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INTRODUCTION

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Land managers and ecological researchers have long had an uneasy relationship. Ideally, land management and research should be intimately intertwined: managers need a solid scientific basis for their planning and strategies (Perry 1998), and researchers need a context for their research that demonstrates its relevance in solving today's conservation problems (Lubchenco 1998). In short, managers need answers to questions, and researchers need support for answering questions. In an ideal world, these two needs would provide a synergistic effect allowing managers and researchers to work together closely.

The real world is not always ideal. Although in some places land managers and researchers have a long history of working together closely and effectively, in many other situations tension exists between the two groups. While the value of both research and management to each other should be apparent, there exist many reasons why research and management do not mesh well. For instance, the scientific basis of a proposed management action is only one of several factors that must be woven into the development of an overall strategic land management plan (Johnson et al. 1999). Similarly, while the management relevance of a scientific question may be one motivation to encourage scientists to investigate the question, for many researchers this motivation may be less important than publishability, funding, and an intrinsic curiosity to investigate the question.

In an era of limited funding for research and increased scrutiny of land management, it is imperative that the tension between research and planning be reduced whenever possible (Huenneke 1995). To this end, examination of the research-management interaction at places where the two groups collaborate can be instructive. In November 1996, we gathered together a group of avian ecologists working on long-term projects at the Savannah River Site, a U.S. Department of Energy facility in South Carolina. The purposes of the workshop were varied, but an important theme was to examine how research and management interacted at this facility whose primary mission was not natural resource management.

The Savannah River Site hosts a wide variety of research ranging from ecology to environmental science to nuclear physics. Biological researchers included scientists with the U.S. Forest Service, university faculty and students, and other individuals with various research facilities located on the site. Managers of the Savannah River Site include professionals with the U.S. Forest Service, Department of Energy, and private companies such as Westinghouse that run the daily operations.

In part the workshop was held to introduce the participants to the wide range of avian research being conducted on the SRS. As pointed out previously by Huenneke (1995), such personal contact between and among researchers and managers is a crucial step in fostering collaboration. A major additional goal was to explore how researchers worked with the land-management structure of the SRS to accomplish the researchers' plans and meet the strategic goals of the Department of Energy, as those goals apply to natural resource management. We discovered many examples of positive collaboration between research and management, including programs in environmental recovery from anthropogenic stress, monitoring of sensitive species, mitigation for human development, landscape ecology, and the accumulation of a tremendous amount of new ecological knowledge. We also discovered many strong opinions on how researchers and managers should or should not interact.

Following the conclusion of the two-day workshop, participants agreed to produce a series of papers summarizing their experiences and thoughts on working in a research/management framework. The current collection of papers is the result of this agreement. Not all participants were able to submit papers for publication, and we also solicited manuscripts from people invited to the workshop who were unable to attend. The result is a broad-ranging collection of papers demonstrating how some people have been able to exploit the combined interests of basic and applied research foci successfully. The papers in this collection also include some essays on how collaborative initiatives between researchers and managers can be implemented, and why doing so is important. We hope that the publication of these papers can further the discussion that is in progress on this important topic.

WHY ARE THERE PROBLEMS BETWEEN LAND MANAGERS AND ECOLOGICAL RESEARCHERS?

While the reasons for a lack of collaboration between individual researchers and land man-

agers are probably as varied as the individuals themselves, we offer a few reasons why such collaborations can be difficult to establish and maintain smoothly.

- Some managers do not see the need for supporting basic research directly on their lands, viewing it as superfluous and generally not directly related to the strategic goals of their operation.
- Some researchers work on arcane topics of little immediate obvious value to conservation and management.
- Research on management questions may be viewed as too site-specific, species-specific or limited in applicability to interest researchers (and their publication outlets) in general (Huenneke 1995).
- Researchers hesitate to link their results directly to recommendations for specific land-use decisions, preferring the safer "more research needed" approach when asked to respond to specific management questions (Pouyat 1999).
- Managers must meet short-term goals and annual quotas, and research results may suggest actions that are inconsistent with these short-term goals.
- Researchers demand long-term funding to allow their research to unfold, while managers demand quick answers to specific questions that may not be the main focus of the research.
- Researchers dislike working with managers who do not value scientific information, or who misuse such information and cite it out of context (Mills et al. 1998).
- Managers dislike working with researchers who refuse to get involved in decision making processes, but who then criticize decisions from a distance (Mills et al. 1998).

BASIC DICHOTOMIES

Part of the separation between researchers and managers stems from application of inaccurate labels onto the work that people do, labels that tend to support separation (Huenneke 1995). A dichotomy exists between managers and researchers, but within the research ranks, further divisions exist that tend to increase confusion. Basic research is viewed as distinct from applied research, and university (or academic) research is viewed as distinct from that conducted by government agencies or private research firms. Furthermore, these dichotomies themselves can be confused. University research is not always basic, and agency research is not always applied. Much applied research is conducted in natural resource departments within universities, for example.

