents also think that "most" (26%) or "some" (54%) "of Maine's forest lands are well managed." Only 6% indicated they believe that "none of Maine's forest lands are well managed." These results suggest that there is not a widespread belief that Maine's forests are being overharvested and poorly managed.

Twenty-seven percent of respondents own forest land in Maine, with an average ownership of 55 acres and a high of 1,000 acres. Only 20% of these landowners harvest wood from their land. Ten percent of respondents belong to an environmental group, with Maine Audubon (32%), The Nature Conservancy (27%) and The Sportsman Alliance of Maine (24%) being cited most frequently. (Note respondents could check more than one group.) Eight percent were employed in Maine's timber industry (primarily logging and papermaking, 26% and 29%, respectively). These results indicate the sample is not dominated by people who have a vested interest in Maine's timber industry, forest land owners or people with strong environmental leanings.

Respondent Evaluations of Individual Levels of Forest Practices

The results reported in this section are taken from the preference questions portrayed by the example in Figure 3. For purposes of data analyses, the numerical response categories were recoded to the following scale:



That is, "0" was recoded to "-3", "1" was recoded to "-2" and so on. This was done so negative numbers will designate undesirable levels and positive numbers will designate desirable levels.

The percentages reported here are based on the results for respondents who actually completed the preference scales and people who answered "unsure" for each level are excluded.[11]

The white bar in Figure 6, as noted in the legend, denotes public preferences for timber harvesting on 90% of the land. The number under the bar (-1.93) represents the height of the bar and is the average rating respondents gave this level of timber harvesting. An average rating of –1.93 indicates that allowing timber harvesting on 90% of the land is quite undesirable. Allowing timber harvesting on 80% of the land (the first shaded box) is also undesirable with an average rating of –1.21. Timber harvesting on 50% of the land (the black bar), with an average rating of 0.21, is somewhat desirable. Timber harvesting on only 20% of the land, with an average rating of 0.08, is not significantly different from zero; this indicates that this level is neither desirable nor undesirable. Restricting timber harvesting to only 10% of the land is somewhat undesirable. A similar protocol can be used to interpret the preference results for each of the other forest management practices that are presented in subsequent figures in this section.

Using 50% of the land for timber harvesting and setting the other 50% of the land aside as a natural area was the most desired land-use mix (Figure 6). Respondents clearly found that 90% for timber harvesting was undesirable and only 10% for timber harvesting was somewhat undesirable. Our interpretation is that respondents clearly want to see more protected forest land. Their reasons for wanting to allow some timber harvesting could be to generate revenue to help cover the costs of managing the land, forest roads provide access for recreation, and our interpretation of the focus groups was that people recognize that timber harvesting creates habitat (e.g., forest openings and edge) that

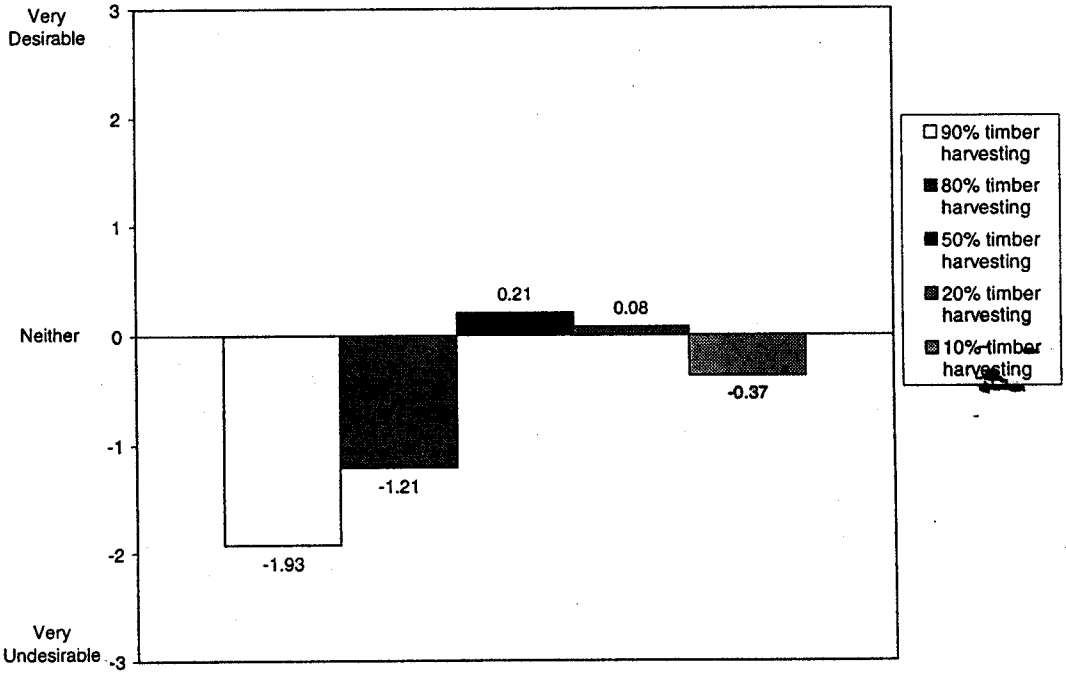


Figure 6. Respondents' average ratings of alternatives for the percentage of land available for timber harvesting.

