# Foresters' Perceptions of Forest Regeneration and Possible Barriers to Regeneration in New York State

**March 2010**

**HDRU Series No 10-2**

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## AKNOWLEDGMENTS

We thank the foresters who met with us to discuss the study and/or reviewed the questionnaire (Andy Metz, John Mueller, Christopher Nowak , Ralph Nyland, Richard Pancoe, David Skeval, Matt Swayze, Bruce Williamson, and Mark Zubal). The sample list for the study was provided by the New York State Department of Environmental Conservation, the New York Chapter of the Society of American Foresters, the Empire State Forest Products Association, and the New York Sustainable Forestry Initiative Implementation Committee.

Special thanks are extended to Human Dimensions Research Unit staff member, Karlene Smith, who implemented the survey and entered the data on computer. Margie Peech assisted with table preparation and report formatting. Dan Decker and Shorna Allred reviewed drafts of the report. The Survey Research Institute at Cornell University conducted the nonrespondent telephone follow-ups.

This work was supported by a joint research and extension program funded by Cornell University Agricultural Experiment Station (Hatch funds) and Cornell Cooperative Extension (Smith-Lever funds) received from Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

## ABSTRACT

The primary purpose of this study was to estimate the extent of deer damage compared with other impacts on forest regeneration in New York State. To do this, all impacts to forest regeneration must be considered, not just deer. Obtaining actual field measurements on a statewide basis is cost prohibitive, so we took an indirect approach to gauging impacts on forest regeneration. A statewide mail survey, with a telephone follow-up to a sample of nonrespondents, was implemented to gather the expert opinions' of foresters currently working in New York. A total of 278 people responded to the questionnaire, 197 completed the survey and 81 indicated they were not currently practicing in the field, for an adjusted response rate of 54%. Foresters practicing in New York State estimated that forest regeneration, in stands opened up for regeneration, was moderately or highly successful only 30% of the time. Nonrespondents to the mail survey indicated that they thought regeneration was a bit more successful than respondents, so the overall success rate statewide might be a bit higher than 30%. Deer browsing and interfering vegetation were the biggest problems for regeneration statewide. Foresters indicated that 72% of the marginally successful or completely failed stands statewide were impacted by deer browsing. Half were impacted by interfering vegetation. Foresters generally recommended a specific harvest method or TSI control of less desirable stems to encourage successful regeneration. In areas outside the Adirondacks, most foresters also recommended antlerless deer harvest. Fencing to exclude deer was rarely recommended, presumably because the cost of fencing exceeds the value of most timber stands.

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# INTRODUCTION

Regeneration of diverse tree species requires favorable site and forest conditions to establish seedlings (Ward et al. 2006). An adequate number of seedlings must then escape herbivory especially from white-tailed deer (*Odocoileus virginianus*). Herbivory is believed to be a severe limitation on regeneration for many woody plants because of high deer densities. For example, in southern New York deer abundance can exceed 36 deer per sq. mi. (14 deer per sq. km) (Riley et al. 2003). With this level of pressure from deer herbivory, seedlings of species preferred by deer such as oaks (*Quercus* spp.), maple (*Acer* spp.), and ash (*Fraxinus* spp.) have little chance for successful reestablishment. Tree species that are less preferred by deer, such as American beech (*Fagus grandifolia*) and striped maple (*Acer pensylvanicum*), currently dominate the seedling and sapling layer in many northeastern forests (Ward et al. 2006).

The extent of deer impacts compared with other possible barriers (e.g., poor silviculture, soil conditions, and insect damage) on forest regeneration in New York State has not been recently assessed. The purpose of this study was to estimate the extent of deer damage compared with other impacts on forest regeneration in New York State, and to examine the economic impact poor regeneration might be having on the value of products from the forest. To do this, all impacts to forest regeneration must be considered, not just deer. Obtaining actual field measurements on a statewide basis is cost prohibitive, so we take an indirect approach to gauging impacts on forest regeneration. A statewide mail survey was implemented to gather the expert opinions' of foresters currently working in New York.

Understanding barriers to forest regeneration is valuable because owners and managers can adjust their management practices to offset the dominant barriers on a particular site. Focusing scarce resources on the most limiting barriers will have the greatest positive impact on sustainable regeneration of woodlands. Further, policy makers, educators, and agency professionals who develop and administer landowner assistance programs can target information and resources to achieve the best conditions for successful regeneration. This report concludes with recommendations for outreach by educators, foresters, and others providing forest management assistance to landowners.

# METHODS

Our target survey population was all foresters practicing in New York State who might have observations about forest regeneration in the state. Currently, no single source exists listing all professional foresters in New York. Therefore, we gathered lists from several sources, removed duplicates, and included all people we thought were likely to be actively working in forests of New York. The cover letter accompanying the questionnaire indicated that we expected some people who received the questionnaire might not be active field foresters, and asked those people to return the blank questionnaire so we could get a count of those practicing in New York and avoid recontacting those not practicing with further reminder notices or telephone calls. We obtained lists of foresters from the New York State Department of Environmental Conservation, the New York Chapter of the Society of American Foresters, the

Empire State Forest Products Association, and the New York Sustainable Forestry Initiative Implementation Committee. A total of 514 potentially practicing foresters were identified.

The mail questionnaire was developed using questions from previous surveys, plus input from practicing foresters who attended a meeting to discuss survey design. The questionnaire was also pre-tested/reviewed by NYSDEC, consulting, industry, and academic foresters. While the intent of the research was to assess the relative impact of deer on forest regeneration, the questionnaire did not highlight deer in any way, to avoid the potential for biasing respondents.

The questionnaire had two sections. The first dealt with foresters': general experiences with forest regeneration, commonly encountered barriers to successful regeneration, management activities they would recommend, and activities they thought landowners would implement. For the purposes of this survey, regeneration success was defined in the questionnaire as adequate stocking of desirable species at least 5 feet tall. The second section asked foresters to focus on a specific stand (i.e., individual management unit) they had recently visited and to describe the characteristics of the stand, regeneration success, barriers to regeneration, management activities to improve regeneration, and how the value of the forest products from the stand would change if management activities were undertaken. This provided us with information about a sample of stands where regeneration could be evaluated. See Appendix A for exact content and wording of the questionnaire.

The mail questionnaire was sent to all 514 potentially practicing foresters in early April, 2009. Up to three reminder mailings were sent over the course of the following month to encourage response. A nonrespondent telephone follow-up survey was conducted with a sample of 50 foresters who did not respond to the mail survey. They were asked questions about their engagement in forestry and their perceptions of barriers to regeneration. Respondents and nonrespondents generally did not differ in their responses (discussed in more detail in the Results section). Although we were surveying the entire population of practicing foresters (i.e., attempting a census), not all members of the population responded to the survey. Thus, we have a nonrespresentative sample of the population. Given this situation and because the differences between respondents and the sample of nonrespondents were minor, the data collected from nonrespondents was added to the respondent data for the questions asked of both groups to increase the number of responses for those questions and bring us closer to having responses from the whole population.

Data were entered on the computer and analyzed using SPSS software (Release 16.0.1). Results linked to the number of stands a forester inspected were reported as a percentage of all stands visited by all foresters. For example, we would report "30% of all stands," rather than "30% of foresters." Statistical analysis was appropriate because we do not have data from the entire population. Chi-square and Scheffe's test were used to look for differences between foresters practicing in different parts of the state. T-tests were used to compare means between two groups. Ninety-five percent confidence limits were presented around estimates of the improved value of forests due to management. These research methods have been approved by the Institutional Review Board at Cornell University, protocol #09-02-075.

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# RESULTS

## Mail Survey Response and Tests for Nonresponse Bias

Mail questionnaires were sent to all foresters we could identify who were likely to be practicing in New York State (n=514). Two questionnaires were undeliverable. A total of 278 people responded to the questionnaire, 197 completed the survey and 81 indicated they were not currently practicing in the field, for an adjusted response rate of 54%. Response rates were higher for foresters living in the Adirondacks (55%), Southern Highlands (61%), and Catskill/Lower Hudson/Long Island (54%) compared with other regions of New York (48-49%). (See Figure 1 for a map depicting the regions.) Based on the nonrespondent telephone follow-up survey, where 66% of foresters indicated they were currently practicing, we estimate that 154 of the 234 nonrespondents to the mail survey are currently practicing, for an estimated total population of 351 practicing foresters in New York State. For questions where respondents' and the sample of nonrespondents' data were combined, we have information from 192 foresters, or 55% of the estimated population of practicing foresters in New York State.

