

Supporting Research in Restoration Biology

NSF Workshop Offers Recommendations

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A panel of
practitioners and
researchers advises
creation of separate
program to support
restoration-related
research.

When the National Science Foundation initiated the Special Program in Conservation and Restoration Biology (CRB) in 1989, restorationists saw it as a milestone in the coming age of restoration. Most previous research in restoration had been funded privately or, where state and federal funds were involved, was more often for the utilitarian purposes of reclamation or rehabilitation. This was the first time restoration was treated as a legitimate area for basic research. The CRB Program seemed like a move that would help improve the quality of restoration research and promote increased participation by academic researchers.

However, the results of the program have been disappointing. Out of some 15 proposals funded each year, on average only one or two were restoration proposals. This reflected the small proportion of restoration proposals submitted and raises the question of why so few researchers chose to submit restoration-oriented proposals. In contrast, the program has been enormously successful for conservation researchers, who submitted the bulk of the funded proposals. Conservation genetics and population-level conservation research have made great strides in both basic and applied research since 1989, and have become part of mainstream research in population ecology and genetics. Partly for this reason, future proposals in this area are likely to be well received by reviewers and panelists engaged in mainstream genetics and population biology research. In

fact, "mainstreaming" is the intent of special programs at NSF, the idea being to promote areas that have previously been neglected, raising them to the status of traditional research areas. Special programs at NSF are designed to last some four years, but after seven years of the CRB Program restoration research has still not become part of ecological mainstream research, and has progressed little in conceptual development.

To help change this trend in restoration research, we organized a workshop on "Developing the Conceptual Basis for Restoration Biology." We consulted with Scott Collins, a CRB program officer, on the approaches and results that would be most useful for NSF. There are social, political and economic limitations to restoration, but NSF can help only in the area of scientific limitations so we focused our workshop on the scientific aspects of restoration. We all felt that one of the reasons so few ecologists chose to submit proposals is that restoration is still viewed as a discipline without the conceptual basis needed to support basic research. Michael Soule and Kathryn Kohm's book, *Research Priorities for Conservation Biology* (1989), helped to develop the conceptual basis for conservation biology, but a similar approach has never been taken for restoration. While Soule and Kohm discussed restoration, they presented it as a job for land managers, and not a scientific discipline. They also downplayed the importance of restoration for conservation, arguing that

we should be more concerned with conserving existing land than restoring disturbed sites. However, interest in restoration research has been increasing, and ecologists have pointed out the need for restoration to develop its own conceptual base (Pickett and Parker, 1994). It was with this in mind that we assembled a group of restoration researchers and practitioners to discuss this issue.

The workshop was held at the National Center for Ecological Analysis and Synthesis in Santa Barbara on April 19-21, 1996. Of the 37 participants, about one-third were practicing restorationists and/or agency researchers, and two-thirds had university affiliations. There were approximately equal proportions of participants with interests in population, community, ecosystem and landscape ecology, representing both aquatic and terrestrial habitats. The participants included researchers who had been on the CRB panel as reviewers, several who had had proposals funded by the program, and several whose proposals had been rejected. Below are the results of four general areas of discussion, including the interactions between practitioners and scientists, a summary of basic concepts in need of research, problems intrinsic to restoration research, and recommendations the group made to NSF regarding the restoration research program.

Interactions Between Researchers and Practitioners

During the first day of the workshop we discussed the need for a better relationship between restoration researchers and practitioners. There are thousands of restoration projects underway across the United States, but relatively little involvement by researchers in planning and carrying them out. The workshop began with presentations of several prominent case studies, including those being carried out at the Kishwaukee River, Midwestern prairies, and streams in the Pacific Northwest. The group felt that in all these cases results could be improved through the use of adaptive management—building partnerships between practitioners and researchers, and closing the decision-making loop from planning to implementation, to assessment and redesign.

While practitioners have taken the lead in this area, often contributing at basic as well as applied levels, it was clear that their success is often limited by their understanding of the ecosystems involved. Restorationists typically think in terms of particular kinds of ecosystems, which often results in a product-oriented rather than a process-oriented approach to restoration. We have to remember that ecosystems are living, changing systems, and that their diversity, functioning, and dynamic processes remain largely unstudied. Furthermore, the assessment portion of the decision-making loop of adaptive management is still open, and this has led to numerous failed efforts. At the same time, failure has often been due to agency-mandated restoration plans that fly in the face of what restorationists already know. This underlines the importance of closer collaboration among agencies, land management agencies, and scientists at all stages of the process. Ultimately, the practice needs to be grounded in science, and scientists need opportunities to conduct research in real-life restoration settings.

