Natural Resources and Environmental Issues

Volume 12 University Education in Natural Resources

Article 10

1-1-2004

Battle at the bridge: Using participatory approaches to develop community researchers in ecological management

Jonathan Long

USDA Forest Service, Rocky Mountain Research Station, Flagstaff, AZ

Delbin Endfield

Watershed Program, White Mountain Apache Tribe, Whiteriver, AZ

Candy Lupe

Watershed Program, White Mountain Apache Tribe, Whiteriver, AZ

Mae Burnette

Watershed Program, White Mountain Apache Tribe, Whiteriver, AZ

Follow this and additional works at: http://digitalcommons.usu.edu/nrei

Recommended Citation

Long, Jonathan; Endfield, Delbin; Lupe, Candy; and Burnette, Mae (2004) "Battle at the bridge: Using participatory approaches to develop community researchers in ecological management," *Natural Resources and Environmental Issues*: Vol. 12, Article 10. Available at: http://digitalcommons.usu.edu/nrei/vol12/iss1/10

This Article is brought to you for free and open access by the Quinney Natural Resources Research Library, S.J. and Jessie E. at DigitalCommons@USU. It has been accepted for inclusion in Natural Resources and Environmental Issues by an authorized administrator of DigitalCommons@USU. For more information, please contact becky.thoms@usu.edu.



Battle at the Bridge: Using Participatory Approaches to Develop Community Researchers in Ecological Management

Jonathan Long¹, Delbin Endfield², Candy Lupe³ and Mae Burnette⁴

ABSTRACT: Land-based communities need problem solvers who can address ecological degradation by bridging gaps between community and outside knowledge systems. Through our experience working for the Watershed Program of the White Mountain Apache Tribe, we have wrestled with the challenge of making ecological research more useful to tribal communities, particularly those that have become highly skeptical of conventional research. Simply importing or exporting knowledge does little to solve long-term ecological problems, which instead require an active dialogue between community and outside knowledge systems to help local institutions evolve with environmental changes. To fulfill these roles, individuals need skills in listening, speaking and thinking from both community and outside worldviews. Unfortunately, university education often isolates students from their community rather than preparing them to help solve problems within the social and cultural setting of their community. Participatory research, in which members of the community help to conduct and guide a research project, provides valuable learning opportunities for individuals seeking to develop research skills. In particular, participatory research helps participants to consider the ethical implications of their work; the social setting in which decisions are made; and tactics for improving communication, managing conflict, and engaging more community members in the research process. While the roots of participatory research extend from the social and management sciences, incorporating this approach into natural science research is a sensible way of integrating ideas and resources from beyond the community with traditional ways of learning about the land.

PRELUDE

A monstrous wildfire had scorched most of the watershed above the village of Cibecue on the White Mountain Apache Reservation. Clouds were beginning to gather in the late afternoon, signaling that the summer monsoon rains would soon arrive. A Federal emergency response team was preparing for the impending floods. One of the team's first proposals was to clear debris from underneath the two bridges that connected the west half of the town to the larger world beyond. Much of the debris was composed of sediments that had washed down in the wake of a large wildfire six years earlier. After

¹ Formerly Advisor to the Watershed Program, White Mountain Apache Tribe. Current address: Rocky Mountain Research Station, Flagstaff, AZ 86001. E-mail: jwlong@fs.fed.us

² Cibecue Project Manager, Watershed Program, White Mountain Apache Tribe, Whiteriver, AZ 85941. E-mail: dendfield@wmat.us

³ Director, Watershed Program, White Mountain Apache Tribe, Whiteriver, AZ 85941. E-mail: clupe@wmat.us

⁴ Field Supervisor, Watershed Program, White Mountain Apache Tribe, Whiteriver, AZ 85941. E-mail: mburnette@wmat.us

that earlier fire, the Tribal Watershed Program had initiated a stream restoration project in the community. As part of this project, local school children had replanted cattails and other plants at one of the bridges (Figure 1). The products of their work now lay in the path of a bulldozer. One resident of the community, whose opinion was shared by others, declared:

The stream is more important to us than the bridge. We do need the bridge, but if nature takes the bridge, that's O.K. We don't want you to destroy that place. Our kids worked to make it beautiful again.