Often, certain stereotypes are applied to researchers—both by managers and by other researchers—based solely on their professional affiliation. For instance, ecology has long been considered one of the "basic" sciences conducted to increase the general knowledge in the field, while resource management has been labeled an "applied" science, conducted to address a particular goal set by society. Using these labels, university ecologists from a field station or ecology department are generally assumed to be interested mostly in basic science approaches, whereas researchers with a management agency such as the U.S. Forest Service are generally assumed to be applied scientists.

These dichotomies were probably never very accurate, and certainly do not apply to the kinds of research conducted on the Savannah River Site. University-based ecologists are finding it crucial to make their research relevant to solving problems of interest to the general public—to make their research more easily applied, in other words. Some (but not all) researchers in the Forest Service and other agencies have always conducted pure, basic research. In spite of this, we have observed a tendency for some scientists in academia to lump all personnel in land-management agencies as "applied scientists" (or even less accurately, "managers," which assumes no research is being done), while some agency managers lump all academic scientists as "basic researchers" whose work is irrelevant to any real-world problems. A major goal of the Savannah River workshop was to get people from all these arenas together and break down some of the barriers that labels can build.

WHY SHOULD THESE PROBLEMS BE OVERCOME?

In spite of all these potential problems, it is critical for all interests to work together if valuable research is to be conducted. The need for management/research collaboration may be easiest to see in the case of long-term research programs, and the papers presented in this collection emphasize long-term studies. To generate answers to some important questions, research programs may need to outlive the typical lifespan of a single research grant, the graduate career of a single student, or even the working career of a single researcher. Long-term research therefore needs consistent support. Similarly, management planning is shifting from short-term goals that dominated the past to long-term ecological management and sustainability (Christensen et al. 1996, Johnson et al. 1999). Thus, managers need research results that guide them in making long-term plans. For both research and management, then, the benefits of

collaboration should make the problems worth overcoming (Nygren 1999).

LONG-TERM RESEARCH FROM THE ORNITHOLOGISTS' PERSPECTIVE

Ornithologists have long realized the value of long-term research. The importance of continued research efforts has been seen in the study of lifetime reproductive success in many birds (Newton 1989), in the teasing apart of genealogies and inter-individual relationships (e.g., Brown 1987), and in the tracking of population dynamics (e.g., Grant and Grant 1989). The value of continuous research on specific topics or ecosystems can be seen in the National Science Foundation's funding of Long-Term Ecological Research sites (Bildstein and Brisbin 1990).

The recognition of the value of long-term research contrasts vividly with the 2–3 year length of a standard research grant. To develop a long-term program, a researcher is usually forced to write a series of proposals, each focusing on short-term goals. Given the shortage of research funds in general, researchers commonly must write many proposals to ensure that enough are funded to support the research. It is not uncommon for researchers to be confronted with gaps in funding, during which research may be suspended or abandoned. It is due to the increasing occurrence of such difficulties that calls for increased support for long-term research have been issued. Direct collaboration with management at a study site offers the possibility of long-term support for research.

This support is not just in terms of money, but also in logistical support. Researchers need to know that their study sites are going not going to be compromised by changes in management during the study. Researchers need long-term access to the study region, ability to use the necessary tools to perform experiments, and a supportive attitude among personnel with whom the research teams must interact. Management agencies can be the source of background data, which indicate how study sites were treated in the past, and planning documents can provide expectations of how site conditions are expected to change in the future. This latter point can shape the entire experiment that is being designed, as researchers use future management actions as the experimental manipulations being studied. Huenneke (1995) argues that research on conservation-related topics, done in collaboration with local managers, is attractive to both undergraduates and graduate students, improving the quality of assistants willing to work on a research project. Thus, researchers can find many benefits in implementing a long-term research program in areas that are under strong land management.

THE VALUE OF LONG-TERM RESEARCH FROM THE MANAGER'S PERSPECTIVE

Given the shifting emphasis from short-term to long-term planning, resource managers increasingly require information on the long-term effects of management practices. Monitoring of population numbers and health is critical for managers to discern trends in populations over time (Holling 1993). Information on whether populations are increasing, decreasing, or remaining stable may dictate whether action is needed to reverse or slow the observed trends. However, monitoring alone is not enough. Long-term research is required to relate temporal and spatial trends in populations to a particular management practice or risk factor. Research also allows managers to understand the processes and causal mechanisms underlying the observed patterns, and to be able to predict trends into the future. This is especially true when dealing with forested ecosystems and timber management plans covering 50–100 years.

