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## Mutual Benefits of Teacher/Scientist Partnerships

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### Abstract

University ecologists, science educators and natural resource agency scientists have been working with science teachers in a partnership called “Teachers in the Woods”. Teachers work with field scientists to implement a variety of ecological research and monitoring projects on federal agency land. Scientists and teachers were interviewed to obtain insights into the benefits of this partnership. These partnerships generated greater teacher knowledge of local ecological communities and processes and fostered a mutual respect for the work of both classroom teachers and scientists.

### Background

Natural resource agencies have relied on volunteer-collected data since their inception. The earliest examples of volunteers participating in natural resource monitoring activities date back to the late 1800s when the US Weather Service documented rainfall and air temperature using data collected by volunteer observers (Firehock & West, 1995). Today, volunteers continue to collect data for a large percentage of National Weather Service Stations and their participation with other agencies in water quality data collection has become widespread. State and federal agencies have been utilizing more volunteer-collected data as one way of reconciling decreasing agency budgets with increasing mandates to monitor resources. Agencies have also responded by implementing improvements in volunteer training programs. Additionally, these agencies are increasingly recognizing the merits of working directly with the public to garner wider support for their missions.

Teachers constitute a unique group of volunteers. One of the most significant impacts of engaging science teachers as researchers is the consequential modification of their teaching practices in response to their experiences. Having personally benefited from direct experience in ecological science alongside practicing scientists, teachers are better situated to create authentic science experiences for their students.

Creating authentic opportunities for environmental learning, in contrast to standard practices in traditional science education, is important to make science more meaningful to students (Darling-Hammond, 1996). Although students’ inquiry into authentic questions is desirable, there is a considerable gap between this goal and how it is implemented in classrooms (National Research Council, 1996). Creating meaningful scientific investigations for students involves placing them in real-world situations, enabling them to emulate the behavior of scientists who similarly collect and analyze data, and thereby make a direct contribution to the field of science. When students are also provided with the opportunity to situate their project in the community or publicly present the results of their work, they will more likely place a higher value on their

learning.

Teachers in the Woods (funded by NSF ESIE grants # 9619052 and #0101957), has provided professional development for approximately 260 science teachers through a six week summer forest research experience. Throughout the course of the program, faculty from Portland State University (PSU), Oregon State University (OSU), and scientists from the U.S. Forest Service (USFS) and National Park Service (NPS) worked alongside teacher participants as they conducted monitoring projects at local National Forest and National Park sites. Following their summer research experience, teachers created projects near their schools to engage their students in authentic ecology fieldwork. The program has successfully generated greater teacher motivation, confidence, knowledge, and skills in the instruction of biology and environmental sciences in the field. Teachers attributed their success to enduring professional contacts with scientists, other like minded teachers, and science educators, typically lasting a year or longer, and to their six-week field experience conducting authentic ecology research and monitoring projects (Dresner, 2002). Some teachers repeated the program for a second year. This paper presents the results of an additional investigation of the value of the partnerships to these teachers and to the scientists.

Scientists who worked with the Teachers in the Woods program all worked in some capacity for federal land management agencies involved in long term research at a forested field site in the Pacific Northwest. This included the USFS, NPS, and scientists from OSU working at the H.J. Andrews Long Term Ecological Research site. Some of the projects carried out by teacher-volunteers provided information to these geologists and biologists for the establishment of baseline datasets or for ongoing resource monitoring projects. Some participating teachers worked on the same projects for the entire month of the program, while other teachers worked on a variety of wildlife, botany, and forest ecology projects.

Teachers conduct their summer field research in National forests selected for their proximity to participants' homes and schools. This arrangement not only allowed participants to travel between their homes and the monitoring sites relatively easily, but also provided the opportunity to immerse themselves in the ecological communities that surround them back at home in their daily lives.

Using the specific attributes of a place as a foundation for learning can have far-reaching effects. Placing learning within a local context allows learners to build knowledge based on actualities not abstractions. Using real world problems as a basis for learning can increase the degree of student engagement, keep teachers excited and motivated, and strengthen community relationships (Chin, 2001). Education that is grounded in place reconnects the isolated spheres of school and community, producing more cohesion. The communities themselves, which include federal land management agencies in this example, also provide practical illustrations of successful ways to work and apply learning outside the school context.

