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Synthesis: What Are the Lessons for Landscape Ecologists?

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9.1. LESSONS FROM THE BOOK

The main goal of this book was to create an awareness of the need for knowledge transfer among forest landscape ecologists. To that end, we considered aspects of knowledge transfer and extension in general, critically examined the aspects of transfer that are unique to forest landscape ecology, and highlighted several examples of successful landscape ecological knowledge transfer. In the preceding chapters, we have explored various facets of the application of landscape ecology in forest policy and management from a North American perspective. In this chapter, we summarize the main messages contained in the book.

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9.1.1. Knowledge Transfer Is Necessary

A considerable gap is evident between the large body of forest landscape ecological knowledge and its application. This gap exists and may continue to widen even as the potential for applications expands because the flow of knowledge from developers to users is not automatic. Many factors favor the application of forest landscape ecological knowledge. Users of landscape ecological knowledge are many and range from legislators to forest policymakers, planners, and managers, with each group having unique information needs at different scales (as emphasized by Buse and Perera 2006; King and Perera 2006; Perera et al 2006). As forest managers begin to consider larger scales, the potential for application of this knowledge is also expanding. Computing technology, once considered an obstacle, has advanced and become more accessible; combined with readily available and relatively inexpensive data, this technological capacity is now less of an impediment to applying landscape ecological knowledge. However, other barriers to knowledge flow to users still exist, such as a lack of awareness of the available knowledge, the complexity and unfamiliarity of the knowledge, and the fact that much landscape ecological knowledge is not available in a directly usable form.

Much of the unfamiliarity stems from the breadth of the spatial and temporal scales that define landscape ecology (King and Perera 2006). Given the infeasibility of typical cause-and-effect experimentation at broad scales, simulating scenarios and exploring if–then situations using simulation models have become the research tools of choice in landscape ecology. Simulation models are not only a principal vehicle for experimentation and generation of knowledge, but are also useful to transfer knowledge. They may be unpalatable to potential users for many reasons: unfamiliarity with the technology; lack of understanding of the purpose of the model; unclear assumptions; discomfort with abstract concepts, coarseness of the model's scale, stochasticity, and complexity; and distrust of the mechanisms underlying the model and conceptual validation methods. As Gustafson et al. (2006) indicated, user difficulties with models can lead to inappropriate use and ultimately to rejection of the models. These can be avoided by proactive knowledge transfer.

9.1.2. Knowledge Transfer Is an Active Process

Developers of landscape ecological knowledge should actively partake in transferring knowledge to potential users. Several broad categories of approach can help developers accomplish this transfer: supply-driven ("push"), demand-driven ("pull"), and collaborative-iterative processes, as well as various combinations of the three, can all be potentially useful depending on the nature of the audience, the stage of development of the application, and the nature of the knowledge transferred (Perera et al. 2006). Regardless of the approach, the applications, and the users, landscape ecologists must first understand the fundamentals of knowledge transfer.

Reed and Simon-Brown (2006) describe in detail some key considerations for the developers of landscape ecology knowledge who wish to engage in knowledge

transfer, many of which are illustrated in practice in the case study chapters (Buse and Perera 2006, Gustafson et al. 2006; Hampton et al. 2006; Lytle et al 2006).

All case studies stress that the first step is to identify the primary users of the knowledge and engage them from the outset of the knowledge development process rather than waiting until after the knowledge has been developed. Early engagement helps knowledge developers to identify specific user needs and develop a working rapport with users that persuades this audience their needs are being met and that their input is valued. Flexibility and objectivity in the approach to selecting and implementing specific knowledge transfer mechanisms are important because users differ in their learning styles. Transferring concepts (knowledge) first and allowing users to explore further and apply their knowledge by providing access to appropriate tools (technology) is an effective means for users to discover alternatives rather than relying on knowledge developers to provide a single, possibly suboptimal, solution. This approach reinforces the landscape ecological concepts, strengthens the relationship between the developers and users of knowledge, and supports a process of continuous engagement.

As well, transfer is an interactive process, in which both developers and users benefit from continuous engagement. It enables knowledge developers to be flexible so as to adapt their approach to the needs of the users, and users to become progressively comfortable with the new knowledge or tools in incremental stages. Participants in knowledge transfer must clearly understand the specific needs and characteristics of the users, whether that knowledge informs policy or becomes a management tool. The relationship between users and developers must be collaborative and is best established early and fostered continually.