Although the members of the emergency team were experienced with working with Native American communities (most were employees of the Bureau of Indian Affairs, and a few were tribal employees), the imposition of a command-and-control system staffed by mostly unfamiliar persons did not quell the fears of the residents. Their status as technical experts in the outside world did not engender much trust among the community. Some residents even argued that they should fight the fire with the "old ways" of saws and hand tools. Many of them recalled past ecological destruction at the hands of outside researchers. In the 1960s, the Federal Government and State of Arizona had sponsored an experimental effort to increase water yield to downstream non-Indian communities by girdling and poisoning cottonwood trees along streams in the community (Long 2000). Seeing bulldozers again preparing to clear vegetation from those streams triggered the community's memory of that traumatic episode. That view of watershed management had only recently begun to be supplanted by the more participatory, community-based approach that had governed stream restoration work for the past several years.

While a crisis such as impending floods is not conducive to the informal, time-consuming, and consensus-based methods enshrined in participatory research, the confrontation at the bridge highlighted the need for the community to have more of its own problem solvers who would be aware of local concerns and trusted by the residents. The need was not to ensure that the community's voice was merely heard; rather, it was having individuals who could effectively translate knowledge between the community and outsiders to achieve a more comprehensive understanding of the problem.



Figure 1: Before the Rodeo-Chediski fire, co-author Delbin Endfield described the recovery of vegetation, including cattails planted by local students, at the bridge in Cibecue for a video on the community-based restoration work.

INTRODUCTION

During the past decade, we have been engaged in building the Tribe's Watershed Program, which today has an eight-person staff devoted to protecting and restoring the health of water resources that flow within 1.66 million acres of tribal lands. The Program grew from research to address external threats to the Tribe's sovereignty by developing local institutional capacity in natural resources management (Long 1994). The Program has moved beyond the initial objective of assuming authority over water quality protection to conserving and restoring Tribal lands and waters. Conventional ecological research has been an integral part of the Program's activities. However, participatory research methods have also played a major role in conducting work in tribal communities such as Cibecue, where residents have been skeptical of any government proposals for improving their lives (Taylor-Ide and Taylor 2002).

Participatory Research

Participatory Research (PR) and associated methodologies such as "Action Research," "Community-Based Research," and "Participatory Action Research," are rooted in the

premise that members of a community or organization can and should assume greater responsibility in researching solutions to particular problems, through which they become researchers themselves. A central theme in these approaches is to change power relationships so that historically disadvantaged parts of the community or organization have greater vision and voice in solving their problems (Levin 1999). Consequently, participatory research projects aim to make scientific research relevant to everyday people's lives rather than serving to increase the power and knowledge of elites.

The Value of Research within the Community

Conventional research efforts, on the other hand, have inspired a deep skepticism among community members and Tribal representatives, who often view scientific research as a weapon wielded by outsiders. Tribal leaders have recognized that research is needed to defend the Tribe's lifeblood, its natural resources, from being taken or degraded by outside interests. The impacts of a changing climate and growing population have created new challenges for tribal communities that must be addressed with solutions that fit the Tribe's particular ecological, social, and cultural context.

Regardless of whether natural resource problems are long-standing or new, the solutions will require working with a variety of community members who depend on the land. Particularly in rural watersheds with dispersed populations, command-and-control strategies for watershed management are much more likely to fail than systems that follow a more adaptive and participatory approach (Uphoff 1986). Land management activities, such as livestock grazing, agriculture, burning, protection of water resources, and erosion control, have long-standing precedents guided by traditional cultural practices (Long et al. 2003). Because local cultural traditions have co-evolved with local ecosystems, they may be more sustainable than management traditions imported from other ecosystems. To meet growing challenges such as environmental degradation, local institutions need time to adapt (Uphoff 1986).

