GETTING SCIENCE OUT—A BOSTON MOUNTAINS FOREST UNDERPLANTING TOOL ONLINE

Martin A. Spetich, Daniel C. Dey, and Jim Lootens[1]

Abstract—Scientists typically publish research results in scientific journals in formats, language, and styles that are not always useful to many professional and general public users. To address this gap in technology transfer, we developed a method to get research published in journal articles out to a broader spectrum of users. This paper uses a study of oak regeneration to illustrate how scientific information can be conveyed to the user in a more useful, applied way. Due to the quantitative and complex technical nature of the published model, its usefulness was limited mainly to scientists and others who have skills in statistics and computer programming. To communicate these research results to non-scientists we developed an interactive, Internet-based version of the oak regeneration model which we named the Oak Underplanting Success (OAKUS) model. Foresters can use OAKUS online to evaluate combinations of alternative silvicultural treatments (i.e., shelterwood harvest, underplanting oak seedlings and controlling competition) before they actually start the regeneration process http://ncrs.fs.fed.us/oakus/. Using the OAKUS model can reduce the need to invest in post-harvest remedial measures. It also can be used to teach the fundamentals of regeneration ecology and to introduce silvicultural methods. This work represents a major technology transfer effort, delivers research results to resource managers on demand, and provides a management decision tool that can improve the quality of resource decisions. Between January 2003 and January 2008, there were 13,844 successful page requests for OAKUS.

INTRODUCTION

As scientists, we are encouraged to report results primarily in scientific journals. However, due to the complex nature and importance of scientific work we need to make greater effort to get this science out to the public in a more useful format. In this paper, we explain how we did that through a simple process that we used to transfer results from research on oak regeneration. The result is an accessible Internet-based program managers can use to predict planting success under different conditions.

The example research that we use examined the success of northern red oak (*Quercus rubra* L.) seedlings that had been underplanted in shelterwoods. In 2002 we developed a model of oak regeneration for the Boston Mountains of Arkansas, which was published in Forest Science (Spetich and others 2002). The model explains the dynamic and complex relationships of hardwood reproduction following stand disturbances. However, due to the quantitative and complex technical nature of the published model, its usefulness was limited mainly to scientists and others who have skills in statistics and computer programming. We felt that a new way to effectively communicate these research results to non-scientists was needed. With an easily accessible and interactive model, foresters would be better able to evaluate combinations of alternative silvicultural treatments (i.e., shelterwood harvest, underplanting oak seedlings and controlling competition) for regenerating oak before actually initiating the regeneration process. We developed an interactive Web-based tool we named the Oak Underplanting Success (OAKUS) model.

METHODS

We developed and followed a simple 4-step approach to technology transfer. This consists of (1) doing the science and publishing results in an appropriate journal, (2) developing technical transfer presentations of the work and obtaining feedback, (3) developing a technology transfer publication of the research, which practitioners can easily understand and use, and (4) for complex models, developing an interactive management decision tool that is widely accessible (this incorporates results of steps 1 through 3).

Our study examined the relationship of northern red oak seedlings and competing vegetation over an 11-year period in Arkansas' Boston Mountains forests. Planted oaks were considered successful if they became dominant or codominant trees in the developing forest stand 11 growing seasons after planting (8 growing seasons after shelterwood removal). The study was implemented with shelterwood creation in the fall of 1986 and subsequent underplanting of over 4,000 northern red oak seedlings in April 1987. Planted trees and their competitors were remeasured after 11 growing seasons as well as in intervening years. For study details, see Spetich and others (2002) and Spetich and others (2004).

RESULTS

Original study results were published in Forest Science (Spetich and others 2002). Those results are expressed as the

[1]Research Forester, U.S. Forest Service, Southern Research Station, Hot Springs, AR 71902; Research Forester, Information Technology Specialist, U.S. Forest Service, North Central Research Station, Columbia, MO 65211, respectively.

probability that a planted tree will successfully compete with other trees to attain a dominant or codominant position in the future tree canopy. In summary, this dominance probability depends on initial seedling stem caliper (diameter) before planting, site quality expressed as site index, weed control intensity, and shelterwood percent stocking. The probability of success increases with decreasing shelterwood stocking, decreasing site quality (measured as site index), increasing initial stem caliper, and increasing intensity of woody competition control. The reciprocals of the dominance probabilities provide silviculturally useful estimates of the numbers of trees that would need to be planted to obtain, on the average, one competitively successful tree in the future.