Ultimately, the goal of the transfer process is to elevate the level of engagement from cooperation to collaboration and eventually to an ongoing partnership (Reed and Simon-Brown 2006). As described by Perera et al. (2006), the details of the knowledge transfer process may be complex, but the overall process can be conceptualized simply as a flow of information among developers (e.g., researchers), practitioners (e.g., users), and transfer specialists (e.g., extension and GIS specialists) by means of ongoing engagement and communication. The knowledge transferred through this process can range from conceptual principles to user tools to data. Although these fundamentals are broadly applicable, the specific techniques and approaches required may vary depending on the knowledge being transferred, the nature of the audience, and the stage in the knowledge transfer process.

9.1.3. Knowledge Transfer Experiences Are Diverse

The case studies of applications of landscape ecology in forestry presented in this book range from experience with transferring a single user tool to one user group in a forest management area to experience transferring a variety of concepts, knowledge, and user tools to a hierarchy of diverse user groups in a national forest management agency. Despite their geographical, cultural, and situational differences, many commonalities are evident among these case studies, particularly in how knowledge developers approached the transfer process and what they considered important to a successful outcome (Table 9.1). For example, knowledge developers who strive to

Table 9.1. A synoptic comparison of knowledge transfer experiences reported in case study chapters, with the goals and audiences broadening from Gustafson et al. (2006) to Crow (2006)

	Case study chapters				
	Gustafson et al. (2006)	Hampton et al. (2006)	Lytle et al. (2006)	Buse and Perera (2006)	Crow (2006)
Setting	A forest management area within one category of land ownership	A large forest management area with multiple land ownerships	A forested region with multiple land ownerships across the border between Canada and the U.S.	A subnational (provincial) forest management agency	A national forest management agency
Audience	Forest managers	Forest managers, the public, specific stakeholders	Forest managers in public land management agencies, and specific stakeholders	A hierarchy of decisionmakers in a public land management agency, forest managers, and stakeholders	
Transfer goals	Transfer technology to support forest management planning	Transfer knowledge and tools for forest assessment and planning	Transfer knowledge and technology to support strategic forest planning	Incorporate concepts, knowledge, and technology in the development of legislation and policy, in strategic planning, and in forest management	
Material transferred	Models, tools	Concepts, data, tools	Knowledge, models, tools	Concepts, knowledge, models, data, tools	
Participants	Developers, users, local experts	Developers, users, the public, stakeholders	Developers, users, public agencies, stakeholders	Developers, transfer specialists, local experts, users, GIS technologists	Developers, managers, planners, policy-makers, stakeholders
Transfer approaches and methods	Continuous personal interaction between developers and users through workshops, discussion forums, and informal communication			A variety of methods, including push-based, pull-based, and collaborative approaches	
	Collaborative, iterative approach	Push-based and collaborative approaches	Push-based, pull-based, and collaborative approaches		

Keys to success	Shared vision of the outcome and commitment of all participants			Political will to adapt, local capacity to generate knowledge, and an enabling technological and personnel infrastructure	Demonstrating an ability to solve critical issues
Major challenges	Technological barriers, and the lack of a common language	Organizational cultures, resource constraints, and technological barriers	Land ownership complexity, difficulties coordinating among numerous and dispersed partners, shifting organizational priorities	Complexities associated with multiple, diverse audiences; shifting organizational priorities; and bureaucratic barriers	Institutional and organizational barriers, and an inadequate technological infrastructure

transfer their findings to users should be aware that it requires a long-term and continuous commitment of both time and resources. The lack of a common language can slow the transfer process initially. As well, it can be difficult to empower audiences without oversimplifying the issues. Use of a common language helps to establish a common vision, goals, and commitment. As well, the case studies clearly reveal the value of establishing the context for the knowledge transfer, and emphasize the transfer of concepts first, even when the transfer of tools is the final goal.