Interactions between Insiders and Outside Researchers

While cultural traditions provide foundations for management, outside research can provide valuable ideas that can stimulate the evolution of those management systems. By contrasting the roles and perspectives of "insiders" and "outsiders," participatory research frameworks help to understand interactions between community members and outside researchers (Elden and Levin 1991). Insiders have direct knowledge of the organization and are primarily concerned with solving practical problems facing themselves and their organization. Outside researchers bring expertise and experience in conducting experiments, recognizing general patterns, and communicating results to others in the research community. Participatory research seeks to bridge the gap between insiders and outsiders by working together to create a "local theory" of the situation (Elden and Levin 1991).

Facilitating the exchange of ideas between insiders and outsiders is not easy, because their customs and beliefs often set in sharp contrast, as shown in Table 1. In such a climate, natural resource issues often become struggles between the "traditional ways" and "indaa bínatsíkęęs" ("white people's thinking"). Community members describe how academic or bureaucratic representatives with formal education often magnify these tensions by using big words to "show off" or "talk down to the people." Expressing similar frustrations, advocates of participatory research have criticized the notion that universities produce "expert knowers" or that a scientist's theory about one's world is more valid than one's own (Elden and Levin 1991, Stringer 1997).

Outside Society and Funding Entities	Tribal Community and Government
Institutional education	Traditional learning
Written communication in English	Oral communication in native language
Communication with outside scientific community	Communication with community members
Conceptual knowledge	Practical knowledge
Basic research into general problems	Applied research into specific problems
Conservation biology	Resource conservation
Experimental data collection and analysis	Project implementation
Formal reporting about projects	Physical upkeep of projects
Urban lifestyle including fast pace of time and individualism	Rural lifestyle such as slow pace of time and collectivism
Emphasis on objectivity through distance and open-mindedness	Emphasis on participating in the community and upholding traditional values

Table 1: Common tensions between management approaches

Being able to bridge the two worlds can help to improve ecological management, as our efforts in participatory research have demonstrated. An event in the wake of the wildfires of 2002 exemplifies the value of promoting individuals who can bridge the two worlds. Post-fire erosion threatened a culturally important wetland. A federal implementation leader suggested using metal gabion baskets to stabilize the channel at the site, but a Tribal project coordinator (one of the authors, M.B.) responded that such a treatment would not be a good solution. For one reason, metal is not appropriate for a cultural site, as many cultural ceremonies prohibit the use of metal. For another reason, she had observed many failures of gabion baskets at other locations. Fortunately, the staff of the Watershed Program had been engaged in participatory research with outside scientists to develop a riffle formation technique that uses native rock and plants materials (Long and Burnette 2000) (Figure 2). Further research had demonstrated that the technique was

remarkably similar to traditional erosion control practices (Long et al. 2003), in large part because it relied on native materials. Therefore, the Tribal project coordinator was able to recommend using the natural materials approach with support from her traditional perspective and from her experience as a collaborator in the field research.



Figure 2: Co-author Candy Lupe and an outside researcher work together to install a riffle formation at a culturally important restoration site.

While members of the community highly regard traditional knowledge, they recognize that outside education can help individuals to learn new skills and be more successful in life. For this reason, educational scholarships constitute one-fifth of the annual allocations from the Tribe's permanently endowed Land Restoration Fund. Elders have recognized that contemporary ecological research can play an important role in supplementing traditional ways of learning about the land that are in decline. For example, students who have studied plant identification are better prepared to interact with elders who are knowledgeable about traditional plants, even though there are major differences in their approach and types of knowledge. The ability to develop new knowledge while retaining the old requires considerable skill in moving between the two worlds. However, such skill can be taught and developed through practice.