Fisheries-related projects implemented at USFS and NPS sites included large woody debris monitoring in streams, hydrology, and juvenile fish estimates. A large woody debris project conducted in Fish Creek in Mt. Hood National Forest, helped biologists assess how much old wood moved out of the stream and how many new pieces moved in after the 1996 flood. A hydrology project at Redwood National Park helped geologists monitor the shifts in bedload in an aggraded stream along which the tallest redwood trees occur. An OSU scientist-lead invertebrate monitoring project using pitfall trapping helped establish links between particular arthropod species and certain ecosystem characteristics for possible future use as arthropod indicator species in public land management practices.

Following their participation as research assistants during the summer, teachers went on to create student projects reflecting their newfound expertise utilizing research protocols. As the teachers designed and implemented student projects over the academic year, in many cases, the scientists with whom they had worked assisted them with visits to the classroom, by loaning the class field equipment, providing updated information to the teachers, or helping to identify specimens that students had collected. For example, a team of high school teachers involved their students in monitoring terrestrial invertebrates in a 54 acre mitigated wetland. Samples were collected from vegetation using sweep nets and from the ground with a series of pitfall traps. The data was used to determine baseline levels of invertebrates at the site and classify them according to microhabitat. Over successive years, the data was used to determine changes in conditions of the wetlands. Participating scientists assisted students in the field during the monitoring process. Scientists also assisted in identifying the species of arthropods students had collected.

Another teacher's student project involved investigating differences in invertebrate populations in forest stands having different soil compositions and microbial diversity. A university scientist helped provide the teacher with ideas to frame the research in the context of the most current knowledge and need for additional research about the environment.

### **Methodology**

Seven participating scientists from universities and federal natural resource agencies were interviewed over several years (2000-2003) to obtain insights into the benefits they received through their involvement in the Teachers in the Woods program. The majority were the managers who supervised the field crews or were the lead scientists; they were selected due to the breadth of their experience working with teachers over successive summers. One was chosen due to the depth of his experience; he worked directly with teams of teachers in the field every day for the entire summer session.

Four different groups of teachers, totaling 22, were informally surveyed in small groups at the end of their summer work over a four year period (2001-2004). All taught life sciences at middle or high schools. These teachers were selected because they had participated in the program for at least one year previous to being interviewed. The teachers were asked to reflect on how the partnerships with scientists had affected them professionally over the past year.

### **Results of Interviews With Scientists**

From the perspective of resource agency scientists, there are several reasons why they engage volunteers in monitoring. The first one was pragmatic. Fully implementing the monitoring activities identified within agency Management Plans would require far more funding and staffing than is presently available, and as their budgets continue to shrink, they have been compelled to find creative ways to get the work done. Working with suitable high school and middle school teachers can meet part of the monitoring workload. For example, one scientist said:

“I could use my own field crews more efficiently by dividing them into more groups that included teachers.”

A second stated reason for engaging volunteers in agency projects was to increase public awareness of the Forest Service's mission. In the past, USFS scientists and NPS naturalists had helped provide environmental

education by hosting classes on field trips or making presentations in classrooms. These activities have been drastically curtailed. As an alternative, the agencies work directly with teachers and, through them, reach a larger audience of students in the future. As one biologist reported:

“A considerable multiplying effect for the number of students directly reached is achieved. While the traditional trip to the classroom may bring a biologist into contact with 30 students, a teacher has the potential to reach hundreds of students over several years.”

Because of its emphasis on academic pursuits, university scientists benefit in unique ways from working with knowledgeable colleagues such as science teachers. University-based scientists have been able to publish research papers with usable data collected through these collaborations (e.g. Moldenke, 1999). One scientist reported that working with teachers was a refreshing break from the more typical summer work crew of college students:

“It was pleasure to work with people (teachers) visibly eager to learn and contribute.”

Another scientist similarly commented that she like working with teachers because they challenged her with questions about the relevance of the research or monitoring work:

“...it reminds me of why I originally chose my profession. The teachers were refreshingly frank.”

Through their work directly in classrooms during the academic year, scientists model their passion for their own work for the students. Several scientists stated that their ongoing work in these teachers' classrooms had enabled them to fulfill a personal goal to inspire greater interest in natural history in children.

Although working with high school students is not typically highly valued by university administrators, this service may have a direct impact on the high school students in the future as college students making academic and career choices (Field, 2002). One scientist in this study described the disconnect between the value of faculty work with K-12 schools and the university's expectations:

“University administrators need to credit faculty for work with K-12 teachers, especially in making promotion and tenure decisions.”