To further refine our understanding of the needs of resource specialists, we presented results at ten meetings through oral presentations and at one meeting using a poster. Through feedback from conversations at those meetings, we determined that managers needed and wanted more information to help them implement the underplanting method. In response we developed a technology transfer publication that presents this information in more accessible language and with new graphics (Spetich and others 2004). In the recommendations section of that publication, we provided practical management methods for optimizing success of underplanted northern red oak seedlings and to reach future stocking goals. In part we accomplished this through a simplified six-step process that practitioners can use to implement the underplanting method. Although this provided more accessible information for practitioners and specific steps to implement the method, it did not fully address the complexities of the oak regeneration model.

Due to the complexity of the oak regeneration model, its application was only completely available to scientists and others who had skills in statistics and computer programming. A new design was needed to more effectively deliver these results to managers and others who wanted to use this model to develop plans for oak underplanting. To address this need, we developed an interactive, Internet-based version of the models that we term the OAKUS model. OAKUS is available from the Internet site http://ncrs.fs.fed.us/oakus/. The introductory page of the site briefly explains oak underplanting, introduces OAKUS, and provides links to related publications (fig. 1).

Users desiring a more immediate interactive experience of the OAKUS interface can go directly to the OAKUS program by clicking on “Start using OAKUS” (fig. 1). For those who prefer further information, we provide greater detail on the study, as well as an example scenario to help users understand the applicability of OAKUS (figs. 2 and 3). For non-practitioners, we also provide a glossary and hyperlinks to terms throughout, thus broadening the usability of the site. The page describing how to use OAKUS was deliberately kept brief to accommodate quick use of the program (fig. 4).

The OAKUS interface requires only six essential input variables that describe site quality (site index), seedling quality (initial stem caliper), the degree of woody competition control (competition control), shelterwood density (percent stocking), desired number of successful trees per acre and whether or not the shoots will be clipped (shoots) (fig. 5).

After entering the six variables, the user clicks on the “submit” button to run the data through the OAKUS model. For example, if the input variables were site index = 55, initial stem caliper = 1, competition control = two herbicide treatments, 40 to 60 percent stocking, the target trees per acre = 100 and shoots are clipped, then OAKUS would return the window in figure 6 below.

The “management suggestions” in figure 6 are brief and to the point. Based on the input variables, in the last paragraph the program reveals that 134 trees would need to be planted in order to obtain the target number of successful trees per acre that she entered (100) 11 years after planting. The field practitioner can combine that information with planting recommendations also provided on the OAKUS Web site. The Web site also includes links to find related publications, a search box, and other Forest Service, U.S. Department of Agriculture links. Instructors can use the OAKUS interface to teach the fundamentals of regeneration ecology and to introduce students to silvicultural methods.

The potential impact of this work has been exhibited by the interest in the OAKUS model. For instance, from January 2003 through January 2008 there were 13,844 successful page requests for OAKUS. Nearly one-half of the page requests originated from commercial search engines while searches through Federal Web sites were the second most used search tool (fig. 7).

