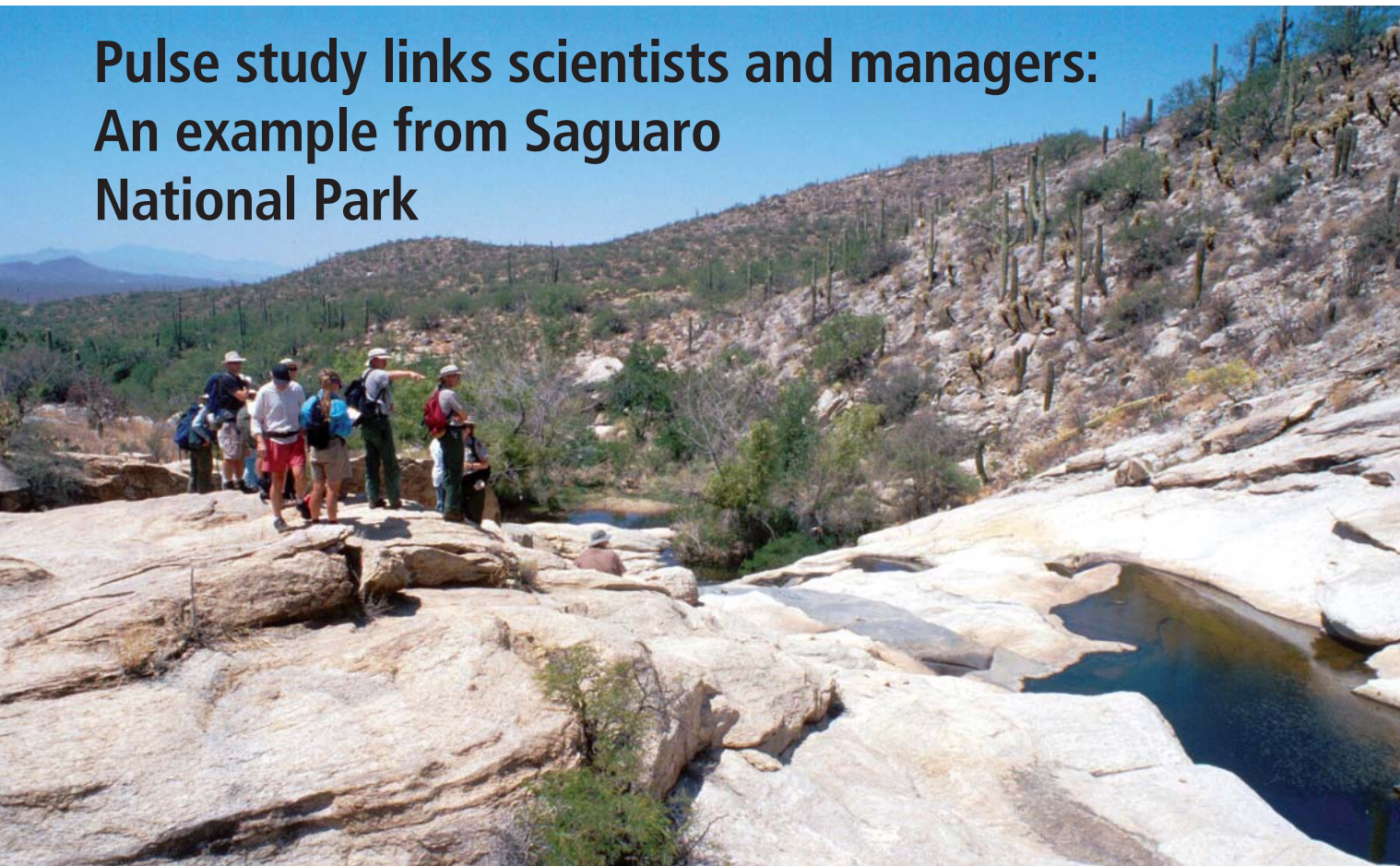


Case Study

Pulse study links scientists and managers: An example from Saguaro National Park



TAYLOR EDWARDS

By Don E. Swann, Margaret W. Weesner, Sarah Craighead, and Larry L. Norris

THE VERY FIRST ISSUE OF *PARK Science* featured a story on a “pulse study” at the Hoh River drainage in Olympic National Park in Washington (Anonymous 1980). Inspired by this example and similar studies in Sequoia and Kings Canyon national parks in 1982 and 1994 (Matthews 1983, 1994), Saguaro National Park sponsored a pulse study of the Madrona Ranger Station area (“Madrona”) in May 2003. Although it has been an important site for park (backcountry) operations for years, park managers knew little about Madrona’s natural or cultural history and resources. Pulse studies vary, but basically they bring together scientists and managers to “take the pulse”; that is, quickly assess the ecological health of an ecosystem or area. Pulse studies originated