Conceptual Issues in Restoration Biology

The second day of the workshop was devoted to the conceptual issues that form the basis of the report to NSF. Scientists working at the population, community, ecosystem, and landscape levels discussed conceptual issues restorationists deal with at those levels—first in talks by individual speakers, and then in discussion groups. In addition to the report to NSF, participants agreed to write more-extended treatments that will be published in *Restoration Ecology*. The charge to the participants was to develop conceptual issues in a form that might be used in a call for proposals to an NSF restoration program. The groups discussed scientific issues that are central to restoration ecology, and identified specific conceptual and practical research needed to advance the science of restoration ecology. These included:

- Defining reference conditions or reference sites;
- Determining the genetic effects of non-indigenous populations on indigenous populations;

- Understanding community development on restored sites;
- Identifying and restoring natural disturbance-regimes;
- Developing and using quantitative methods for evaluating unreplicated restoration trials;
- Defining the minimum area needed to restore ecosystem functioning;
- Understanding the landscape and scale effects on the outcome of restoration efforts.

Even though practitioners regularly confront many of these issues in their work, there is a lack of basic research that must be conducted before restorationists can practice their art and be assured of the outcome. In this way, a restoration research program can feed directly into the practice.

Intrinsic Problems of Restoration Ecology

The group also discussed problems intrinsic to restoration that might discourage submission of proposals or place restoration-related proposals at a disadvantage in the review process. We identified three such problems. The first was lack of control when research is carried out in concert with an actual restoration project. In cases where scientists have cooperated with agency-directed restoration projects, they have typically played little or no part in the project design. Generally, such projects are mandated, and proceed along a set timetable that does not accommodate the needs of the researcher. Reviewers understandably frown on this lack of control. To alleviate this problem, reviewers must be sensitized to the limitations imposed by practical work. Likewise, researchers must take a pro-active approach and assert their interests in the planning of projects. In addition, new statistical methods are needed, and are being developed in several disciplines such as landscape ecology and aquatic ecology, where replication is also limited or not possible.

The second problem the group discussed was the fundamental difficulty of identifying the critical elements that define the ecosystem being restored. Being

complex systems, ecosystems offer a virtually limitless array of processes and interactions, any of which may repay investigation from a purely intellectual point of view. Outside restoration ecology, the ecologist is free to investigate whatever he or she finds intriguing. But the task of restoring an ecosystem places certain constraints on this process, placing a premium on identifying factors that actually play key roles in the ecology of the system and prioritizing research objectives accordingly. This not necessarily a compromise—in fact it offers a basis for organizing research in a way that is both intellectually rigorous and of maximum practical value. At the same time, the resulting priorities may conflict with those of the research community, and thus can cause problems in the review process.

Third, we discussed the problem of selecting reference sites or reference conditions. It is unclear whether inability to define reference conditions has inhibited restoration research, but the kinds of measurements needed to compare restored and reference sites certainly are problematic. Species composition may be a convenient index of success, but evaluations should also include assessments of function, which are usually more difficult to design and implement. A related problem is time, since the usual two- to three-year funding period may be inadequate for much restoration-related research. The NSF's Long Term Research in Environmental Biology (LTREB) program would be suitable for smaller projects, and linkages with Long Term Ecological Research (LTER) sites

obviously provide opportunities for long-term studies that deal with ecosystem types found in the 18 sites of the LTER network.

Recommendations for a New Restoration Biology Program

The final topic of discussion was the form that a revised Restoration Biology Program should take at NSF. All of the participants agreed that the program is ineffective in its present form, and that a panel that is overwhelmingly dominated by conservation biologists will continue to fund conservation biology proposals in preference to those related to restoration. The discussants recommended that a separate restoration program is needed. This program could take several forms. A special restoration competition that replaces the existing CRB Program could be created. Or restoration could be subsumed under the existing programs in the Division of Environmental Biology, which includes Ecosystem Studies, the Ecology Program, Population Biology, Systematics, and Longterm Programs (LTER and LTREB). All of the participants also agreed that cooperation between NSF and agencies with an interest or mandate in restoration should be encouraged. Of course, inter-agency cooperation is currently in fashion, but it is especially desirable in the area of restoration because of the high costs and large areas involved, and because of the importance of coordinating funding and accommodating the wide range of interests that are commonly involved in restoration efforts.

In addition to direct funding of restoration research, investigators and agencies might also arrange for "in kind" support—for example, providing access to restoration sites in exchange for needed research. All participants agreed on the importance of this idea, and recommended that NSF should take a leadership role in initiating new inter-agency efforts no matter what the form of the new restoration program may be.

The full report of the group's discussion is available on the World Wide Web site of the National Center for Ecological Analysis and Synthesis at <http://www.nceas.ucsb.edu/nceas.web/rsrch/proposals/95ALLEN1/results1.html>

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