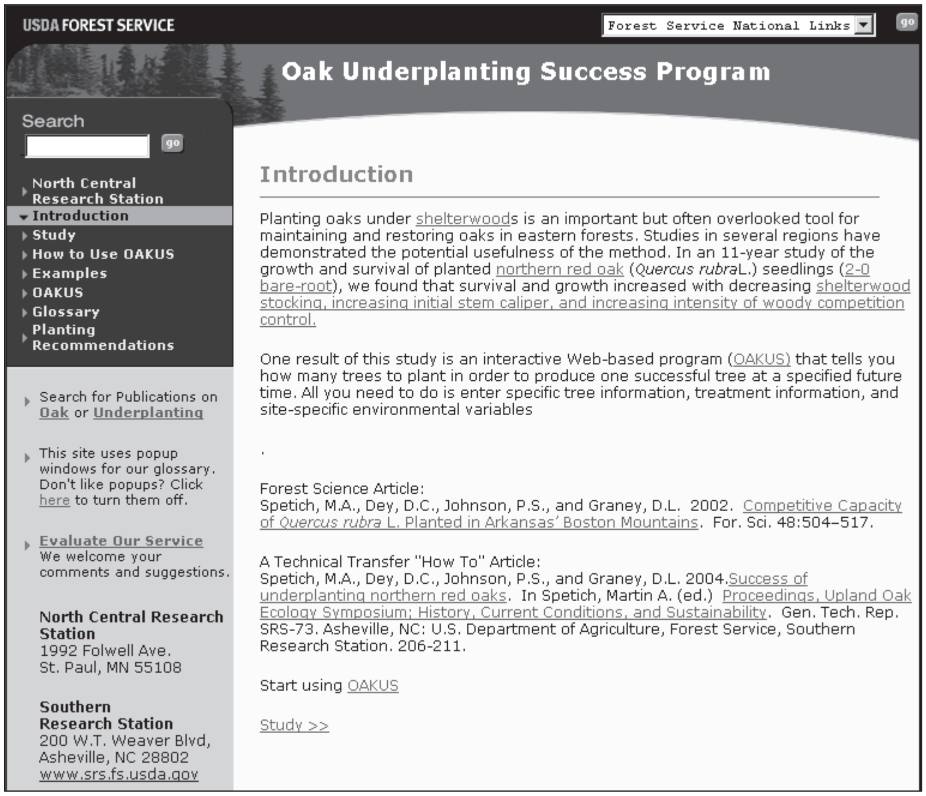
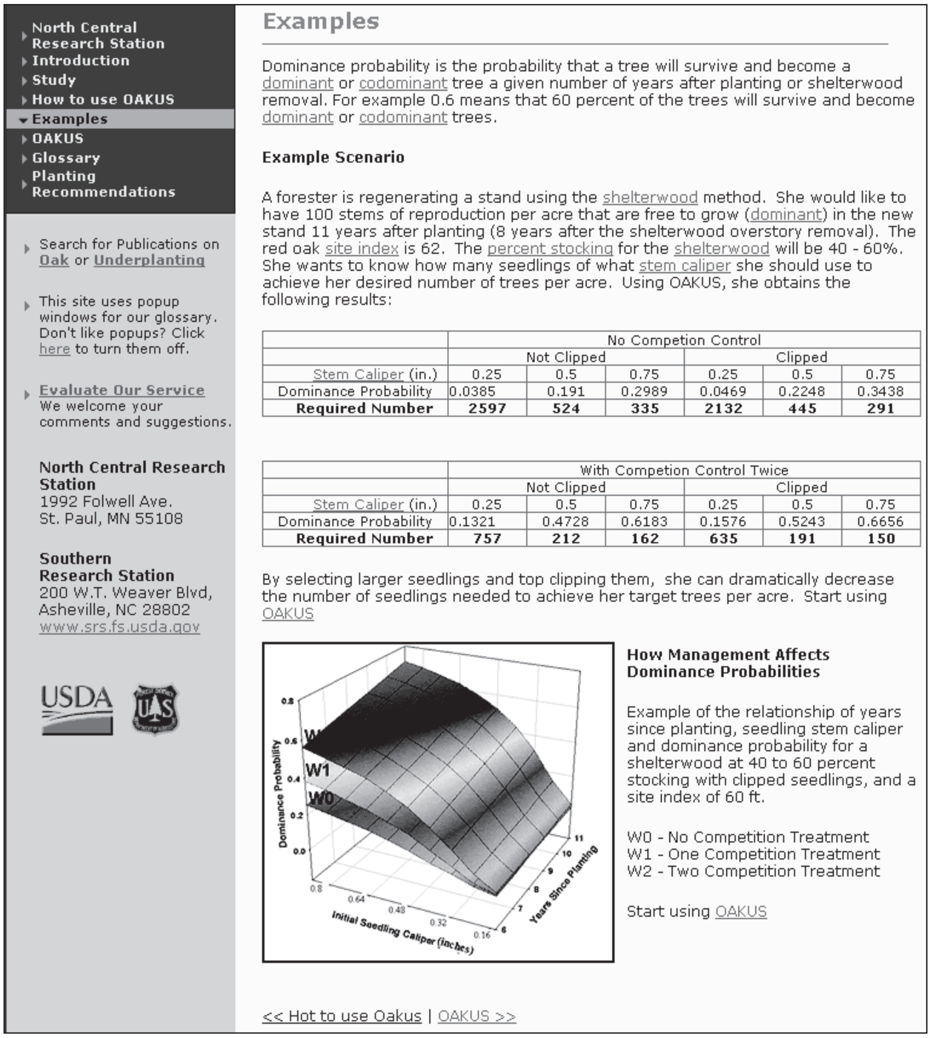