Respondents to the mail survey and nonrespondents did not differ in their general characteristics (i.e., employment sector, ability to answer questions about forest regeneration). Few differences (3 of 15 questions asked) were found in the information they provided about a specific stand. The only significant differences of note were that respondents were more likely than nonrespondents to indicate that regeneration was only marginally successful or a complete failure, and the impact of interfering vegetation or deer browsing was moderate or severe. Therefore, when we discuss these results later in the report we will caution readers that the success of regeneration may be underestimated and the impact of interfering vegetation or deer browsing may be overstated if only respondent data are considered. See Appendix Table B-1 for all comparisons made between respondents and nonrespondents.

## Characteristics of Foresters

The majority of responding foresters work for either the government, including federal, state, and city/county governments (42%), or as private consulting foresters (31%). Seventeen percent work for industries and 5% work for nongovernmental organizations. The remaining 5% indicated they worked in other employment sectors. One might expect that regeneration success, barriers to regeneration, and activities recommended by foresters might differ by employment sector, but that was not the case. Only one noteworthy difference related to management activity recommendations is discussed later in the report.

Respondents indicated that they worked most frequently during the last 12 months in either the Southern Highlands or the Adirondacks (Figure 1). Fewer respondents worked in the other three ecological regions. Because of the small number of respondents in these regions, they are combined into an "Other" group in subsequent analysis. Respondents typically work most frequently in the region where they live (90-95% in the Adirondacks, Southern Highlands, and Catskill/Lower Hudson/Long Island). In the Mohawk Valley/Capital District and Lake Plain

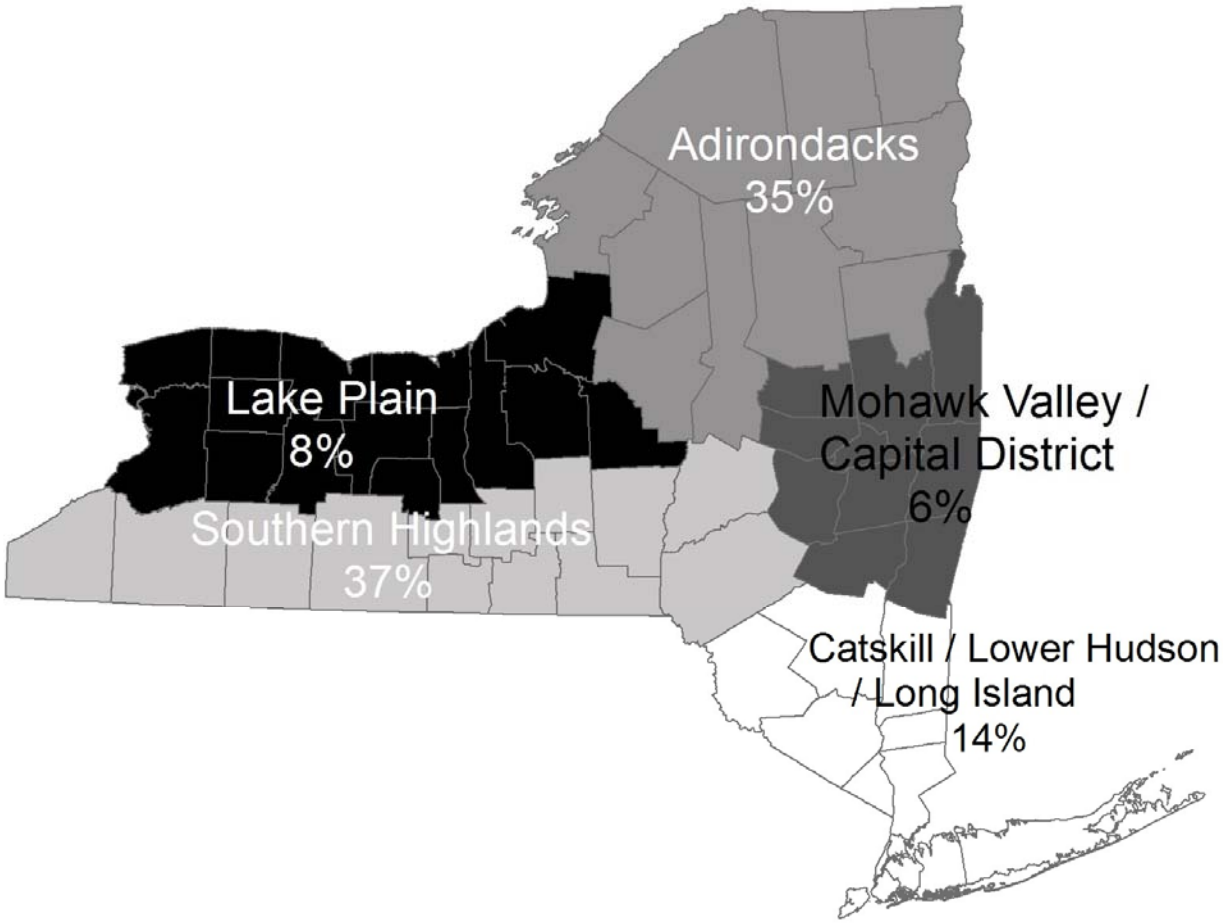


Figure 1. Percent of responding foresters who worked most frequently in each of the ecological regions in New York State.

regions, about half of the foresters (47-50%) who live in those regions work most frequently outside them.

**Foresters' General Experience with Forest Regeneration in New York State**

Respondents indicated that they had examined almost 5,000 properties in the past year in the region they worked in most, during times when snow depth did not limit their ability to assess forest regeneration. This represents almost 17,000 stands and 700,000 acres examined. The average number of stands per property was higher in the Adirondacks (18) than in the Other Regions (5). The average number of acres per stand was also higher in the Adirondacks (90 acres) compared to the Southern Highlands (35 acres) and the Other Regions (58 acres), but the number of stands and the number of acres per stand visited by foresters in each region varied widely, so the differences were not statistically significant.

Two-thirds of respondents (65%) indicated that they always look for evidence of regeneration when inspecting a forest stand. Another 27% said they looked most of the time. Only 8% said they looked only some of the time or rarely.

Foresters reported that 31% of all the stands (and 30% of all the acreage) they evaluated in the past year were ready to be regenerated (e.g., the stand had been opened up so that regeneration could take place, the landowner's objective was to harvest the stand). Of those stands, the successful regeneration of most would be impeded if no action was taken to reduce deer browsing (Table 1). This was particularly true of stands in the Other Regions (Lake Plain, Mohawk Valley/Capital District, Catskill/Lower Hudson/Long Island). Interfering vegetation (native and exotic) was the second-most-frequently-mentioned barrier; a concern for almost half of the stands statewide. In the Adirondacks and Southern Highlands, the number of stands impacted by deer (38-59%) was very similar to the number impacted by interfering vegetation (46-47%). (We caution that because of nonresponse bias, these estimates might be slightly overstated.) Landowner lack of interest or willingness to invest in the stand was seen as a barrier for only one-quarter of stands. Soil/site limitations and forest health were not considered barriers to regeneration for most stands in New York.

When regeneration is a management goal, most foresters recommended a specific harvest method or timber stand improvement (TSI) control of less desirable stems to encourage successful regeneration (Table 2). In areas outside the Adirondacks, most foresters also recommended antlerless deer harvest. Antlerless deer harvest is limited to archery and muzzeloading seasons and by special permit on certain lands in the Adirondacks, which perhaps limits this strategy as a recommendation by foresters. About one-third of foresters frequently recommend mechanical control of interfering understory vegetation; fewer recommend using herbicides, except in the Southern Highlands where over one-third frequently recommend using herbicides, despite the perception that interfering vegetation was impacting almost half of the stands (Table 1). Fencing to exclude deer was rarely recommended.