[11] The harvest area level of 36 to 125 acres received the highest percentage of unsure responses (7%) and the harvest area practice was the only practice with unsure percentages greater than 5%.

are beneficial to some species of wildlife that the public likes.

Respondents indicated that less dense forest roads (one every mile) are desirable and more dense roads are undesirable (one every 1/4 mile) (Figure 7). The rating of 0.04 for one road every half mile is not statistically different from zero, which indicates that this density of roads is neither desirable nor undesirable. If the typical skidding distance leads to forest roads every half mile, the results here suggest that people prefer that some roads be abandoned after the land is purchased for public ownership. We suspect that respondents believe that less dense roads contribute, perhaps, to the feeling of a more wild forest, but also serve to reduce surface water pollution from erosion.

We now turn to attributes that specifically address logging on the portion of the land that is open to timber harvesting.

Respondents prefer leaving more dead and dying trees in harvested areas (Figure 8). If current OSHA regulations lead to removing most dead and dying trees from harvest areas, this practice, while providing for logger safety, may not be the best practice in terms of public preferences or for the forest ecosystem. Leaving more dead and dying trees is an important consideration for wildlife habitats.

Interestingly, the rating for leaving 459 live trees per acre (six inches or greater dbh) is lower than the rating for 153 trees per acre (Figure 9). Leaving no trees greater than 6 inches dbh is clearly undesirable. Taking all trees greater than 6 inches dbh is consistent with what has been referred to as forest high grading, and this practice can limit the quality of the future forest stands for timber harvesting, recreation, and wildlife habitats. The pattern of preferences here suggests that respondents recognize that timber harvesting requires taking trees to be commercially viable, but they do not want a harvest that removes all trees of any substantial size.

Respondents gave the highest rating to harvest areas that range from 5 to 35 acres in size (Figure 10). The rating of -0.03 for harvest areas less than 5 acres in size is not significantly different from zero, which indicates this harvest size is neither desirable nor undesirable. It is interesting that respondents chose the current practice here. While the cuts are small, they leave the forest landscape in a pattern of small patchwork cuts that may ultimately have some undesirable features. Only when harvest areas exceed 125 acres did respondents indicate that these sizes are undesirable.

Respondents found that leaving 75-foot wetland protection zones to be undesirable (Figure 11).