with University of Washington professor and U.S. Forest Service ecologist Jerry Franklin, who believed passionately that science is essential for managing natural areas but requires scientists who can think outside of their narrow disciplines, and managers who take the time to listen and understand. Franklin would invite scientists from a range of disciplines to join managers for intensive field-based studies. Participants worked and camped together, sharing ideas around the campfire at night. Superintendent Boyd Evison lauded the pulse study at Sequoia and Kings Canyon national parks for providing the kind of interdisciplinary information “that most parks unfortunately seem to have little hope of obtaining” (Matthews 1994, p. 5).

Madrona is a lush desert oasis of spring-fed pools far from the park’s popular cactus forest (fig. 1). The Madrona Ranger

Figure 1. The desert oasis of the Madrona pools in Saguaro National Park was the site of a pulse study in May 2003. The dynamic pulse process provides immediate results and mountains of data for park planning and decision making.

Station had been the longtime base camp for Saguaro National Park’s backcountry operation but was abandoned around 1999 because of environmental and health hazards associated with the deteriorating facility. Public access had been limited for decades, but potential changes in management and visitor use, and rapid development outside park boundaries, raised concerns about the site’s future. Park staff had heard about pulse studies and thought that this model might be a cost-effective—and quick—way to gather information that would be useful for making decisions about the site.

Table 1. Madrona pulse study participants

Participant	Expertise/Discipline	Affiliation
Emma Benenati	Aquatic ecology	Northern Arizona University [NAU]
Kevin Bonine	Herpetology	University of Arizona [UA]
Alice Boyle	Ornithology	UA
Courtney Conway	Ornithology	UA
Taylor Edwards	Science coordinator	UA
Danielle Foster	Plant ecology	National Park Service [NPS]
Vicki Gempko	Plant ecology	NPS
Randy Gimblett	Social science	UA
Floyd Gray	Geologist	U.S. Geological Survey [USGS]
Kevin Harper	Cultural resources	NPS
Mark Holden	Plant ecology	NPS
Donna King	Plant ecology	NPS
Natasha Kline	Ornithology	NPS
Meg Koppen	Chef	N/A
Meg Quinn	Botany	Independent
Todd Nelson	Site coordinator	NPS
Larry Norris	Workshop moderator	Desert Southwest Cooperative Ecosystem Studies Unit
Bruce Perger	History	NPS volunteer
Cecil Schwalbe	Herpetology	USGS
Joseph Shannon	Aquatic ecology	NAU
Chris Sharpe	Social science	UA
Bill Shaw	Workshop moderator	UA
Ronnie Sidner	Mammalogy	UA
Don Swann	Mammalogy	NPS
Meg Weesner	Social science	NPS



KEVIN BONINE

Figure 2. During the pulse study, participants conducted surveys of plants and herpetofauna. Here Ranger John Williams (Saguaro National Park) photographs a variable sand snake (*Chilomeniscus stramineus*).

The Madrona pulse study—2003

Saguaro National Park's Madrona pulse study took place during a warm spring week in May 2003. Scientists from many disciplines and organizations participated. Biologists, ecologists, geologists, social scientists, and cultural resource specialists, as well as NPS resource management specialists, comprised the group (table 1). The Western National Parks Association (\$7,500) and Friends of Saguaro National Park (\$10,000) funded the study, with additional support from the Community Foundation of Southern Arizona and Earth Friends Wildlife Fund.

The Madrona pulse study started with field trips to the Romero pools in the Santa Catalina District of the Coronado National Forest, and Brown Canyon in the Buenos Aires National Wildlife Refuge. Both sites have perennial desert streams similar to

Madrona's, but they offer different issues and management strategies that helped place Madrona in its larger ecological and management context.