Figure 1—Introductory OAKUS page. All blue, underlined text is hyperlinked.

Figure 2—Part of our one-page explanation of the study.



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Examples

Dominance probability is the probability that a tree will survive and become a dominant or codominant tree a given number of years after planting or shelterwood removal. For example 0.6 means that 60 percent of the trees will survive and become dominant or codominant trees.

Example Scenario

A forester is regenerating a stand using the shelterwood method. She would like to have 100 stems of reproduction per acre that are free to grow (dominant) in the new stand 11 years after planting (8 years after the shelterwood overstory removal). The red oak site index is 62. The percent stocking for the shelterwood will be 40 - 60%. She wants to know how many seedlings of what stem caliper she should use to achieve her desired number of trees per acre. Using OAKUS, she obtains the following results:

	No Competion Control					
	Not Clipped			Clipped		
Stem Caliper (in.)	0.25	0.5	0.75	0.25	0.5	0.75
Dominance Probability	0.0385	0.191	0.2989	0.0469	0.2248	0.3438
Required Number	**2597**	**524**	**335**	**2132**	**445**	**291**

	With Competion Control Twice					
	Not Clipped			Clipped		
Stem Caliper (in.)	0.25	0.5	0.75	0.25	0.5	0.75
Dominance Probability	0.1321	0.4728	0.6183	0.1576	0.5243	0.6656
Required Number	**757**	**212**	**162**	**635**	**191**	**150**

By selecting larger seedlings and top clipping them, she can dramatically decrease the number of seedlings needed to achieve her target trees per acre. Start using OAKUS

How Management Affects Dominance Probabilities

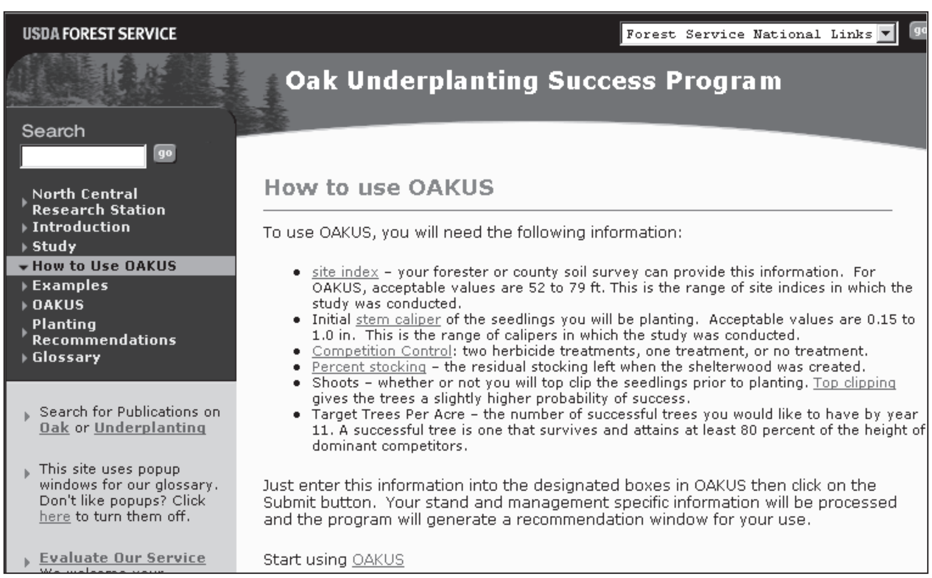
Example of the relationship of years since planting, seedling stem caliper and dominance probability for a shelterwood at 40 to 60 percent stocking with clipped seedlings, and a site index of 60 ft.

