iSWOOP Update

Carlsbad Caverns National Park (CAVE)

January-April 2014

Even in a highly technological age, observation remains a fundamental practice of science, especially in fields where deep looking is a core means of finding questions, generating data, and constructing evidence (Wilson 2006).

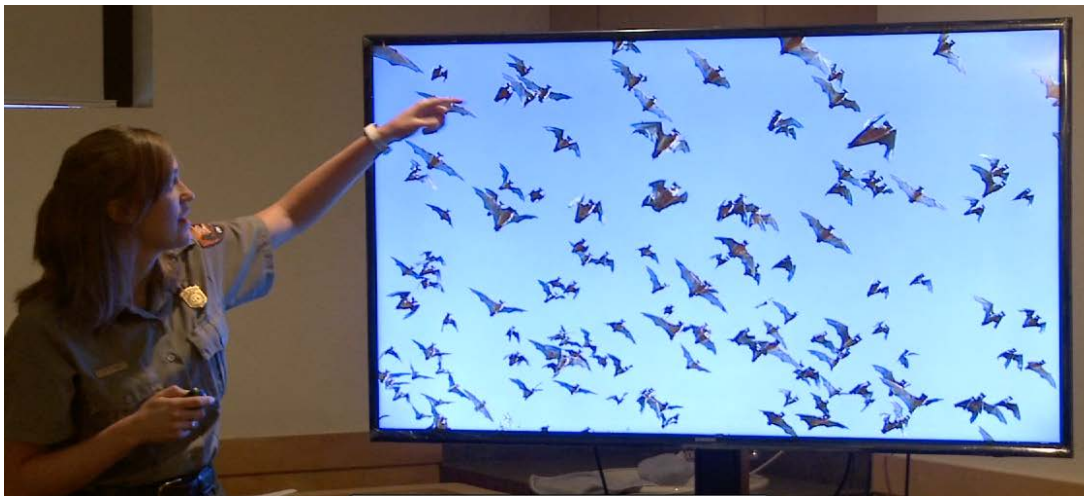
iSWOOP (Interpreters and Scientists Working on Our Parks) project leaders and advisors are scattered around the country—from Boston to NC, from Colorado to Oregon. For those of us at a distance interested in how iSWOOP is affecting park rangers' interactions with visitors, the feedback interpreters logged after using the iSWOOP cart gives us some answers. Evaluators want to know:

> *How does the public respond to new programming? To what extent is there visitor participation during presentations? Is there evidence of new learning about ways of looking, about bats, population estimates, bat behavior, the technology that is part of scientific investigation underway at Carlsbad Caverns National Park (CAVE)?*

Interpreters' observations are revealing.

In the summer when the bats roost at Carlsbad Caverns, park visitors are keen to learn about bats. With the addition of seasonal staff, many more iSWOOP programs are on the weekly schedule. Project leaders Nick Hristov, Louise Allen, and Martha Merson initiated a new group of park rangers to iSWOOP in June. Later this summer the evaluation team will conduct several observations and we have video recordings of some iSWOOP programs for further analysis. However, this memo, with its focus on data from January-April is the sneak preview, a taste of how the visitors have responded, based solely on interpreters' reports January through April 2014.

From mid-January to mid-April, interpreters regularly rolled the iSWOOP cart (laptop and 60" screen)



into public spaces of the visitors' center. They led formal interpretive talks and chatted informally with interested visitors. Interpreters tried out their new facilitation moves, designed to prompt visitors to observe, predict, and form questions about the bats, the research underway, or the technology leveraged to build understanding of the nocturnal, Brazilian free-tailed bat. Participants, ranging from young children to retirees, chimed in with questions and observations. The interpreters documented visitors' responses on a Google form (Appendix A). We report on 50 programs interpreters led

reaching approximately 270 visitors. This is the data set we draw on to report progress toward using compelling visual data and graphs as a jumping off point for STEM learning.