At Madrona, as in previous pulse studies, scientists and managers worked side by side all week in the field. Days began with bird surveys at dawn and checking mammal traps before breakfast. Mornings were spent on herpetofaunal and plant surveys (fig. 2), water quality measurements, sampling for aquatic invertebrates, and examining trails and the park boundary nearby. At night, participants searched for frogs and checked mist nets for bats (fig. 3, next page). During delicious meals (provided by sponsors and cooked by master field chef Meg Koppen), Meg Weesner (see table 1) led talks about the day's research findings and how they might inform management issues at Madrona. Participants studied and learned together, and engaged in spirited discussions about the importance of desert waters, the po-

tential impacts of recreation, the future of the ranger station, and many other topics throughout the cool evenings and unseasonably hot days.

The last two days of the pulse study were distinguished from most others in that staff from every division of the park, as well as members of the Friends of Saguaro National Park and other organizations, arrived at Madrona to participate in an outdoor workshop. In sessions moderated by research coordinator Larry Norris and University of Arizona wildlife professor Bill Shaw (see table 1), each scientist presented his or her week's findings. Additional speakers included Julia Fonseca, a hydrologist from Pima County, Arizona, and Pat Haddad, NPS manager of the mule-packing program. Most importantly, the workshop included opportunities for park staff to work in the field with scientists and share information about Madrona's history and cultural resources.



Figure 3. As part of the pulse study, participants set mist nets over the Madrona pools to inventory bats.

As with other pulse studies, the participants left Madrona with as many questions as they had answered: What were the dynamics of water volume and water quality in the pools? How many visitors used the site? How was wildlife activity changing over time? How large was the threat from exotic species? Nonetheless, participating scientists concluded that the Madrona pools were rich in ecological and cultural resources. In the weeklong study, investigators observed more than 50 species of birds and 153 species of plants; they also documented a large, stable population of lowland leopard frog (*Rana yavaipensis*)—a species of special concern (fig. 4). Moreover, the scientists confirmed that the pools were fed by bedrock springs in an unusual geologic setting, that is, a metamorphic core complex adjacent to the Catalina detachment fault. Such complexes are a newly recognized, hotly debated geologic phenomenon of basin-and-range crustal extension, shearing, and faulting. Another overarching conclusion of the researchers was that the Madrona pools are probably the least impacted aquatic resource of their kind in the

Tucson area due to low levels of historic diversions and current recreation.

Research and monitoring at Madrona since the pulse study

Soon after the study ended, Saguaro National Park published a technical report with chapters by participating scientists (Edwards and Swann 2003) and an illustrated executive summary for lay readers. The report identifies a series of data gaps and recommends further research and monitoring. In the six years since publication, the park has followed up with studies and monitoring, which address some of these gaps.