Figure 3 represents different pathways through which knowledge may be transferred between the local community and the world of outside researchers. Because Apache culture compares knowledge with water, we can represent local knowledge with the traditional wicker basket, or tus, while representing non-local knowledge with a metal pail. The first path represents conventional research, in which the local knowledge has been exported from the community to outsiders. Community members have criticized this approach as, "continuous probing by outsiders who want answers and knowledge for curiosity's sake, for exploitation, or for research that does not benefit us" (Adley-SantaMaria 1997). To prevent exportation of knowledge, the Tribal community has adopted policies, including an intellectual property committee to review proposed research and publications. The second path represents the introduction of an outsider researcher into the community, where he or she is supposed to learn and support local knowledge without removing or damaging it. The third path represents efforts to bring outside knowledge to community members within the community setting. The fourth path represents conventional education, in which a community member leaves the community to learn outside knowledge.

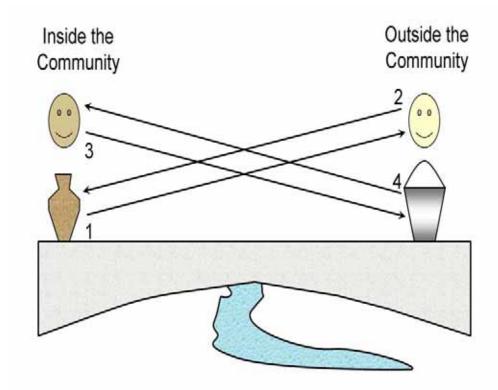


Figure 3: Four pathways through which insider and outsider knowledge can be transferred between people in the community and those outside the community.

Since the benefits of conventional research are seen as mostly accruing to outsiders, the Tribe has focused on the other paths to solve problems. Following the second path, the Tribe has recruited experienced outsiders to perform technical and managerial roles

within the government. Persons who have remained for several years have helped to lead many projects and develop local institutions. Some researchers (e.g., Cornell and Kalt 1995) have attributed part of the Tribe's economic success to its willingness to employ outsiders with specific expertise. Various strategies, such as collaborative research projects and involvement in community activities, can help outsiders to better understand the local culture (Ruano 1991). However, due to the time it takes for an outsider to understand the insider's world, this path is not particularly efficient (Elden and Levin 1991). Bringing in outsider researchers can help to address many short-term technical challenges, but this path is likely to be less effective in addressing chronic problems such as ecological degradation.

The third path brings outside education to tribal members within the Reservation setting. Opportunities such as community college and on-site training programs can help community members to develop research skills as part of their jobs on the Reservation. This approach reduces the cost of education in terms of money and time spent away from family. However, the difficulties of having young families and low incomes often make it difficult for people to commit the time and money to pursue such personal professional development. In addition, science and technical classes at the local community college emphasize individual completion of a fixed curriculum, rather than encouraging group learning through constructivist teaching methods. Many students are not well-prepared in foundational skills such as writing and mathematics. For these reasons, enrollments in college classes tend to be low, and drop-out rates are high. Attempts to make the benefits of such education more tangible (for example, by offering raises when a degree is completed) have the side-effect of seeming to devalue insider knowledge. Furthermore, tribal members who pursue degrees while remaining within the local community may not learn to see the world from such a different perspective as do those who leave the community.

Community members who follow the fourth path, by attending university often report that the experience helped them to become more open-minded and inquisitive. When they return, these individuals can stimulate institutional growth by suggesting new technologies to diagnose or address long-standing problems. Although both outsiders and tribal members who pursue higher education off-Reservation can bring in tools, community members may be better able to see the tradeoffs in adopting a new idea from the perspective of an insider and an outsider. Unfortunately, there are many obstacles facing tribal members in university. Many of the community members have not been well prepared for university-level coursework or for living outside of the structure of their home. Furthermore, removing tribal members from their home environment tends to weaken their ties to the community. Consequently, the few who commit to going off-Reservation for school may become even less likely to return.