W0 - No Competition Treatment
W1 - One Competition Treatment
W2 - Two Competition Treatment

Start using OAKUS

<< Hot to use Oakus | OAKUS >>

Figure 3—An example page with an example scenario of using OAKUS. For more numerically oriented users we provide summary tables and for the graphically oriented user we provide a graphic summary.



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How to use OAKUS

To use OAKUS, you will need the following information:

- site index – your forester or county soil survey can provide this information. For OAKUS, acceptable values are 52 to 79 ft. This is the range of site indices in which the study was conducted.
- Initial stem caliper of the seedlings you will be planting. Acceptable values are 0.15 to 1.0 in. This is the range of calipers in which the study was conducted.
- Competition Control: two herbicide treatments, one treatment, or no treatment.
- Percent stocking – the residual stocking left when the shelterwood was created.
- Shoots – whether or not you will top clip the seedlings prior to planting. Top clipping gives the trees a slightly higher probability of success.
- Target Trees Per Acre – the number of successful trees you would like to have by year 11. A successful tree is one that survives and attains at least 80 percent of the height of dominant competitors.

Just enter this information into the designated boxes in OAKUS then click on the Submit button. Your stand and management specific information will be processed and the program will generate a recommendation window for your use.

Start using OAKUS

Figure 4—Brief introduction on using OAKUS.

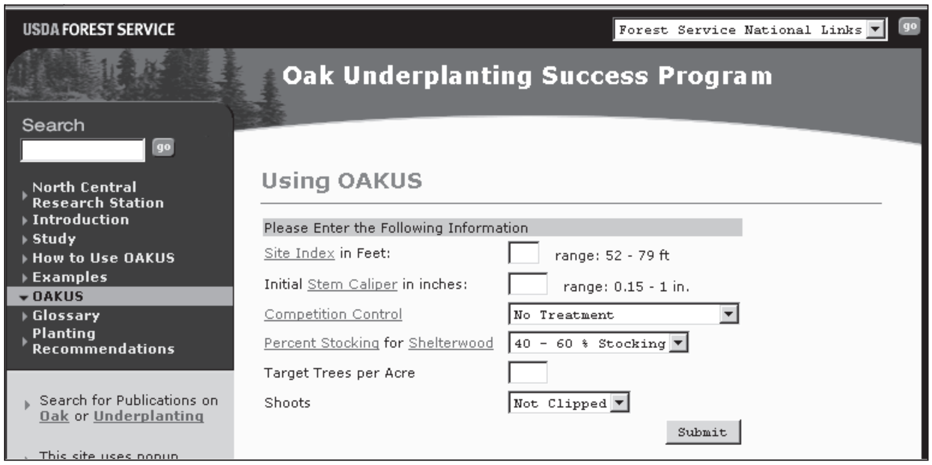

Figure 5—The OAKUS program interface.