Hydrological research and monitoring

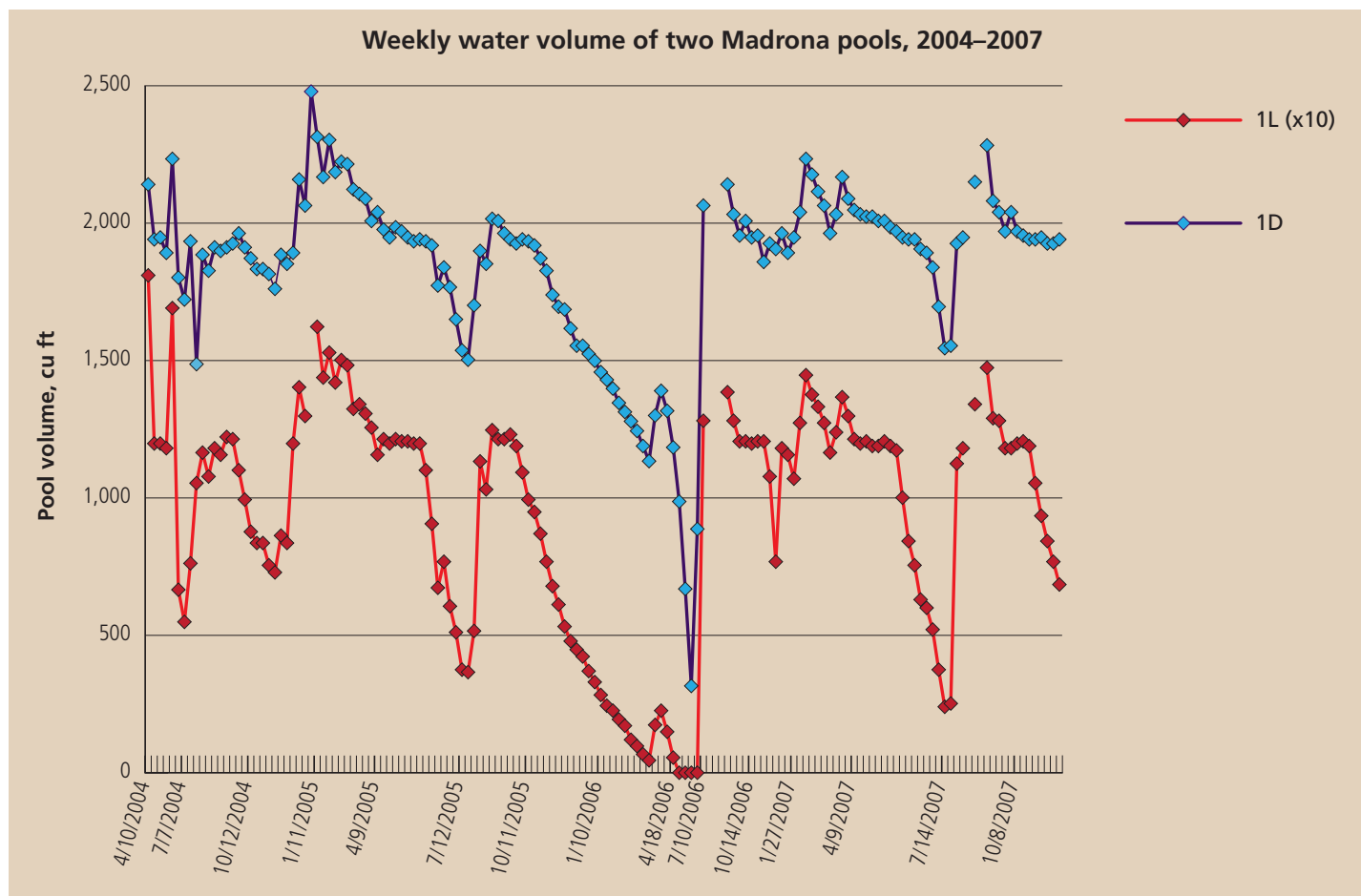
In the same year as the pulse study, park volunteers Mike Chehoski and Chuck Perger began regular monitoring of water levels in Chimenea Creek and nearby Rincon Creek. During one of the most



Figure 4. An important result of the pulse study was an understanding of the regional significance of the robust population of lowland leopard frogs near the Madrona Ranger Station.

severe droughts on record, from 2005 to 2006, many of the pools went dry, but the largest pool retained more than 300 ft³ (8.5 m³) of water (fig. 5; Swann et al. 2008). Recognizing that the greatest data gap at the Madrona pools was information about water resources, park staff applied for technical assistance from the NPS Water Resources Division, Water Rights Branch. In 2005, NPS hydrologists Chris Gable and Colleen Filippone helped park staff map the topography of the Madrona pools (fig. 6), installed a staff gauge, and established datums at the site.

A grant from the Western National Parks Association has allowed continued water monitoring at Madrona and tracking of sediment levels in pools throughout the park. Results of sediment studies indicate that the Madrona pools have low (<25%) levels of sediment, in contrast to stream-fed pools where sediment input following wildfires larger than 5,000 acres (2,024 ha) has inundated habitat of leopard frogs and other aquatic life. Parker (2006) found that high volumes of sediment delivered from hillslopes to canyon headwaters greatly impacted leopard frog habitat following the 2003 Helen's II Fire in an area where most fires had been suppressed for many years. In contrast, fire management activities in the watershed above Madrona, including prescribed fire and wildland



NPS/CHUCK PERGER AND DON SWANN

Figure 5. The pulse study was the impetus for weekly monitoring of water volume and quality of the Madrona pools. This graph shows 2004–2007 results from two pools (1L and 1D). Volume of pool 1L is multiplied by 10 for illustration purposes.