Landowners who consulted with foresters don't always act on those recommendations, according to the foresters (Table 3). Half to two-thirds of foresters thought landowners would frequently or always implement the recommendation of harvest method or TSI control of less

**Table 1. Of the forest stands inspected by respondents in the last 12 months that are ready to be regenerated, the percent that will be impeded from successful regeneration by various barriers, statewide and by region.**

| | Statewide | Adirondacks | Southern Highlands | Other Regions |
|---|---|---|---|---|
| ***Barriers to regeneration*** | Percent of stands impacted* | | | |
| Deer browsing | 64.9 | 38.0 | 59.2 | 90.5 |
| Interfering vegetation (native and exotic) | 47.1 | 47.2 | 45.6 | 49.3 |
| Landowner isn't interested or knowledgeable enough to ensure that logger or forester attempts necessary management activities | 25.4 | 16.3 | 25.1 | 31.8 |
| Landowner will not invest adequate money in appropriate management practice | 21.3 | 17.8 | 29.2 | 12.1 |
| Soil or site limitations | 13.5 | 17.8 | 9.3 | 16.7 |
| Forest health (e.g., defoliation, drought) | 9.6 | 11.7 | 7.8 | 10.9 |

*Percentages can add to more than 100% because more than one barrier could be causing an impact.

| **Table 2. Frequency of forester recommendation of various management activities when regeneration is one of the client's management goals, statewide and by region.** | | | | |
|---|---|---|---|---|
| ***Recommend management activity when regeneration a goal*** | Statewide | Adirondacks | Southern Highlands | Other Regions |
| | Percent | | | |
| *Harvest method* | | | | |
| Frequent/Always | 76.2 | 85.2 | 75.9 | 65.1 |
| Occasionally | 17.9 | 7.4 | 20.4 | 27.9 |
| Rarely/Never | 6.0 | 7.4 | 3.7 | 7.0 |
| *TSI control of less desirable stems** | | | | |
| Frequently/Always | 73.0 | 49.1 | 83.6 | 88.6 |
| Occasionally | 14.5 | 24.5 | 10.9 | 6.8 |
| Rarely/Never | 12.5 | 26.4 | 5.5 | 4.5 |
| *Antlerless deer harvest** | | | | |
| Frequently/Always | 59.2 | 39.2 | 69.2 | 70.5 |
| Occasionally | 17.7 | 23.5 | 15.4 | 13.6 |
| Rarely/Never | 23.1 | 37.3 | 15.4 | 15.9 |
| *Mechanical control of interfering understory vegetation* | | | | |
| Frequently/Always | 33.3 | 25.0 | 39.6 | 35.7 |
| Occasionally | 34.7 | 44.2 | 28.3 | 31.0 |
| Rarely/Never | 32.0 | 30.8 | 32.1 | 33.3 |
| *Herbicide of interfering understory vegetation** | | | | |
| Frequently/Always | 22.5 | 13.2 | 37.0 | 15.9 |
| Occasionally | 34.4 | 28.3 | 33.3 | 43.2 |
| Rarely/Never | 43.0 | 58.5 | 29.6 | 40.9 |
| *Fencing to exclude deer** | | | | |
| Frequently/Always | 7.6 | 3.9 | 5.9 | 14.0 |
| Occasionally | 12.4 | 3.9 | 11.8 | 23.3 |
| Rarely/Never | 80.0 | 92.2 | 82.4 | 62.8 |
| *Statistically significant difference between regions at P = 0.05 using Chi-square test. | | | | |

| **Table 3. Frequency with which landowners implement foresters' recommendations for various regeneration management activities, statewide and by region.** | | | | |
|---|---|---|---|---|
| ***Landowners implement regeneration management activity*** | Statewide | Adirondacks | Southern Highlands | Other Regions |
| | Percent | | | |
| *Harvest method* | | | | |
| Frequently/Always | 58.9 | 66.7 | 56.9 | 51.3 |
| Occasionally | 33.3 | 25.5 | 39.2 | 35.9 |
| Rarely/Never | 7.8 | 7.8 | 3.9 | 12.8 |
| *TSI control of less desirable stems** | | | | |
| Frequently/Always | 45.1 | 34.7 | 53.8 | 46.5 |
| Occasionally | 33.3 | 26.5 | 38.5 | 34.9 |
| Rarely/Never | 21.5 | 38.8 | 7.7 | 18.6 |
| *Antlerless deer harvest* | | | | |
| Frequently/Always | 25.5 | 18.4 | 26.5 | 33.3 |
| Occasionally | 40.9 | 42.9 | 46.9 | 30.8 |
| Rarely/Never | 33.6 | 38.8 | 26.5 | 35.9 |
| *Mechanical control of interfering understory vegetation* | | | | |
| Frequently/Always | 23.7 | 20.8 | 30.6 | 19.0 |
| Occasionally | 31.7 | 31.2 | 30.6 | 33.3 |
| Rarely/Never | 44.6 | 47.9 | 38.8 | 47.6 |
| *Herbicide of interfering understory vegetation* | | | | |
| Frequently/Always | 11.4 | 10.4 | 11.8 | 12.2 |
| Occasionally | 19.3 | 8.3 | 23.5 | 26.8 |
| Rarely/Never | 69.3 | 81.2 | 64.7 | 61.0 |
| *Fencing to exclude deer* | | | | |
| Frequently/Always | 5.2 | 4.2 | 4.3 | 7.7 |
| Occasionally | 6.0 | 6.2 | 4.3 | 7.7 |
| Rarely/Never | 88.8 | 89.6 | 91.5 | 84.6 |
| *Statistically significant difference between regions at P = 0.05 using Chi-square test. | | | | |

desirable stems. Recall that the landowners that foresters were working with could be their own government agencies or industrial owners, private family landowners, or other types of owners. In this case, foresters reported that private family forest owners (78%) more so than government agencies (49%) were likely to always or frequently take their advice about harvest method. No other differences were found between foresters in different employment sectors. One-quarter or fewer foresters thought landowners would frequently or always implement any of the other recommendations, including antlerless deer harvest and vegetation management practices that would address the top two barriers to regeneration. Almost all foresters said landowners would rarely or never use fencing to exclude deer.

Respondents thought that most landowners would be unwilling to limit their profits to improve the potential for successful forest regeneration. On average, foresters thought approximately half (48%) of the landowners they work with would be willing to delay full harvest revenue to improve the chances for sustainable production and regeneration, such as a preparatory cut for the shelterwood harvest method. On average, foresters thought about one-third (32%) of landowners would be willing to reinvest harvest revenue to assure successful regeneration.

Forty-one percent of all the stands foresters inspected in the past year had experienced no harvest activity during the last 10 years (Table 4). The proportion was a bit higher in the Other Regions (47%). About one-fifth to one-quarter of the stands had some type of intermediate treatment (e.g., TSI, thinning), with a slightly higher proportion in the Adirondack region (29%). About 20% received a treatment where regeneration was a management goal, and the remainder (10-20%, depending on the region) had been high-graded or had a diameter-limit cut. The nature of harvests more than 10 years old was not reported and could include any of these cutting strategies.

**Table 4. Of the forest stands inspected by respondents in the last 12 months, where snow depth did not limit their ability to assess regeneration, the percent receiving different treatments in the last 10 years, statewide and by region.**

| | Statewide | Adirondacks | Southern Highlands | Other Regions |
|---|---|---|---|---|
| ***Treatment in last 10 years*** | Percent of stands inspected | | | |
| Regeneration was a management goal | 20.0 | 20.7 | 21.0 | 15.2 |
| Intermediate treatment (e.g., TSI, thinning) | 22.9 | 28.7 | 22.1 | 17.2 |
| High graded or diameter-limit cut | 16.5 | 10.7 | 17.8 | 20.5 |
| No harvest activity | 40.6 | 39.9 | 39.1 | 47.1 |

Foresters indicated that about one-quarter (28%) of all the stands and 27% of all the acreage that they inspected last year had a harvest in the last 10 years that was sufficiently intense to open the canopy for sunlight that could establish a new age class of trees. The anticipated regeneration success of those stands statewide was largely unsuccessful (Table 5). For some of the stands, particularly in the Adirondacks, it was still too early to assess regeneration success. If we look only at stands where foresters could assess regeneration (bottom part of Table 5), statewide regeneration was evaluated by foresters to be moderately or highly successful only 30% of the time. Anticipated moderately to highly successful regeneration was better in the Adirondacks and worse in the Other Regions.