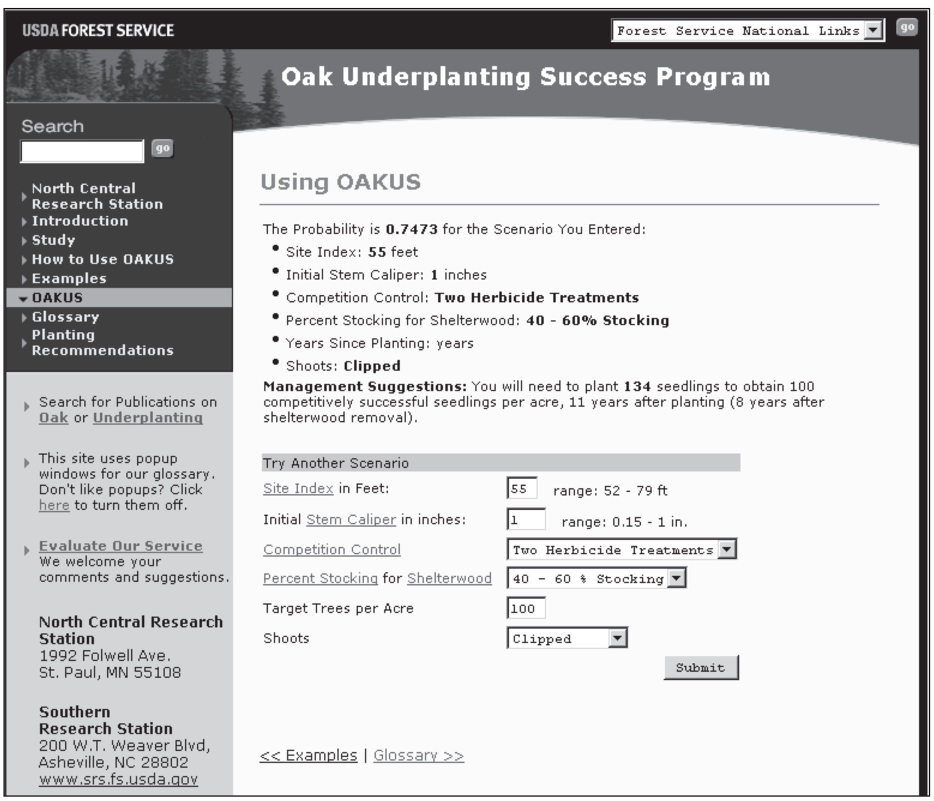

Figure 6—An example of information returned from OAKUS after submitting: site index = 55, initial stem caliper = 1, competition control = two herbicide treatments, 40 to 60 percent stocking, the target trees per acre = 100 and shoots are clipped.

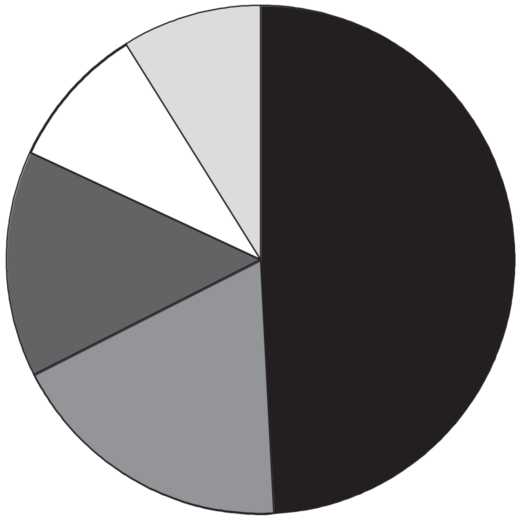

Figure 7—Of the 13,844 successful page requests for OAKUS 6,824 were commercial (.com) search engines, 2,526 were Federal Web sites (either ending in fs.fed.us or .gov), 2,001 were other organizations—there were 361 organizations, 1,272 were linked to Internet Protocol (IP) addresses and 1,221 were search engines ending in .net.

CONCLUSIONS

We used published research results to introduce a simple 4-step process that resulted in OAKUS, an interactive Web-based product for managers to use to reach oak regeneration goals. OAKUS represents a relatively new technology transfer effort, delivers research results to resource managers and others on demand, and provides a flexible management decision tool that can improve the quality of resource decisions. The Web site includes information explaining the study and terminology for new users, provides examples, and introduces an accessible program interface.

Resource managers (and others) can use the Web-based model to evaluate alternative silvicultural treatments for regenerating oak—before shelterwood creation and underplanting—and predict the future success of various underplanting options. Use of the OAKUS model can reduce the need to invest in post-harvest remedial measures. OAKUS also can be used to help teach the fundamentals of regeneration ecology and to introduce students to silvicultural methods.

Through this process we not only get science done in a way conducive to scientific progress, but we also are getting science out to non-scientists in a useful, practical, applied way!

ACKNOWLEDGMENTS

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REFERENCES

Spetich, M.A.; Dey, D.C.; Johnson, P.S.; Graney, D.L. 2002. Competitive capacity of Quercus rubra L. planted in Arkansas' Boston Mountains. Forest Science. 48(3): 504-517.

Spetich, M.A.; Dey, D.C.; Johnson, P.S.; Graney, D.L. 2004. Success of underplanting northern red oaks. In: Spetich, M.A., ed. Proceedings, Upland Oak Ecology Symposium: History, Current Conditions, and Sustainability. Gen. Tech. Rep. SRS–73. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 206-211.