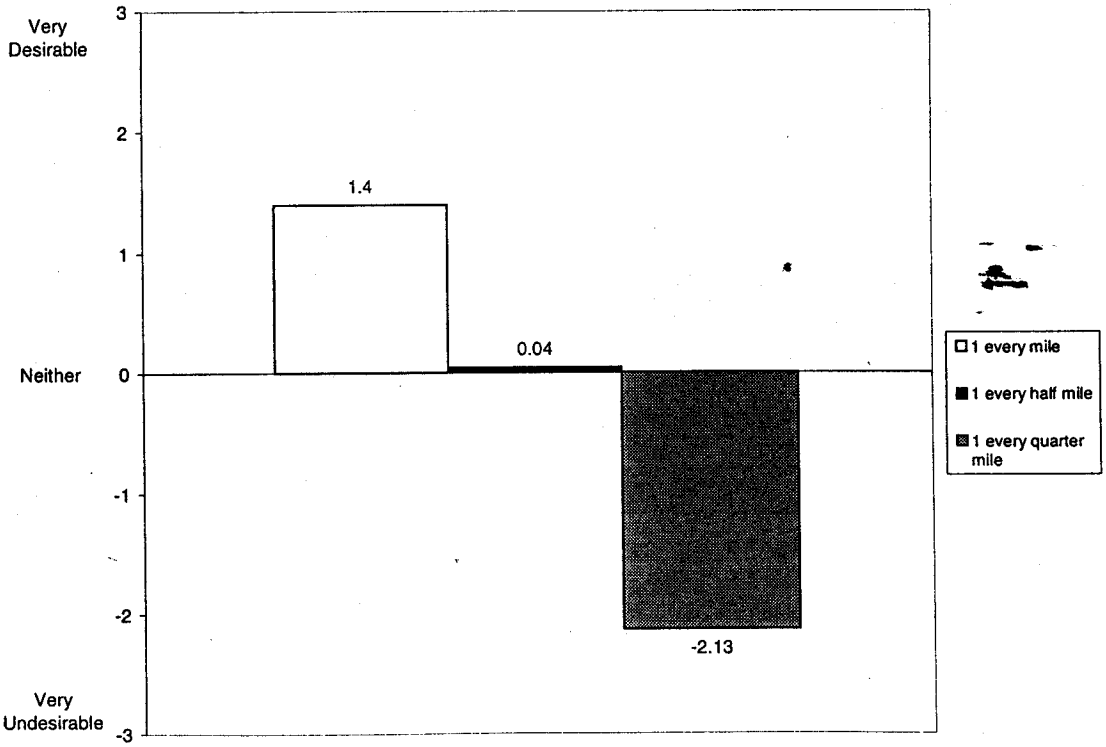


Figure 7. Respondents' average ratings of road density alternatives.

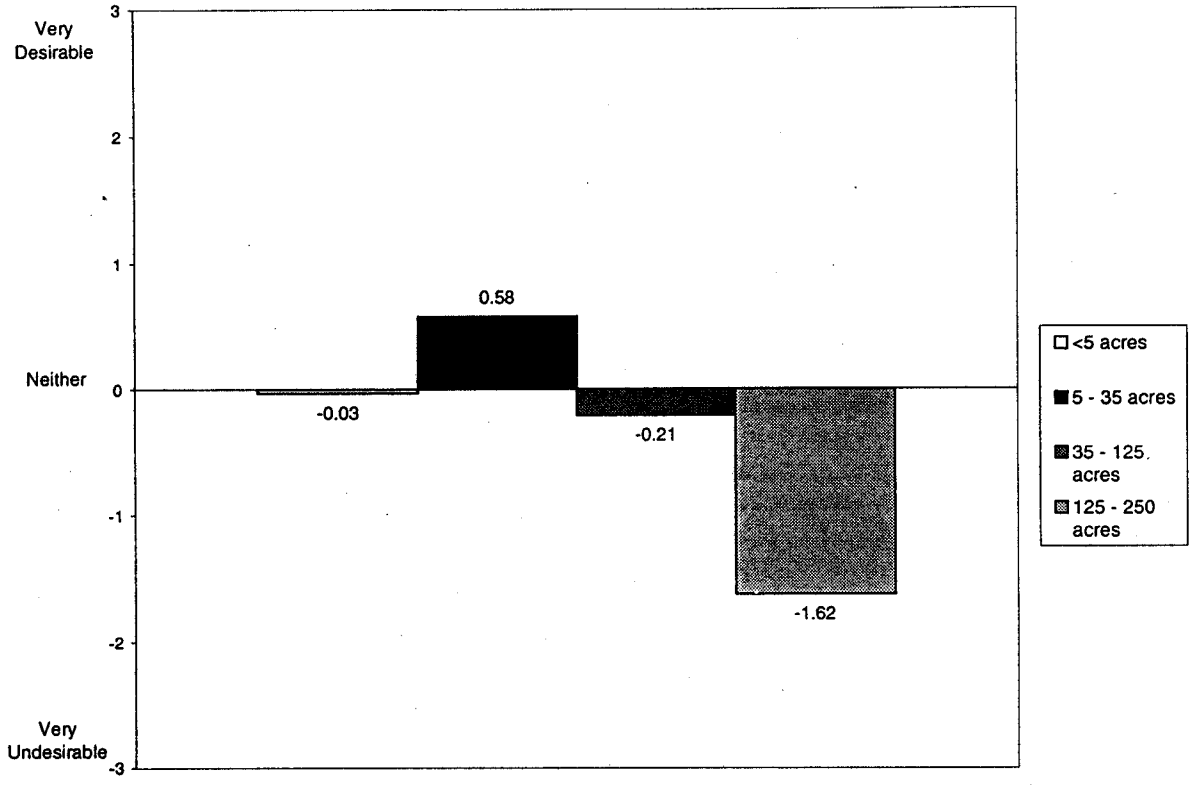


Figure 10. Respondents' average ratings of the maximum size of harvest opening alternatives.

Wetland protection zones of 250 feet and 500 feet were equally desirable. Wetland protection zones are important for protecting surface water from nonpoint pollution due to timber harvesting activities and as wildlife habitat.

Distributing slash along skid trails and leaving the slash in the forest are the preferred treatments of slash (Figure 12). Removing the slash to a loading area by the road or whole-tree harvesting is undesirable. Slash also provides important wildlife habitats and helps soil fertility for future stands of trees.