Again, barriers to regeneration success were linked primarily to deer, either in the form of deer browsing or the presence of interfering vegetation (Table 6). Foresters indicated that 72% of all the marginally successful or completely failed stands statewide were impacted by deer browsing. Half of all stands were also impacted by interfering vegetation. Deer were the overwhelming barrier in the Other Regions, but were quite similar in effect to interfering vegetation when considering only the Adirondacks and Southern Highlands. Deer were reported to be less of a concern in the Adirondacks. Deer browsing impacted a greater proportion of stands in the Other Regions, whereas interfering vegetation was cited more frequently in the Southern Highlands than in other regions. Landowner knowledge was reported as a barrier affecting more stands in the Other Regions. Forest health or soil/site limitations seldom were considered barriers to regeneration.

**Estimating the Value of Forest Management and the Effect of Poor Regeneration: Stand-Level Response to Regeneration Barriers**

To estimate the value of forest management and to look more in-depth at the causes and possible solutions for poor forest regeneration, foresters were asked to consider, from memory, a particular stand that they had recently visited where a forest harvest had taken place and enough time had passed that regeneration success could be assessed. The forester may not have been involved with the recommendation or implementation of the harvest they were considering. The intent was to have a diversity of stand types and locations represented by foresters such that the economic value could be calculated by stand type, and reflect the condition of stands across the state. A sufficient number of responses was obtained to examine hardwood stands by the three regions defined earlier, but a statewide estimate for hardwoods is not recommended for this analysis due to the small number of responses by region (Table 7) and the need for weighting to obtain a statewide estimate. Estimates for conifer stands will be made at the statewide level.

Conifer stands evaluated by foresters were mostly even-aged stands owned by government agencies, which were being managed for sawtimber (Table 7). Selection or row thinning were the primary treatments that created the opportunity for regeneration. All stands had a forester involved in the management prescription that created the opportunity for regeneration. For hardwood stands, ownership was more diverse, with the majority being private family forests. The hardwood stands were primarily even-aged, but in the Adirondacks the majority were two-aged. Almost all were being managed for sawtimber. Selection, high-grading, or shelterwood were most likely to be the treatments that created the opportunity for regeneration. Foresters were involved in almost all (87%) of the management prescriptions that

**Table 5. Of the forest stands inspected by respondents in the last 12 months, where snow depth did not limit their ability to assess regeneration, and there had been a harvest in the last 10 years that was sufficiently intense to open the canopy for sunlight that could establish a new age class of trees, the success rate of regeneration, statewide and by region.**

| | Statewide | Adirondacks | Southern Highlands | Other Regions |
|---|---|---|---|---|
| ***Regeneration success*** | Percent of stands with a harvest in last 10 years | | | |
| Too early to tell | 23.8 | 40.3 | 20.8 | 14.8 |
| Highly successful | 9.9 | 7.1 | 12.9 | 7.1 |
| Moderately successful | 13.4 | 18.6 | 10.5 | 13.5 |
| Marginally successful | 34.1 | 30.1 | 37.0 | 32.4 |
| Completely failed | 18.8 | 3.9 | 18.8 | 32.2 |
| | | | | |
| ***Regeneration success for stands where regeneration could be assessed*** | Percent of stands where regeneration success could be assessed | | | |
| Highly successful | 13.0 | 11.9 | 16.3 | 8.3 |
| Moderately successful | 17.4 | 31.2 | 13.2 | 15.9 |
| Marginally successful | 44.9 | 50.4 | 46.8 | 38.0 |
| Completely failed | 24.7 | 6.5 | 23.7 | 37.8 |

**Table 6. Of the forest stands that experienced either marginal or failed regeneration, the percentage that were impacted by various barriers, statewide and by region.**

| | Statewide | Adirondacks | Southern Highlands | Other Regions |
|---|---|---|---|---|
| ***Barriers to regeneration*** | Percent of stands impacted* | | | |
| Deer browsing | 71.7 | 38.3 | 75.6 | 81.1 |
| Interfering vegetation (native and exotic) | 50.4 | 42.3 | 59.9 | 39.3 |
| Landowner wasn't interested or knowledgeable enough to ensure that logger or forester attempted necessary management activities | 26.5 | 9.2 | 23.2 | 39.7 |
| Landowner did not invest adequate money in appropriate management practice | 14.0 | 15.8 | 16.6 | 9.0 |
| Soil or site limitations | 14.0 | 13.8 | 10.7 | 19.3 |
| Forest health (e.g., defoliation, drought) | 9.6 | 11.1 | 6.1 | 14.5 |

*Percentages can add to more than 100% because more than one barrier could be causing an impact.

| **Table 7. Characteristics of the stand foresters evaluated for change in economic value, by type of forest stand and region.** | | | | |
|---|---|---|---|---|
| Characteristics of the stand: | Conifer | Hardwood | | |
| | Statewide | Adirondacks | Southern Highlands | Other Regions |
| n | 16 | 28 | 32 | 27 |
| Mean acres | 63 | 132 | 54 | 70 |
| | | | | |
| | Percent | | | |
| Land ownership | | | | |
| *Family forest* | 18.8 | 46.4 | 43.8 | 51.9 |
| *Government* | 68.8 | 10.7 | 18.8 | 22.2 |
| *Industry* | 6.2 | 25.0 | 15.6 | 11.1 |
| *Other* | 6.2 | 17.9 | 21.8 | 14.8 |
| Stand age structure | | | | |
| *Even-aged* | 83.3 | 34.8 | 52.0 | 52.6 |
| *Two-aged* | 16.7 | 52.2 | 24.0 | 21.1 |
| *Uneven-aged* | 0.0 | 13.0 | 20.0 | 26.3 |
| *Uncertain* | 0.0 | 0.0 | 4.0 | 0.0 |
| Treatment that created opportunity for regeneration | | | | |
| *Shelterwood* | 8.3 | 36.4 | 24.0 | 29.4 |
| *Selection* | 33.4 | 18.2 | 28.0 | 17.6 |
| *Diameter-limit cut, high-grade or other exploitive harvest* | 0.0 | 13.6 | 20.0 | 17.6 |
| *Seed tree* | 8.3 | 18.2 | 8.0 | 5.9 |
| *Clear cut or patch clear cut* | 16.6 | 0.0 | 8.0 | 17.7 |
| *Two-aged stand* | 0.0 | 4.5 | 4.0 | 5.9 |
| *Other* | 33.4 | 9.1 | 8.0 | 5.9 |
| Highest value forest product stand being managed for | | | | |
| *Sawtimber* | 92.9 | 89.3 | 96.9 | 92.6 |
| *Other* | 7.1 | 10.7 | 3.1 | 7.4 |

created the opportunity for regeneration. Only one respondent indicated some type of annual harvest, such as maple sap, so no estimates of the economic value could be done for lands with annual harvests.

Foresters reporting on conifer stands indicated that the vast majority were moderately or highly successful in regenerating (Table 8). Deer browsing and interfering vegetation were having a moderate impact on some stands (Table 9). If stands had no further management activities, then foresters' estimated the value per acre would increase by $49 each year until harvest, which would be on average 48 years from now (Table 10). (This estimate was calculated by taking the value per acre in today's dollars provided by foresters and dividing it by the number of years until the next highest-value-product harvest.) If management activities were undertaken (likely TSI), foresters estimated the value per acre per year would go up to $82 for a

| **Table 8. Foresters' assessment of the regeneration success of the stand they evaluated for change in economic value, by type of forest stand and region.** | | | | |
|---|---|---|---|---|
| | Conifer | Hardwood | | |
| | Statewide | Adirondacks | Southern Highlands | Other Regions |
| ***Regeneration success*** | Percent | | | |
| Highly successful | 37.5 | 10.7 | 21.9 | 18.5 |
| Moderately successful | 56.3 | 53.6 | 34.4 | 44.5 |
| Marginally successful | 6.2 | 32.1 | 31.2 | 22.2 |
| Complete failure | 0.0 | 3.6 | 12.5 | 14.8 |

gain in value of $33 per acre per year, with harvest a few years sooner (45 years). This estimate of gain in value is based on 16 responses and the 95% confidence interval is $15 to $51. Since foresters anticipated most regeneration was successful and costs to improve regeneration were near zero, the projected increase in value is likely due to management activities unrelated to regeneration. Costs associated with these activities were not assessed in this survey, but would need to be subtracted from the gain in value of $33 per acre per year for a true estimate of profit.