The case studies also revealed challenges to knowledge transfer in landscape ecology. In contrast to the above-mentioned commonalities in the success factors, challenges are more difficult to generalize because they tend to depend on the situation. The most commonly cited challenge relates to institutional barriers stemming from the diverse organizational structures and cultures of stakeholder and knowledge developer organizations. Technological barriers, although diminishing, remain in some instances.

As Gustafson et al. (2006) suggest, engaging in a collaborative, iterative approach in transferring knowledge and user tools is effective when users and developers are equally committed and share a common desired outcome. Engaging local experts as partners in addition to users and developers can improve the efficacy of the process. The collaborative-iterative approach is preferred to push-only (developer initiated) or pull-only (user initiated) approaches when a specific tool will be transferred to a particular user group to accomplish a specific purpose. The time, effort, and commitment required from all participants may preclude exclusive use of this approach when the transfer material, application goals, and audience are more complex. This is evident in the experiences of Hampton et al. (2006) and Lytle et al. (2006), for which the user audiences were diverse and the transfer goals were broad: Because of the intense time commitments that arise from the long time frame often associated with complex transfer situations, push and pull approaches complemented the collaborative-iterative approach and helped to establish effective relationships. Lytle et al. pointed out the importance of identifying and engaging leaders within each of the intended user organizations to champion the process. In addition, adopting a flexible approach by resorting to a suite of transfer methods is beneficial. Hampton et al. (2006) emphasized the advantages of using transfer to support decisionmaking rather than to generate or advocate solutions. At this scale, differences in organizational cultures begin to affect knowledge transfer, and the relative effort spent on building and maintaining relationships and providing opportunities for engagement among users becomes significant.

Evidence of knowledge transfer at the institutional scale is present in policies, strategic plans, and management practices at both a national scale (Crow 2006) and a subnational scale (Buse and Perera 2006). Although it is difficult to generalize the suitability of specific transfer techniques in these instances, it is apparent that a combination of push-based, pull-based, and collaborative-iterative approaches are relevant. The presence of an institutional will to adapt is the major reason for success in knowledge transfer at broad scales. The major challenges are also institutional, and include bureaucratic barriers, shifting priorities, and political realities (Buse and Perera 2006). In addition, the composition of the audience and stakeholders becomes

extremely diverse and complex. Experiences at the institutional scale also suggest that the integration of landscape ecology knowledge into policies and strategic plans (and even into legislation) as a result of knowledge transfer is possible, but that this requires a sustained effort over a longer period, and the use of more than one approach.

9.1.4. Knowledge Transfer Benefits Developers

Transfer of landscape ecological knowledge should not be seen as a process that only benefits the users; as Gustafson et al. (2006) and King and Perera (2006) suggest, there are also many advantages for knowledge developers. One is that the transfer process offers a form of peer review in which the users of knowledge provide feedback on its *applicability*; this is clearly different from peer review by colleagues, which focuses only on the scientific content, often irrespective of its practical relevance. This review not only improves the final application of the knowledge but also increases confidence in its use. The collaborative-iterative approach is an excellent example of peer review and feedback that progressively enhances the quality and applicability of the knowledge and leads to shared ownership of the transferred knowledge. Communication between developers and users during the transfer process also provides opportunities for developers to gain valuable insights that might not be available through customary discussions with their peers. Such insights can provide important guidance for future research efforts. As well, ongoing dialogue with potential users of landscape ecological knowledge helps to broaden the developer's perspective and, in academic environments, may expose graduate students in forest landscape ecology to real-world scenarios that help them appreciate the potential for application of their knowledge. Finally, forest landscape ecology is an applied science in which research knowledge is developed specifically for use in forest management. Engaging in knowledge transfer provides developers with an opportunity to view the benefits of their research efforts.

However, as Perera et al. (2006) point out, successful applications should not be confused with successful transfer. Although the ultimate success of transfer is reflected in advances in the application of knowledge, this is not the sole determinant of a successful transfer process. For example, transfer can be deemed successful when users understand the concepts, use the tools appropriately, and can apply the knowledge they have gained. Application of that knowledge in developing policies or practices may not occur because successful implementation results from myriad other influences unrelated to the knowledge exchange between developers and users of the knowledge.