Overall, these results clearly indicate a preference for setting half of the land aside from timber harvesting. On land where timber harvesting would occur, more benign harvesting practices are preferred that preclude clear cuts. In making this statement, it is important to acknowledge that respondents were constrained to the forest practices and the levels of these practices presented in the survey. Despite these constraints, respondents did not always pick the polar extremes of each practice. Respondents prefer that some live trees greater than 6 inches dbh be left, but they did not give the highest average rating to the maximum number (459/acre). They also did not generally choose the smallest possible harvest area, preferred a balance of harvesting and land set aside from harvesting, and gave roughly equal ratings to 250 foot and 500 foot wetland protection zones.

These singular evaluations of forest practice levels provide evidence of how the public feels about individual forest management practices, but the individual evaluations do not reveal how people will respond to forest management plans that comprise combinations of one level of each practice. As we will see in the next section, a slightly different picture arises when respondents were asked to evaluate forest management plans.

Evaluations of Management Plans

As noted above, each respondent was presented with four management plans to evaluate (Figure 4). Respondents yes/no responses to the referendum questions portrayed in Figure 5 were used to estimate an equation where the forest practices specified in the management plans are used as variables to explain responses (Appendix B). We found that respondents were more likely to answer yes if a management plan included setting some land is set

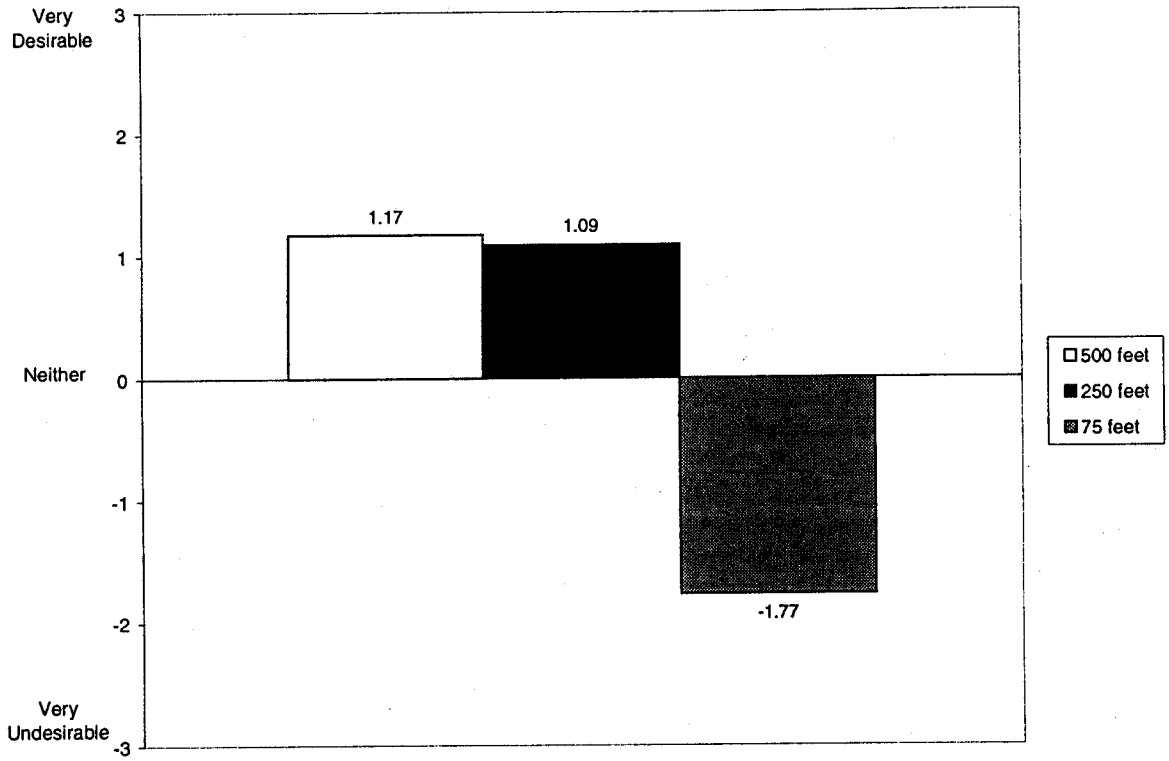


Figure 11. Respondents' average ratings of the maximum size of harvest opening alternatives.