Foresters' assessment of hardwood stand regeneration success was less positive, with one-third or more indicating regeneration was marginally successful or a complete failure (Table 8). Success seemed more likely in the Adirondacks compared with other regions. Deer browsing, and to a lesser extent interfering vegetation, were considered to have a severe impact on the regeneration success of stands across all three regions (Table 9). The severity of the impact by deer browsing was significantly correlated with foresters' assessment of regeneration success (0.479, Pearson's correlation coefficient). The correlation was not as strong for interfering vegetation, but still significant (0.338). Interestingly, the severity of the impact caused by deer browsing was not significantly correlated with the severity of the impact caused by interfering vegetation. Both deer herbivory and interfering vegetation were significant barriers statewide (Table 1) and can interact to magnify regeneration failure (Horsley et al. 2003). However, in a particular stand as assessed here, the emphasis of one barrier may be more apparent than for the other, and thus not reflect a strong co-occurrence.

For stands where foresters assessed regeneration as marginal or a complete failure, most said antlerless deer harvest will be necessary to bring about adequate regeneration (Table 11). Many also felt that herbicide or mechanical control of interfering understory vegetation, TSI control of less desirable stems, and fencing to exclude deer would be necessary. Foresters indicated that all stands with regeneration concerns would benefit from some type of management. However, the majority thought only antlerless deer harvest, TSI, and mechanical control would be implemented by the landowners. No one thought fencing to exclude deer would be done. If the landowners engage in practices foresters thought they would do, then foresters thought 69% of the stands were somewhat likely and 28% very likely to be successfully regenerated from stands originally assessed as marginal or a complete failure.

**Table 9. Foresters' assessment of the impact of various barriers to regeneration of the stand they evaluated for change in economic value, by type of forest stand and region.**

| ***Barriers to regeneration*** | Conifer | Hardwood | | |
|---|---|---|---|---|
| | Statewide | Adirondacks | Southern Highlands | Other Regions |
| | Percent | | | |
| Deer browsing | | | | |
| *No impact* | 18.8 | 7.1 | 0.0 | 14.8 |
| *Slight impact* | 31.2 | 14.3 | 15.6 | 11.1 |
| *Moderate impact* | 37.5 | 39.3 | 59.4 | 33.3 |
| *Severe impact* | 12.5 | 35.7 | 25.0 | 40.8 |
| *Not sure* | 0.0 | 3.6 | 0.0 | 0.0 |
| Interfering vegetation (native and exotic) | | | | |
| *No impact* | 37.6 | 10.7 | 9.4 | 14.8 |
| *Slight impact* | 31.2 | 42.8 | 28.1 | 40.8 |
| *Moderate impact* | 31.2 | 28.6 | 40.6 | 37.0 |
| *Severe impact* | 0.0 | 14.3 | 21.9 | 7.4 |
| *Not sure* | 0.0 | 3.6 | 0.0 | 0.0 |
| Landowner wasn't interested or knowledgeable enough to ensure that logger or forester attempted necessary management activities | | | | |
| *No impact* | 73.3 | 77.8 | 58.0 | 53.9 |
| *Slight impact* | 13.3 | 3.7 | 9.7 | 23.2 |
| *Moderate impact* | 0.0 | 14.8 | 9.7 | 11.5 |
| *Severe impact* | 6.7 | 3.7 | 9.7 | 3.8 |
| *Not sure* | 6.7 | 0.0 | 12.9 | 7.6 |
| Landowner did not invest adequate money in appropriate management practice | | | | |
| *No impact* | 68.8 | 59.3 | 53.2 | 64.0 |
| *Slight impact* | 12.5 | 18.5 | 16.7 | 16.0 |
| *Moderate impact* | 6.2 | 7.4 | 16.7 | 12.0 |
| *Severe impact* | 0.0 | 14.8 | 6.7 | 4.0 |
| *Not sure* | 12.5 | 0.0 | 6.7 | 4.0 |
| Soil or site limitations | | | | |
| *No impact* | 50.1 | 25.0 | 40.7 | 44.5 |
| *Slight impact* | 37.5 | 50.0 | 40.6 | 40.7 |
| *Moderate impact* | 6.2 | 17.9 | 15.6 | 14.8 |
| *Severe impact* | 6.2 | 7.1 | 3.1 | 0.0 |
| *Not sure* | 0.0 | 0.0 | 0.0 | 0.0 |
| Forest health (e.g., defoliation, drought) | | | | |
| *No impact* | 43.7 | 28.6 | 42.9 | 55.6 |
| *Slight impact* | 37.5 | 35.7 | 32.1 | 29.6 |
| *Moderate impact* | 18.8 | 21.4 | 14.3 | 14.8 |
| *Severe impact* | 0.0 | 10.7 | 7.1 | 0.0 |
| *Not sure* | 0.0 | 3.6 | 3.6 | 0.0 |

In an attempt to focus solely on the impacts caused by deer, we looked at respondents who said the stand they examined was moderately or severely impacted by deer, but no other barrier to regeneration. This group represents only 19% of respondents to this question, indicating that deer are not usually the only problem for regeneration. Among those that thought only deer were moderately or severely impacting the stand, just over half (56%) still thought the stand regeneration was moderately or highly successful. We assume this apparent contradiction is due to the relative nature of impacts, and with only one impact (deer) at work, even if severe, still allows for some regeneration. For those that thought regeneration was marginally successful or a complete failure, all recommended antlerless deer harvest to address the situation and zero management costs were associated with that approach. Only one respondent would recommend deer fencing for the stand they were considering.

If stands had no further management activities, then foresters' estimated the value per acre in 2009 dollars would increase depending on the region $42 to $411 each year until harvest, which would be on average 47 to 50 years into the future (Table 10). If management activities were undertaken (both to improve regeneration and adjust the current forest structure and composition), foresters estimated the value per acre per year would increase to $75 to $460 for a gain in value of $32 to $75 per acre per year, with harvest a few years sooner (44 to 47 years). These estimates were made based on information collected from 27 to 32 stands per region. The standard error was quite large for some of the estimates (Table 10), but they indicate the magnitude of the value associated with forest management.

Costs for improved regeneration of marginally or completely failed stands averaged between $7 to $11 per year (Table 10). (Realistically all these costs occur in the first few years, but in order to compare costs with gains in value, both numbers must be divided by the number of years until the next harvest.) The costs for improved regeneration, as well as costs for other management activities, which we did not assess, should be subtracted from the gain in value for a true estimate of profit. Our results show a gain in value, less any regeneration costs, of $30 to $72 in 2009 dollars per acre per year.

The value of the regeneration layer that foresters assessed as already having highly or moderately successful regeneration was considerably higher than stands initially assessed with marginal or completely failed regeneration (Table 12). The difference in stand value between these regeneration categories remained true after management activities took place that presumably were done in part to improve regeneration success. Interestingly, the gain in value from management was not significantly different ($64 versus $33). The stands with moderately or highly successful regeneration may exist on better sites than stands with poor regeneration. The better sites would likely produce higher quality timber. The insignificant difference in gain (Table 12) indicates high variation in estimated costs and values. The markedly lower value of stands that are not adequately regenerated may suggest differences in site quality or differences in species composition and stem quality associated with previous management activity.

**Table 10. Maximum potential value of forest stands with and without management activities to enhance regeneration and the mean number of years until the next harvest, by type of forest stand and region.**

| | Conifer | Hardwood | | |
|---|---|---|---|---|
| | Statewide | Adirondacks | Southern Highlands | Other Regions |
| | Mean in 2009 dollars (standard error) | | | |
| Value per acre per year without management | 49(18) | 60(23) | 411(231) | 42(14) |
| Value per acre per year with management | 82(20) | 135(54) | 460(229) | 75(16) |
| Gain in value | 33(9) | 75(32) | 49(14) | 32(10) |
| For stands with marginal or complete failure of regeneration, cost of management per acre per year to improve regeneration | 1(*) | 7(3) | 11(5) | 8(3) |
| Gain in value minus costs of management activities to improve regeneration | 33(9) | 72(32) | 44(14) | 30(10) |
| | | | | |
| # years till next harvest: | Mean # years | | | |
| without management | 48(8) | 50(6) | 47(6) | 48(6) |
| with management | 45(7) | 44(5) | 44(6) | 47(6) |

*Sample size too small for standard error to be calculated.