All four paths may be appropriate for addressing particular problems, especially short-term ones. But none of these four paths is well-suited for solving long-term problems. When water sits, in either a tus or a pail, it stagnates. Consequently, the answers to long-term, dynamic problems must come from a living body of water, an evolving body of knowledge. By sharing their knowledge as they deliberate, people realize that answers

36

come from the stream that runs through the two worlds. The stream brings new opportunities for discovery, and washes away the ideas that no longer have value. The challenge of community-based research lies in building a bridge that promotes the exchange of ideas while not disrupting the stream below.

Tensions on the Bridge

Participatory researchers learn to highly value community knowledge, but they also believe that outside ideas can serve as a catalyst for problem-solving. Consequently, participatory research often focuses on bridging outsider and insider knowledge systems. The tensions between "old ways" and "new ways" are tangible in many communities. Efforts to build research capacity within such communities must confront these tensions to move beyond the models of either exporting or importing researchers or knowledge. Successful exchanges of knowledge occur when there is reciprocity between individuals, rather than one-way transfers. When realized to its fullest, participatory research promotes collaboration among members with diverse skills and knowledge. It is difficult to design a research effort that balances the needs of the community, the researcher in academia, and all of the local collaborators. But the result of such an effort is that answers emerge from the sharing of inside and outside knowledge.

One of the main complications of university education is that it often becomes associated with status. Rather than adding to the knowledge of the community, outside education begins to compete with it. Statements and policies that afford special status to community members with college degrees can be seen as devaluing those who do have degrees. Declarations that employees who complete degrees will be first in line for promotions and pay increases reinforce the belief that education is an undertaking for personal, not collective, advancement. An emphasis on personal achievement conflicts with an Apache norm emphasizing humility. Persons who declare that they have particular kinds of knowledge may be considered boastful and disrespectful, and therefore likely to lose that knowledge or suffer some sort of personal harm. In addition, there is a concern that knowledge that is made freely available may be misused; in extreme cases, for malevolent purposes. Consequently, traditional attitudes toward knowledge run counter to the norms and expectations of academic research, which emphasizes publicizing one's knowledge to validate it.

In many cases, individuals who have not pursued outside education are likely to have lived in Reservation communities for their whole lives, to be fluent in the Apache language, and to have a good foundation of traditional knowledge. Many are admired for being able to "speak from the heart." Many staff members emphasize the importance of humility and teamwork in completing projects, which contrasts with the individual achievement represented by a college degree. For this reason, staff members argue that new employees need to prove themselves by completing projects that involve manual labor and communicating with local land users and other community members. For issues involving land in particular, persons with college degrees may be seen as lacking authority because of their youth and inexperience. Young graduates who assume that authority comes with a particular position risk violating long-standing social norms.

There is an acknowledged double-standard regarding the expectations of tribal members and non-tribal members in management positions, because tribal members are expected to understand and adhere to cultural traditions more strongly than outsiders. If new managers propose changes in the organization, their motives are more likely to be called into question because they may be seen as having more to gain from it. Consequently, when appointed to a management position within a hierarchical system of "bosses and workers," tribal members often face greater resistance among employees than do non-members (Trosper 1988).

Freshly minted graduates must recognize that their education gives them tools for answering questions facing the community, but it does not give them the answers themselves. Incorporating participatory research methods into natural resources education for community members reinforces that research process is a dynamic learning opportunity. The process of designing and conducting participatory research helps problem solvers to learn how to communicate ideas to members of the community, to address conflicts, and to interpret how social networks and organization structures affect decision-making.

Changing Communication Methods

Since the key to solving research questions for a community lies in the interaction of knowledge systems, some of the most important skills are communication and teaching. Participatory research emphasizes that trust should be built before trying to gain information or propose solutions within the community. Customs such as introducing oneself through one's family background is an important strategy for establishing trust with community members. However, learning how to communicate effectively with outsider institutions is also important, because support for research is often leveraged from beyond the community.