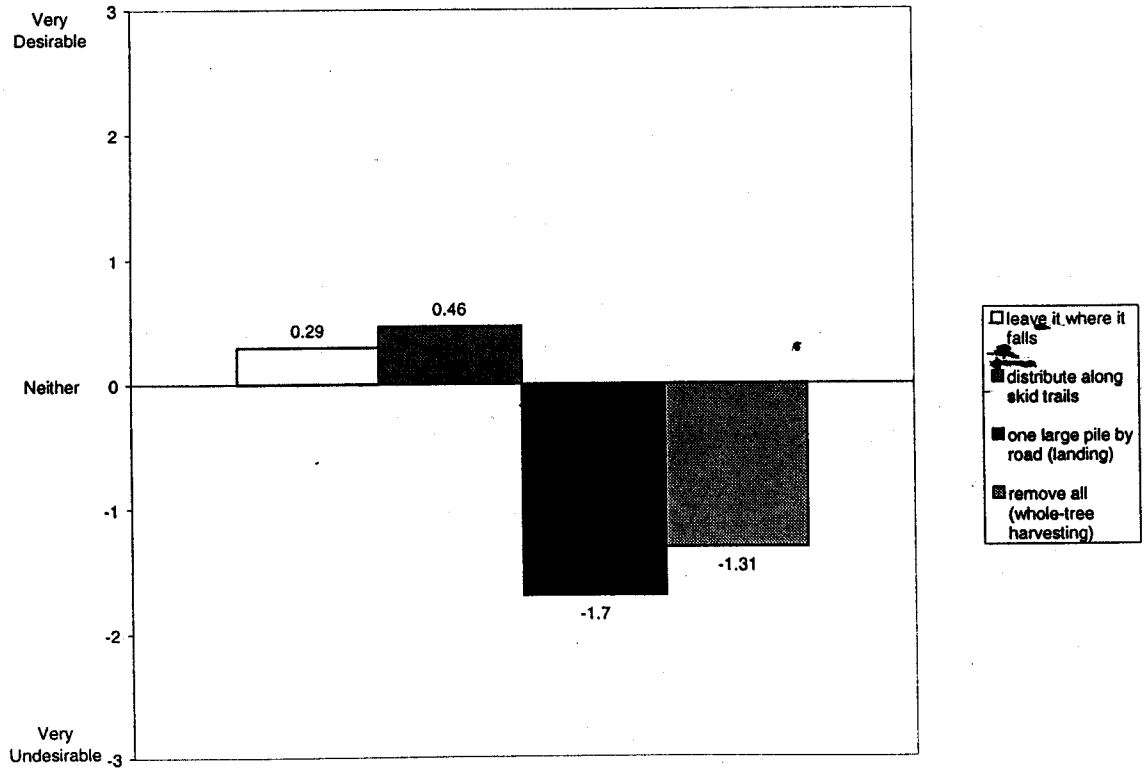


Figure 11. Respondents' average ratings of the slash disposal alternatives.

aside from timber harvesting, less dense roads, leaving dead and dying trees in harvest areas, leaving live trees larger than 6 inches dbh left in harvest areas, and slash is distributed in the forest. Neither the size of harvest areas nor moving from 250-foot to 500-foot wetland protection zones were significant predictors of yes responses.

A summary of the statistical results is portrayed in Table 2 with the one-time increase in state income taxes used to convert the effects into monetary measures of willingness to pay. The willingness to pay numbers reveal incremental payments for the parcel of land if each specific level of the forest management practices is applied. Significant effects are denoted in bold. In modeling the effects of the forest management practices on response, it is necessary to use one level of each practice as a baseline. The baseline levels are denoted by the zeros in the "marginal values" column of Table 2. The nonzero values represent increments or decrements above or below the baselines.

For example, moving from 20% of the land available for timber harvesting to 50% *increases* marginal willingness to pay by $18, and moving from 20% to 80% available for timber harvesting *reduces* marginal willingness to pay by $127. However, only the move from 20% to 80% is significantly different from zero. This implies that within the analyses of forest management plans, the public is indifferent between having 20% of the land available for timber harvesting and having 50% available; in the singular evaluations the average ratings for 20% and 50% were approximately the same.

Moving from one road every half mile to one road every mile significantly increases marginal willingness to pay by $68, and this result supports the strong preference reported for the average ratings in the singular analyses.

Turning to specific aspects of harvesting on the portion of the land open to timber harvesting generally supports the evaluations of forest practices singularly—more benign harvesting practices are preferred.

Leaving five or 10 dead and dying trees per acre are both significantly preferred to leaving none. While leaving 10 dead and dying trees per acre had the highest average rating in the singular analyses,

Table 2. Results of the analysis of management plans.