Background: What is iSWOOP? What is different about an iSWOOP program?

iSWOOP has many facets: Interpreter, Josh Nelson, summed up the different ways he and his peers have defined iSWOOP. The statements can be seen along a continuum from focused on bats, the featured park resource, to focused on the research process. But all reference the lens of research and two of them emphasize visitors taking an active role in dialogue.

Bat focused	Bridge	Research-focused
An inside look at the inner workings of the bats at Carlsbad Caverns through the eyes of our researchers and the technology they use.	iSWOOP is about bringing visitors, interpreters and scientists together into an active conversation. Our National Parks are not static places; our National Parks are active learning environments. iSWOOP is a way to be true to that reality.	An iSWOOP program should actively engage visitors in a dialog on research happening in National Parks, while allowing them to find their own relevance through STEM learning

(from blog post, March 13, 2014)

iSWOOP programs are illustrated talks. They draw on visuals about park phenomena. The ultimate goal of park-based programs is evoking conservation and an impulse to care for the park and its species. iSWOOP talks come at this goal from the angle of shared questioning, wondering, predicting, observing, and building understanding of bats. All iSWOOP programs featured visuals displayed on the iSWOOP cart. Researchers Hristov and Allen shared 43 media elements, a combination of still images, video and animations of 3D models. Interpreters choose from a variety of images including bats in flight, images from the crèche, newborn, young, and mature bats as well as images that illustrate the process and applications for high-speed video, motion capture, laser scanning and 3D models of the cave. iSWOOP offers participants opportunities to practice close examination of visual data. Scientific observation is a highly refined and practiced form of attention that requires particular ways of coordinating the mind and the eye. (Norris 1985). Scientists are so practiced at it, schooled in it, they are nearly oblivious to the fact that they do it and others need to be taught how.

Return Flight

- Slow motion video
- Shows the morning behavior of BFT bats returning to a cave.
- Notice how bats try to avoid interactions with other individuals. This video was taken in the morning, what senses do you think they are using to avoid collisions and return home safely?
- Pair with videos of emerging bats.

This is an example of an entry in the image index compiled by Allen to help interpreters plan presentations

In iSWOOP talks led during this period, nearly all visitors saw video of the emergence of Brazilian free-tailed bats at dusk. However, interpreters used this video in different ways.

- As a window into finding patterns, and problem solving. Interpreters asked: *How could you study a small, fast-moving creature in the dark? What technology do you carry with you? Could it help you?*

- As the prompt for a challenge for a process or model. After showing the video, interpreters asked: *How could you count the bats?*
- As the focus for examining and hypothesizing about structure and function: *Are they bumping into each other? What senses do you think bats are using to avoid collisions?*
- To probe for relationships between quantity and time. One interpreter chatted with participants as they gathered to learn if they had witnessed bat flight in the past. *How does this emergence compare with one you have seen? Why do you think the numbers might fluctuate?*
- As the answer to visitors' questions or predictions. *Do bats ever glide?*

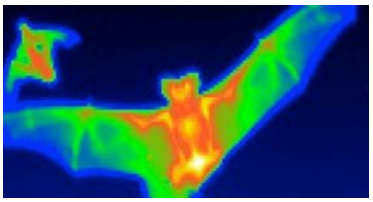
All of these uses foster deeper engagement, going beyond the role of teaser.

Questions upon close examination of visual data (and visual literacy)

During iSWOOP programs visitors asked dozens of questions. This is not unusual. Visitors participating in tours, Bat Flight, and other programs frequently questions. However, in those settings their questions tend to cluster in the realm of bat facts. Questions of this sort cropped up during iSWOOP programs too. Interpreters noted when this was the case.