**Table 11. For stands where regeneration success was assessed as marginal or a complete failure, management activities suggested by foresters to bring about adequate regeneration and the likelihood of landowners implementing each activity.**

| **Management activities for regeneration** | Statewide<br>Percent checking* (Percent likely to be implemented by landowner) |
|---|---|
| Antlerless deer harvest | 80.0 (67.9) |
| Herbicide of interfering understory vegetation | 54.3 (31.6) |
| TSI control of less desirable stems | 45.7 (68.8) |
| Fencing to exclude deer | 42.9 (0.0) |
| Mechanical control of interfering understory vegetation | 34.3 (58.3) |
| Tree planting | 22.9 (50.0) |
| Soil fertility enhancement | 11.4 (50.0) |
| Tree tubes | 11.4 (100.0) |
| Insect disease control | 8.6 (66.7) |
| Other | 12.1 (25.0) |

*Percentages can add to more than 100% because more than one management activity could be recommended.

| **Table 12. Maximum potential value of hardwood forest stands starting with or without successful regeneration.** | | | |
|---|---|---|---|
| | Stands starting with highly or moderately successful regeneration | Stands starting with marginally successful or a complete failure of regeneration | Significance Level of T-test |
| | Mean | | |
| Value per acre per year without management | $286 | $24 | 0.069 |
| Value per acre per year with management | $350 | $58 | 0.044 |
| Gain in value | $64 | $33 | 0.126 |

## CONCLUSIONS AND RECOMENDATIONS

Foresters practicing in New York State estimated that forest regeneration, in stands opened up for regeneration, was moderately or highly successful only 30% of the time. Nonrespondents to the mail survey indicated that they thought regeneration was a bit more successful than respondents, so the overall success rate statewide might be a bit higher than 30%. Still this finding indicates that regeneration is a serious problem in New York State. Given current perceptions of the effects of deer, interfering vegetation, and unsustainable harvest practices, issues with regeneration will compound over time. Poor regeneration will limit the ability of the forests to provide the array of values and qualities that society needs. The situation with regeneration was better in the Adirondacks and worse in the Other Regions. Regeneration also appeared to be better for softwoods compared with hardwoods.

This study elicited foresters' evaluation of the success of regeneration in forest stands having canopies that were opened sufficiently to expect regeneration. Forest stands treated by repeated low intensity high-grading would not likely fit the criteria and thus would have been excluded. Low intensity high-grading favors species that are shade tolerant and not palatable by deer, species such as American beech, and striped maple. These species do not constitute successful regeneration for sawtimber. As such, our estimate of the percentage of harvesting that results in successful regeneration is over estimated by the number of stands subjected to high-grading.

Deer browsing and interfering vegetation were the biggest problems for regeneration statewide. Foresters indicated that 72% of the marginally successful or completely failed stands statewide were impacted by deer browsing. Half were impacted by interfering vegetation. Foresters indicated that deer were less of a problem in the Adirondacks, where deer densities are lower. Recent research (as yet unpublished) by one of the authors indicates that deer browsing may be more of a problem in the Adirondacks, even at lower deer densities, than foresters currently perceive.

Foresters generally recommended a specific harvest method or TSI control of less desirable stems to encourage successful regeneration. In areas outside the Adirondacks, most foresters also recommended antlerless deer harvest. Fencing to exclude deer is rarely recommended, presumably because the cost of fencing exceeds the value of most timber stands.

Some support/recognition among landowners of the importance of regeneration, was evidenced by the finding that foresters thought almost half (48%) of the landowners they work with would be willing to delay full harvest revenue to improve the chances for sustainable production and regeneration, such as the preparatory cut for the shelterwood harvest method. Foresters felt that half of the landowners (52%) would not delay a commercial harvest as a strategy to improve the chances of successful regeneration. Foresters thought about one-third (32%) of landowners would be willing to reinvest harvest revenue to assure successful regeneration. Although not investigated in this study, a number of factors influence the decisions owners make about the revenue from their property and their willingness to reinvest. These factors include owner values and attitudes, property tax policy, owner demographics, and owner awareness.

By asking foresters to think about a specific stand, we were able to evaluate the value of management to improve forest stands. In the case of conifers, where the stands reported on by foresters were mostly regenerating successfully, the increased value attributed to management ($33 per acre per year) was most likely associated with TSI. For hardwoods where regeneration was not always successful, foresters estimated it would cost $7 to $11 per acre per year (if costs are apportioned equally over the years until the next harvest), or approximately $300 to $500 per acre, for management activities to improve regeneration on stands where regeneration was marginally successful or completed failed. Thus, to the extent that society benefits from successful regeneration, they are receiving value at the rate of approximately $300-500/acre if owners invest in management. In the few cases where deer browsing was seen as the only barrier to successful regeneration, anticipated management costs were $0 because the primary recommendation made by foresters was antlerless deer harvest. The gain in value to the existing regeneration layer from management for both regeneration and other stand improvements was estimated at $32 to $75 in 2009 dollars per acre per year until the next harvest.

Reliable estimates of the gain in value associated specifically with regeneration are hard to find, and further trying to parse out the impacts of deer is very difficult as noted by Marquis (1981). Further study will be needed, if it is even possible, to tease apart the impacts of deer versus other factors to estimate the economic impacts associated with deer on forest regeneration.

**Implications for Education and Outreach**

Education programs for foresters should emphasize building their skills in working with landowners to understand the favorable potential consequences of delaying a harvest and utilizing appropriate tools to control deer and interfering vegetation (native and exotic). Some foresters may not fully recognize the impacts of deer and interfering vegetation on the regenerative capacity of forests. Deer and interfering vegetation are prominent and common barriers, yet managing these barriers may complicate the commission-based fee for services business models used by many foresters. Improved business management skills and business models that improve the stability of revenue despite diverse management recommendations may help foresters more effectively encourage owners to implement sustainable practices. Tools and guides to help assess deer impacts, at different deer densities, may help foresters better communicate with owners. The limited consideration given to herbicides, despite their efficiency in many situations of interfering vegetation, suggests a lack of forester awareness of the tool, a perception that owners can't or won't use herbicides, a lack of certified pesticide applicators, or that public attitudes are not supportive of the recommendation or use of herbicides.

Woodland owners need improved skills in assessing how their decisions impact the future sustainability of their woods. Their unwillingness to invest money, implement management recommendations, or delay revenue may result from a poor understanding of the consequences of their decisions. Owners need access to creative and cost-effective strategies to implement practices. Owners need to be able to locate and confidently select qualified service providers who can implement the recommended practices.

Deer impacts are the dominant barrier to regeneration in Other Regions, typified as those associated with urban centers (e.g., Buffalo, Rochester, Syracuse, Albany, and metro NYC). In other parts of the state deer and interfering vegetation are nearly equal in perceived impacts. Educational programs should target the dominant barriers specific to the geographic region.

Public policy makers and the public more broadly could better appreciate the significant costs that owners incur associated with the practice of sustainable forestry. A healthy forest environment (and the associated industrial, recreational and tourist economies) depends on successful forest regeneration on private woodlands. Active management, often with an investment or change in behavior, is recommended for woodlands with poor success in regeneration.

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# APPENDIX A:

Mail Questionnaire

# Forest Regeneration In New York State:

## A Survey of Foresters

Cornell University
Department of Natural Resources
Human Dimensions Research Unit

№ 744

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# Forest Regeneration in New York State: A Survey of Foresters

**Research conducted by the Human Dimensions Research Unit in the Department of Natural Resources, College of Agriculture and Life Sciences, Cornell University**

**Conducted in cooperation with Cornell University Cooperative Extension and with assistance from NYSDEC, NYSAF, ESFPA, and the NY SFI Implementation Committee**

The purpose of this survey is to learn more about how much forest regeneration is taking place in New York State and to document the impact of barriers to regeneration. To do this, we need information from foresters, such as you, who have on-the-ground experience and knowledge of the various barriers to forest regeneration. Information from this survey will help us estimate the economic impacts of poor forest regeneration and encourage policies that support sustainable forestry practices.