Practices	Marginal Values
Percentage of Land Available for Timber Harvesting	
20%	0[a]
50%	$18
80%	**-$127**[b]
Road Density	
1 every ½ mile	0
1 every mile	**$68**
Dead and Dying Trees Left	
None	0
5/Acre	**$88**
10/Acre	**$59**
Live Trees Greater than 6 inches dbh Left	
None	0
153/Acre	**$178**
459/Acre	**$114**
Harvesting Opening Sizes	
<5 Acres	0
5–35 Acres	$29
35–125 Acres	$23
Wetland Protection Zones	
250 Feet	0
500 Feet	$14
Slash	
Leave where it falls	0
Distribute	**-$10**
Remove	**-$15**

[a] Zero's indicate the base level for each practice from which the other levels of the respective practice are evaluated.
[b] Marginal values denoted in bold are significantly different from the baseline level of the respective practice.

leaving five per acre has the highest marginal value ($88). Leaving 153 or 459 live trees per acre (6 inches dbh) are significantly preferred to leaving none, and similar to the singular analyses, leaving 153 trees per acre has the highest marginal value ($178).

Harvesting areas of five to 35 acres and 35–125 acres are not significantly different from harvest areas of less than five acres. These results suggest the public is indifferent between different sizes of harvest areas with the maximum size of 125 acres evaluated here. A 500-foot wetland protection zone was not preferred to a 250-foot zone. These results are consistent with the singular results where the average ratings were approximately the same for each level for both practices.

Distributing slash along skid trails and removing slash resulted in significantly lower marginal willingness to pays than leaving slash where it falls, with removing slash reducing marginal willingness to pay by $51. In the singular evaluations distributing slash along skid trails had a slightly higher average rating than leaving slash where it falls.

These results suggest that respondents are more concerned with the timber harvesting practices that are implemented on the land than they are with the actual size of the harvest area as long as the area is less that 125 acres (the maximum size evaluated in the study). Likewise, once a 250-foot wetland protection zone is established, respondents again appear to be more concerned with the actual timber harvesting practices rather than expanding the wetland protection zone. For the practices the public is concerned about, they appear to prefer the middle levels rather than choosing the extremes.

While some differences occur between the results for the singular analyses, as portrayed by the average ratings, and the significance of marginal values reported here, in general the singular results and the results for forest management plans are similar. We place more confidence in the findings reported here for the forest management plans.

The monetary values in Table 2 can be used to derive an estimate what the public is willing to pay for the land to be purchased for public ownership. The conditions for this scenario are specified in Table 3, where the first column is assumed to portray practices on the land prior to public purchase and the second column portrays practices after the land has been purchased. We estimate that the average willingness to pay as a one-time payment to purchase this land is $444 per household (See Appendix B). Expanding this estimate to the population of Maine, while assuming non-respondents to the survey have a value of $0, yields an aggregate estimate of $92 million.[12]

Given that the sample tends to have more high-income people than the general population of Maine, the estimate of $444 per household may be high for generalizing to the 55% of Maine households who did not respond to the survey. However, the qualitative finding of a strong preference for more benign timber harvesting practices and a willingness to back up this preference with tax dollars, we believe, can be generalized to the population of Maine. This means that there is substantial support for proposals by various groups, including Governor King's proposed bond issue, for public purchases of commercial forest land in Maine that will be used for multiple uses including timber harvesting, dispersed recreation, and ecosystem protection.

Table 3. Variable specifications for calculating average willingness to pay.

Variable	Assume Current Harvesting Practices Prior to Purchase	Proposed Harvesting Practices After Purchase
Percentage of Land Available for Timber Harvesting	80%	50%
Road Density	1 every ½ mile	1 every mile
Dead and Dying Trees Left	None	5/acre
Live Trees Greater than 6 inches dbh Left	153	153
Harvest Areas Sizes	5 – 35 acres	5 – 35 acres
Wetland Protection Zones	250 feet	500 feet
Slash	Remove all	Leave where it falls

[12] $92,225,345 = ([1,242,051 persons] ÷ [2.69 persons per household] x 0.45 x $444)

In fact, if we take a conservative marginal willingness to pay of $100 per household (less than 25% of the mean of $444), the aggregate willingness to pay is still about $21 million, or about $903 per acre for the 23,000 parcel. This calculation suggests that the public's willingness to pay likely exceeds the cost of purchasing commercial forest land. This does not, however, imply that the land should be purchased at a cost just equal to the public's marginal willingness to pay. Such a condition would result in the public being indifferent between purchasing and not purchasing the land. In fact, public satisfaction is enhanced by purchasing the land for the lowest possible price.

Continuing to assume a one-time cost of $100 per household, our model predicts that 27% of the public would vote to approve the purchase even if the current practices specified in Table 3 continued to be employed on the land. While this is not a majority, it appears that a substantial portion of the public simply desires to see more Maine forest land held in public ownership. When the more benign practices listed in Table 3 would be employed, our model predicts that 69% would vote to approve the purchase. While only 45% of the people to whom we sent the survey responded, we would argue that individuals who responded are likely to be the voters who would turn out for a referendum on such a purchase. (Note: people who answered "unsure" to the referendum question were excluded from the analyses.) We believe that this support for the purchase of commercial forest land by the state is due to the small amount of land (<4%) held in all forms of public ownership in Maine.