However, of the 75 questions interpreters recorded, one-third illustrate the extent to which the iSWOOP programs encouraged close examination of visual data and consideration of the technology researchers are using. These questions ranged from the factual to the hypothetical:

> Is this video [from the roost] during the day or during bat flight?
>
> Why are the plants hot?
>
> Why does each bat have a yellow dot in its center?
>
> Will the thermal camera that will be installed in the cave be able to move on its own?



Visitors wondered:

> The latter group was wondering if bats may return to CAVE earlier this year because of the seemingly early spring. This pondering led to a discussion about the greater picture that can be achieved through thermal imaging counts and climate data, etc.

Thermal images surfaced questions and sparked curiosity and conversations not only about researchers' work, but also about the 'constructedness' of visual data. For example:

- Photographs are not simply 'records of reality'; at both capture and editing stage, they are manipulated in ways that influence meaning-making
- Both the content and the composition of an image influence meaning-making;
- Visuals, including photos have many potential meanings. Different individuals will read the same image in different ways depending on their knowledge, skill, experience, beliefs and values.

By expanding opportunities for participants to pose questions to the interpreter and each other, interpreters heard questions that spoke to these different aspects of interpreting visual data. Visitors asked orientation questions that would affect their interpretations:

> From what angle are we looking at the roost?
>
> How does size of a bat alter the thermal reading?
>
> When we were working through the thermal primer, mom wondered why she could notice the intricate differences of heat signatures in the last color combination (the one more dependent on shades of blue) more than the other color combinations. Do humans, specifically women, discern variations in blue more than other colors?

Interpreters who extended opportunities to audience members to interpret the image elicited contributions that enriched the program:

> When we moved on to motion capture, one man, unprompted, started giving examples of ways motion capture is used in animation.

Examples of engagement—challenges and successes

Interpreters observed visitors' level of engagement, reporting positive response:

> They were pretty amazed with the orientation video of thermal imaging, there were wows when the candle was blown out and you could still see it [the heat] in the thermal image.
>
> On the screen the video of the bat flight was playing. I started off by introducing iSWOOP. I asked the visitors what they would do if they where a scientists and were interested in learning more about the animal that they were observing emerge from the cave. What are some of the challenges that they might have to deal with or overcome to get answers to their questions? Some of the challenges that the visitors pointed out from watching the video included, the bats are fast and they are nocturnal.
> We then talked about technologies available to us and how they could be helpful in studying bats.
> … They were curious and interested …
>
> They were interested in the science behind counting bats, but we talked a lot about the natural history of Brazilian free-tails as well. They were especially interested in the pups, how females know their pup from others, what it is like in the roost, etc. Some of their spontaneous questions included: are those bats flying in or out of the cave and how do you know? Why does each bat have a yellow dot in its center (from the thermal image set)?

Even when verbal interaction was low, interpreters were attentive to visitors' responses and described non-verbal interaction.

> They were both older couples and seemed very unwilling to contribute to the conversation. They were however, very passively engaged intently listening to everything I was saying.
>
> I had 6 visitors from Cambodia. 1 spoke some English and translated for the others. The program was difficult with the language problem. I showed them several images from the cart, thermal bat flight and bat flying in wind tunnel. The bat in flight was what they were interested in.

Interpreters incorporated activities within their illustrated talks. One interpreter asked participants to record the number of bats they saw during six seconds of an emergence. Then she asked participants act out the steps in an algorithm for sequencing the estimates. Another interpreter encouraged groups

to compare and contrast bats of two species in flight in a wind tunnel filmed with high speed cameras. Comments were positive:

> People usually respond well when I ask them to brainstorm what kinds of instructions you'd have to tell the computer to be able to count the bats. One mom was really excited about the algorithm. She had me go back to that slide and explain it again for her son, so he would understand a little more why kids study what seems like useless algebra in school--because later you can put it to good, practical use.

The invitation to compare and contrast two bat species in flight in a wind tunnel filmed with high-speed cameras generated discussion among participants.