Your name was selected for this survey because we thought you might be actively engaged in forestry in New York State. If we have contacted you in error, or if you feel that you can't answer the questions, please write a note to that effect on the questionnaire and return it to us, so that we don't bother you with reminder notices.

Please complete this questionnaire at your earliest convenience, seal it with the white resealable label provided, and drop it in any mailbox; return postage has been provided. Your participation in this survey is voluntary, but we sincerely hope you will take just a few minutes to answer our questions. Your identity will be kept confidential and the information you give us will never be associated with your name.

**THANK YOU FOR YOUR ASSISTANCE!**

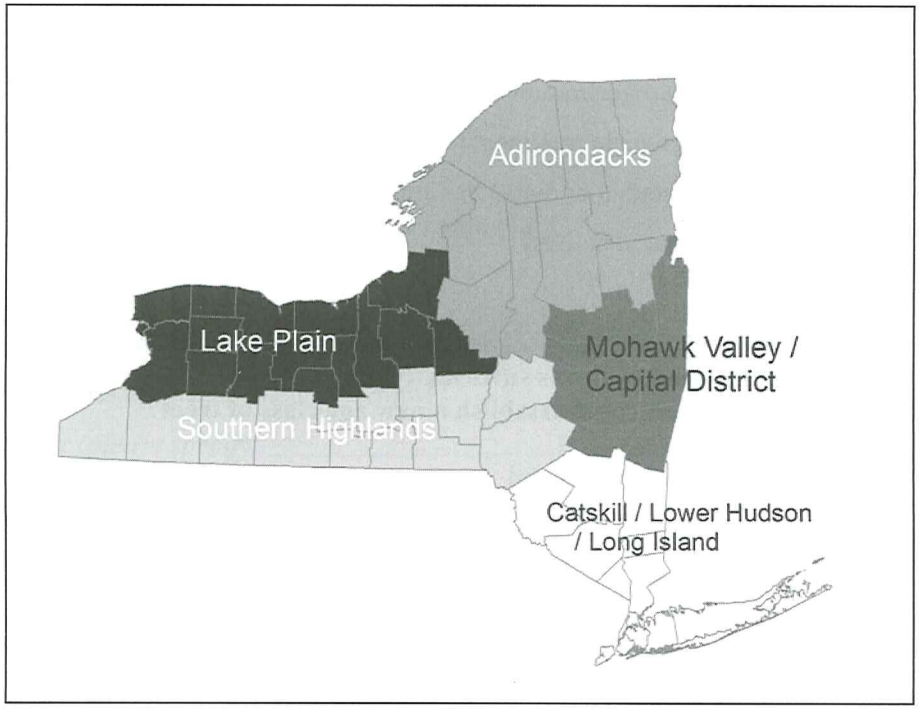
## GENERAL EXPERIENCE IN NEW YORK STATE

1. **What employment sector do you work in?** *(Check one.)*

   _____ Government (e.g., federal, state, city/county)
   _____ Industry
   _____ Nongovernmental organization (NGO)
   _____ Private consulting forester
   _____ Other

2. **Referring to the map below, which ecological region of New York State have you worked in most frequently during the last 12 months?** *(Check only one.)*

   _____ Adirondacks
   _____ Mohawk Valley/Capital District
   _____ Catskill/Lower Hudson/Long Island
   _____ Lake Plain
   _____ Southern Highlands



3. **Approximately how many forested properties have you inspected in the ecological region you checked in Question 2 within the last 12 months, where snow depth would not have limited your ability to assess regeneration?** *(Please answer all 3 items.)*

_____ total number of properties

_____ total number of forest stands

_____ total forested acres

4. **When you inspect a forest stand, how frequently do you look for evidence of regeneration?**

_____ always
_____ most of the time
_____ some of the time
_____ rarely

5. **Of the stands you inspected and included in Question 3 above, how many received the following treatments in the last 10 years?** *(Please include all stands you inspected, not just those you manage.)*

_____ # where regeneration was a management goal

_____ # intermediate treatment (e.g., TSI, thinning)

_____ # high graded or diameter-limit cut

_____ # no harvest activity

6. **How many of the forest stands that you inspected had a harvest in the last 10 years that was sufficiently intense to open the canopy for sunlight that could establish a new age class of trees?**

_____ # of forest stands and _____ approximate total # of acres

7. **Please estimate regeneration success for the stands included in Question 6.** ***(For the purposes of this survey, regeneration success is defined as adequate stocking of desirable species at least 5 feet tall.)***

***Percentage (%)***
_____ highly successful
_____ moderately successful
_____ marginally successful
_____ completely failed
_____ too early to tell

8. **For the stands included above (Q. #7) that experienced either marginal or failed regeneration, what percentage were impacted by the barriers listed below?** *(The percentages here could add to more than 100%, because a stand could be impacted by more than one barrier.)*

| ***Barrier*** | **% impacted** |
|---|---|
| Interfering vegetation (native and exotic) | _____ |
| Deer browsing | _____ |
| Forest health (e.g., defoliation, drought) | _____ |
| Soil or site limitations | _____ |
| Landowner did not invest adequate money in appropriate management practice | _____ |
| Landowner wasn't interested or knowledgeable enough to ensure that logger or forester attempted necessary management activities | _____ |
| Other *(please specify:* _____ _____) | _____ |

**9a. Now thinking back to all the stands you inspected in the past year in the region you worked in most, where snow depth would not have limited your ability to assess regeneration, how many are ready to be regenerated?**

_____ # stands ready to be regenerated, and

_____ approximate total # of acres

**9b. Without proper actions, what percent of these stands will be impeded from successful regeneration by the barriers listed below?** *(The percentages here could add to more than 100% because a stand could be impacted by more than one barrier.)*

| ***Barrier*** | **% impacted** |
|---|---|
| Interfering vegetation (native and exotic) | _____ |
| Deer browsing | _____ |
| Forest health (e.g., defoliation, drought) | _____ |
| Soil or site limitations | _____ |
| Landowner will not invest adequate money in appropriate management practice | _____ |
| Landowner isn't interested or knowledgeable enough to ensure that logger or forester attempts necessary management activities | _____ |
| Other *(please specify:*_____ | _____ |

_____)

**10. Where regeneration is one of your or your client's management goals, how often do you recommend the following management activities?** *(Check one category for each management activity.)*

| ***Management Activity*** | Never | Rarely | Occasionally | Frequently | Always |
|---|---|---|---|---|---|
| Herbicide of interfering understory vegetation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Mechanical control of interfering understory vegetation | ☐ | ☐ | ☐ | ☐ | ☐ |
| TSI control of less desirable stems | ☐ | ☐ | ☐ | ☐ | ☐ |
| Antlerless deer harvest | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fencing to exclude deer | ☐ | ☐ | ☐ | ☐ | ☐ |
| Harvest method | ☐ | ☐ | ☐ | ☐ | ☐ |

**11. How often do landowners that you work with implement your recommendations for the following regeneration management activities?** *(Check one category for each management activity.)*

| ***Management Activity*** | Never | Rarely | Occasionally | Frequently | Always |
|---|---|---|---|---|---|
| Herbicide of interfering understory vegetation | ☐ | ☐ | ☐ | ☐ | ☐ |
| Mechanical control of interfering understory vegetation | ☐ | ☐ | ☐ | ☐ | ☐ |
| TSI control of less desirable stems | ☐ | ☐ | ☐ | ☐ | ☐ |
| Antlerless deer harvest | ☐ | ☐ | ☐ | ☐ | ☐ |
| Fencing to exclude deer | ☐ | ☐ | ☐ | ☐ | ☐ |
| Harvest method | ☐ | ☐ | ☐ | ☐ | ☐ |

**12. What percent of landowners that you work with are willing to reinvest harvest revenue to assure successful regeneration?**

_____ % of landowners

**13. What percent of landowners that you work with are willing to delay full harvest revenue to improve chances of sustainable production and regeneration (e.g., preparatory cut of shelterwood method)?**