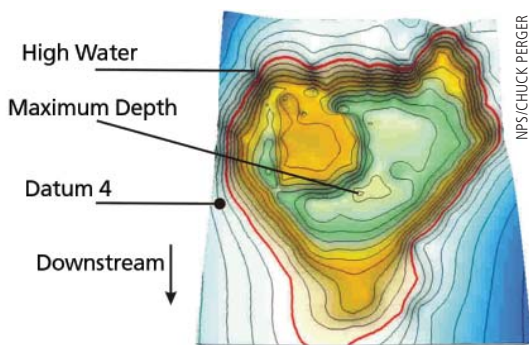


Figure 6. In addition to water volume and quality, water resource data include the topography of the Madrona pools. This topographic map details the bedrock contours of pool 1E. The contour interval is 0.5 ft (0.15 m), and the maximum depth (deepest point) is 5.1 ft (1.6 m). "Datum 4" is the elevation benchmark used for estimating pool volume. Flow is to the south (bottom of map).

fire use, may have important long-term benefits for pool habitat.

Since 2003, park staff has also cooperated with scientists from the U.S. Geological Survey (USGS) and the University of Arizona to study water quality in the pools. A graduate-student project examined the relationship between recreational use and water quality, and USGS scientists have begun baseline monitoring of heavy metals and other water quality parameters.

Wildlife monitoring

To learn more about aquatic wildlife and provide a control area to support an NPS water rights application on nearby Rincon Creek, the NPS Water Resources Division and Western National Parks Association provided additional funding to study So-

nora mud turtles (*Kinosternon sonoriense*) and amphibians at Madrona. This study confirmed the importance of the Madrona pools for aquatic species. During the 2005–2006 drought, leopard frogs and canyon treefrogs (*Hyla arenicolor*) disappeared, and many mud turtles died along Rincon Creek when it went completely dry for nearly a year; however, most frogs and turtles survived in the Madrona pools (Stitt et al. 2008).

In addition, using infrared-triggered wildlife cameras that volunteers check weekly, park staff has continued to monitor mammals. After six years of surveillance, the number of medium and large mammal species detected at Madrona has risen to 20, including species of management interest such as mountain lion (*Puma*

Case Study

concolor) and white-nosed coati (*Nasua narica*; fig. 7).

Restoration and visitor use monitoring

In 2004 and 2005, Saguaro National Park received two grants from the Department of the Interior, Cooperative Conservation Initiative, for studies at Madrona. One of the grants was for restoration and the other was for applied visitor research; both projects were outcomes of the pulse study. Park managers installed trail counters to determine visitation patterns over time and have proposed their continued use in the park's general management plan as a method for long-term monitoring and management of visitor use of the pools. Working with the nonprofit Rincon Institute, neighbors, and volunteers, park managers have restored several social trails and the abandoned stable area to native vegetation by seeding native perennials and grasses such as brittlebush (*Encelia farinosa*) and cane bluestem (*Bothriochloa barinoides*), and planting shrubs such as white-thorn acacia (*Acacia constricta*) and blue paloverde (*Parkinsonia florida*). Volunteers have also removed exotic species such as wild oat (*Avena fatuas*), tamarisk (*Tamarix ramosissima*), and African buffelgrass (*Pennisetum ciliare*).

Management implications

General management and trail plans

The major driver of the pulse study was the need to gather information for the park's general management plan. The concern was how to appropriately manage and plan for a sensitive resource site that is also the location of obsolete housing and support facilities. The pulse study helped confirm for managers that not only does the site have unique resources but also that it had received a high degree of protection by on-site rangers. Alternatives in the general management plan recognize the educational and scientific value of the Madrona pools. The approved plan calls for



Figure 7. Six years of infrared-triggered camera data, acquired since the pulse study, show that many rarely seen species frequent Madrona. This photograph captures a visit by a white-nosed coati.

visitor use to be highly regulated to protect sensitive resources. Staff housing and new corrals, if developed, are to be located so that impacts on the site's most sensitive resources are minimized.

