

The Goldilocks Syndrome

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Across protected lands, cutting-edge research is underway. The findings are vital to habitat protection and make for compelling stories and opportunities for STEM (science, technology, engineering and mathematics) learning and civic participation. This conference session aimed to showcase strategies that insure that both staff and visitors benefit from the park-based research. Like Goldilocks, those of us who work in or with parks tend to encounter expectations of scientists that are too big and too small. At times scientists' expectations of what parks can do are too ambitious, and other times they are unnecessarily limited. Presenters asked themselves and each other: what are the questions we can pose as brokers between parks and researchers to get it just right?

Session presenters shared their perspectives, including Jim Pfeifferberger, Education Coordinator at Ocean Alaska Science Learning Center, Paul E. Super, Education Coordinator at the Appalachian Highlands Science Learning Center at Purchase Knob, Great Smoky Mountains National Park, Brent Everitt, representing the Gulf Islands National Seashore, and Martha Merson from the Interpreters and Scientists Working on Our Parks (iSWOOP). Martha Merson and Brent Everitt

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facilitated the session, asking participants to share ideas and challenges they are confronting. This discussion set the stage for presenters' vignettes of more and less successful efforts. The session concluded with small groups listing tips for park staff to advise scientists for outreach to different audiences.

The challenges in communicating science to the public are many. Participants mentioned several, including the following:

- Research might not result in clear solutions to communicate.
- Managers want guidance.
- One research study involved 12 parks, findings vary, and there's much complexity.
- Climate change plays a role, and that can add a political element.
- Competing priorities for research and other projects mean there are challenges to sustaining momentum. Turnover in administration (at the local or federal level) could also mean waning interest in supporting particular research projects.
- Adverse stakeholder groups could seek to undermine the research, or events where research is discussed.
- Limited staffing: no one person is designated for outreach.

The goal presenters embrace is not only to come up with realistic projects, but to make outreach a routine, standard part of scientists' experience in parks, with options that fit the park's needs as well as scientists' varied skills and interests. Given demands on scientists such as funding research in the field, training assistants, and managing the analysis process, as well as reporting and permitting, well-planned outreach and education can easily get lost in a long list of competing priorities. Park staff are also pulled in multiple directions, but with a protocol to guide conversations early on, education coordinators have found that they can shape outreach and education opportunities that are rewarding for participants and scientists.

Pfeiffenberger's advice to researchers is to find an educator to collaborate with early on. If the same care that's given to a research plan is given to an outreach and education plan, meaningful connections between various audiences can result. In a pinch, yes, if the data have already been collected and even analyzed, parks can probably still help connect researchers with an audience, but if the outreach plan is designed early on, there is time to plan targeted events and create appropriate products.

An example, from a recently funded research project on marine invertebrates, makes the point. With Pfeiffenberger's help, the researchers realized that the significance of their study went far beyond the mussels and clams in the marine environment. Giving the study more context, the proposers related the health of the invertebrates to bear nutrition. The funder awarded nearly \$100,000 for outreach (of a grant totaling \$800,000), which the project has used in a number of ways: to fund summer interns dedicated to raising awareness of the research; to produce a film that is traveling to Alaska communities, letting adults and youth know about the research in their park; and to produce fact sheets or research briefs that are designed with commercial boat operators in mind, since their livelihoods are intricately tied to the scenic marine habitats where researchers have set up their study. Project leaders have also contracted with an educational designer of virtual field trips, expanding opportunities for teachers and students to connect classroom learning with park-based science.

Paul Super shared details from several citizen science projects that grew out of conversations with researchers about their needs, and opportunities for visitor engagement. Citizen science can take many forms, such as water monitoring, or bird counts. Typically, several elements make citizen science distinct from other education and research projects. Ideally, citizen science results in meaningful, useful data that advance scientific understanding, and may be applied to real-world problems. Objectives include education about specific organisms or systems, the scientific process, or conservation and natural resource management.

A project that uses citizen volunteers to collect data but does not include an educational component is taking advantage of unpaid labor. It might advance science, but doesn't advance science education, or scientific literacy. Paul Super considers the balance. A bird banding station that welcomes in the public and allows visitors to assist with banding sounds more like education for visitors than useful for scientists. However, a project where volunteers are trained in pollinator ecology, and then help with a bumble bee inventory, collecting data at sites that the principle investigator can't (because of time or limited resources), that hits the sweet spot—the project is both educational for volunteers and useful for scientists.

Another example brings together several points. Dr. Chris Carlton planned to collect a certain beetle that lives in fungi in Great Smoky Mountains National Park. After several weeks, he had failed to find the fungus or the beetles he wanted to study. Mr. Super wondered if Dr. Carlton's research would be a good match for a citizen science project.

Before long, Super arranged to have Dr. Carlton give a talk to the Asheville Mushroom Club, which held a fungal foray (Figure 1), and collecting a large bag of stinkhorns, Dr. Carlton's target fungus. Then Super arranged to have a camp group of middle school students paw through the fungi, locating the beetles (Figure 2). In a matter of hours, Dr. Carlton had achieved his data collection goals, Mushroom Club members and middle-school students had learned about an inter-species relationship between fungi and beetles, and both groups had the satisfaction of helping a researcher. Last, the park had a better grasp of the beetle population. In this case, however, the broader public still went about its park visits none the wiser about the research inquiries into the beetles which are fond of stinkhorn fungus.