Frequently managers are faced with questions whose answers require research conducted over long time periods. Managers and researchers both become frustrated when the pressing issues facing managers change by the time a specific research program is completed. To the manager, the information generated by the research no longer seems important, whereas to the researcher, the utility of the information seems compromised. However, if the questions were clearly developed and the study carefully designed, the results ultimately will still prove useful, since pressing issues in natural resource management rarely disappear completely. Reliable knowledge based on sound ecological principles, as established by careful, long-term research, will always be useful in management.

THE SAVANNAH RIVER SITE AS A CASE STUDY

A major goal of the 1996 workshop was to illustrate how research in a variety of avian ecology fields has been conducted within a management framework at the Savannah River Site. While there have certainly been numerous conflicts between research and management over the years, some ecologists at the workshop have developed important research programs with the assistance of the various agencies, institutes, and laboratories present on the SRS. The following papers outline these successes, and offer thoughts on how such collaborations might be developed further. The organization of the papers in this collection is as follows.

The first set of papers describes the SRS, its early history, and the first attempts at avian research done on the Site. White and Gaines describe the region and the natural habitats contained within the Site, and offer an historical perspective on how the land was used prior to the creation of the Department of Energy facility. As one of the first scientists funded to do ecological research on the Savannah River Site, Eugene Odum has a unique perspective on "long-term" research there. Meyers and Odum summarize the work done in the early 1950s on the bird communities present as the nuclear research facilities were created. An additional historical perspective is provided by McNair and Post, who use old museum specimens to determine if the status of several species in South Carolina has changed over the last century. Although the original specimen collections were not done on what was to become the SRS itself, McNair and Post demonstrate the value of older records in documenting long-term change.

A second set of papers gives examples of long-term avian research conducted on the Savannah River Site. Each paper illustrates a different kind of research, and each set of authors was asked to address how their work benefited, or benefited from, management interactions. Kennamer and Hepp describe their research on Wood Duck (*Aix sponsa*) breeding biology, done in part as monitoring of the ecological systems required by the Department of Energy. Bryan, Coulter, and Brisbin present a summary of their research on Wood Storks (*Mycteria americana*). Their research was initiated as part of a mitigation project required because of the loss of foraging habitat for this endangered species due to a construction project. Brisbin and Kennamer summarize their radioecology studies of the American Coot (*Fulica americana*). Contamination of ecological systems by radioactive elements was an early worry of the operators of the Savannah River Site, and the understanding of how contaminants act in ecological systems has long been a priority research goal. Franzreb and Lloyd describe their studies of the endangered Red-cockaded Woodpecker (*Picoides borealis*), whose habitat needs and population dynamics are strongly affected by forest management. Dunning, Danielson, Watts, Liu, and Krementz outline how the study of habitat needs of Bachman's Sparrow (*Aimophila aestivalis*) evolved into an integrated program of landscape analysis and population modeling to determine the impacts of long-term timber management. Taking a multi-species approach, Kilgo, Franzreb, Gauthreaux, Miller, and Chapman examine the question of how the intensive forest management associated with the establishment of the Savannah River Site has affected the regional assemblage of breeding birds. Finally in this section, McCallum, Leatherman, and Mayer compare the birds studied in Odum's initial studies to those studied in projects undertaken in subsequent decades to determine which species have been inadvertently "falling through the cracks" of scientific coverage and therefore in the understanding of local impacts.

A third set of papers presents a variety of conceptual approaches to merging management and research needs. The workshop stimulated the participants to discuss the implications of the research/management interaction from many different perspectives. In this third section, some authors offer descriptions of research programs that bring some of these perspectives to light. Other contributions address how future research could be conducted to increase the viability of the management/research interaction.

Blake and LeMaster present a manager's perspective on how research might best be designed and conducted to produce information useful to management. Moorman offers advice from a researcher's perspective on how researchers can present proposed work in a way that might ease integration with management systems and goals. Burger offers a variety of reasons why Department of Energy lands offer excellent prospects for long-term avian research and how such research could fit into the strategic goals and futures of these properties. Hamel and Dunning address one of the most difficult aspects of determining how populations have changed long-term—that of reconstructing the past histories of study areas. Their paper makes specific recommendations on how historical data could be retained in management databases to make long-term research easier to accomplish. Pilcher and Dunning offer a review of landscape ecology as one arena where managers and researchers are both aware of the benefits of expanded research and collaboration. Rogers and Heard argue that testing of cutting-edge ecological theory is a research goal not often embraced by land managers, but one that could potentially yield great benefits to all concerned. They use testing of the mesopredator effect as an example of this kind of research that could be accomplished at Savannah River. Kilgo, Miller, and Moore describe how a long-term research program can be created by the integration of a series of short-term projects with specific, yet interwoven research goals. Finally, Odum presents some brief remarks on the 40-year history of ornithological research that he has witnessed at the Savannah River Site.

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