## **Results of Teacher Interviews**

The teachers invariably reported that they enjoyed working side by side with the scientists in the field. Some described their appreciation of being able to gain cutting edge information and considerable knowledge from their first-hand experience. One teacher described the confidence he had gained since he had achieved mastery of several field techniques and incorporated these techniques into student projects.

“I have gained improved means of developing field explorations for my students, gained ideas for studying forest mycorrhizae in a lab setting”

The experience of actively conducting field research in collaboration with local scientists was described as life changing by some teachers. Others explained that the process had helped make their teaching practices more meaningful, since they had learned how to do science in a more authentic context. They learned how data is gathered in the field and how it is framed in a larger context to build an understanding about how ecosystems function. Having learned science in a meaningful context themselves, teachers felt more prepared to teach science in a more meaningful way. As one teacher explained:

“So much of high school science involves memorizing what scientists know, with little time spend actually doing science. My training this summer has allowed me to get my students out doing real science”

Disturbingly, most teachers reported that they had never before had direct experience participating in meaningful scientific research, even during their undergraduate teacher preparation experiences. Consequently, they had been teaching science mainly based upon textbooks. One teacher reported that the fieldwork he experienced through the program was one of the best things he had ever done in his 15 years of teaching science. He explained that when he had learned biology in college, it had not been tied to anything. The particular project he was involved during his summer experience, measuring percent plant cover, had direct applicability to his own students. He realized: “Kids can do this.”

Another teacher described a feeling of invigoration and new understanding about science stemming from his fieldwork experience. He said:

“Kids feed off of the way their teacher feels about their subject. As my students pick up on this, their own genuine interest can show and spread.”

Partnerships with local scientists provide teachers with a broader understanding of the processes utilized in science to develop new information and ideas. The process of immersion in a research experience made it more likely that teachers will adapt their practice to include the use of field biology in their teaching. Teaching science more like scientists apply it can help teachers make their classes more exciting and may encourage students to place higher value on their learning. One teacher reported:

“Students are working at a higher level; their work gained them more respect from the community.”

Another teacher described: “The attitude of the whole class changed through work on their projects.”

Evaluation results have shown increases in students’ science inquiry skills as a consequence of their work on field projects (Dresner, 02). The use of projects has also been found to increase students’ standardized test scores, attendance, decrease discipline problems, and generate greater student interest in science (Lieberman & Hoody, 1998).

The field research experience often invoked a sense of wonder and deep appreciation for the natural world as teachers and students began to recognize certain species of plants and animals and gain insight into the intricate ecological relationships that exist between them. Because both teachers and their students experience these things in a local setting, the knowledge they attained and the renewed appreciation for nature that they had experienced in the field were just as easily sparked at home. One teacher quipped:

“My field experience of surveying butterflies on Mt. Hood somehow coincided with the sudden “magical” appearance of butterflies everywhere in my neighborhood.”

Many teachers commented on how their students’ experience working in the field conferred them with an increased ability to recognize the diversity of life in their own backyards in minuet detail. Students began to bring insects they had collected in their own backyards in to school. One teacher reported:

“One girl asked to borrow our collecting equipment so she could carry out her own study in her backyard. Parents love this.”

This sharpened awareness of local ecology is important because it provides a more complete picture of the places people call home and the complicated web of ecological relationships of which they themselves are part.

### **Conclusions**

The Teachers in the Woods program illustrates avenues whereby scientists and teachers have worked together for mutual benefit. Teachers provide the knowledge about what does and does not work in a classroom setting, the constraints of the educational system and what may or may not be age appropriate. University faculty provide new approaches to teaching and learning, current scientific content knowledge and training in research skills not typically available to K-12 teachers. Agency scientists provide a meaningful local context in which to implement a variety of monitoring tasks. Teachers gather research and monitoring data, which would not otherwise be collected. In addition, a stronger link between the resource agencies, universities, and the community can be achieved as scientists work directly with teachers and their schools. University scientists, through collaborations with science teachers, can help achieve a vision of greater local ecological knowledge and skills. The main benefits gained by teachers who participate in the Teachers in the Woods program include a renewed excitement and passion for teaching, increased knowledge, enthusiasm, ideas and skills for teaching authentic science in their schools, and an ability to make science more meaningful for their students.

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