Consequently, bilingual ability, in both speech and thought, is a vital ingredient of community problem solving. Many community members greatly admire skillful use of the Apache language. When a concept or project can be successfully explained using Apache words, then community members are more likely to put their faith in it. Because the Apache language has traditionally been transmitted orally, writing imposes additional barriers to shared understandings. Yet, proposals and reports written in English are the standard currency for most outside sponsors of research.

Visual techniques, such as poster displays, repeat photography, digital video, and maps, avoid the need for translation and have proven more effective for describing ecological changes. Videos (Figure 1) have allowed people to experience the vitality of the land through their eyes, their ears, and their native tongue. The warm reception by community members, especially elders, to these approaches demonstrate that new technologies can be used to stimulate, rather than replace, old ways of teaching and communicating about the land. Participatory research projects naturally gravitate towards such inclusive media to promote community participation.

Participatory research has shown that changing patterns of communication and teaching is critical for social learning and organizational growth. For example, informal and nonformal training methods, such as role-playing and group-problem solving, are often more effective than conventional lecture-based teaching (Uphoff 1986, Stringer 1997). Games, group projects, and field activities have proven far more effective than lectures in teaching watershed management concepts and skills to full-time staff members and interns. Many staff members have said that they learned more by working with an adviser than by taking classes or training courses. Such approaches are more consistent with the teacher-apprentice styles that elders have traditionally used for instruction. Participatory research often demands that participants teach each other while avoiding lecture styles that can cause friction.

Interpreting and Managing Conflict

Being able to design and coordinate participatory research requires understanding how a project can be conducted and how to manage the resources needed to get it done. For this reason, an effective community researcher must possess management skills that go beyond the technical skills that are generally the focus of classes in research methods. Interpreting the social interactions among the members of an organization is critical skill that participatory research can help develop. Persons working in science-based fields often narrowly define their work to ignore these interactions. Not uncommonly conflicts arise in which persons of different status end up blaming each other for "not doing their jobs," rather than trying to understand the social basis of their conflicts (Putnam 1996). Seeking the participation, self-evaluation, and reflection needed to understand these conflicts can become a burden on individuals who are already overworked (Santos 1991). Participatory research methods teach that leadership is less about making decisions than about improving communications (Grundy 1996). This principle helps to address potential conflicts before they grow to become too costly.

Understanding Political Dimensions of Work

In addition to considering communications and interactions, participatory research approaches also must confront how decisions are made within the community or organization. At this point, the political nature of participatory research comes more sharply into view. By encouraging community members to become agents of change, action-oriented participatory research becomes an inherently political endeavor. Because researchers with backgrounds in the natural sciences often have not been trained to understand the political dimensions of their work, they often regard decision processes as a confusing, perhaps even insidious, black box of politics. Because these issues often have long histories, researchers may not realize the ramifications of their work. For instance, issues concerning rare species have become intertwined with the complex world of water rights (Lupe 1992), so that even seemingly innocuous biological studies can become enmeshed in costly legal battles. Consequently, researchers must possess high degrees of social, political, and ethical awareness in addition to technical competence. The procedural requirements common to participatory projects, such as obtaining

permissions, arranging compensation for community members, and determining how results will be used, often help researchers to more fully consider the political and ethical ramifications of their work.

Advocates of participatory research recognize the research activities must avoid creating new elites with control over knowledge. Because an underlying goal of participatory research is to democratize decision-making, these approaches emphasize avoid concentrating authority and information within individuals by having community groups assign job responsibilities, discouraging specialization, and rotating people through positions (Uphoff 1986). Dispersing knowledge among individuals reduces the potential for any one individual to monopolize knowledge or drain it from the institutions should they leave (Elden and Levin 1991). Unfortunately, there often are not enough resources to dedicate more than one or two individuals to a research project. The need to recruit multiple persons with a wide variety of skills inevitably slows the process of developing community researchers.