9.2. WHERE DO KNOWLEDGE DEVELOPERS GO FROM HERE?

As we learned, the transfer of forest landscape ecological knowledge is possible under a range of scenarios, from implementation of a single tool that will influence a limited set of decisions to the development of policies with a broad range of social

repercussions. When the transfer situation becomes more complex, from single to multiple applications, one to many user groups, single to multiple organizations, one to many ownerships, and narrow to wide impact of the application, common keys to success as well as challenges emerge. In addition, no single transfer method or list of obstacles to be overcome can be identified before engagement between knowledge developers and users begins because each situation is unique. There are also many participants in knowledge transfer beyond developers and users, such as transfer specialists and other experts, and all of them share partial responsibility for the process. Amidst these complexities, researchers must accept the responsibility to identify the needs and opportunities for application of their knowledge and to ensure transfer of the knowledge they develop.

Imagine the following scenario. A group of elected officials visits a forestry research agency. The officials are well aware that the agency's scientists conduct outstanding research and that their work and the publications resulting from their research are held in high regard by the broader scientific community. But the officials are not interested in exemplary publications produced by renowned scientists; instead, they want to know about the relevance of the work, how it could solve important problems, whether the researchers accomplished their original goals, and—not surprising given that these are elected officials—whether the work will help their constituents. Not only do the scientists need to make clear the relevance of their research but they also have to present their science in a manner that makes sense to the elected officials. Furthermore, the scientists have only a few minutes to make their case before the policymakers hurry off to their next appointment.

Although this scenario is purely hypothetical, researchers who receive government funding will recognize its plausibility. Those responsible for funding scientific research increasingly want to know what they are getting for their money, and want to receive this information in clear and unambiguous terms. They want to know about outcomes, not just outputs. Unfortunately, though scientists are trained to communicate with their peers, there is much less emphasis placed on communicating with the much larger and more diverse audience of policymakers, knowledge users (such as planners and managers), public officials, and the general public. As Scheuering and Barbour (2004) observed, "Science does not exist in a vacuum, but reading scientific publications might make you think it does."

During these times of decreasing funding for research and increasing accountability of researchers to those who fund their work, the need to close the gap between those who produce knowledge and those who use it is growing. As we have stressed in this book, this requires a reciprocal relationship in which a partnership is formed; in the case of forest science, the partnership is between those who manage the natural resource and those who study the resource, and the partnership exists for their mutual benefit. Although the importance of this relationship between producer and consumer of knowledge has been stated many times before, it is worth repeating. Bridging this gap calls for fundamental changes in the ways that universities train both the producers and the consumers of knowledge and it requires changes in the ways research organizations reward their scientists. In an interesting essay on the role

of the university, Rowe (1990) argued that universities have become "overloaded and top-heavy with expertness and information." Instead of being "a know-how institution" they should become "know-why institutions." The know-how approach is rich with information but poor in knowledge. It is this knowledge and the basic understanding that provides "ethical alternatives on which to act." As a profession, we researchers are good at collecting information; we also need to turn this information into knowledge that is useful to those who support our efforts.

In making our case for knowledge transfer, we also must recognize the pitfalls. Many of these have been identified in the preceding chapters. One, however, deserves special attention. If research is justified solely on its perceived merits to society, there is a risk of failing to support programs that are presently "out of favor" but that nonetheless have value, as well as high-risk ventures that constitute some of the research community's most innovative work. We contend, however, that by closing the gap between producers and consumers of knowledge, the likelihood of support for this research is increased, not diminished; people will support what they understand more readily than abstract concepts that appear to have no relevance. This is also true of funding agencies: research funds will be more readily awarded when the agency understands how the research helps meet the agency's goals.

Those involved in landscape ecology, and specifically in forest landscape ecology, have been successful in persuading the policy community that our science should be taken seriously (Klijn 2005). A landscape perspective, with its emphasis on spatial relationships, on collaboration across disciplines, on multiple scales and hierarchies, and on the importance of context and local processes, is the right science at the right time for resource managers. Consequently, the most important job for researchers is to ensure that this science does not operate in a vacuum, and to act on opportunities for the application of landscape ecological knowledge. We hope that by introducing the concept of knowledge transfer to the vocabulary of forest landscape ecological researchers, this book will serve as a catalyst for future endeavors to improve the effectiveness of knowledge transfer and will contribute to successful application of this knowledge.

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