DISCUSSION

The survey results reported here suggest that there is broad public support in Maine for purchases of commercial timberland that will be held in public ownership for multiple uses. One-half of the land would be set aside from timber harvesting. Multiple uses would allow timber harvesting on half of the land, but, on the half where timber harvesting could occur, the public prefers that the harvesting be more benign than what is commonly employed on commercial timberlands in Maine. These more benign practices include prohibiting clear cuts (no trees ≤ 6 inches dbh left after harvesting), but allows harvest areas up to at least 125 acres per cut. In addition, the public is more concerned with the actual practices employed in harvesting areas than they are with the actual sizes of harvest areas (<250 acres) or with increasing wetland protection zones (>250 feet). These preferences are backed up with the public's willingness to pay for these purchases. We estimate that the upper bound on a one-time payment for the purchase of 23,000 acres (one township) of commercial timber land northwest of Baxter State Park is an average of $444 per household.

Our research clearly supports the purchase of commercial timberlands to be held in public ownership for multiple uses. Our research does not directly address the issue of regulating timber harvesting on private forest land (the Ban Clear Cutting and Governor's Compact referendums), but we would suggest that our findings indicate that the public prefers setting forest land aside from timber harvesting and employing more benign timber harvesting practices on public land where timber harvesting is allowed to occur. These benign practices would preclude clear cuts where all trees ≤ 6 inches dbh are removed from the harvest area. If we extrapolate from research using what we have seen from research elsewhere on public preferences in general, our results suggest that people are likely to want stronger restrictions on timber harvesting on public lands than private lands.

APPENDIX A--EXAMPLE OF SELECTED INFORMATION PROVIDED TO RESPONDENTS FOR LEAVING DEAD AND DYING TREES IN THE HARVEST AREA

Each forest practice was allocated two facing pages in the information booklet. The left facing page portrayed two black-and-white drawings representing alternative levels of the respective forest practice. Drawings were used instead of photographs to avoid the possibility that some pictures might contain background images, not related to the specific survey topic(s), that may be relatively more or less appealing to respondents than other pictures. The facing page provided written descriptions of each practice, including the current status quo (or what was believed to be the most commonly used practice on Maine's industrial forest lands).

Dead and dying trees can be used as an example of the information presented to respondents. Respondents were provided with a definition:

> *"This forest management activity refers to trees that are still standing or partially standing, but are no longer part of the growing stock of trees. These trees are in the process of decaying."*

Subsequently the respondents were told the standard practice (or what was presumed to be the most common practice) in Maine:

> *"The standard practice, under OSHA (Occupational Safety and Health Administration) regulations, is to remove all dead and broken or rotten tree limbs in a harvest area before harvesting."*

Respondents also were given alternative perspectives on the practice:

> *"Dead and dying trees in harvest areas pose a hazard to people who work and recreate in the forest."*

> *"Hundreds of wildlife species in Maine use dead and dying trees for shelter and nesting such as the pileated woodpecker, raccoon and spotted salamander."*

We did not attempt to represent all views; rather we simply tried to present pro and con arguments relative to each practice. The alternative levels respondents were asked to consider were specified:

> *"Remove all the dead and dying trees in harvest areas."*

All Dead and Dying Trees Removed

One Dead and Dying Tree Left Every 66 Feet (10 Trees per Acre)

Figure A-1. Dead and dying trees left in harvest area drawings

"Leave one dead and dying tree about every 93 feet after harvesting (5 trees per acre)."

"Leave one dead or dying tree about every 66 feet after harvesting (10 trees per acre)."

We did not attempt to have respondents evaluate all possible levels of the forest practices, just what was considered to be a representative range. The black-and-white drawings on the left page for dead and dying trees represented conditions where all are removed and 10 dead and dying trees per acre are left (Figure A-1).

The information for each practice contained the same categories of information, but were customized to each specific practice. Some practices had more than two alternative perspectives (up to seven for the percentage of land available for harvesting), and some practices had more than three levels for respondents to consider (up to five for the percentage of land available for harvesting).