In 2005, park managers began developing a new trails plan. The pulse study noted that Madrona would become a primary destination if a rerouting of the Arizona Trail ran through the area as proposed. Furthermore, heavy recreational use would adversely affect natural and cultural values. As a result, the trails plan calls for the Arizona Trail to connect to the Manning Camp Trail through a scenic area west of the site rather than through Madrona itself.

Other benefits

The Madrona pulse study benefited Saguaro National Park in ways not anticipated in 2003. For example, more detailed information from this one site has helped park managers better understand threats to aquatic resources throughout the park, especially at Rincon Creek, and played an important role in conservation of lowland leopard frog in the Tucson area. For the past six years, park staff has worked in partnership with the Arizona Game and Fish Department and several nongovernmental organizations to raise lowland leopard frogs in backyard ponds for potential translocations in areas where this species no longer occurs. Tadpoles from

Madrona have spawned frog populations elsewhere in the Rincon Valley.

An unexpected benefit of the pulse study was a renewed appreciation for the park's history and the cultural values of wilderness. One of the more spirited discussions during the pulse study workshop was about mule packing. Mules had carried the gear of generations of seasonal wildland firefighters to the park's high-elevation fire base camp at the historic Manning Cabin, but prior to the pulse study the program's future was uncertain. The pulse study reinvigorated the packing program and led to a celebration in 2005 of the Manning Cabin's 100th anniversary, which brought back many old-timers who had lived, worked, and packed in the park's wilderness areas. While mules and historic cabins were not part of the goals of the pulse study, having people from different viewpoints sit down together and talk about these issues resulted in significant, though unanticipated, outcomes.

Implications for other parks

The results and follow-up studies over the past six years show that pulse studies are a very useful, though underutilized, tool for bridging the gap that commonly develops between how scientists and managers view public lands. The NPS Omnibus Management Act of 1998 directed the National Park Service to integrate scientific knowledge into management decisions. The jobs of decision makers are made much easier, and the decisions are better, when the science is relevant, readily available, and clearly communicated (Lewis 2007).

Traditional "science for management" projects are often expensive and take years to finish. Furthermore, scientists and managers often perceive problems differently. In contrast, pulse studies are

inexpensive and rapid, and place park staff and scientists in direct contact with each other (Weesner 2006). They also help to focus any follow-up research. These studies seem to be ideally suited for site-specific resource issues that demand information in a short time but are complex enough to require a range of expertise. Although pulse studies did not originally include cultural resource specialists and social scientists, their participation greatly improved the process and results of the Madrona pulse study. Even when the issues appear to be primarily ecological, cultural resource and social science expertise results in unexpected benefits.

The disadvantage of pulse studies compared with research projects is, of course, that their brevity rarely results in a full understanding of the system. But this disadvantage is offset by the benefit of having many experts discussing issues together in a focused way—something that rarely happens under usual conditions. Participants can gather an amazing amount of data, which is immediately peer-reviewed in the field and around the campfire. Pulse studies also can get the attention and interest of park management in ways that reports and conferences often do not. Interaction during the pulse study can focus the work of scientists on the practical issues and concerns of the managers, so that the latter may see that the scientists are producing worthwhile and useful products. Also, interaction during the pulse study can have a positive influence on follow-up research and monitoring.

The major costs for the Madrona pulse study were salaries. Most academic and governmental scientists donated their time, but junior scientists (usually graduate students) received a stipend upon completion of their final report. Park funds covered salaries of NPS staff. “The pulse payoff for the park,” said Sequoia and Kings Canyon national parks ecologist Annie Esperanza in a 1994 interview in

Park Science, “is the short-term labor force it affords us, the collection of a mountain of data, the stimulation and excitement of the participants who work in this important place. . . . The long-term payoff is the way it helps us keep long-term research alive here” (Matthews 1994, p. 6). Like Esperanza, Saguaro National Park staff appreciated the excitement the Madrona pulse study generated. This excitement has carried over for six years, and in ways not originally anticipated.

Pulse studies ... bring together scientists and managers to ... quickly assess the ecological health of an ecosystem or area.

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*Participants completed a long list of logistical tips to make pulse studies proceed more smoothly. Contact the author, **Don E.***

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