_____ % of landowners

## THINKING ABOUT A SPECIFIC FOREST STAND

***For the questions in this section, please think about the last single stand that you visited where the following conditions apply:***

- ***it is in the ecological region you worked in most,***
- ***where a forest harvest took place in the last 10 years (not necessarily prescribed by you) that was sufficiently intense to open the canopy for sunlight that could establish a new age class of trees,***
- ***where snow depth did not limit your ability to assess regeneration, and***
- ***enough time has passed that the success of regeneration can be assessed.***

**14. Characteristics of the stand.**

**a. What New York county was this stand located in?**

_____

**b. How many acres was it?** _____ # acres

**c. What type of forest stand was it?**

_____ Northern hardwood
_____ Mixed oak
_____ Other mixed hardwood
_____ White or red pine
_____ Other conifers

**d. In your opinion, what is the stand age structure?**

_____ Even-aged
_____ Uneven-aged
_____ Two-aged
_____ Age structure uncertain

**e. Who owns the land?**

_____ Government
_____ Industry
_____ Family forest
_____ Other

**f. What do you think was the treatment that created the opportunity for regeneration?**

_____ Clear cut
_____ Patch clear cut
_____ Seed tree
_____ Shelterwood
_____ Two-aged stand
_____ Selection
_____ Diameter-limit cut, high-grade, or other exploitive harvest
_____ Other *(please specify:* _____*)*

**g. Was any forester involved in the management prescription that created the opportunity for regeneration?**

_____ No _____ Yes _____ Don't know

**h. In your professional opinion, how successful was regeneration of this stand?**

_____ Highly successful
_____ Moderately successful
_____ Marginally successful
_____ Complete failure

**i. What is the highest value forest product this stand is being managed for?**

_____ sawtimber
_____ pulpwood/fuelwood
_____ utility/cabin poles
_____ sugarbush
_____ hunting lease
_____ other *(please specify:* _____*)*

**15. How impacted is this stand by the following barriers to regeneration?**
*(Check one level of impact for each barrier.)*

| ***Barrier*** | No impact | Slight impact | Moderate impact | Severe impact | Not sure |
|---|---|---|---|---|---|
| Interfering vegetation (native and exotic) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Deer browsing | ☐ | ☐ | ☐ | ☐ | ☐ |
| Forest health (e.g., defoliation, drought) | ☐ | ☐ | ☐ | ☐ | ☐ |
| Soil or site limitations | ☐ | ☐ | ☐ | ☐ | ☐ |
| Landowner did not invest adequate money in appropriate management practice | ☐ | ☐ | ☐ | ☐ | ☐ |
| Landowner wasn't interested or knowledgeable enough to ensure that logger or forester attempted necessary management activities | ☐ | ☐ | ☐ | ☐ | ☐ |
| Other *(please specify):* _____ _____) | ☐ | ☐ | ☐ | ☐ | ☐ |

**16a. If you estimated the regeneration success of this stand as marginally successful or complete failure (Q. 14h), which management activities will be necessary to bring about adequate regeneration?** *(Check all that apply.)*

_____ Herbicide of interfering understory vegetation
_____ Mechanical control of interfering understory vegetation
_____ Soil fertility enhancement
_____ Antlerless deer harvest
_____ Fencing to exclude deer
_____ Tree tubes
_____ TSI control of less desirable stems
_____ Insect disease control
_____ Tree planting
_____ Other *(please specify:* _____)
_____ No combination of management activities are sufficient for adequate regeneration

**16b. Of the activities you checked above, please circle those that the landowner is likely to implement.**

**16c. Please estimate the total cost per acre for all the management activities <u>checked</u> above.**

$_____ per acre

**16d. If the landowner implements those activities you believe they will do (circled above), what is the likelihood of successful regeneration?** *(Check one.)*

_____ Very likely
_____ Somewhat likely
_____ Neither likely nor unlikely
_____ Somewhat unlikely
_____ Very unlikely

**17. Extrapolating from the existing regeneration layer of this stand, *in the absence of any additional management activities*, what do you estimate its maximum potential value if allowed to grow to its highest value forest product?** *Do not include the value of any residual overstory or other current sources of income (e.g., maple syrup production, hunting leases).*

$ _____ per acre (in today's dollars)

_____ Number of years before its next highest value product harvest

Will this harvest be annual (e.g., maple sap) or periodic (e.g., sawtimber)?

_____ Annual _____ Periodic

**18. Extrapolating from the existing regeneration layer of this stand, *given adequate management activities*, what do you estimate its maximum potential value if allowed to grow to its highest value forest product?** *Do not include the value of any residual overstory or other current sources of income (e.g., maple syrup production, hunting leases).*

$ _____ per acre (in today's dollars)

_____ Number of years before its next highest value product harvest

Will this harvest be annual (e.g., maple sap) or periodic (e.g., sawtimber)?

_____ Annual _____ Periodic

**Please use the space below for any additional comments you may wish to make. The results of this survey will be posted on ForestConnect.info.**

## Thank you for your time and effort!

To return this questionnaire, simply seal it with the white removable seal, and drop it in the mail (return postage has been provided).

# APPENDIX B:

Tests for Nonresponse Bias

| **Table B-1. Tests for nonresponse bias.** | | |
|---|---|---|
| | Respondents | Nonrespondents |
| ***Questions*** | Percent | |
| *Able to answer questions about forest regeneration in New York* | | |
| Yes | 70.9 | 66.0 |
| No | 29.1 | 34.0 |
| | NS* | |
| *Employment sector* | | |
| Government | 42.4 | 27.3 |
| Industry | 16.8 | 18.2 |
| Private consulting forester | 30.6 | 48.5 |
| Other | 10.2 | 6.0 |
| | NS | |
| **Regarding a specific stand:** | | |
| *Type of forest stand* | | |
| Northern hardwood | 66.0 | 57.6 |
| Other hardwood | 18.3 | 24.2 |
| Softwood | 15.7 | 18.2 |
| | NS | |
| *Land ownership* | | |
| Government | 28.0 | 21.9 |
| Family forest | 44.0 | 46.9 |
| Other | 28.0 | 31.2 |
| | NS | |
| *Regeneration success* | | |
| Highly successful | 19.8 | 33.3 |
| Moderately successful | 37.0 | 45.5 |
| Marginally successful or complete failure | 43.2 | 21.2 |
| | $x^2$ = 6.16, df = 2, p = .046 | |
| *Highest value forest product stand being managed for* | | |
| Sawtimber | 87.3 | 93.9 |
| Other | 12.7 | 6.1 |
| | NS | |
| *Interfering vegetation impact* | | |
| None or slight | 44.2 | 65.7 |
| Moderate or severe | 55.8 | 34.3 |
| | $x^2$ = 4.93, df = 1, p = .026 | |
| *Deer browsing impact* | | |
| None or slight | 22.7 | 48.5 |
| Moderate or severe | 77.3 | 51.5 |
| | $x^2$ = 9.25, df = 1, p = .002 | |

| **Table B-1. (cont.)** | | |
|---|---|---|
| | Respondents | Nonrespondents |
| ***Questions*** | Percent | |
| *Forest health impact* | | |
| None or slight | 78.0 | 75.8 |
| Moderate or severe | 22.0 | 24.2 |
| | NS | |
| *Soil or site limitations impact* | | |
| None or slight | 72.4 | 87.8 |
| Moderate or severe | 27.6 | 12.2 |
| | NS | |
| *Impact of landowner not investing in management* | | |
| None or slight | 76.2 | 87.5 |
| Moderate or severe | 23.8 | 12.5 |
| | NS | |
| *Impact of landowner not interested in management* | | |
| None or slight | 79.4 | 83.8 |
| Moderate or severe | 20.6 | 16.2 |
| | NS | |
| | | |
| | Mean | |
| # Acres in stand | 120.9 | 65.5 |
| | NS | |
| Value per acre w/o management | $1,696 | $5,569 |
| | NS | |
| Value per acre w/management | $3,209 | $7,952 |
| | NS | |
| Years until harvest w/o management | 44.2 | 38.2 |
| | NS | |
| Years until harvest w/management | 45.6 | 37.7 |
| | NS | |
| *NS = not significant | | |