Furthermore, pursuing democratic ideals may conflict with the structures and policies of the institutions that are involved in research. Community institutions that have evolved to present a unified voice to outsiders often have a strongly hierarchical structure that does not facilitate democratic decision-making. In these situations, accepting that institutions need time to evolve is important. Effective exchange of knowledge means that local institutions should evolve, rather than simply importing an idealized structure developed elsewhere. Because of institutional constraints, participatory approaches often may seem infeasible. However, striving to uphold the principles of participatory research will help to avoid many of the problems that have stymied conventional research in jaded, disenfranchised communities.

Need for Land-Focused Participatory Research

A shortcoming of participatory research as practiced in the United States is that it has been largely the domain of the social sciences rather than the natural sciences. Consequently, the focus of research has been on people's relationships to landscapes, rather than on the land itself. Staff members of the Watershed Program emphasize the need to learn directly from the land when engaged in research. For example, they assert that new project managers should be responsible for learning about and caring for a particular area. Elders describe these long-standing traditions as "drinking from places" (Basso 1996) and "having vision for the land" (Long et al. 2003). Only through such direct experience will individuals cultivate and demonstrate the proper frame of mind needed to solve ecological problems. In this way, traditional values can guide the process of conducting experiments with new technologies. Research in this manner can lead to better ways of applying old ideas. Combining the land focus of conventional ecological research with the social framework of participatory research can help build a better bridge between university and traditional knowledge systems.

41

CONCLUSIONS

Redressing long-term ecological problems requires changing human values, behaviors, and institutions. Communities need to cultivate ecological problem solves who possess skills in understanding and managing ecological, social, and political environments. Outsiders seeking to help solve ecological problems within a community must recognize the risks that such efforts entail. Universities in particular must acknowledge the danger of conferring special status upon community members based on their technical knowledge without teaching the responsibility to use that knowledge wisely. Neither "technology transfer" to communities nor conventional education of community members adequately cultivates shared understandings across cultures. Just as transferred technology often sits idle, college educated staff members with insufficient experience in addressing problems at the community level can become frustrated. One of the best ways for students to learn how to bridge the worlds is to engage in participatory research, because it focuses on the critical tensions between outsider and insider knowledge systems. By being more aware of and realistic about the nature of these challenges, researchers will improve their efforts to foster the research capacity within a community. This adaptive process requires times and patience, as 'successes' collapse and 'failures' emerge as successes (Uphoff 1986). As one elder advised her grandson, a restoration project manager (and one of the authors, D.E.), "Go slowly. Listen to the land and it will tell you what to do." People dedicated to fostering community research in ecological management should heed this advice, to ensure that their efforts to build bridges do not undermine what the community has already achieved.

EPILOGUE

By proposing to clear the stream underneath the bridge in Cibecue without understanding the history of that place, the emergency rehabilitation team perpetuated the outsiders' tradition of dismissing the traditional values and knowledge of the community as outmoded. On the other hand, by contending that it would be better for the bridge to be washed out than to sacrifice the streamside habitat underneath it, some of the community members were diminishing their connection to the outside world, which includes vital services such as emergency health care. Neither side fully acknowledged the risks of different responses; consequently, each was vulnerable to making a poor decision. In the end, a compromise was reached, allowing the team to remove debris from an area extending 30 feet above and 30 feet below the bridge. Community members say that the bulldozer operator did not follow those restrictions closely enough, but they were happier about the outcome than what happened at the second bridge in town (Figure 4). At that site, more extensive dozer work was performed and significant bank erosion occurred subsequently. Since the fire, local problem-solvers have been watching the bridges to see how the stream responds, so that next time, they will find better answers.



Figure 4: Staffers from the Watershed Program examine bank erosion below the lower bridge in Cibecue.

ACKNOWLEDGMENTS

We wish to thank our fellow researchers in the Tribal Watershed Program, including Floyd Cheney, Michael Cromwell, Arnold Pailzote, and Daryl Tenijieth, who contributed their ideas on developing ecological management on the Reservation.