APPENDIX B—ANALYSIS OF THE RESPONSES TO THE REFERENDUM QUESTION FOR THE MANAGEMENT PLANTS

The responses to the referendum questions were analyzed using a logit model:

$$\Pr(\text{Yes}) = 1/(1 + \exp(-\beta X))$$

where exp is the exponential operator, β is a vector of coefficients to be estimated that reveal the effects of the levels of individual practices, and X is a vector of variables that represent the levels of the individual practices. In turn:

$$\beta X = \beta_0 + \beta_1(50\%) + \beta_2(80\%) + \beta_3(\text{Roads}) + \beta_4(5/\text{acre}) + \beta_5(10/\text{acre}) + \beta_6(153/\text{acre}) + \beta_7(459/\text{acre}) + \beta_8(5\text{–}35 \text{ acres}) + \beta_9(35\text{–}125 \text{ acres}) + \beta_{10}(\text{Wetland zone}) + \beta_{11}(\text{Distsl}) + \beta_{12}(\text{Removesl}) + \beta_{13}(\$)$$

where β_{Ri} are the coefficients to be estimated with β_o as an intercept, and
50% = 1 if 50% available for harvesting and 0 otherwise,
80% = 1 if 80% available for harvesting and 0 otherwise,
Roads = 1 if every mile and 0 if every ½ mile,
5/acre = 1 if 5 dead and dying trees are left per acre and 0 otherwise,
10/acre = 1 if 10 dead and dying trees are left per acre and 0 otherwise,
153/acre = 1 if 153 live trees are left per acre and 0 otherwise,
459/acre = 1 if 459 live trees are left per acre and 0 otherwise,
5-35 acres = 1 if harvest openings are between 5 and 35 acres and 0 otherwise,
35-125 acres = 1 if harvest openings are between 35 and 125 acres and 0 otherwise,
Wetland zone = 1 if zone equals 500 feet and 0 if 250 feet,
Distsl = 1 if slash is distributed and 0 otherwise,
Removesl = 1 if slash is removed and 0 otherwise, and
$ = the one-time tax payment.

The interpretation of the β's are as follows. For the percentage of the land available for harvesting, β_1 and β_2 measure the effects of 50% and 80% available relative to the omitted category of 20%. If β_1 and/or β_2 are significantly different from zero, then 50% and/or 80% is preferred (positive effect) or not preferred (negative effect) to 20%. In making predictions, setting 50% and 80% equal to zero portrays 20% available for harvesting, setting 50% equal to one and 80% equal to zero portrays 50% of the land available for harvesting, and the opposite coding applies for 80% of the land available for timber harvesting. Similar logic applies for interpreting the variables and their coefficients for the other forest practices and their levels.

The coefficients are estimated using maximum likelihood and the estimates are reported in Table B-1.[1] The estimated coefficients are used to calculate the marginal willingness to pay for each forest practice level as:

$$MV_i = \hat{\beta}_i / |\hat{\beta}_s|, \quad \forall \quad i \neq \$$$

where the hats denote estimated coefficients. These are the numbers reported in Table 2. For example, the marginal value for 50% of the land available for timber harvesting reported in Table 3 is $18, which is equal to 0.0705/0.0040.[2] The marginal willingness to pay for purchasing the land when more benign harvesting practices are employed is calculated as:

$$MV = (\sum_i \hat{\beta}_i X_{ib} - \sum_i \hat{\beta}_i X_{ic}) / |\hat{\beta}_s|, \quad \forall \; i \neq \$$$

[1]Judge, George G., W.E. Griffiths, R. Carter Hill, H. Lutkepohl, and T-C. Lee. 1985. *The Theory and Practice of Econometrics.* New York: John Wiley and Sons.

[2]Cameron, T.A. 1988. A new paradigm for valuing non-market goods using referendum data: Maximum likelihood estimation by censored logistic regression. *J. Environmental Economics & Management* 15(3): 355–379.

Table B-1. Maximum likelihood estimates of logit coefficients for analyses of referendum responses to the management plans.

Variable	Coefficient Estimate
Intercept	-0.3746*[a]
	(0.1954)[b]
50%	0.0705
	(0.1276)
80%	-0.5064*
	(0.1274)
Roads	0.2715*
	(0.1054)
5/acre	0.3530*
	(0.1305)
10/acre	0.2357*
	(0.1279)
153/acre	0.7131*
	(0.1297)
459/acre	0.4570*
	(0.1270)
5-35 acres	0.1144
	(0.1279)
35-125 acres	0.0923
	(0.1276)
Wetland Zone	0.0552
	(0.1043)
Distsl	-0.0416
	(0.1267)
Removesl	-0.5178*
	(0.1282)
	$-0.0040*
	(0.0006)

[a] Asterisks denote significance at the 10% level.
[b] Standard errors are reported in parentheses.

where the subscript "b" denotes variables set at the benign levels specified in Table 3 and the subscript "c" denotes variables set at the current levels specified in Table 3.

Predicted probabilities of voting yes are calculated as:

$$\Pr(Yes_c) = 1/(1+\exp(-\hat{\beta} X_c))$$

and

where $ is set equal to $100, c denotes current practices, and B denotes the more environmentally benign practices.

$$\Pr(Yes_B) = 1/(1+\exp(-\hat{\beta} X_B))$$