> When showing the two bats flying side-by-side someone instantly noticed the ear size difference. That than led to why that might occur and what the different behaviors/diets might be.
>
> 
>
> When I first switched from regular speed of bat flight to the slow motion version, they audibly gasped and got closer to the screen to look at the details. They offered observations on the differences between the two species of bats in the wind tunnel, and asked why their wings looked so different. They spent a long time on that slide pointing out their observations to each other.

Interpreters found participants able to make connections and to contribute to the program. For example:

> This group understood thermal imaging pretty well, as one of the men used it to detect where heat escapes from houses.
>
> The couple predicted that bats would be sleeping during the day. I played the thermal video of the bats in the Bat Cave and they were surprised to see that they are quite active.
>
> They also brainstormed a lot of reasons at the end why there might be more bats one night than another, or even one year than another.

Although Hirstov and Allen's approaches (using expensive thermal and high speed video cameras and research subjects (bats that fly 10,000 feet in the air and make their homes underground) seem far removed from most people's daily lives, high levels of engagement were evident to interpreters who observed attentiveness to images, audible gasps, and active participation: counting acting out the algorithm, brainstorming, questioning, sharing predictions, making contributions of prior knowledge, and observations.

Visitors' statements about STEM learning, new insights

During 35 of the 50 iSWOOP programs, interpreters explicitly asked their groups of visitors:

> How many of you saw something in a new way?

During 30 of the 50 programs, interpreters asked,

> Did you learn something new about scientists' work?

On half of the occasions when the questions were posed (n=35; n=30), the response was unanimous or near unanimous. Of the approximately 230 visitors who were asked:

- 71% affirmed that they saw something in a new way
- 65% affirmed that they learned something about scientists' work.

Interpreters asked for examples. Comments about seeing something a new way ranged from facts about vision and bats' ability to employ echolocation to comments about the role of technology in scientists' studies. Two examples follow. More are in Appendix B.

  - He had seen the thermal imaging stills on some temporary exhibits, but never imagined how those translated to actually counting the bats. He found the counting part to be the most interesting.
  - Realization bat population is not constant; beneficial; new respect for bats and how they survive; long lifespan; size of colony
  - High speed of bat flight; computers detect and count; never seen motion capture; tech answers basic questions; thermal imaging gives you a new way to see bat flight; tech improves counting and estimates;
  - Most expressed that they were really unaware that scientists even did work in National Parks.

Comments about scientists working in national parks occurred on more than 10% (n= 65) of occasions when the question was posed. Besides building an awareness of the research happening at the park, we would like to make sure we take this further, to the "so what," encouraging visitors to articulate the relevance of this research at their parks. One interpreter offers a summary of the project at the end of his talk, explaining that this is our park; research is being done with our tax dollars for our benefit.

Challenges: iSWOOP taking hold at Carlsbad Caverns

On-site support is critical for iSWOOP's success.

In its first four months of implementation, interpreters and supervisors maintained high levels of enthusiasm about the project. The team at CAVE faced various kinds of logistical challenges. Managing the schedule so that interpreters charged with carrying out iSWOOP programs were equitably assigned program time slots was not trivial. Then interpreters had the iSWOOP cart with images and screen, but choosing a place that made sense proved a challenge, particularly as the visitor center exhibit area was under construction. Finding an outlet and a reasonable set-up, getting agreement on how far the cart can stray, getting a chance to practice with the laptop have all added unanticipated challenges to implementation. Without Pam Cox's superlative problems solving skills, iSWOOP could have been derailed. Cox has observed programs, advocated for the theater as a venue where participants can sit and focus, intervened in scheduling decisions, and advocated for additional Mac computers.

Incorporating science content *and* meeting interpretive goals are both critical.

We have noticed the following challenges to using scientific data as the centerpiece of interpretive programs: 1) introducing visitors to complex technologies 2) giving visitors a window into the frustrations, obstacles, and creative problem solving that are part of site-based scientific research and, 3) in line with the vision for audience-centered interpretation and guidelines for facilitated dialogue, making programs even more interactive.