LITERATURE CITED

Adley-SantaMaria, Bernadette. 1997. White Mountain Apache language: Issues in language shift, textbook development, and native speaker-university collaboration. P. 129-143 in Joy Reyhner, editor, Teaching indigenous languages. Flagstaff, AZ: Northern Arizona University.

Basso, Keith H. 1996. Wisdom sits in places: Landscape and language among the Western Apache. Albuquerque: University of New Mexico Press.

Cornell, Stephen and Joseph P. Kalt. 1995. "Where does economic development really come from? Constitutional rule among the contemporary Sioux and Apache." Economic Inquiry 33: 402-426.

Elden, Max and Morten Levin. 1991. Co-generative Learning. P. 127-142 in William Foote Whyte, editor, Participatory action research. Newbury Park, CA: SAGE Publications.

Grundy, Shirley. 1996. Towards empowering leadership: The importance of imagining. P. 106-120 in Toulmin, S. and B. Gustavsen, Beyond theory: Changing organizations through participation. Philadelphia: John Benjamins Publishing Company.

Levin, Morton. 1999. Action research paradigms. P. 25-37 in Greenwood, Davydd J., editor. Action research: From practice to writing in an international action research development program. Philadelphia: John Benjamins Publishing Company.

Long, Jonathan W. 1994. Building connections: A strategy for integrating natural resource management. Master's thesis. Harvard University, Cambridge, MA.

Long, Jonathan W. 2000. Cibecue watershed projects: then, now, and in the future. Pages 227-233 in Peter F. Ffolliott et al., technical editors, Proceedings of land stewardship in the 21st Century: The contributions of watershed management, March 13-16, 2000, Tucson, AZ. RMRS-P-13. U. S. Forest Service Rocky Mountain Research Station, Fort Collins, CO.

Long, Jonathan W. and B. Mae Burnette. 2000. Soldier Spring restoration project. Pages 361-362 in Peter F. Ffolliott et al., technical editors, Proceedings of land stewardship in the 21st Century: The contributions of watershed management, March 13-16, 2000, Tucson, AZ. RMRS-P-13. U. S. Forest Service Rocky Mountain Research Station, Fort Collins, CO.

Long, Jonathan, Aregai Tecle, and B. Mae Burnette. 2003. Cultural foundations for ecological restoration on the White Mountain Apache Reservation. Ecology and Society 8(1): 4. Retrieved March 26, 2004, from http://www.ecologyandsociety.org/vol8/iss1/art4/

Lupe, Ronnie. 1992. The challenges of leadership and self-government: A perspective from the White Mountain Apaches. Speech given October 1992. Working Paper Series Publication 92-5. Cambridge, MA: The Harvard Project on American Indian Economic Development.

Putnam, Robert W. 1996. Creating reflective dialogue. P. 41-52 in Stephen Toulmin and Björn Gustavsen, editors, Beyond theory: changing organizations through participation. John Benjamins Publishing Company: Philadelphia PA. 1996.

Ruano, Sergio. 1991. The role of the social scientist in participatory action research. P. 210-217 in William Foote Whyte, editor, Participatory action research. Newbury Park, CA: SAGE Publications.

Santos, Jose Luis Gonzalez. 1991. Participatory action research: A view from FAGOR. P. 77-84 in William Foote Whyte, editor, Participatory action research. Newbury Park, CA: SAGE Publications.

Stringer, Ernie. 1997. Teaching community-based ethnography. P. 17-37 in Ernie Stringer et al., Community-based ethnography: Breaking traditional boundaries of research, teaching, and learning. Mahwah, NJ: Lawrence Erlbaum Associates.

Taylor-Ide, Daniel and Carl E. Taylor. 2002. Just and lasting change: When communities own their futures. Baltimore: The Johns Hopkins University Press in association with Future Generations. 350 p.

Trosper, Ronald L. 1988. Multicriterion decision-making in a tribal context. Policy Studies Journal 16(4):826-842.

Uphoff, Norman. 1986. Local institutional development: An analytical sourcebook with cases. West Hartford, CT: Kumarian Press. 421 p.