If citizen science isn't the complete answer, what is? Merson explained that a collection of visuals can be a springboard to building science and visual literacy in parks and other protected lands. The iSWOOP project, piloted at Carlsbad Caverns in New Mexico, brought scientists and park rangers into direct contact. Through field- and classroom-based experiences, the park rangers became conversant in studies of the Brazilian free-tailed bat, led by Nickolay Hristov and Louise Allen. Visitors to the Caverns tend to ask questions about the bats. With information on the park-relevant and park-based research, park rangers could answer questions, but because the scientists shared a library of visual images (animation, video from thermal and high-speed cameras, and 3D models), park rangers could do more. They could reveal something about a natural resource that visitors might not otherwise see. They could invite visitors to observe, predict, and speculate. The visual library served multiple purposes. Park rangers commented on how running a video could act as a hook, captivating attention in the visitor's center. Hristov and Allen have footage of bats flying at sunset, startlingly beautiful. One ranger loved to show a dense cluster of very young bats, prompting visitors to observe differences between infant bats and mature bats. In addition to eliciting surprise and inquiry, scientists' visuals can also function as a springboard for conversations



Figure 1. The Asheville Mushroom Club with the findings of their fungal foray. NPS photo.



Figure 2. Dr. Carlton overseeing the middle school students digging through the stinkhorn fungus to find beetles. NPS photo.

about the role and relevance of research. One ranger used thermal video footage from the roost to reveal the bats' activity level during daylight hours. She concluded by asking visitors how the use of technology might change their park experience. Did it make it better? Different?

Park rangers have attested to the impact of their iSWOOP experiences. For some, access to the visual library was the most valuable component (compared to opportunities to gain new strategies for interaction; Char 2015). Collecting scientists' images is a concrete step toward making research a more prominent and interactive part of visitors' experiences (Table 1); iSWOOP has paired the visual library with direct contact with scientists. Whether or not the latter kind of professional development can be arranged, having an image collection can prompt substantive conversations about the science underway on-site. Establishing a visual library should include agreement on these four elements:

- guidelines for fair use and a credit line (list funder, affiliated university, etc.);
- preferred ways to direct people to more information (e.g., an online researcher biography of the researcher, a website citing published work, or social media);
- where the image library will be located and accessible to those who need it; and
- strategies for promoting the collaboration, if this is of interest to the park and researcher.

Gulf Islands National Park has been proactive about giving visibility to its park-based research projects. Susan Teel, Chief of Resource Education, advises, "Find out about research on charismatic species or resources that need protection. Make the project famous! Use as many outreach strategies as possible." At Gulf Islands, they are serious about using every vehicle at their disposal, including actual vehicles. Researchers are given large signs to attach to their vehicles, indicating they are "Park Researchers." This strategy increases awareness of the park as a site for research,

TYPE	PURPOSE	EXAMPLE	MEDIA
High-resolution images of the resource	Make aspects of the resource visible; inspire stewardship	Bottomland hardwood forest	
High-resolution images of the research instrument	Visual reference for scientists' tools; illustrate an innovation	Low-tech artificial nest boxes	
Visual of the researcher in action	Illustrate the science process; put a human face to scientific research	Field assistant removing a bird from the net	
Visual of human interaction with the resource	Model how to handle the resource; get across scale	A migratory songbird whose weight is equal to a car key	
Visual that documents the focus of study	Illustrate what was investigated	Emergence of 1000s of bats from roost	
Video or audio of the phenomenon	Help viewers imagine themselves in the scene	Group dynamics in a dense flight formation	
Image that precedes a graph or visualization	Show the process of data analysis; what the instruments pick up that is then analyzed	Analysis of bat emergence with computer vision	
Graphs, spectrographs or visualization	Show the data and other results of the research activity; illustrate evidence	Each colorful trail shows the trajectory of a bat	
Tutorial visual that demonstrates the technology	Scaffold understanding by showing technology in use with familiar objects	Thermal image of candle and ice pack	
Juxtaposition of any kind	Help viewers imagine themselves in the scene	Hot flame versus a frozen ice pack	

Table 1. Elements of a visual library.

and the signs fuel curiosity and spark conversations. But this is just one of many ways staff try to make the research famous. Their goals are to increase visibility of park-based science and to increase stewardship.

To create a visible, effective campaign, park staff ask themselves these questions:

- Who needs to care?
- What is cute or appealing about this?
- How will caring change visitor behavior?
- Is there an action for visitors to take at the park and at home?
- What message could a magnet or other souvenir carry (e.g., “I slow down for chicks.”)?
- How could the research lead to an annual event?
- How can teens be involved?

Known for Turtle THIS (Teens Helping in the Seashore), Gulf Islands interpretation and education division leaders have found ways to highlight research to build public awareness of challenges facing wildlife, for example, light pollution decreasing infant turtle survival, to establish career paths for youth (from intern opportunities to programs in bio-tech, with paid positions), and, perhaps most gratifying, to spark behavior change among visitors.

Applying ideas from Turtle THIS, the park staff came up with simple strategies to build interest in chicks and awareness of humans’ impact on their mortality. Publishing a daily count of chick births on a white board in the visitor center leverages interest in baby animals, offers something new all the time, and invites questions about the park’s seabird research and management. A magnet souvenir reminds visitors of the action they can take while in the park—“slow down for chicks.”

Participants of the session left on a hopeful note with a list of reasons to make park research visible. We have a powerful rationale. Research in parks (and refuges) is federally-mandated, fun, vital to connection with surrounding community, vital to inspire people to live in harmony with nature, and vital to managing resources and making decisions. Nearly any research topic, from stinkhorns to mussels, can find an appreciative audience. Topics like dinosaurs, the plight of young chicks, and the challenges facing turtle hatchlings, are a gateway, an opening to more science learning. Interested readers can obtain a questionnaire with hints for planning and brokering productive outreach and education partnerships by contacting the lead author.

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