Interpreters are experimenting: setting expectations for their programs with their audience; incorporating sequences of slides; enticing visitors to comment on the data and why it matters. Orchestrating interpretive programs that invite visitors to offer predictions and answers to their own questions requires discipline. Interpreters need to provide scaffolding without telling the best parts. Because of their collaboration and field-work with scientists, iSWOOP interpreters can draw on first-hand experiences with laser scanning and high-speed videography to highlight the possibilities for research. Nevertheless, crafting a program that is science-based, but maintains a narrative thread with the result of inspiring audiences to care about conservation is a tall order.

Louise Allen, biologist, and Martha Merson, STEM educator, provide support online and in scheduled conference calls. They respond to blog posts as well as email.

Plans for the Future

As we continue to document the response to iSWOOP programs, we feel increasingly confident that scientists' visuals in the hands of park interpreters can function as a meaningful and engaging jumping off point for STEM learning. Our formative research has led us to generate and refine the visuals available. That is, we are documenting visitors' questions and interpreters' motivation to speak to various topics, which has led Nick and Louise to refine the media elements available. To maximize our impact, we have a new idea in its testing phase at Carlsbad Caverns and questions to guide our ongoing research.

1) Supply a cart with laptop as we have with the iSWOOP cart, but offer additional options for display. At Carlsbad Caverns we have outfitted two iPads with Nick and Louise's images as well as animations of the cave based on laser scans for which interpreters collected data. These travel with interpreters as they rove through the cave and Visitor's Center. The make for a personal, intimate exchange as visitors gather to be close to the screen. Where parks already use a TV or LCD screen display, this could increase awareness of environmental processes and scientists' research if it cycled through images (possibly with captions in multiple languages). What are the trade-offs between the cart and iPads, more formal and less formal presentations? What other display options might visitors and interpreters embrace?
2) Examine why the thermal images seem to generate greater interest and discussion than others. It may be that the sequence we have for this (accessible, compelling research questions like what is happening in the roost or how many bats are there is answerable with an intro slide contrasting typical and thermal images of a candle; several examples in and outside the cave; culminating with a clear scientific application as viewers see a computer tally bats) is something we need to replicate for any topic or instrumentation. In the professional development for new iSWOOP interpreters in June, we spent time on bio-acoustics and visualizations of sound within and beyond human hearing. Visitors will be able to experiment: vocalizing and then seeing a colorful depiction of frequency, tone, and volume in the sound. It will be interesting to see in what ways this hands-on component sparks questions and hypotheses.
3) Encourage dialogue on the blog and among advisors in response to the idea that visitors now have greater awareness of science happening at the park. Is this a satisfying end in itself? Is there an elegant way to weave a take-home message about park-based science with the

conservation message and concern for the parks that interpreters wish to convey? Can interpreters convey all of this without becoming preachy or didactic?

iSWOOP project leaders will offer the following kinds of support to interpreters.

1) Reiterate that interpreters can work from their strength: storytelling, while encouraging observation of patterns (in colony size), the attention to scale (size of moms and babies), and structure, and comparisons and contrast of function (of wings and ears).
2) Narrow the pedagogical focus on engagement by encouraging interpreters to involve participants in comparison and contrast as this is one of the most promising techniques for engaging visitors and making them more active participants in programs.
3) Help interpreters generalize what they learn. The iSWOOP approach is not confined to bats. As interpreters from the January pilot report using findings from research in their tours and Bat Flight talks, it is clear that scientists' research enriches their work. However, this is a limited view. iSWOOP has the potential to give visitors a window into the challenges and technology that make thinking through the answers to questions about cave formation, cave swallows, and cacti as exciting as coming up with questions. Actively finding out is exciting; being told an answer is typically not.

iSWOOP interpreters are offering their iSWOOP programs to thousands this summer. Next report, we will have more to share about the programs interpreters have crafted that feature researchers' methods, data and visualizations. And what interpreters have to say about the process.

Citation

Louw, M., & Crowley, K. (2013). New Ways of Looking and Learning in Natural History Museums: The Use of Gigapixel Imaging to Bring Science and Publics Together. *Curator: The Museum Journal,* 87-104.

Appendix A

Feedback on iSWOOP Programs

1. Your Name

2. Program Title

3. Date and time, notes on duration

4. Estimated size of the group attending your iSWOOP program
If more than 15, it's okay to round to the nearest 5 or 10. Count ages four and older.

5. Visitors' observations, comments, questions, predictions
Record at least a couple examples that stood out for you.

5. Results of show of hands--Who saw something in a new way?
If possible, report as a ratio, e.g., 11 out of 17

6. Examples from a few volunteers--Who saw something in a new way?

7. Results of show of hands--Who found out something about scientists' work they didn't know before
If possible, report as a ratio, e.g., 19 out of 20

8. Examples from a few volunteers--What kinds of things about scientists' work did they learn?

Anything else? Group configurations (ages, couples, friends, families, etc.)
You can also tell us more on the blog about your experience

Appendix B

Participants' responses to what they learned. Responses are aggregated from eight interpreters' feedback over four months, and grouped by topic.

Black are responses to the question, "Who saw something in a new way? What?"

Purple are responses to What kinds of things about scientists' work did you learn?

Topic	Examples
Behavior, anatomy, population & species (24 mentions)	Active during the day in the roost; bats vocalizing; Different types; reproduction—how bats raise pups; finding bat pup in crèche; [Saw] flight in a new way; how different bat flight is from birds' flight. Bats can be trained to fly in wind tunnels. Flight is like swimming in air. Relationship of bats' features and their behavior; Wonder about bat lives; bats aren't blind; [Existence of the] species of bat called Brazilian free-tailed Migration speculation related to weather conditions. Realization bat population is not constant; beneficial; new respect for bats and how they survive; long lifespan; size of colony I "quadrupled–maybe even quintupled!" his knowledge about bats 
Technology (21 mentions)	High speed of bat flight; computers detect and count; never seen motion capture; tech answers basic questions; thermal imaging gives you a new way to see bat flight; tech improves counting and estimates; beneficial—able to track population health given WNS; awareness of new technologies; technology in use in parks They really loved learning how fancy technology can be used to study bats. They hadn't thought about that application. Value of tech and computer processing to study of bats; thermal could have different color keys; imaging tech to map cave; computer counts bats with a sensor; impressed; They did not know that researchers were using some of these technologies; We had a discussion on high speed cameras and how to capture the bat in flight footage. The potential to study mechanics of bat flight
Basic science (12 mentions)	Scientists work hard to answer basic questions; how DO they count the bats? Never thought about how much I miss on a quick glance; He had seen the thermal imaging stills on some temporary exhibits, but never imagined how those translated to actually counting the bats. He found the counting part to be the most interesting Thermal imaging useful in bat studies. Scientists study bats (1st graders). correcting historic estimates; how arrived at estimates; there are a lot of exceptions (re: questions and hypothesizing; the work env can change so much; how hard it is to verify results and be accurate Obvious but serious challenges like darkness; How to count bats.
Awareness of science at park (10 mentions)	Bat studies happen at CAVE; most didn't even realize scientists were studying bats. I think people understand research happens they just don't really comprehend that it happens in places they visit.

Continued: Awareness of science at park (10 mentions)	Researchers go to gross places (re: droppings in the roost) Another knew studies were ongoing but didn't realize on what. They learned about the need to make observations first in order to generate good questions. They learned that questions are sometimes more important than answers (this from the guy who asked about peripheral vision of echo location). One person noted that they didn't know scientists were studying bats here. I moved that observation into a thought I've been working in lately about parks as active research centers.